

FEDERAL GUIDELINES (DRAFT)

STATE AND LOCAL PRETREATMENT PROGRAMS

VOLUME I



AUGUST 1975

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**U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF WATER PROGRAM OPERATIONS
WASHINGTON, D.C.**

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U. S. Environmental Protection Agency
Office of Water Program Operations
Municipal Construction Division
Washington, D.C. 20460

**STATE AND LOCAL
PRETREATMENT PROGRAMS**

VOLUME I

**PROJECT OFFICER
GARY F. OTAKIE
MUNICIPAL CONSTRUCTION DIVISION
OFFICE OF WATER PROGRAM OPERATIONS
WASHINGTON, D.C.**

EPA CONTRACT NO. 68-01-2963

**PROJECT MANAGER
ARNOLD S. VERNICK
BURNS & ROE, INC.
PARAMUS N.J.**

**PREPARED FOR
U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF WATER PROGRAM OPERATIONS
WASHINGTON, D.C. 20460**

U.S. ENVIRONMENTAL PROTECTION AGENCY

FOREWORD

In response to the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500), this country has undertaken an unprecedented program of cleaning up our Nation's waters. There will be a substantial investment by Federal, State, and local government as well as by private industry in treatment works to achieve the goals of the Act. It is important that this investment in publicly owned treatment works (POTW's) be protected from damage and from interference with proper operation, and that water quality be protected from pollutants which may pass through the POTW.

These guidelines were developed by the Environmental Protection Agency in accordance with Section 304(f) of the Act for the purpose of assisting States and municipalities in meeting NPDES permit requirements. It is important to note the clear requirements in the Act that there be both national pretreatment standards, Federally enforceable, and pretreatment guidelines to assist States and municipalities in developing local pretreatment requirements. Some factors in pretreatment are not amenable to a national standard. The Environmental Protection Agency therefore encourages the establishment of local pretreatment requirements, tailored to the conditions at a specific publicly owned treatment works. Such requirements are considered essential to ensure compliance with permits issued under the National Pollutant Discharge Elimination System.

The guidelines are a revision of the previous guidelines, "Pretreatment of Pollutants Introduced Into Publicly Owned Treatment Works." Contained in this revision is additional technical information on pollutants which may interfere with or pass through publicly owned treatment works. Also, guidance is presented to assist State and local governments in developing their own pretreatment programs to comply with NPDES permit conditions. The guidelines are the result of extensive reviews and numerous field trips and discussions with EPA Regional Offices, city, regional, State and interstate agencies. We are extremely grateful for the cooperation of those who assisted in the preparation of the guidelines.

Administrator

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SECTION A
INTRODUCTION

Purpose

Background

Authority

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Effluent Limitations for POTW's

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SECTION A INTRODUCTION

Purpose

These guidelines are established to assist municipalities, States, Federal agencies, and others in developing requirements for the pretreatment of wastewaters which are introduced into publicly owned treatment works (POTW's). This document is a revision of an earlier publication dated October 1973, and presents a compilation of technical and administrative information relative to pretreatment and the control of industrial wastewaters in publicly owned systems. Information contained herein is designed to provide the operators of POTW systems with a sound basis for determining the impact of non-residential wastewaters, as well as appropriate approaches for controlling pollutants from these sources.

Additionally, this document provides guidance helpful in complying with those special conditions of the National Pollutant Discharge Elimination System (NPDES) permits issued to POTW's that relate to non-residential wastewaters. Technical aspects, including data on pollutants which may interfere with the operation of POTW's, and the removal of pollutants in treatment facilities are covered in detail. Legal considerations encompassing methods for establishing pollutant limitations and a recommended ordinance for industrial use of sewers are also addressed. Additionally, information on the management and monitoring requirements of an industrial wastewater control program and summaries of the wastewater characteristics and pretreatment information for major industrial categories are included.

In summary, this document provides guidance to State and local governments concerned with both implementing pretreatment policies in accordance with appropriate Federal Regulations and developing supplemental pretreatment requirements as necessary.

Background

Up until 1972, the emphasis in Federal legislation had been oriented toward water quality standards. With the enactment of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) a number of fundamental changes in the approach to achieving clean water were instituted. One of the most significant changes was from an emphasis on the ambient quality of streams to direct control of effluents through the establishment of regulations and standards which form a basis for the issuance of discharge permits. In addition, the 1972 Amendments required the

development of pretreatment guidelines and standards to provide a uniform approach to the control of industrial pollutants introduced into POTW's.

Public Law 92-500 established a national system for preventing, reducing, and eventually eliminating water pollution. By the creation of the National Pollutant Discharge Elimination System (NPDES), the Act has required that all point sources (including POTW's) obtain a permit for the discharge of wastewaters to the navigable waters of the United States.

The Act further requires that as a minimum intermediate objective, all point sources other than POTW's treat their wastewaters by the application of the best practicable control technology. Subsequently, the minimum requirement for industrial wastewaters would be the application of best available treatment technology. For POTW's the initial objective is secondary treatment, as outlined in "Secondary Treatment Information" promulgated by the Environmental Protection Agency on August 17, 1973 (Appendix 2).

As an additional measure designed to protect the quality of navigable waters, Public Law 92-500 also contains provisions that require regulating the pretreatment of non-domestic wastewaters contributed to POTW's. In the following section, those portions of the Act that pertain to pretreatment, including the section providing authority for the development of this document are discussed.

Authority

Under Title III of the Act, "Standards and Enforcement," several sections are included that specifically refer to the pretreatment of pollutants introduced into POTW's. Authority for development and revision of this guidelines document is contained in Section 304(f) which states:

"For the purpose of assisting States in carrying out programs under section 402 of this Act, the Administrator shall publish..... and review at least annually thereafter and if appropriate, revise guidelines for pretreatment of pollutants which he determines are not susceptible to treatment by publicly owned treatment works. Guidelines under this subsection shall be established to control and prevent the discharge into the navigable waters, the contiguous zone, or the ocean (either directly or through publicly owned treatment works) of any pollutant which interferes with, passes through, or otherwise is incompatible with such works."

These guidelines should not be confused with pretreatment standards for both existing and new sources, promulgated under the authority of Sections 307(b) and 307(c) respectively. Section 307(b) is directed toward existing sources, and states:

"The Administrator shall.....publish proposed regulations establishing pretreatment standards for introduction of pollutants into treatment works.....which are publicly owned for those pollutants which are determined not to be susceptible to treatment by such treatment works or which would interfere with the operation of such treatment works."

Under the authority of this Section, the EPA promulgated on November 8, 1973, general pretreatment standards, which are included in Appendix 1 of this document. These pretreatment standards set forth rules and regulations designed to protect POTW's from the possible harmful effects of industrial wastewaters introduced into such systems. In addition to the general pretreatment standards, this section also provides authority for the development of pretreatment standards for specific major industrial categories of non-residential contributors. Similarly, Section 307(c) authorizes the promulgation of pretreatment performance standards for new sources.

The distinction between pretreatment standards and pretreatment guidelines must be emphasized. This document, as indicated, is strictly advisory, for the purpose of providing pretreatment assistance to interested parties. As such, these guidelines only recommend approaches to developing pretreatment policy. In contrast, the pretreatment standards as promulgated under Section 307 of the Act, represent rules and regulations which are enforceable by the Federal government.

Federal Pretreatment Standards

EPA has issued general standards for pretreatment of pollutants introduced into POTW's (Appendix 1). Subsequent to the promulgation of pretreatment standards on November 8, 1973, the Agency has proposed and promulgated numerous pretreatment standards relative to specific industry category wastewater discharges for both existing sources and new sources. As a result of these proposed and promulgated regulations, the Agency has received numerous indications that its pretreatment procedures, both for the establishment of and for the enforcement of pretreatment standards, and

the pretreatment standards themselves were not clearly understood by many segments of the general public. For this reason, the Agency has decided to clarify and simplify the existing pretreatment standards. This will be accomplished by proposing new general pretreatment regulations to replace the existing standards contained in Appendix 1. It is anticipated that the proposed standards will be published in the Federal Register in the near future. At that time the proposed regulation and an appropriate discussion will be incorporated in these guidelines.

The pretreatment standards are intended to be national in scope. In many cases, it will be necessary for a State or a municipality to supplement the Federal standards with additional pretreatment requirements which take into account local conditions. Factors such as stringent water quality standards reflected in the POTW's NPDES permit or characteristics of the treatment process may necessitate more restrictive pretreatment requirements in specific instances. The Federal pretreatment standards do not preclude municipalities and States from establishing pretreatment standards of their own, not in conflict with any Federal pretreatment standard, as stated in Section 307(b)(4) of P.L.92-500. State or local standards may be necessary to control types, flows, concentration and variability of industrial and commercial discharges into municipal treatment works.

There may be specific situations when the Federal pretreatment standards will not be sufficient to protect the operation of the publicly owned treatment works. This might be the case when the quantity of a pollutant not susceptible to treatment in a POTW, introduced by a major contributing industry, would result in a concentration of the pollutant in the influent to the treatment works which would inhibit the performance of the treatment process. In such a case, the municipality would have to supplement the Federal standards. Additionally, State or local pretreatment standards may be necessary for pollutants susceptible to treatment in a POTW. Pretreatment of wastewaters containing susceptible pollutants may be necessary in the form of spill protection or flow equalization in order to ensure compliance with the Federal pretreatment standards and permitted effluent limitations.

EPA has been, and is currently in the process of promulgating rules and regulations setting forth effluent limitations guidelines and standards of performance for the treatment of specific industrial wastes discharged to navigable waters. In pursuit of this goal, EPA has categorized wastewater producing commercial activities, and has, on an industry by industry basis, published effluent standards in the Federal Register (40 CFR 400 series). In each of these rules and regulations for specific major industries, pretreatment

standards are either proposed or promulgated in addition to the requirements for wastewaters which are directly discharged. To date, pretreatment standards for new sources have generally been established in final form, while final rules and regulations for the pretreatment of existing sources have only been partially promulgated. Pretreatment standards for existing sources within fifteen major industrial categories were promulgated on February 11, 1975 (Appendix 1), with approximately twenty additional industrial pretreatment standards still pending. The pretreatment standards published for the first fifteen industries do not establish limitations on pollutants contributed to municipal systems because the pollutants from these industries are usually susceptible to treatment in a POTW. In other words, for the first fifteen industrial categories, there is no specific numerical pretreatment requirement at the Federal level. However, there are general prohibitions provided in the pretreatment standards contained in Appendix 1.

On the other hand, the pretreatment standards promulgated for new sources in various industrial categories generally contain limitations on the level of specific pollutants allowable in the wastewater discharged to POTW's. The nature of the pretreatment standards to be established for the remaining major industrial categories is unknown at this time. When issued, the information in these remaining standards will be useful to local governments in determining exact pretreatment requirements for the industries in question. For new sources, pretreatment standards have been established for a number of major industries and have been published in the Federal Register.

Effluent Limitations for POTW's

As a result of the fundamental changes instituted by Public Law 92-500, POTW's are now required to obtain permits for their discharges and to meet certain minimum effluent standards. Both POTW permits and effluent standards have a direct bearing on the control of industrial pollutants that must be undertaken within a particular system.

Since most POTW's discharge their effluents to navigable waters, the Act requires that effluent limiting regulations be promulgated. As indicated, EPA has published in the Federal Register rules and regulations governing POTW discharges entitled "Secondary Treatment Information," (Appendix 2). These regulations set forth specific concentration limits to be achieved by secondary wastewater treatment facilities. Limits are placed on permissible discharge concentrations (or removal efficiencies) for BOD, suspended

solids, and fecal coliform bacteria. Additionally, an acceptable pH range for secondary POTW effluents is set. The pollutants limited in the regulation are generally susceptible to treatment in POTW's. As a consequence, industrial pollutants only become important with regard to secondary treatment standards when the contribution causes these pollutant discharge limitations to be exceeded.

In many instances, State or local water quality standards require a degree of treatment greater than that required to meet the secondary treatment regulations, such as more stringent BOD or suspended solids requirements. Additionally, water quality standards often exist for pollutants other than those regulated in the secondary treatment standards, such as phosphorous, nitrogen compounds, metals, etc. Treatment requirements necessary to meet water quality standards are normally incorporated into the NPDES permit. Consequently, control of applicable industrial pollutants can be extremely important in helping the municipality meet its NPDES permit requirements.

Procedures developed under Section 402 of the Act provide details for implementation of the NPDES permit program. Under the program, all point sources, including POTW's, must obtain a permit to discharge to navigable waters of the United States. NPDES permits are not required for industrial sources contributing to POTW's, but many limitations placed on a POTW, beyond standard secondary treatment, are aimed at controlling the effects of non-domestic wastewaters.

The NPDES permit has several impacts on State or local pretreatment policy. First, as a part of the permit application, the permittee must obtain preliminary information on the activities and wastewater characteristics of major industrial contributors within the collection system. Based on this information, effluent limitations for pollutants not susceptible to treatment in a POTW may be individually established by the permitting agency.

Secondly, under the Federal NPDES permit regulations (40CFR126) the permittee is required to provide notice to the Regional Administrator of the following:

(i) Any new introduction of pollutants into such treatment works from a source which would be a new source as defined in Section 306 of the Act if such source were discharging pollutants;

(ii) Any new introduction of pollutants which exceeds 10,000 gallons on any one day into such treatment works from a source which would be subject to Section 301 of the Act if such source were discharging pollutants; and

(iii) Any substantial change in volume or character of pollutants being introduced into such treatment works by a source introducing pollutants into such works at the time of issuance of the permit.

This notice must include information on the quantity and quality of wastewater introduced by the new source into the publicly owned treatment works, and any anticipated impact on the effluent discharged from such works.

In addition to effluent limitations, the permit sets forth special conditions that pertain to pretreatment activities. Municipalities are considered the first line of defense for Federal pretreatment programs. For this reason, they are encouraged to enact an ordinance giving them the power to enforce Federal pretreatment standards as well as State and local standards "not in conflict" with Federal pretreatment standards. In an efficient POTW system, a properly designed ordinance acts as the impetus for a responsible approach to control and pretreatment of industrial pollutants. Guidance is provided in this document to aid in the development of a municipal ordinance for industrial use of publicly owned sewers.

Organization of Guidelines

These guidelines are presented in two volumes. Volume I contains the main body of the guidelines, and seven appendices furnishing the backup data to various sections of the document. Volume II is devoted to Appendix 8, containing pretreatment information for major industrial source categories compiled from published and unpublished Effluent Limitation Guidelines Development Documents.

The main body of the guidelines is composed of six major sections. The first four sections provide the essential information necessary to establish and administrate an industrial pollutant control program. Specific aspects discussed include organization, financial considerations, policy and public relations in Section B, legal aspects in Section C and monitoring in Section D. The legal aspects consist primarily of considerations related to an ordinance for industrial use of publicly owned sewerage facilities. A recommended ordinance is contained in Appendix 3 of the first volume.

One of the prime considerations in the development of a workable ordinance is the establishment of limitations for specific pollutants contained in industrial discharges to publicly owned sewerage systems. Administrative considerations for setting such limits are discussed in Section C. The technical information necessary to establish limits in a particular system is contained in Sections E and F and Appendices 5 and 6 of Volume I, and Appendix 8 in Volume II. Section E and Appendix 5 present technical data on the interference and inhibition characteristics of pollutants contained in industrial discharges. The data presented includes information on major organic and inorganic constituents, explosive and corrosive wastes and excessive discharges. Section F and Appendix 6 provide the results of a survey to determine the removal or pass through characteristics of various pollutants in POTW's. Appendix 8 is a compilation of information on major industries, with emphasis on the typical wastewater characteristics of plants within the subcategories established for each industry.

SECTION B
MANAGEMENT OF A CONTROL PROGRAM

Purpose

Organizational Structure

- Large Systems
 - Administrative
 - Industrial Waste Division
 - Field Monitoring
 - Laboratory
 - Legal-Enforcement
- Medium Size Systems
- Small Systems

Financial Aspects

Policy

- Pretreatment
- Joint Treatment
- Sludge Disposal
- Summary

Public Relations

SECTION B MANAGEMENT OF A CONTROL PROGRAM

Purpose

The objective of an industrial pollutant control program is to assure continuity of treatment, provide physical protection of treatment facilities, and prevent the discharge of pollutants from the treatment facilities which would be in violation of NPDES permit conditions and other regulatory requirements. In order to achieve these objectives, POTW operators must develop programs which provide a data base for establishing local requirements and which after the requirements have been established, form a framework for administering these requirements. The purpose of this section is to discuss various aspects relating to the management of an industrial pollutant control program.

The scope of such a program depends to a large degree on a number of factors. Of prime importance is the size of the sewerage system and the number and type of industries utilizing the system. Other significant elements include the type of treatment facility, the water quality standards applicable to the POTW and the provisions of the plant's NPDES permit.

In this section, management approaches are discussed on three levels, for large, medium, and small systems, referring in general to systems with average dry weather flows in excess of 100 mgd, between 10 and 100 mgd, and less than 10 mgd. However, a system with a heavy industrial contribution, but an average flow of under 10 mgd may opt for a more extensive program, whereas a system with an average flow in excess of 10 mgd but only limited industrial contribution may adopt a less comprehensive program. Thus the categorization by size is provided as a general guideline only, and should be considered flexible depending upon the needs of a particular system. The degree of industrialization in a community and the type of industrial facilities contributing to the system, are major factors in determining the requirements of an industrial pollutant control program for a given POTW.

Historically, municipalities and authorities that have developed effective programs to control industrial pollutants have generally been motivated by several factors. The most effective industrial pollutant control programs have generally been instituted where the need to protect treatment facilities, plant operation or receiving waters has been apparent. In those cases, the motivating force toward a control program

was either frequent or serious plant upsets or the requirement of meeting stringent water quality standards. Also, many POTW's have established industrial programs primarily as a revenue producing mechanism through the use of surcharges. Surcharge fees have been applied not only to flow and organic loading, but in many instances surcharges have been imposed upon incompatible pollutants as well.

For many POTW's interest in controlling non-residential contributions to their system is an outgrowth of the requirements of Public Law 92-500 and the subsequent receipt of an NPDES permit. The permit generally places limitations on the quality of discharge permissible by the POTW. As a result, it is important that interferences that might decrease the treatment plant's operating efficiency, or pollutants that might pass through a system be avoided. In addition, the permit may require that an enforceable ordinance be enacted. Municipalities are encouraged by the EPA to adopt local ordinances to control pollutants which might upset the POTW, decrease treatment efficiency, or cause a violation of the effluent limitations in the NPDES permit. Consequently, an effective program is essential not only to control pollutants entering the treatment plant which in turn affect its effluent, but also to develop and enforce an appropriate ordinance for the control of industrial pollutants.

Beyond fulfilling the specific requirements of the NPDES permit, a properly administered industrial pollutant control program also serves several other essential functions. Depending on the degree to which the POTW is cognizant of non-residential contributions to its system, the control program can serve as a basis for obtaining data on industrial contributors and in turn identify potential problem areas. The program should offer an ordered mechanism through which information can be transferred on the degree of compliance with ordinance requirements and Federal regulations. Above all, the control program provides the mechanism and enforcement tools necessary to assure treatment continuity and the protection of public facilities.

Additionally, industrial pollutant control programs may be used to establish procedures for implementing surcharge or user charge policies. The EPA Construction Grant Regulations (40 CFR 35) require construction grant applicants for funds authorized under Title II of PL-92-500 to establish and maintain a proportionate system of user charges for operation and maintenance costs and industrial cost recovery for capital costs. These requirements can be most effectively implemented through an industrial pollutant control program.

Organizational Structure

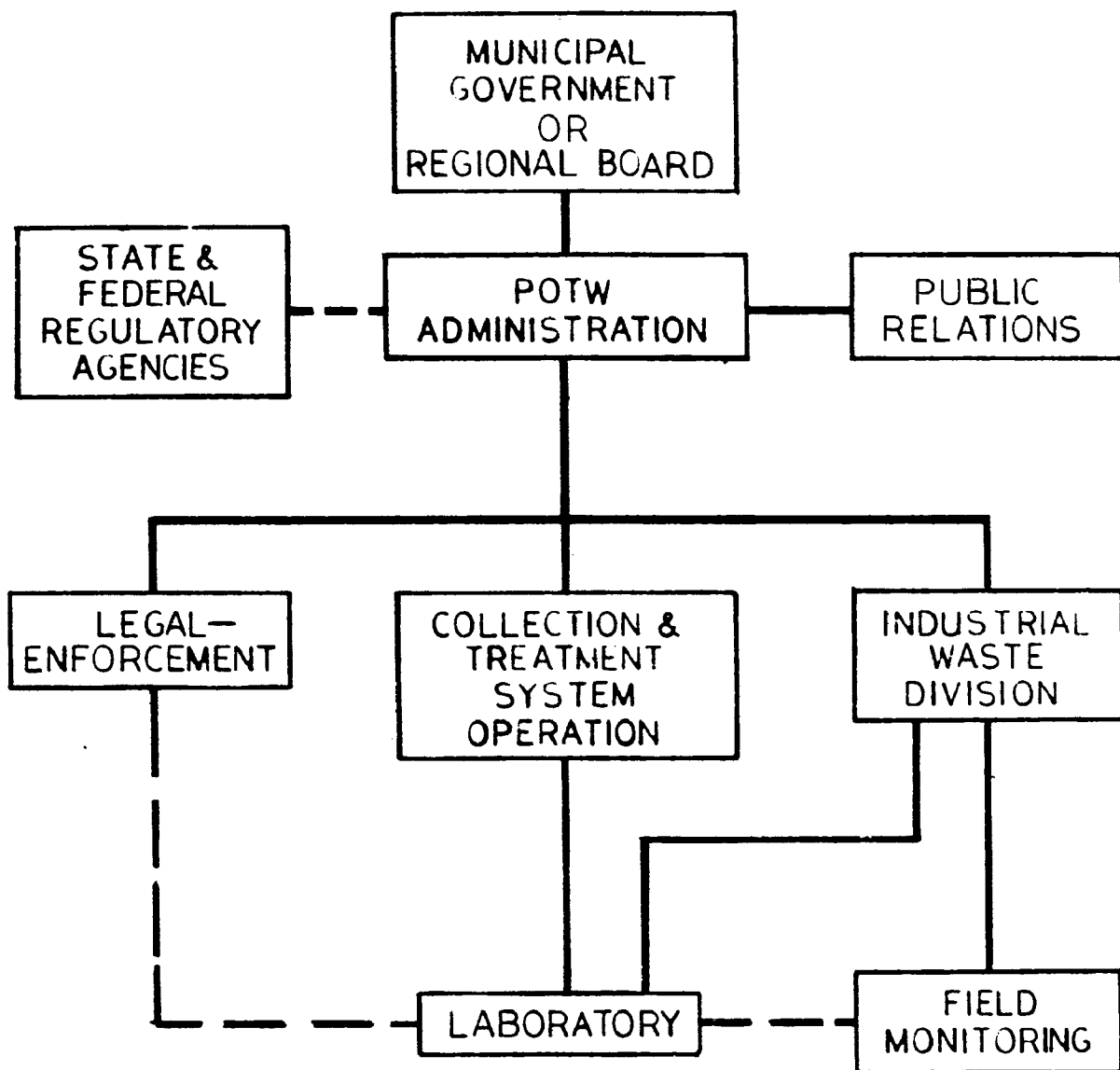
The industrial pollutant control program consists of the activities and personnel assigned specific functions and responsibilities in relation to the control of industrial pollutants. For most larger systems, this involves a well-defined organizational structure with assigned personnel having specialized training and qualifications. For smaller systems, it may involve only a part time assignment for a single individual. However, even small systems should be aware of the functional steps involved in an industrial pollutant control program and provide for these functions on an appropriate scale.

Figure B-1 illustrates a conceptual organizational structure based on the functions required for a workable control program. The manner in which these elements are organized can vary greatly depending on the local situation. The essential aspect is the need for an efficient information transfer mechanism. The typical organization shown outlines the interrelationship of the essential elements of a program.

Generally, the larger the system, the more complex the organization. Individual responsibilities also become more clearly defined as the system increases in size. For very small systems, outside experts are frequently utilized to provide engineering, legal and laboratory expertise. In order to supply the most meaningful guidance, the organization necessary for an effective industrial pollutant control program is specifically discussed in the following paragraphs in terms of small, medium and large systems.

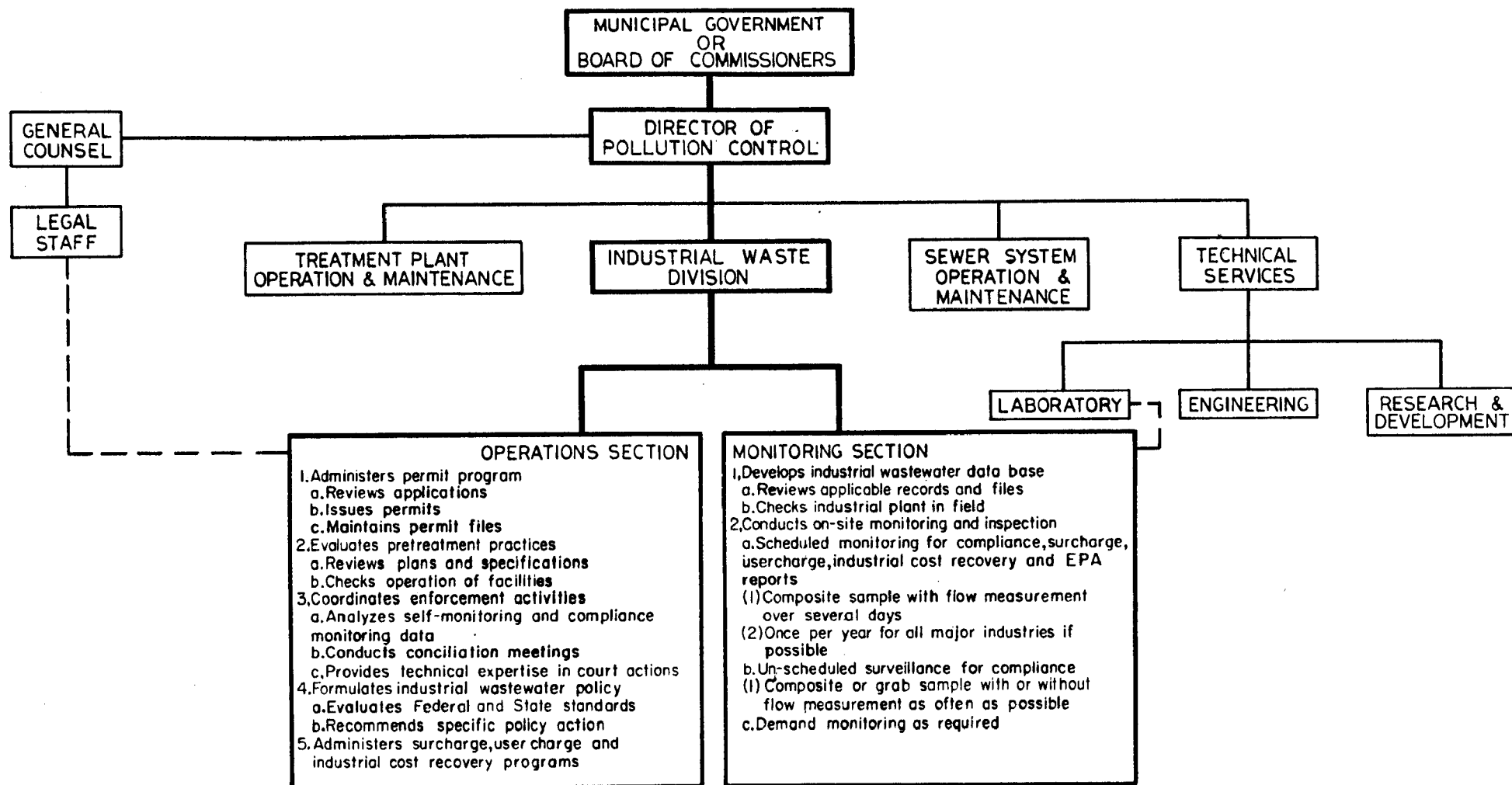
Large Systems

Figure B-2 presents an example of an industrial waste control program organization for a large POTW system. The chart illustrates the need for a structured organization to most effectively administer a control program in a large system. The larger and more complex the POTW, the more highly developed and structured the organization should be. Nevertheless the components of an effective organization demonstrated by the chart are essential for a functional industrial waste control program in any large system. Specific sections of an industrial waste control organization for a large system should include the following:



CONCEPTUAL ORGANIZATION OF AN
INDUSTRIAL WASTEWATER CONTROL PROGRAM

FIGURE B-1



TYPICAL ORGANIZATION OF A LARGE SYSTEM
FIGURE B-2

Administrative

Administrative responsibility for the program should rest with a single person who has intimate knowledge of all aspects of pollution control and wastewater treatment within the jurisdictional boundaries. In municipal systems, usually the Director of Public Works or Superintendent of Sanitation would be the appropriate individual. In regional authorities, there is most often a Board of Commissioners which has overall responsibility for the entire POTW system. Commissioners are generally appointed by appropriate governmental officials such as the governor of the state, and frequently act only in an overall policy and management capacity. In this sense, such boards can be considered as analogous to the mayor and council in a municipality. Day-to-day operations are usually administered by an Executive Director, General Manager, Chief Engineer or Superintendent who can be compared for these purposes to the Commissioner of Public Works in municipal operations.

Decisions pertinent to pretreatment policy should be made by this individual drawing upon information supplied by key subordinates. These subordinates should include personnel such as the Chief Industrial Waste Engineer, Chief Plant Operator, Chief Chemist, and other specialists concerned with the control program, including field investigators, engineers and attorneys.

Specific functions of the administrative section should include (1) basic policy decisions (2) management of budgetary needs (3) personnel administration and (4) coordination with the public and appropriate municipal, State and Federal authorities.

Industrial Waste Division

The individuals comprising the industrial waste division represent the heart of any industrial waste control program. Generally the division is comprised of engineers that conduct the program and secretarial personnel, field inspectors and laboratory technicians that provide the necessary support for effective operation. The engineering staff engaged in this activity should be the most knowledgeable group of individuals on all aspects of industrial wastewater within a given system. They should be thoroughly familiar with the operation and wastewater produced by industries in the system, pretreatment facilities utilized by the industries, applicable provisions of Federal and State standards and local ordinances and characteristics of the treatment processes

utilized in the system. If a local permit program is employed, the industrial waste division would undoubtedly administer its operation. Generally this group will formulate industrial wastewater policy and recommend specific policies to the administrator for implementation. The industrial waste division would also generally coordinate enforcement activities and provide necessary technical expertise to the legal staff in court actions.

Staff levels vary considerably depending upon size, fiscal resources, organizational structure, number and type of industries present and the specific NPDES permit requirements of the system. The largest POTW systems in the country have as many as 50 to 80 individuals reporting to the Chief Industrial Waste Engineer. Smaller cities and regional authorities obviously require smaller staffs, with the level generally varying from approximately 1/2 to 2 individuals per 10 MGD, depending upon the factors indicated above.

Field Monitoring

The organization should include a group of inspectors whose only responsibility is the monitoring of non-residential contributors. These field investigations should include initial plant surveys, data acquisition at the plant site, and all follow-up monitoring and inspection activities. Monitoring and the general conduct of field investigations is an important subject which is covered in detail in Section D of these guidelines.

The field monitoring section should have total responsibility for surveillance of non-residential sources. Specific functions to be carried out by field inspectors include: (1) sampling and flow measurement at wastewater sources, (2) inspection of plant and pretreatment operations at the time of sampling, (3) maintenance of specialized field equipment, and (4) performance of specialized monitoring activities in connection with locating the source of problems within the system, enforcement activities, etc. The Metropolitan Sanitary District of Greater Chicago provides uniforms and badges for its inspectors to formalize their status in the community. This can be helpful in gaining quick access to industrial facilities when necessary. In any event, all field inspectors should be provided with proper credentials which should be carried for identification at all times.

Laboratory

An industrial pollutant control program will generally require some expansion of the typical laboratory required for control of biological treatment processes. As a result, additional personnel may be necessary to carry out analyses in conjunction with a monitoring program. Frequently, these technicians are incorporated into the existing laboratory organization, so that coordination with the industrial waste division is essential. Some POTW's are structured so that laboratory personnel engaged in industrial wastewater analysis report directly to the Chief Industrial Waste Engineer. Such an arrangement may be preferable for improved communications and delineation of responsibility.

Where this function is part of the overall laboratory responsibility, then data must be reported to the industrial waste division so that pretreatment performance can be evaluated. If any ordinance violations are suspected, then analytical data would also be passed on to the legal staff for evaluation and possible enforcement action. The specific functions of the laboratory in connection with industrial wastewaters include (1) analysis of field samples, (2) maintenance of laboratory equipment and (3) proper record keeping and reporting in support of industrial waste division activities.

Legal - Enforcement

One or more attorneys may be required to provide legal services with regard to enforcement of ordinance regulations. Attorneys may not have full time responsibility in connection with ordinance enforcement. Instead the legal staff may serve the dual function of supporting legal action against ordinance violators, and general legal support of other activities in the water pollution control area.

For enforcement activity, the legal group should receive information directly from the industrial waste division staff, as well as from field monitoring and laboratory personnel. The special functions of enforcement include (1) assistance in evaluation of suspected ordinance violations, (2) notification of suspected violators, (3) participation in follow-up meetings with violators (4) preparation of briefs for litigation; and (5) court action.

Medium Size Systems

As the size of a POTW decreases, the operation of the industrial pollutant control program becomes less of a separate entity, and more entwined in the overall operation of the

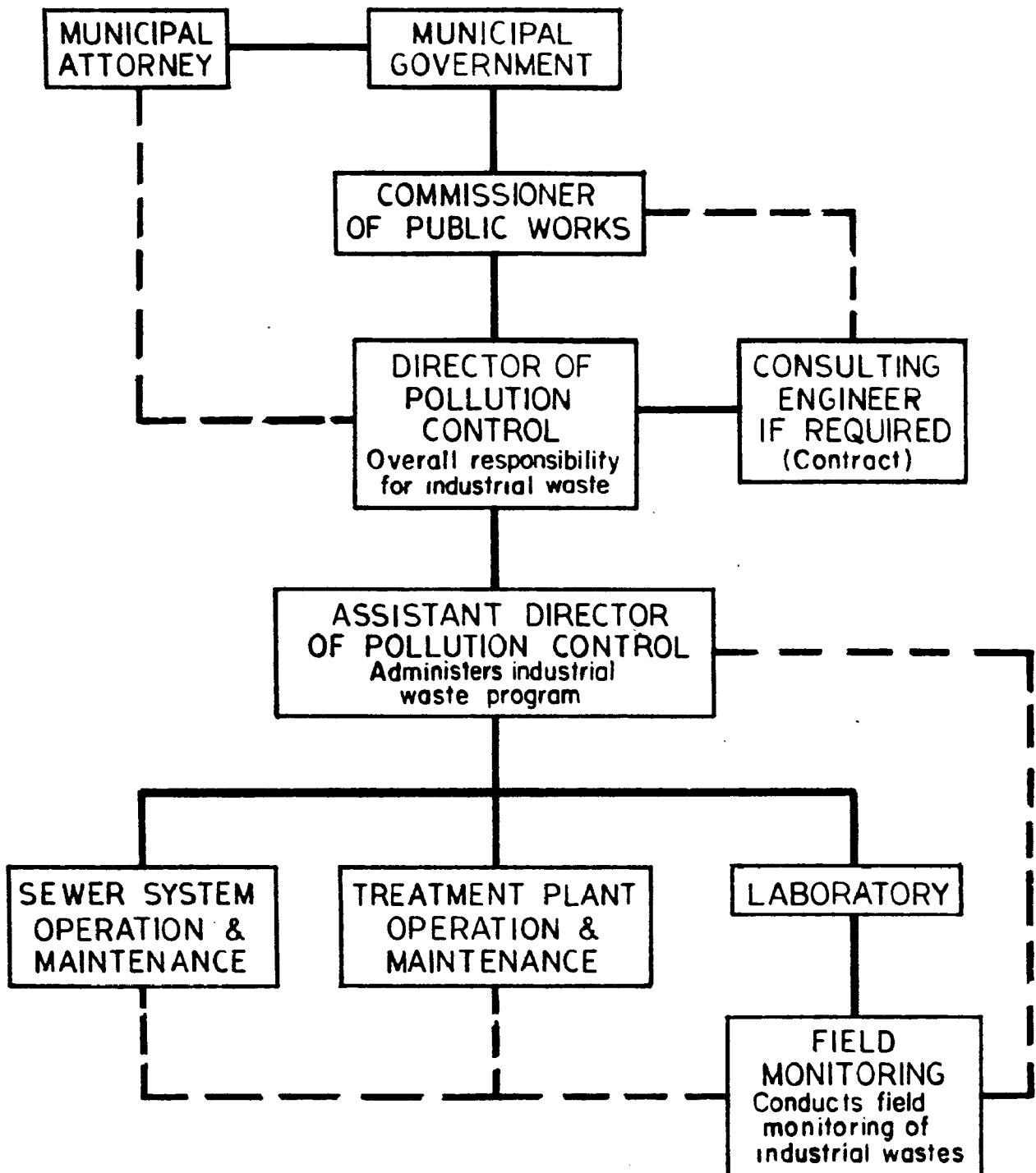
wastewater collection and treatment facility. Because of limited resources, administrative and laboratory personnel generally become responsible for both plant operations and control of pollutants contributed by non-residential sources. Figure B-3 provides a typical organization chart for a medium size POTW system.

Although fewer individuals are involved, the specific organizational elements of a control program must be maintained. The organization will not be as structured as in large systems, but the essential functions of industrial waste control must be performed in conjunction with other duties. Among these functions is the use of a field monitoring group to carry out plant inspections and effluent sampling. The field crew is essential for all of the specific monitoring requirements necessary to control industrial contributors to the system. Likewise, other specific functions of a control program would have to be maintained in a medium size system, such as ordinance enforcement, summary and analysis of industrial data and surcharge administration. However, unlike the large system organization where individuals or groups of individuals have well defined task assignments, the control program for a medium size system will most likely contain individuals with multiple functions and responsibilities. Some medium size systems with many industrial contributors may find it necessary to have an industrial waste engineer or other individual specifically assigned to the control of discharges from these facilities.

Small Systems

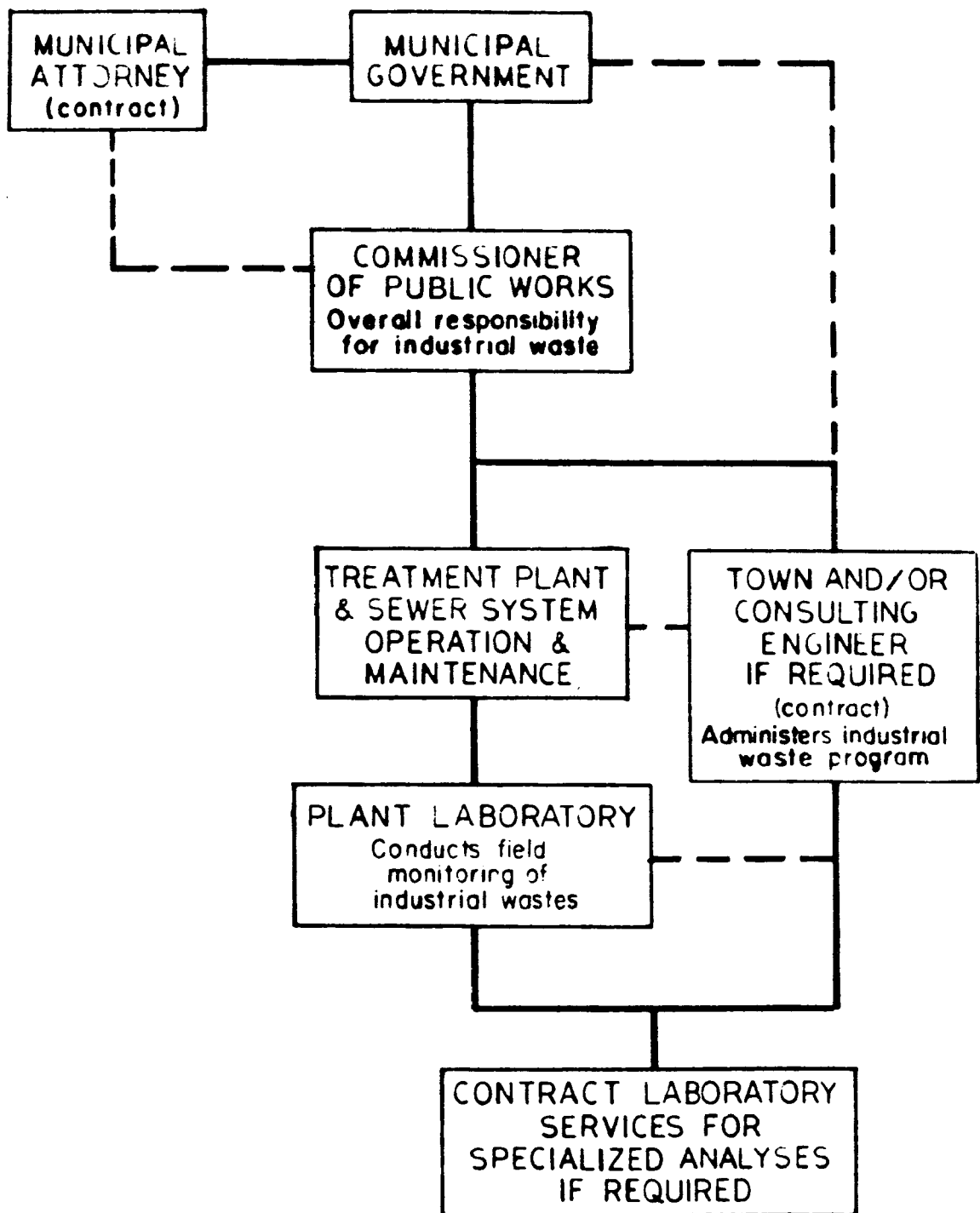
A large proportion of municipal POTW's that treat non-residential wastes fall into the small system category. In a small system, adequate resources would generally not be available to have any individual whose sole responsibility lies in the area of non-domestic pollutant control. Instead, all of the elements of an industrial pollutant control program that are delineated for large systems would have to be handled by personnel currently employed by the municipality. This is not unrealistic, since quite often a small system would be concerned with only a few, or even a single industrial contributor.

Figure B-4 illustrates an organizational arrangement for a typical small system. The structure shown is only one of several that could be effectively utilized in a small municipality. The variety encountered in the organization of small local governments suggests that a number of different



TYPICAL ORGANIZATION
OF A MEDIUM SIZE SYSTEM

FIGURE B-3



TYPICAL ORGANIZATION OF A SMALL SYSTEM

FIGURE B-4

arrangements may be equally effective in the administration of an industrial pollutant control program. Nevertheless, in the small system case, generally one person has responsibility for monitoring and all specialized analysis is contracted to commercial laboratories. Similarly, the Director of Public Works would most likely have overall administrative responsibility in addition to performing the functions of the industrial waste engineer. A town engineer may be utilized for industrial waste control, reporting either to the Director of Public Works or directly to the governing body. The town engineer may be a full time employee if the needs of the system dictate, but he is most frequently a consulting engineer under a retainer type contract to the municipality. Specialized engineering requirements would usually be provided by either the town engineer or another consultant, with legal questions being handled by the municipal attorney. Since the NPDES permit program for POTW's, large or small, encourage implementation of Federal pretreatment standards, it is recommended that industrial pollutant control be implemented, even in the smallest of systems, where there are industrial users.

Financial Aspects

As might be expected, the cost of an industrial pollutant control program is a function of both the total system flow and of the proportion of the industrial wastewater contribution. A survey of municipal and regional sewerage systems with dry weather flows ranging from 15 to over 1,000 mgd was conducted. The survey showed that the annual direct cost of the industrial pollutant control program was generally in the order of \$1,000 per million gallons per day of dry weather flow for systems having some significant portion of the total wastewater flow from industrial contributors. On this basis, the direct cost of a program covering industries for a system with an average flow of 50 mgd might be \$50,000 per year (1975 dollars). Assuming an average salary level of \$15,000 per year for personnel assigned to such a program, this system would support a staff of 3 persons.

Many systems have traditionally recovered the additional costs for treating and monitoring industrial wastewater through imposition of a surcharge. These surcharges have generally been related to the additional cost of treating for removal of suspended solids and BOD for industrial wastewaters that exceed domestic sewage in these components. In addition, PL 92-500 and the EPA construction grant regulations now require Federal construction grant recipients to establish and maintain a user charge program and a system of industrial

cost recovery. The proportionate costs of an industrial pollutant control program such as outlined above, could be added to the user charge for the industrial contributors. In this way, the cost of the industrial pollutant control program would be distributed back to the contributor of the industrial wastewater being controlled. The cost of the control program could be recovered through a formula similar to the user charge formula where flow, loading, and a charge per connection or a charge per monitoring visit are used to determine an equitable cost distribution.

It should be noted that a well run, efficient industrial pollutant control program may be cost effective for both the POTW and the industrial contributors to the system. In some cases, the control program can pay for itself by means of increased surcharge or user charge revenue derived from the identification and continued surveillance of industrial discharges to the POTW. Industries in the system may also benefit from the cost savings in economy of scale realized in cases where the municipality performs all of the monitoring functions. In such instances, lower costs should result from the use of a central laboratory and experienced monitoring field personnel, than the industry would incur in administering its own monitoring program. In particular, small industries with limited resources may prefer that the municipality perform this function.

Policy

Pretreatment

Most States or municipalities will require pretreatment in order to comply with the effluent limitations in the NPDES permit. Pollutants which would interfere with or pass through the POTW, resulting in a violation of any of these NPDES permit requirements, must be pretreated or rejected from the system. The following sections of the guidelines contain technical information to assist the State or municipality in determining specific pretreatment requirements. Pretreatment may be necessary for compatible or incompatible pollutants since both may be limited in the NPDES permit, and since either can cause plant upsets. Generally, however, where design capacity is available, except for shock loading provisions, pretreatment would not be required for compatible pollutants. Pretreatment is most commonly required for incompatible pollutants to prevent interference with treatment processes or pass through to receiving waters.

Federal pretreatment standards for fifteen categories of existing industrial sources have been promulgated (Appendix 1) but these standards, in effect, require no pretreatment as the wastewaters involved are generally susceptible to treatment in POTW facilities. However, this does not preclude local pretreatment requirements for compatible pollutants, if necessary. Where design capacity is not available, pretreatment for compatible pollutants may be necessary to comply with NPDES permit effluent limitations. Pretreatment regulations for the remaining major existing industrial categories are still pending, with specific standards anticipated for most incompatible pollutants.

In addition to the regulatory aspects, pretreatment of incompatible wastes offers several operational advantages to POTW's. One significant advantage to the municipality is the specialized treatment that each wastewater contribution receives, and the fact that the potential for plant upset is greatly reduced by pretreatment. Local control can also serve as an insurance measure to protect against damage to the POTW from industrial wastes. Finally, the problem of incompatible pollutants contaminating the sludge from the POTW is reduced, as discussed in the following section on sludge disposal.

Joint Treatment

Joint treatment is a policy alternative that can be advantageous to both the POTW and the industry with regard to pollutants susceptible to treatment in POTW's. Generally, the treatment of industrial wastewaters in a POTW is incidental to its primary function of treating domestic sewage. Where the industrial contribution constitutes a significant portion of the total flow and substantially alters the concentration of pollutants normally contained in domestic sewage, the public agency may resort to the joint treatment approach. In this approach, the industry or industries contributing the pollutants is made a partner in the design and construction of the system, and the treatment works are designed to specifically remove the industrial pollutants. Both capital costs and operating costs are allocated to the industry and the public agency according to an agreement arrived at through negotiation, or as required by Federal regulations if construction grant funds are involved.

Joint treatment of industrial wastewaters with municipal domestic sewage offers these advantages:

- Savings in capital and operating expenses due to the economics of large-scale treatment facilities

- Increased flow which can result in reduced ratios of peak to average flows
- More efficient use of land resources, particularly in cases where available land for treatment facilities is scarce
- Improved operation (larger plants are potentially better operated than smaller plants)
- Increased number of treatment modules with resultant gains in reliability and flexibility
- More efficient disposal of sludges resulting from treatment of wastewaters containing pollutants susceptible to treatment in POTW's
- Utilization of the nutrients available in domestic wastes for biological treatment of industrial wastes which are nutrient deficient

Possible disadvantages of joint treatment are as follows:

- Where the pollutants are different from those usually treated in a POTW, design to treat the combined industrial-domestic waste stream for these pollutants may not be cost-effective (Reference F-25)
- Joint treatment by definition implies that the POTW was designed so as not to be interfered with by industrial wastes. However, where this requires design modifications ordinarily not required for domestic wastes, joint treatment may not be cost effective
- If joint treatment results in sludge disposal or utilization problems it may not be acceptable
- Some costs for the construction of joint treatment works solely to treat industrial pollutants are not eligible for Federal construction grants

Sludge Disposal

The ultimate disposal of sludges produced by either pre-treatment or joint treatment operations is an important factor to consider. The POTW must be aware of the effect of its policies on environmental problems that may result from sludge disposal.

Generally pretreatment facilities will remove incompatible pollutants that may eventually be deposited in the sludge produced by the operation of the publicly owned treatment works. This can be a meaningful advantage in terms of the environmental effects of the ultimate disposal of sludge from the POTW. Incompatible pollutants in sludges can cause problems in most disposal techniques utilized, including incineration, landfills, ocean dumping and land spreading. Consequently, the removal of incompatible pollutants at their source by pretreatment is usually advantageous to the POTW in terms of its sludge disposal.

Nevertheless, incompatible pollutants removed by pretreatment also require an ultimate disposition, although the impact on the POTW may have been eliminated. In some cases the sludge produced by pretreatment operations may be pure enough to warrant by-product recovery or recycle. When this is not economically or technically feasible, disposal of sludge is necessary. Although the sludges produced by industrial pretreatment may not technically be under municipal regulatory control, the impact on other environmental areas should be noted. A possible approach to this problem would be an effort by the municipality to coordinate off-site disposal with appropriate regulatory agencies. If on-site disposal is utilized by the industry, attempts should be made to evaluate proposed disposal schemes to prevent future air and water pollution problems.

Summary

The treatment policy instituted by a POTW, whether pretreatment or joint treatment, should be determined on the basis of the conditions within the system. One of the most important factors to consider is the potential effect of the chosen course of action. The POTW must be aware of its policy's effect on critical environmental problems such as sludge disposal. As a result, the treatment policy should be instituted on the basis of a broad overview of all aspects and consequences of action taken.

Public Relations

It must be recognized that some industries using a public sewerage system will be reluctant to provide the necessary pretreatment facilities, particularly if they have been using the public system for some time and the effects of their contribution are not apparent. One way in which some public agencies have been able to enlist the support of their contributing industries is through the formation of an informal coordinating committee, which would consist of representatives

of the affected industries and the public agency. This committee would explore all aspects of the Federal regulation, including pretreatment requirements and the NPDES permit for the POTW, and develop programs which would meet the requirement of the regulatory agencies. Such committees would be purely advisory and would not have any legal status, but could serve as a forum for the exchange of ideas.

SECTION C

LEGAL ASPECTS OF A CONTROL PROGRAM

Introduction

Legal Authority

Sewer Use Ordinances

Historical Development

Types of Ordinances

**Recommended Ordinance for Industrial Use of Publicly Owned
Sewerage Facilities (Appendix 3)**

Introductory Sections

Regulatory Sections

Excessive Discharge Rate

Establishing Limitations for Pollutant Parameters

Other Regulatory Sections

Optional and Procedural Clauses

SECTION C LEGAL ASPECTS OF A CONTROL PROGRAM

Introduction

The legal considerations inherent in the development and administration of an industrial pollutant control program are perhaps the most significant factor in the establishment of a viable program. The legal aspects are particularly important in instituting a control program in terms of providing the legal authority over industrial discharges to the sewerage system. In many cases, legal authority may be complicated by the structure of a sewer district or regional sewer authority. Many districts and regional authorities act essentially as wholesalers serving a number of political subdivisions, and do not have any direct contact with industries in the system. However, where the service area coincides with political boundaries, then legal authority can usually be established in a relatively simple manner, by the promulgation of an ordinance for the control of industrial use of publicly owned sewerage facilities.

The ordinance is the heart of any industrial pollutant control program, providing the essential mechanism for controlling the discharge from industries within the POTW system. Consequently, the ordinance must be carefully drawn to include all essential ingredients for the particular system. Once promulgated, the ordinance should be utilized for the control of all industrial wastewater discharges and the eventual enforcement of its terms against all violators. Therefore, the administration or enforcement of the ordinance is equally as important as its contents. Enforcement must be an integral part of any industrial pollutant control program. Consequently, legal assistance must be viewed as a continuing need which does not end once the ordinance is drawn and instituted. Proper enforcement requires teamwork between administrators, engineers, attorneys and field and laboratory personnel, with the legal role being the key to eventual resolution of problems through conciliation or court action.

Legal Authority

One of the most significant factors in the establishment of a viable industrial pollutant control program is the provision of adequate legal authority to develop, administer and enforce the program. Whatever agency is designated to operate the program must have sufficient power to enforce its rules and regulations on industrial users and to obtain the data necessary to monitor how its rules are being complied with.

If the service area of a public sewerage agency coincides with the boundaries of a political subdivision (city, county, etc.) the legal problems are usually relatively simple. However, if the sewerage agency serves more than one political jurisdiction, and particularly if it serves them essentially as a wholesaler, the problems can become more complicated. The solution depends to some extent on the legal structure of the sewerage agency. If it is only a voluntary association of independent municipalities, the agency will generally only have such authority as has been delegated to it by the compact creating the sewerage authority or district. If the sewerage agency has been established by a superior governmental jurisdiction, it then may be able to superimpose its authority on that of the local municipalities.

In any case, many existing regional sewerage authorities or districts are not able to legally interface with industries in the system because the industries discharge to municipal sewers which in turn connect to the regional agency. In such instances, the development and enforcement of ordinances controlling the discharge of industrial wastewaters is legally the responsibility of the individual municipalities in the system. They may look toward the regional agency for guidance in such matters, but nevertheless the municipalities in these cases would retain the legal authority to deal with industries in their systems in these situations.

With the advent of the NPDES permit program, it becomes increasingly important for the permittee to have the right to directly control the wastewaters from all contributors within the sewerage system. If an industrial discharger causes an upset in treatment plant operations and a resulting violation of the permit provisions, the POTW must have the right to directly and immediately control the industrial discharge. Regional agencies with the most effective industrial pollutant control programs at present have obtained the legal authority to control industries in their system directly. In some instances it was necessary to have the state legislature revise the compact or charter of the regional agency in order to obtain this authority. In other instances, renegotiation of the agreement between the regional agency and the municipalities in the service area might be the most direct method for obtaining legal authority. In any case, to comply with NPDES permit requirements, it is essential that the operating agency of the POTW obtain the power to deal directly with the industries contributing to its system in order to establish a viable industrial pollutant control program.

Sewer Use Ordinances

The following describes the content of sewer use ordinances, factors that control the content, the historical development of such ordinances, types of ordinances, and the application of sewer use ordinances to industrial users of publicly owned sewerage facilities.

Historical Development

The content of sewer use ordinances has evolved over the years roughly paralleling the increased sophistication in wastewater treatment facilities. Early ordinances were outgrowths of local plumbing and health codes, the contents of which were primarily devoted to standardization of materials used in the construction of sewers and connections thereto. Since sewage treatment was limited to settling of solid material, the content of ordinances at this stage focused on protection of sewers from clogging, corrosion and explosive hazards. Most ordinances are built around these basic provisions and have increased in scope as new needs have arisen.

With the advent of secondary treatment processes and the development of anaerobic digestion, closer control over certain dissolved organic and inorganic pollutants became necessary to prevent inhibitory effects in these units. In many instances, this type of control was provided by setting concentration limits for the acceptable discharge of critical pollutants.

The recent application of State and Federal water quality standards, which in many cases require the removal of even trace quantities of certain toxic pollutants, has caused many POTW's to establish direct control over significant industrial users. To gain information and control over these sources, many ordinances are now including permit provisions and self-monitoring provisions, or both.

Finally, as the costs of providing increased levels of treatment have risen, many POTW's have been forced to expand their revenue base. This has taken the form of surcharging provisions for users whose wastes have greater strength than normal domestic sewage.

There is no single ordinance now in force that could be considered typical of all, or even most, ordinances currently being utilized. Effective control of sewer use has been obtained by both simple and complex ordinance structures.

Types of Ordinances

Two factors influence the size and content of a sewer use ordinance. The first of these is whether the ordinance is designed to be self-contained, or whether it simply states general provisions and relies on separately published rules and regulations for interpretation and implementation. The second factor is whether or not the ordinance incorporates a permit system for either industrial users or all users of the system. Obviously, an ordinance which is self-contained will be a longer document than one which is not. Permit systems, if used, will also add length. Generally, smaller communities with relatively few industries will use a self-contained ordinance and will not employ a permit system. Enforcement of the ordinance for the few industrial users in such cases can be achieved on the basis of personal contact between the pollution control officer and the industry plant manager. As the size of the POTW increases or, more importantly, as the number of industrial users increases, it becomes more difficult to provide flexibility for the numerous individual differences between users within the ordinance document itself. In these systems, a shorter document stating general provisions may be more effective. This type of ordinance is usually supplemented by a separate set of rules and regulations that explain the responsibilities of users with respect to the general provisions. The supplemental regulations may take the form of a permit system with or without industrial self-monitoring provisions. Permit and self-monitoring requirements are particularly useful for POTW's which are starting a comprehensive industrial discharge control program to meet NPDES requirements, and have to comply with a schedule for the development of information on industrial users. By using these provisions, the enforcement authority can expand the coverage of a smaller initial staff. In subsequent years, as both field and laboratory capability is increased, more direct methods of compliance monitoring can be used. In a fully developed industrial waste control program, compliance monitoring is usually the most effective tool for enforcement of the ordinance.

Regardless of the type of ordinance employed, its scope and complexity should be limited to the resources available to the enforcement authority. If enforcement of the ordinance relies heavily on a permit system and self-monitoring, then

there should be an adequate office and field staff to issue and review permits and to check the periodic self-monitoring information. If enforcement is based on analysis of samples taken by the authority, then an adequate field and laboratory capability is necessary. In all cases, sufficient manpower should be available to follow up violations through the administrative procedures provided in the ordinance. Only by following up on each violation to gain compliance, will credibility for both the ordinance and the enforcement authority be established.

Recommended Ordinance for Industrial Use of Publicly Owned Sewerage Facilities (Appendix 3)

The recommended ordinance contained in Appendix 3 covers those portions of a complete sewer use ordinance which relate only to the industrial use of sewer systems. Excluded from Appendix 3 are those parts of a typical ordinance which relate to standards for construction of sewers and appurtenances, provisions relating to the control of infiltration and inflow, surcharge fees, and other miscellaneous provisions. These portions of a typical sewer use ordinance are adequately covered in other reference sources.

The recommended ordinance is designed to be self-contained, and in its full form could be used independently as a separate document to control the industrial use of sewerage facilities. In addition, individual sections of the recommended ordinance may be used separately as an addendum or a major revision to an existing ordinance. Finally, individual clauses contained in the recommended ordinance may be used to supplement an otherwise complete document.

The recommended ordinance contains nine sections which can be grouped into four basic parts as follows:

A. Introductory sections consisting of the introduction, purpose, legislative background and definitions.

B. The body of the regulation consisting of prohibitions and limitations on discharges, control of prohibited wastes, sampling and analysis of wastes and enforcement procedures.

C. Optional add-on sections for permits and self-monitoring if desired.

D. Procedural clauses.

Introductory Sections

The introduction is simply a short statement of the content of the ordinance. It usually includes the precise location (city, county, state) of the area under jurisdiction of the ordinance. This blank in the recommended ordinance, as well as all other blanks in parenthesis, must be completed to suit the enforcement agency responsible for implementation. The introduction used in the recommended ordinance is a statement of the content of Appendix 3, and will need to be modified for ordinances whose scope is greater or smaller than that contained therein.

The purpose and legislative background portions of the ordinance state the intent of the document and the legal context under which it has been developed. The influence of Public Law 92-500 with regard to both the NPDES permit program (Section 402) and pretreatment standards (Section 307) should be included. Additional applicable regulations of either State or interstate agencies should also be noted in this section of the ordinance.

All ordinances contain a section on definition of terms used in the body of the ordinance. As few as 10, and as many as 50 definitions have been used depending on the sophistication of the ordinance. The recommended document contains 24 entries, or about the average length of a definition section. If a POTW has other sewer ordinances, then the definitions should be changed to be compatible with existing terminology. Many ordinances also have an entry for "other terms" which refers to the "Glossary-Water and Sewage Control Engineering" published by the Water Pollution Control Federation.

Regulatory Sections

This portion of the ordinance contains the essential regulations controlling discharges to sewerage systems, provisions for sampling and analysis, and procedures for enforcement of the ordinance.

Most ordinances cover prohibitions and limitations of wastewater discharges in two parts; general prohibitions on materials which have proven to be hazardous, or interfere with both collection and treatment systems, and limitations on certain critical pollutants which either interfere with or pass through the treatment facilities. The general prohibitions should delineate all objectionable materials

as specifically as possible, and also should provide legal coverage for unanticipated problems. In this context, it should provide the POTW with the flexibility to effectively act against violators discharging materials not specifically named in the ordinance.

Excessive Discharge Rate

One instance in which flexibility is essential is in regard to excessive discharge rate. The recommended ordinance includes, in paragraph 3.1.8 a general prohibition of wastes containing high concentrations of suspended solids, BOD or COD, or unusually high flows which would cause a treatment process upset and subsequent loss of treatment efficiency. This clause is of particular importance to many POTW systems. In a number of instances, industrial dischargers constitute a large percentage of the flow to a POTW. Excessive discharge can be extremely damaging in such cases. In addition, frequently industries with wide seasonal variations in their wastewater characteristics discharge to POTW's. Excessive discharge can also be a significant problem with industries having such seasonal variations in their plant effluent. In any case, it may be possible for a POTW to define excessive discharge more specifically for the system in question. This may be done in terms of design capacity, NPDES permit conditions, or by taking into account the most cost effective means of dealing with excessive discharge. If it is possible to delineate specific limits for excessive discharge incorporating local conditions, that is generally more desirable than the general clause contained in the recommended ordinance.

Establishing Limitations for Pollutant Parameters

The provisions for limitations on wastewater discharges have been shown in both general and specific terms in the recommended ordinance. Whichever option is utilized, the NPDES permit conditions and Federal pretreatment standards should be either referenced directly or used in the development of specific numerical limitations for applicable pollutant parameters. The general limitations provide flexibility for systems which are unable to determine what specific limitations to establish.

If sufficient information is available to select pollutant parameters and set specific numerical limitations, that option is usually preferable. However, it requires thorough knowledge of the sewerage system, data on industrial contributors, and familiarity with applicable water quality standards, Federal pretreatment standards and the provisions of the NPDES permit for the POTW. In establishing specific limits, there are three major factors to consider; Federal

pretreatment standards, inhibition of treatment processes, and pass through of pollutants which would affect the POTW's NPDES permit or water quality standards.

Federal pretreatment standards for new and existing sources within major industrial categories are in various stages of development as described in other sections of these guidelines. When finalized, the limitations prescribed therein should be incorporated into the ordinance for all affected industries. As a result, specific numerical limitations for various incompatible pollutant parameters will be established for a number of major industries. Standards applicable to industries within a given system should be incorporated directly into this section of the ordinance. An efficient way in which this may be accomplished is by use of the Standard Industrial Category (SIC) code for each industry established by the Office of Management and Budget. The SIC numbers are utilized by the EPA in pretreatment rules and regulations, and thus provide a convenient method of cross-referencing for a given industrial category.

The second major consideration in setting numerical limitations is the inhibition of treatment processes that may be caused by particular incompatible pollutants. In this connection, Section E and Appendix 5 of this document provide technical data on the inhibitory effects of both inorganic and organic constituents of industrial wastewaters. The data presented represents a summary of information available in the literature on this subject. It should be used as a guide in establishing a range of values for specific pollutants which may inhibit or upset treatment processes. Nevertheless, a number of factors within a given collection and treatment system will affect the acceptable level of a specific pollutant in a specific treatment plant. Of the many factors to be considered, the type of treatment process utilized is of prime importance. In addition to the inherent differences between unit processes such as activated sludge and trickling filtration, other treatment considerations such as chemical addition and wastewater flow pattern strongly affect inhibition characteristics. Consequently, information that may be available for a particular system should be utilized preferentially as compared to the data contained in these guidelines.

Additional factors to be considered in setting limits based on inhibition are the dilution available, and background levels of the pollutant present in the collection system. Dilution is primarily a function of the size of the system, ranging from insignificant dilution in many small systems, to extremely high levels of dilution in very large systems. Several of the largest systems report that upset

of treatment processes is extremely rare, regardless of the concentration of individual industrial contributions. The background level of a specific pollutant in a sewerage system should also be considered in setting numerical standards based on inhibition. Normally this is a difficult determination, but information from systems without industrial contributors may be helpful. Also, monitoring of all industrial dischargers and plant influent levels, with subsequent calculations will reveal background levels within the system.

In general, judgment is required in developing appropriate limitations based on inhibition of treatment processes, and all factors affecting the determination must be taken into account at the local level. A final consideration in establishing limitations based on inhibition, is the incorporation of an appropriate safety factor into the numerical limits for each pollutant. The inhibition data presented in these guidelines summarizes the results of studies reported in the literature indicating actual numerical values at which inhibition or process upset was observed for specific pollutants. Establishment of limitations based on this information requires the use of a suitable safety factor to ensure that adequate protection is provided for the treatment process.

The third major consideration in setting specific limitations is the pass through of pollutants which would cause the POTW to violate its permit conditions or water quality standards. The method required to establish limits for industrial contributors based on permit or water quality provisions is "back-calculating," using the allowable discharge level in the standard as a starting point. This procedure requires knowledge of the removal capability of the treatment plant for the pollutant parameters of interest, in addition to information on dilution and background levels in the system discussed above. Frequently it is necessary to sample the influent and effluent of the treatment plant to establish its removal capability for a specific pollutant. If data for the system in question is not available, the removal information contained in Section F and Appendix 6 may be utilized to obtain average values for use in calculating specific pollutant limitations. Those portions of the document present the results of a survey of 269 treatment plants to determine the removal capability of treatment processes in regard to various pollutant parameters.

One major POTW system has developed a formula for use in establishing limits on its industrial contributors based on allowable pollutant concentrations in the treatment plant

discharge set by the State. The formula is as follows:

$$L = \frac{(L_e) (S) (R) (P)}{(1-E)} \quad (\text{Reference C-47e, page V-22})$$

where:

L = Maximum allowable concentration in an industrial wastewater discharge (mg/l).

L_e = Allowable effluent concentration at the treatment plant (mg/l).

R = Dilution ratio = $\frac{Q^*}{Q}$

E = Treatment plant removal efficiency (%)

Q^* = Total daily dry weather flow to the treatment plant (millions of gallons).

Q = Total daily industrial flow to which L applies (millions of gallons).

P = Assumed ratio of the maximum to average concentration for any wastewater component in an industrial wastewater discharge.

S = Assumed portion of total that can be controlled (%).

In this formula, L is determined for each pollutant parameter for which an L_e has been established. The dilution ratio (R) is estimated by determining the total flow (Q) of all industries to be regulated for the pollutant in question, and dividing it into the total flow to the treatment plant (Q^*). Values for E, the treatment plant removal efficiency for the pollutant parameter, should be based on operating experience of the specific treatment plant. If such information is unavailable, data for similar treatment facilities presented in Section F may be utilized. The peak to average ratio, P, is an estimate of the ratio of the maximum concentration of a constituent in an industrial effluent to the average concentration of the constituent for all industries included in Q. The more tightly a pollutant is controlled, the lower this ratio will be. The factor S is included to account for background levels in the system. If there is no background level for a particular pollutant, with industry providing the total concentration, then the value of S is 1.0.

The originators of the formula, the County Sanitation Districts of Los Angeles County, have utilized it to aid in determining allowable pollutant concentrations for industrial dischargers within the system. Table C-1 provides a numerical illustration of how the formula was applied to the ocean standards established by the State of California for arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc, and cyanide. The table is included herein only as a guide for utilization of the formula, and not for the presentation of numerical information. Subsequent data obtained by the County Sanitation Districts has resulted in a revision of many of the values shown in the table, particularly for the factors R and S. POTW's applying the formula to their own situation must determine applicable values for all of the factors in the formula based on the characteristics of the individual system. In summary, the formula provides a systematic method for establishing specific numerical limitations for industrial pollutants based on the allowable concentration of each pollutant in the treatment plant effluent.

Responsible State or local regulating agencies should recognize that concentration based limitations have some inherent deficiencies, particularly where the ordinances' numerical limitations are intended to meet water quality requirements. Mainly, in cases where water and sewer costs are less than the cost of installing and operating pretreatment facilities, industrial dischargers may be tempted to use dilution to comply with the concentration limitations, resulting in the degradation of water quality. Dilution could result from the addition of city water, non-contact cooling water or relatively clean process water or storm water.

To detect diluters, the responsible authority should review industrial plans and specifications for pretreatment facilities, and use on-site inspection of pretreatment facilities and plant piping to determine that the appropriate pretreatment facilities have been installed, are being operated, and that there are no permanent connections for dilution water. Additionally, close surveillance of water meter readings and records can often pinpoint diluters. However, this is usually most effective when the concentration limitations first become effective and are first enforced. With these safeguards, concentration limitations will usually provide an effective and enforceable means of preventing the pass through of pollutants which could cause the POTW to violate its permit conditions or water quality standards.

Other Regulatory Sections

Section 4 of the recommended ordinance establishes the authority and procedure for the control of prohibited wastes. It includes the necessary clauses relative to regulatory actions, submission of plans for pretreatment facilities, proper opera-

TABLE C-1

CALCULATION OF MAXIMUM ALLOWABLE INDUSTRIAL DISCHARGE CONCENTRATIONS
COUNTY SANITATION DISTRICTS OF LOS ANGELES COUNTY

CONSTITUENT	Le Ocean Plan Effluent Limit (mg/l)	E Removal Efficiency at plant w/Biolog. Secondary Treatment (%)	Lp Permissible Influent Limit to Plant $\frac{Le}{(1-E)}$ (mg/l)	R Dilution Ratio $\frac{Q^*}{Q}$ (1)	P Assumed Ratio of Maximum to Average Concentration	S Assumed Percentage from Controllable Sources	L Calculated Maximum Concentration Allowable in Industrial Discharge $L = \frac{(Le)(R)(P)(S)}{(1-E)}$ (mg/l)
Arsenic	0.01	48	0.02	28	5	0.9	2.4
Cadmium	0.02	73	0.09	11	4	0.9	2.9
Chromium	0.005	77	0.022	20	2	0.9	0.78
Copper	0.2	76	0.4 (2)	15	2	0.85	10.
Lead	0.1	80	0.6	15	3	0.9	20.
Mercury	0.001	84	0.008	10	5	0.9	0.28
Nickel	0.1	53	0.23	15	2	0.9	5.8
Silver	0.02	69	0.074	20	5	0.9	5.8
Zinc	0.3	77	1.58	6	2	0.9	14.
Cyanide	0.1	55	0.24	8	3	0.9	4.8

Notes: (1) Dilution ratios are based on the Industrial Waste Inventories of the Sanitation Districts. They are obtained by dividing 350 mgd by the total industrial wastewater flow of all industries identified in the inventory as significant contributors of the particular constituent.

(2) The limit of 0.4 mg/l copper is based upon the toxicity relationship of copper to biological wastewater treatment processes and is more restrictive than the influent limit required by the Ocean Plan effluent limit. The restrictive Lp value of 0.4 mg/l was used in lieu of $Le/(1-E)$ in the calculation of L.

tion and maintenance of pretreatment facilities, admission of POTW personnel to industrial plants and reporting of accidental discharges. Section 5 of the ordinance is devoted to sampling and analysis of industrial wastewater. Several clauses are included with regard to monitoring, encompassing the type and frequency of samples and the allocation of costs for sampling and analysis. Section D of these guidelines includes a complete summary of monitoring information for the sampling and analysis of industrial wastewaters.

The section of the recommended ordinance dealing with enforcement provides a structured approach for the handling of violations. The first step in the procedure is notification in writing of the violation, followed by conference and conciliation. If these steps are unsuccessful in solving the problem, then more formal proceedings are instituted. The first is a show cause hearing, which provides the violator with an opportunity to show cause why an order should not be issued directing the discontinuance of the discharge. Show cause hearings are usually open to the public, and held before a hearing board composed of appropriate officials of the municipality, authority or district. Upon submission of all evidence, the hearing board has the option of issuing an order for the cessation of the discharge within a specified time period. If an order is issued, and not complied with, then court action is the next and final step in enforcement of the ordinance. This step-by-step approach to enforcement provides the maximum opportunity for the resolution of ordinance violations without resorting to court proceedings until absolutely necessary.

Optional and Procedural Clauses

The two major optional clauses contained in the recommended ordinance pertain to a permit program and the use of self-monitoring for industrial contributors to the system. Local permit programs are most applicable to large systems, and to date have been used successfully by several large regional agencies. Permit programs greatly increase the paper work associated with industrial pollutant control programs. Although the onus for filing permits is placed on the industries in the system, the POTW must nevertheless scrutinize the permits for completeness, truthfulness, accuracy, etc. The use of permits can be particularly advantageous in instituting a control program in a large system. At the outset, industries must self-monitor and provide all relevant information on their discharges, thus relieving the POTW staff from this initial data gathering task. Local permit programs offer an option which is systematic and thorough, but one which requires a well-trained capable staff to administer.

Self-monitoring is frequently used in conjunction with a permit program. Industries are generally required, under these programs, to self-monitor for the completion of a permit application. Self-monitoring reports are then generally required at varying frequencies to update discharge information. In any event, monitoring for compliance and enforcement activities, and demand monitoring to alleviate operating problems in the system, usually remain the responsibility of the POTW. Few systems utilize self-monitoring as an option for compliance monitoring or any function other than initial data gathering and periodic review.

The procedural clauses included in the recommended ordinance serve several varying functions. The principal clause provides that the bulk of the ordinance remains in force if any section is declared invalid or unconstitutional. Only the affected section is no longer in force, thus "saving" the remainder of the ordinance. This section also references other related ordinances and reconciles differences that may exist between the various ordinances. Finally, the procedural clauses establish the authority of the manager of the system, and set forth the date that the ordinance becomes effective.

SECTION D MONITORING

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SECTION D MONITORING

Functions of a Monitoring Program

Introduction

As outlined in the preceding sections, the management of a pollutant control program requires a constant flow of information on the quality and quantity of industrial contributions to the publicly owned system. In general, the function of a monitoring program is to provide a mechanism by which the POTW operator can obtain information on the pollutants introduced into the sewer system. The information obtained through monitoring activities may then be applied to specific areas of concern to the municipality. These specific areas include compliance to ordinance requirements, ascertaining surcharge fees, and completion of reports required by EPA. Additionally, the POTW operator may use monitoring information to determine the contributors who are responsible for releasing materials potentially harmful to collection or treatment systems.

Depending on the specific situation, information obtained by monitoring may also be used in the development of the ordinance and in its enforcement. Monitoring information can be especially useful in developing those sections of the ordinance that set levels for incompatible pollutants, as well as determining orders of magnitude for an equitable system of surcharge fees. As a result, ordinance development and enforcement work hand in hand with monitoring activities.

Although monitoring in a broad sense performs the single function of transferring quantitative and qualitative information on non-residential contributors, specific subfunctions should also be completed to provide a total program. For monitoring, there are well defined intermediate steps that should be accomplished during the course of the overall program. In a well managed system for industrial pollutant control, information should be transferred in a closed loop where monitoring, ordinance compliance, ordinance enforcement and surcharge fee determination all input to one another. A typical monitoring feedback system is depicted in Figure D-1. Each of the monitoring functions shown are discussed in detail in the following paragraphs. The interrelation of each function is addressed with commentary included on the implementation of the specific monitoring activity.

Development of a Data Base

NPDES permits issued to POTW's often stipulate that the permittee must promulgate an enforceable ordinance. In addition, the permittee is required to submit reports and forms to the EPA regional office concerning the characteristics of contributions from major contributing industries (MCI's) within their system. Once an ordinance is in effect, reports on the progress of the MCI's toward compliance are usually required. The ordinance cannot be completely developed unless the municipality or authority has acquired preliminary information on non-residential contributions in the system. The mechanism for obtaining this data base is provided by the requirement in the typical NPDES permit that the permittee must submit, for each MCI within its system, an EPA Standard Form A - Municipal; Section IV entitled "Industrial Waste Contribution to Municipal Systems." Completion of the Section IV form requires information on production, wastewater flow and wastewater concentration. This information can serve as an initial data base, from which the municipality or authority can plan or implement its industrial pollutant control program. The Section IV form is only required by EPA for MCI's. However, this form provides a convenient tool that could be utilized by municipalities to obtain data on all industrial establishments within their jurisdiction. Consequently, a systematic approach to obtaining Section IV information should be developed. An important preliminary step in this regard is the location, evaluation and classification of non-residential contributors. In order to develop the Section IV data base, two specific tasks must be completed; the identification of non-residential contributors, and differentiating between major and minor sources.

For the small municipality, identifying contributors within the wastewater collection system is usually an easy task. The plant operator, or the system's superintendent, is generally familiar with the area served, and the contributors within it. For larger systems, and those small systems where this familiarity does not exist, identifying industrial contributors can be more complex. The location of wastewater sources can be accomplished by using the various listings of commercial establishments that are available to the public. Such listings include:

- Labor Department Records
- Property Tax Records
- Chamber of Commerce Rosters
- Census Bureau Records
- Local Telephone Directory
- Water Consumption Records

These documents can provide a variety of information on industrial establishments, such as location, product line, production volume and water usage.

Combining the information that can be obtained from the individual listings can provide the municipality with an understanding of which contributors may be considered major or minor. Using the criteria for an MCI established by the EPA, a preliminary breakdown between major and minor contributors generally can be established on the basis of flow. In addition to the Federal definition of a major industry, the municipality must decide, on the basis of specific factors in the POTW system, which industrial facilities to consider significant contributors. The EPA definition of an MCI should be used as a first step in a major-minor delineation. However, other factors including water quality standards, and the POTW's sensitivity to a particular type of wastewater, must also be taken into account. Establishing a list of significant contributing industries on this basis requires direct contact with industry, and detailed analysis or evaluation of each plant's wastewater.

Once a preliminary list of possible MCI's and other significant industries has been developed, each major contributor should be classified into the proper Standard Industrial Category (SIC). This may be accomplished by matching the industry's products or commercial activities to the SIC codes as listed in the Standard Industrial Classification Manual published by the Executive Office of the President; Office of Management and Budget. Depending on the size and resources of the municipality or authority, the MCI's might be required to self-monitor their effluent to provide the Section IV analytical information. If the municipality has the resources, it may elect to do analytical surveys on its own. Once the Section IV reports have been completed, the municipality can then use this information as a data base for the development of ordinance stipulations, including compliance requirements and surcharge fee schedules.

Scheduled Monitoring

Scheduled monitoring involves the systematic sampling and inspection of significant industrial contributors to the POTW system in accordance with a predetermined schedule. The schedule should be developed by the POTW personnel administering the industrial pollutant control program, and should be maintained as confidential information so that the industries in the system are unaware of contemplated monitoring visits. The schedule should attempt to provide for the monitoring of each significant industrial contributor at least once per

year if at all possible. If resources do not permit this type of coverage, then visits should be planned as often as possible within the limitations of available resources.

Scheduled monitoring should serve a number of specific needs, including: (1) checking for compliance with the ordinance, (2) surcharge, user charge and industrial cost recovery determinations, and (3) completion of required EPA reports. Scheduled compliance monitoring should be aimed at obtaining all the information necessary to determine adherence to the local ordinance. The information required for surcharge, user charge and capital cost recovery coincides to a large degree with the data necessary for the completion of required EPA reports. In addition to the Section IV forms, many NPDES permits require the municipality to furnish the EPA with periodic reports on the progress of industrial contributors toward compliance with pretreatment regulations. Also, if the POTW is the recipient of Federal construction grant funds, it is required by Federal regulations to review user charges on an annual basis. This review would usually require that the municipality monitor the quality and quantity of major industrial contributors. Even if the municipality has not been granted Federal funds, a periodic review of surcharge fees is usually needed to keep abreast of changing conditions in the system.

The three elements of scheduled monitoring outlined above (compliance, surcharge and EPA reports), although designed to meet differing needs, all require a similar field effort and technique. All three should be conducted on a reasonably rigorous basis to assure the validity of the data obtained. Each element of scheduled monitoring may require an extended survey of a particular plant's contribution to the municipal sewer. As a result, scheduled monitoring should provide for a single visit to a specific industrial facility for the duration of time necessary to obtain all data required for the purposes indicated above.

In general, scheduled monitoring would include on-site inspection of pretreatment facilities and plant operations, and composite samples and flow measurements taken over a period of several days. On-site inspection is necessary to insure that pretreatment facilities are being operated properly and to detect any dilution of plant wastewaters. The determination of flow is important for several reasons. Primarily, flow information is essential in the calculation of surcharge or user charge fees. Additionally, flow readings are necessary as an added safeguard against dilution and to confirm the validity of concentration measurements taken for ordinance compliance. The degree of care

and conformance to established procedures in obtaining samples and flow measurements during scheduled monitoring visits is an extremely important consideration. Information obtained during this process may ultimately be used in enforcement activities culminating in court action. Additionally, in the determination of surcharges or user charges, the municipality may be compelled to monitor with sufficient rigor to satisfy the industry that the information obtained is sufficiently accurate. This situation is especially valid in those cases where sewer use charges are a significant expense for the industry.

Although detailed composite sampling may be most desirable for compliance monitoring, simple grab samples may often be sufficient to determine ordinance compliance. It is recognized that many POTW systems do not have sufficient resources to monitor each significant contributing industry once per year for a period of several days. The essential aspect is to obtain a sample that will have sufficient validity should it become necessary to use the data for enforcement activities. The applicability of less rigorous sampling, such as simple grab samples, depends largely on the stipulations of the ordinance concerning sampling technique and the municipality's ability to enforce the ordinance using the data derived from a grab sample.

Unscheduled Surveillance

In addition to the planned approach, POTW's should institute a less formal type of compliance monitoring designed to provide a spot check of industrial contributors. This random type of compliance monitoring should be focused on maintaining a degree of surveillance, and would generally not be formally planned by the POTW.

Scheduled compliance monitoring is designed primarily to establish the characteristics of contributions from major sources, whereas unscheduled surveillance attempts to randomly survey all sources within the system. By checking all contributors over an extended period of time, the municipality can continue to expand its data base, and keep abreast of trends and changes within the system. This type of monitoring should be conducted on a random basis, with contributors being observed during normal operation, thus providing information on the true nature of the wastewater. If ordinance violations are suspected, the information obtained during unscheduled surveillance can also be used to evaluate the need for further, more detailed, evaluation of a particular contributor.

Unscheduled surveillance can be conducted with less rigor than scheduled compliance monitoring. Since surveillance activities are intended only to provide a quick spot check to determine the need for future more detailed analysis and evaluation, this type of monitoring can be less formal than a full compliance monitoring visit. Unscheduled surveillance should involve no more than a few samples, perhaps composited over a short period of time, and a cursory inspection of plant operations and pretreatment activities. Where resources are limited, grab samples are frequently used for this type of surveillance. Flow measurements may be taken if facilities are available to obtain readings without difficulty.

Demand Monitoring

As the name implies, demand monitoring should be conducted when an upset or other disruption of system operation occurs, which may have been caused by an industrial source. Additionally, any discharge of prohibited or limited materials can prompt demand monitoring. Specific occurrences that may initiate a demand monitoring sequence are as follows:

1. Contributions of Explosive or Corrosive Materials to the Sewer

Release of these types of materials are generally prohibited by the municipal ordinance. Because of the magnitude and immediacy of the potential impact of explosive or corrosive materials, swift location of the source is essential. The most effective means of locating sources of explosive or corrosive materials is by utilizing sewer back tracking, which is a systematic search upstream through the sewer system until the source is pinpointed.

2. Operating Difficulties

Treatment plant and collection system operating difficulties can also prompt demand monitoring. One of the more serious operating problems is caused by the release of materials into sewers which can cause blockages or plugging. Similarly, excessive quantities of viscous or floating solids entering a treatment plant can disrupt unit operations such as sludge digestion. The presence of excessive foaming can also cause operating difficulties, and may prompt a demand search. In general, any upset of normal operating routine may be considered cause for initiating demand monitoring.

3. Violation of the POTW's Permit Requirements

A POTW's permit generally contains limits on the concentrations of specific pollutants that it can discharge to navigable waters. If the treatment process is disrupted to the extent that these limits are exceeded, it becomes the responsibility of the municipality to determine the source of the materials that might be passing through the system, or causing poor removal of the pollutants that the treatment system is designed to remove.

4. Violation of Pretreatment Regulations

Since many NPDES permits require the development of an ordinance that contains requirements for compliance by MCI's to pretreatment regulations, a suspected violation of these standards can initiate demand monitoring. In such cases, demand monitoring should provide information on the cause of interferences, and the responsible party. In these situations, demand monitoring can be most successful when the municipality has access to a good data base. Using data base information, the probable sources of interfering materials can generally be determined and monitored so that responsibility can be properly assigned.

It should be noted that in those cases where demand monitoring is prompted by the presence of an explosive material, the removal of the explosion hazard must have top priority. It is unwise to attempt sewer backtracking until any possible danger has been eliminated.

Self-Monitoring

Many of the monitoring activities that have been outlined in the preceding paragraphs require that samples be taken at the effluent of an industrial contributor, and analyzed for appropriate pollutant parameters. Depending on the available resources and manpower, the municipality may not be able to perform all of the various monitoring functions required for industrial contributors. At a minimum, the municipality should attempt to conduct, with their own personnel, compliance and demand monitoring activities for all significant industrial contributors within the system. However, complete coverage of all contributors within the system may be more difficult to implement using municipal personnel and resources. One way to circumvent this problem is to require each major contributor to do its own sampling and analysis, a function which is usually termed self-monitoring.

Self-monitoring systems require that a mechanism for reporting and record-keeping be maintained by the industrial establishment. Periodic reports would generally be sent directly to the municipality. The recordkeeping function permits access to a history of source quantity and quality which can aid in both data base development and compliance determination.

Self-monitoring can be particularly helpful in the development of the initial data base. Forms can be forwarded to industrial contributors requesting information on the flow and pollutant characteristics of their effluents. This type of approach is most applicable where a local permit program is utilized, and the form then becomes a permit application. Data accumulated in this manner can serve as the basis for establishment of an industrial pollutant control program, with verification achieved through subsequent compliance monitoring.

Enforcement

An important function of a monitoring program is its ability to provide specific information required by enforcement activities. Enforcement implies that there has been a violation of a regulation. In general, municipalities will use monitoring information to assess deviations from ordinance stipulations. If conducted with the proper rigor and quality control, wastewater sampling and analysis previously performed by the municipality can be used in enforcement activities directed at ordinance violators. Self-monitoring information generally is not used for enforcement. If an industry is aware that its contribution is in violation of the ordinance, it is not likely that it would be willing to submit such data to the municipality for use in enforcement proceedings. Therefore, self-monitoring data should not be considered suitable for enforcement activities. Instead, the municipality should rely on its own monitoring information, legally obtained, with proper technical execution.

Field Considerations in Monitoring

Background

Organizational and managerial aspects of a monitoring program may vary considerably from system to system, but the approach to the technical problems encountered in any field monitoring activities remain fairly constant. The need to maintain rigor and objectivity dictates that sound, uniform

and well defined procedures be maintained during plant investigations and sampling programs. Some guidance on how to develop and carry out a monitoring program is available in an EPA Technology Transfer document entitled "Handbook for Monitoring Industrial Wastewater." This handbook describes technical aspects of monitoring, but its major emphasis is directed at industries discharging directly to navigable waters that are engaged in self-monitoring activities. Although many of the details remain the same, field considerations for monitoring industrial contributors in a pretreatment situation have a slightly different orientation. Special field considerations for monitoring pollutants introduced into POTW's are outlined in this section.

An ordinance will generally prohibit, or set limits on the release of specific materials to the municipal wastewater treatment system. Wastes that cause an explosion hazard, or block or corrode the sewer are generally completely prohibited. Other pollutants that may either inhibit biological processes, or pass through the system, may be limited by ordinance. It is therefore essential that the monitoring program supply data on the contributions of prohibited and limited substances as stipulated in the ordinance. Furthermore, the ordinance may establish the frequencies and the type of sampling required for non-residential contributors. Monitoring activities must also be coordinated with these aspects of the ordinance.

The approach to monitoring in the field subdivides into three basic categories: (1) Monitoring on a scheduled and planned basis, (2) Unscheduled surveillance on a random basis, and (3) Demand monitoring prompted by an emergency condition or violation of standards. Field considerations in plant sampling during a planned visit or random visit for unscheduled surveillance are similar in many respects, although less rigor is required during an unscheduled visit. Consequently, details on the field aspects of monitoring have only been provided for scheduled and demand monitoring, since the information provided under scheduled monitoring may generally be used as a guide for unscheduled surveillance.

Scheduled Monitoring

Scheduling

An attempt should be made to systematically cover all significant contributing industries annually if resources permit. After initial data base development, monitoring should be conducted at each major contributor to determine progress toward compliance. Once compliance is achieved, the contributor

must be sampled periodically to assess continued compliance. Additionally, when a scheduled compliance monitoring visit uncovers a violation, scheduling should be altered to provide more detailed analysis of the wastewater. This extended sampling program is normally required to obtain data sufficiently valid for enforcement activities.

In all cases, the frequency and order of investigations should be determined on the basis of size and importance of the contributor. Sampling should be started with the largest, or most significant industry. Once the major industries are covered for data base and initial compliance purposes, a continuing program of follow-up monitoring should be instituted. It may not be within the resources of the municipality to cover all contributors within its system thoroughly and equally. A schedule in which major contributors are monitored more frequently than minor contributors will generally be necessary.

Preparation for a Monitoring Visit

Industries should not be notified prior to scheduled monitoring or unscheduled surveillance visits. It is generally agreed that by not giving prior notice to the industry, the samples that are obtained will be more representative of daily operation.

Prior to sampling at a contributor, the sampling crew or inspector should obtain specific information about the industry. During the initial visit a plant inspection report should be prepared. Several specific items should be included in this report:

- A sketch of the location of all wastewater effluent lines that flow into the publicly owned sewer system. The sketch should also include the layout of major plant features.
- A description of major product lines and processes utilized within the plant. For MCI's this information may be obtained from the Section IV report.
- A detailed description and appropriate sketches of existing pretreatment facilities, including operating data if available.
- A list of pollutants of interest at the plant, with emphasis on materials limited or prohibited by the ordinance.

Equipment

On-site inspection, flow measurement and sampling should be accomplished during each visit. Accurate flow measurement and sampling techniques are of prime importance in obtaining valid monitoring information. Both flow measurements and sampling can be accomplished either manually or through the use of automatic devices. Three types of sampling may be utilized:

- Grab samples, in which a single volume of wastewater is obtained and analyzed. This type of sample will not always provide an accurate measure of wastewater characteristics, especially when the flow is heterogeneous, or varies with time.

- Simple composite sampling is a timed sequential collection of equal volume grab samples that are combined in a single reservoir. This type of sample can give a partial evaluation of the variability of wastewater composition with time. It does not provide any measure of the total pounds of pollutant discharged since pollutant loading is a flow related value.

- Flow proportioned composite samples are obtained by collecting incremental samples with volumes proportional to flow. This type of sample, when analyzed and compared to total flow, provides the most accurate measure of wastewater quality and pollutant loading.

Automatic sampling devices that can obtain all three sampling types are commercially available. These automatic samplers vary over a wide range in cost, applicability and reliability. Two EPA documents are available which provide thorough evaluation of commercial automatic samplers:

- "Sampling of Wastewater," by Philip E. Shelley
Available through EPA Technology Transfer

- "Wastewater Sampling Methodologies and Flow
Measurement Techniques"
EPA Report 907/9-74-005

The second document also includes information on the performance of portable automatic flow measuring devices. There are considerably fewer devices of this type on the market than automatic samplers. However, a few portable instruments are available that can provide reasonably accurate flow measurement data.

For the smaller system, or those municipalities that have only limited resources, both sampling and flow measurement may be accomplished using manual techniques. All three sample types can be collected using manual methods. In general, there is little equipment commercially available for manual sampling. What is usually needed is an extendable pole, with a stoppered bottle attached to the end. This type of sampling pole can be easily fabricated. The sample bottle should be hinged so that it can be tilted to align parallel to the wastewater flow. This orientation allows for sampling from very shallow streams. The bottle stopper should be attached to a string so that it can be removed while the sample bottle is submerged.

With regard to flow determination, the accuracy of any flow measurement depends greatly on the control surface utilized. Some ordinances may require that major contributors install a special control manhole designed to provide sufficient access for sampling and an appropriate control surface for flow measurement. Depending on the situation, permanent flow recording equipment may also be required. The installation of a standard weir or flume makes flow measurement a simple matter of measuring wastewater depth. No control surface is completely accurate, but the combined use of a quality automatic flow measuring device and a control surface can typically yield flow measurement accuracy of better than $\pm 15\%$.

Special attention should be paid to the accuracy of sampling activities. Whereas flow measurement accuracy can be held to the 15% level, sampling errors can range up to 200% of the true value. The basic problem results from the fact that the typical industrial waste may have a large proportion of its pollutants in the form of suspended solids. As a result, it is important that the quantity of suspended solids entrained during sampling be proportional to the suspended solid content of the total wastewater stream. Common practice is to simply place a suction tube in the wastewater flow, or to immerse an open sampling bottle in the stream. Since solids entrainment is a velocity controlled process, an attempt should be made to obtain samples isokinetically. There should be a minimum fluid velocity difference between the interior and exterior of the sampling tube. Accomplishing this type of sampling is a difficult procedure, but the situation can be significantly improved by aligning the sample tube such that it is facing upstream and is secured rigidly in place. Because of the potential for large errors associated with sampling, it is essential that extreme care be exercised in selecting sampling devices and procedures.

Sample Handling

Once an accurate sample has been obtained, several steps should be taken to assure that the validity and objectivity of the monitoring operation is maintained. All samples must be properly preserved. Sample preservation techniques are outlined in various analytical handbooks such as Standard Methods and the EPA Chemical Methods Manual. The content of these and other similar handbooks are discussed in more detail in the section devoted to laboratory considerations in monitoring.

Because of the heterogeneous nature of many industrial wastewaters, the parameters to be analyzed may require the use of incompatible stabilizing reagents. To solve this problem, it is usually necessary to take a relatively large volume of sample, so that it may be divided for appropriate preservation. In addition to assuring adequate volume for sample preservation, sufficient sample size must be maintained so that a portion of the sample can be offered to the industrial contributor. The option should be given to the industry of independently checking the municipality's analytical results if they so desire.

Chain of Possession

Once an appropriate sample is obtained and properly stabilized, it is essential that the possession of the sample be properly documented. That is, the person completing the field sampling should maintain a log, containing pertinent information such as date, time and location of the sampling activity. Before releasing the sample to the laboratory, or any other appropriate official, a signed receipt should be obtained documenting the exchange. As the sample is transported, a continuous history of its condition and locations should be maintained through successive log entries and receipts.

The reason for such caution in the handling and transfer of samples stems from the need to be certain of sample integrity as part of any enforcement activity. It should be assumed that every scheduled compliance monitoring sample may become evidence in a court of law. In practice, few ordinance violations will require legal action, but nevertheless, sample integrity must be maintained. If the municipality cannot prove that a sample has not been mishandled or tampered with, then any inferences regarding the quality of the wastewater that the sample represents fall into jeopardy. It is therefore essential that a chain of possession be maintained and recorded.

On-Site Safety

Visitors to industrial establishments are usually required to abide by any safety regulations observed by plant management. Ideally, access to wastewater flows should be available from manholes or junction boxes located outside of plant property. In this way, plant inspectors would not be exposed to any hazardous activities and would be able to sample without the need to gain entry to the plant. Unfortunately, accessible manholes located outside of plant boundaries are rare, and consequently inspectors are generally required to enter upon plant property. Under these circumstances, all pertinent safety rules in force at the plant must be adhered to. The first step upon presenting credentials and entering the plant, is to notify appropriate plant management, and request applicable safety information. In most cases, a formal set of safety rules are in effect, and these rules should be recorded and filed with the plant inspection report.

Minimum safety equipment that must be carried by each inspector or inspection crew includes:

- Hard Hat
- Safety Goggles
- Rubber Gloves, Boots and Other Protective Clothing
- First Aid Kit

Special safety precautions and equipment are necessary for any sampling activity that requires manhole entry. The most dangerous aspect of sewer sampling and inspection is the possible presence of dangerous gases in sewers. These gases may include either explosive vapors or poisonous mixtures. Conversely, there may be an oxygen deficiency in the sewer. In order to avoid possible injury, several precautions should be taken and proper equipment should be utilized during the course of sewer inspection as follows:

- Manholes should be opened with a hook rather than a pry bar. Using a hook reduces the possibility of having metal rub against metal, causing a spark and possible explosion.
- Before entering a manhole, the atmosphere within the sewer should be tested for oxygen content, explosion hazard and poisonous gases. Several portable, probe type oxygen and explosion meters are commercially available. Equipment of this type should be utilized during every sewer entry. Many types of indicating ampoules and gas detection test kits are available which can signal the presence of poisonous gases. A

complete set of such test materials must be present and utilized during each sewer inspection.

--Appropriate gas masks and breathing mask respirators should be used whenever there is the slightest indication of danger.

Actual entry into a manhole requires additional special safety precautions. Although nearly all manholes are built with ladder rungs, these rungs may have been used infrequently. As a result of the often corrosive atmosphere in a manhole, it is not advisable to use sewer ladder rungs, since it is possible that they may not be structurally sound. Descent into a manhole should be accomplished utilizing a portable rigid ladder or flexible rope ladder. Even when a ladder is used, each individual entering a manhole should be harnessed with a safety rope leading to the surface. In this way, in the event of a fall, asphyxiation or other injury, the individual can be pulled to the surface with relative ease.

Fire safety should always be practiced whenever within an industrial plant or near an open manhole. No open flames should be permitted, and all equipment should be explosion proof and water resistant. Since many manholes are located on streets or other thoroughfares, additional safety precautions should be taken to avoid automobile accidents and the possibility of pedestrians falling into open manholes. Consequently, appropriate pylons, barricades and flashing lights should be used in the vicinity of the manholes.

Equipment Set-Up and Field Analysis

In the absence of a control manhole equipped with brackets or ledges for mounting automatic samplers and flow measuring devices, a method must be devised for securing and mounting equipment. Within the boundaries of a plant some degree of security can be assumed, but unattended sampling points in public areas can be tempting to vandals. One solution to this type of field problem is the use of a self-contained trailer or van outfitted with appropriate materials and equipment. A further advantage to using a monitoring vehicle is that the time required for set-up and removal of equipment is greatly reduced. Furthermore, the vehicle can be outfitted with appropriate field analytical equipment. Certain parameters require immediate analysis upon sampling, such as dissolved oxygen and pH. Equipment for these analyses can be mounted in the vehicle to facilitate rapid analysis.

For the small system, resources may not be available, nor the need apparent, for a sophisticated well equipped monitoring vehicle. At the very least, a compact package containing necessary equipment should be utilized. A minimum number of separate equipment packages should be maintained, with the dimensions of a foot locker being an ideal size for each equipment carrier.

Continuous On-Line Monitoring

In recent years, equipment has been developed which can automatically monitor various wastewater characteristics. For industrial wastewaters, numerous constituents may be of interest. However, as a result of operating difficulties, generally only a few parameters can be successfully analyzed on a continuous basis. The sensors typically used in automatic monitoring equipment are often very sensitive to interferences found in wastewater, and as a consequence great care should be exercised in choosing this type of specialized equipment. Because of the commonly encountered operating difficulties, continuous on-line monitors generally require a high level of maintenance and attention. If the equipment works well, it can serve as an excellent source of continuous data which will not only aid in wastewater evaluation, but can help in evaluating process operations as well. Various manufacturers offer continuous on-line analytical equipment which can provide excellent monitoring information. However, it should be noted that automatic analysis is still a developing technology, which should be approached with an appropriate degree of caution.

Demand Monitoring

Unlike scheduled monitoring in which a planned and orderly approach can be maintained, demand monitoring results from emergency conditions occurring on a random basis. As outlined under the functions of a monitoring program, specific emergency conditions can prompt a demand monitoring sequence. These situations include:

- Explosion Hazard
- Slugs of Inhibitory Materials
- Plant Upsets
- Sewer Blockages
- Violations of the POTW's NPDES Permit
- Any danger to public health or safety

For demand monitoring, rapid initial detection and prompt location of the violator are essential. To facilitate detection, it is advisable where possible that permanent continuous surveillance stations be established at key points throughout the collection system. As soon as an abnormal wastewater quality or flow rate is detected, either at the treatment plant or at some point in the collection system, an immediate investigation should be initiated. This investigation should be systematic, back tracking in the sewer until the source of the violation is located.

As a result of the transient nature of many violations, it is essential that analytical work done in the course of sewer back tracking be completed rapidly. Presence of a prohibited or limited material in a sewer cannot be used as evidence that a specific industry is the source of the problem. As a result, it is advisable to use quick spot-check methods during back tracking operations. Once the source of the problem is located, then rigorous analytical techniques should be utilized to facilitate possible enforcement activities.

Laboratory Considerations in Monitoring

Once an administrative approach, and technical methodology are developed for obtaining industrial wastewater samples, a mechanism for accurate and rapid analysis of the samples must be provided. It is essential that analytical results be accurate and reproducible to assure that monitoring activities will provide the quality of information necessary for a successful industrial pollutant control program.

Standard Analytical Techniques

Precise and well recognized techniques have been established for the analysis of wastewaters. EPA has promulgated rules and regulations on this subject entitled "Guidelines Establishing Test Procedures for Analysis of Pollutants," dated October 15, 1973 with a proposed revision dated June 9, 1975 (Appendix 4). These rules stipulate specific analytical methods that are recommended by EPA for the determination of 71 chemical and biological parameters as reported in three analytical handbooks. The three referenced manuals are:

- "Manual of Methods for Chemical Analysis of Water and Wastes," available through EPA Technology Transfer

- "Standard Methods for the Examination of Water and Wastewater," published by the American Public Health Association
- "Annual Book of Standards, Part 23, Water, Atmospheric Analysis, 1972," published by the American Society for Testing and Materials (ASTM)

Each of these documents provides a short synopsis of the analytical method for each parameter, information on interfering substances, and step-by-step instructions on how to carry out the analysis. Also included is information on the calculation of results, the precision and accuracy of the analytical method, and techniques for chemically stabilizing and preserving samples.

These three publications should be considered a minimum requirement for any analytical laboratory. These manuals and handbooks supply the basic information that a trained lab technician would need to successfully perform nearly all analytical procedures that may be required in connection with monitoring programs.

Analytical Quality Control

The potential errors encountered during analysis of wastewater samples, although not as great as the errors associated with poor sampling techniques, can nevertheless have a great impact on the acceptability of monitoring information. Without the aid of independent checks and general quality control, the lab technician can report erroneous results without being aware that a problem exists.

Analytical quality control assistance is available in several forms from EPA. A document entitled "Handbook for Analytical Quality Control in Water and Wastewater Laboratories," has been published by the EPA Technology Transfer Program. In this handbook, specific information is provided that can guide the lab technician or chemist toward sound and reliable techniques and procedures. In addition, standard approaches to data handling and reporting, and information on calibrating equipment are included.

The EPA "Manual of Methods for Chemical Analysis of Water and Wastes" also includes information pertinent to laboratory quality control. Each of the ten EPA regional offices has an office of Analytical Quality Control headed by a Regional Analytical Quality Control Coordinator.

Included in the EPA Methods Manual are a listing of the ten Quality Control Coordinators, accompanied by appropriate addresses and telephone numbers. Through the Quality Control Coordinators, any interested party can obtain preanalyzed samples that can be used to test the accuracy of analytical techniques. Periodic analysis of known samples can provide the lab technician with an independent check of his accuracy, providing the opportunity to correct any improper procedures.

Equipment

A document entitled "Estimating Laboratory Needs for Municipal Wastewater Treatment Facilities" published by the Operation and Maintenance Program of the EPA Office of Water Program Operations, provides specific information on the minimum requirements for laboratory facilities at various sized wastewater treatment plants. This publication also includes recommendations on how a laboratory operation may be altered to handle the analysis of pollutants contributed by non-residential sources.

Laboratory equipment required for a municipal wastewater treatment plant is generally standard, with variations occurring only in degree, as the size of the plant varies. If, however, a publicly owned system receives wastewater from a particular industry, specialized analytical equipment may be required. The range of applicability of several special types of equipment are discussed in the following paragraphs.

Atomic Adsorption

Atomic adsorption spectrophotometry provides a rapid and easily performed technique for the analysis of metals in wastewater. Nearly all of the more than thirty elements that can be analyzed by atomic adsorption, can be analyzed by standard wet chemical techniques. However, the wet chemical methods can be tedious and time consuming, requiring detailed sample pretreatment procedures. Atomic adsorption methods provide for metal analyses with minimum sample preparation and, in many instances, analyses can be completed to the parts per billion level, which is not attainable with standard wet chemical techniques.

In some respects atomic adsorption does have limitations. In all cases, atomic adsorption provides only the total concentration of the element. Unless specialized pretreatment is utilized, no breakdown of oxidation state or ionic species can be determined. However, for the analysis of metals at very low concentrations, atomic adsorption is unsurpassed in

speed and accuracy. In situations where a large number of metal analyses may be necessary, such as those POTW's that receive wastewaters from metal processing or finishing industries, atomic adsorption capabilities may be required. But in all cases, the relatively high cost of atomic adsorption equipment should be weighed against the need for high volume trace metal analysis.

Specific Ion Electrodes

Specific ion electrodes are sensing probes that can detect the concentration of chemical species when immersed in a solution containing the substance to be measured. As long as the probe is completely submerged, a concentration can be measured regardless of the volume of sample present. In contrast to atomic adsorption, specific ion electrodes, as the name implies, detect only certain ionic species as they exist in solution. As a consequence, specific ion electrode readings are greatly dependent on the environmental conditions within the sample, such as pH and oxidation-reduction potential.

More than two dozen ionic species can be analyzed using specific ion electrodes. Analyses are rapid, but require some pretreatment to remove interferences prior to simple immersion of the probe in the sample and meter readout. The drawbacks to this type of specialized equipment include possible fouling of the probe membrane, long readout equilibrium periods and the ability to detect only specific ionic species. However, progress is continually being made in ion sensing electrode technology. Excellent use has been made of the commercially available dissolved oxygen probes for measuring oxygen demand, and an ammonia sensing electrode has been successfully used for monitoring nitrification in an activated sludge treatment plant. Because of the potential ease and speed of analysis that can be realized with specific ion electrodes, consideration should be given to the possible use of these methods for selected ionic species.

Automatic Analyzers

A few manufacturers currently market automated wet chemical analyzers that are typically called automatic analyzers. These devices automatically draw a small sample, add pretreatment chemicals, filter the sample if necessary, add chemicals to develop a color with an intensity proportional to the concentration, and finally automatically read and record the con-

centration proportional to the developed color. Other more sophisticated automatic analyzers may use infrared or ultraviolet spectrophotometric detection, and some use fluorometers or flame photometers. In effect, the typical automatic analyzer eliminates the steps that a technician would have to perform in carrying out typical wet chemical analysis.

Although an automatic analyzer can greatly reduce the time required to perform a particular analysis, use of these instruments is only economical when the analysis is required on a mass production basis. Furthermore, automatic analysis instruments are relatively complex devices that can require a substantial maintenance effort. As indicated for the other specialized equipment described in this section, automatic analyzers should only be used when the presence of a specific pollutant contributed by a particular industrial source is so important that frequent analyses are required.

Gas Chromatography

Gas chromatography refers to several variations of a technique in which a wastewater sample is vaporized, and the organic fraction is then analyzed. Gas chromatography is by far the most efficient way of analyzing for trace organics in wastewater, especially pesticides. However, most gas chromatographs are relatively expensive and require highly skilled operators. As a result, this type of equipment finds only limited application in POTW analytical laboratories.

IR-UV Spectrophotometry

Infrared (IR) and ultraviolet (UV) spectrophotometers, like gas chromatographs are used to analyze for organic materials in wastewater. UV spectrophotometry has been used recently for detecting oil and grease in wastewater samples. However, these two types of specialized equipment generally have only limited and specialized uses because of cost and the requirement for skilled operators.

Personnel and Degree of Expertise

Laboratory manpower requirements are outlined in the Operation and Maintenance Program document "Estimating Laboratory Needs for Municipal Wastewater Treatment Facilities." Some quantitative information is provided for determining how laboratory manpower should be altered to handle non-residential contributions. Although a thorough general analysis is provided in the publication, it should be noted that each system presents a unique situation. Nevertheless, it can be stated in general terms, that any monitoring program will require an added degree of laboratory support. For very small systems with few industrial contributors, the

additional analytical work can probably be handled by the technician performing regular sanitary chemistry. Larger systems may require the addition of personnel to handle the greater load created by the industrial monitoring program.

If analyses in connection with the monitoring program require the use of any of the specialized analytical equipment outlined above, technicians or chemists with more than the usual level of expertise may be required. Although the utilization of specific ion electrodes is relatively simple, proper use of atomic adsorption, automatic analyzers, gas chromatographs or IR-UV spectrophotometers does require a higher degree of expertise. Automatic analyzers and atomic adsorption require good technique, and special attention to equipment maintenance. In order to properly utilize either gas chromatography or IR-UV spectrophotometry, special technical expertise beyond the 4-year college level may be required.

Special Analytical Considerations

Underlying the compliance and enforcement uses of analytical data is the need to know the true composition of wastewater contributions so that the presence of harmful materials can be detected. In general, EPA recommends that wastewater samples be stabilized in a manner that will solubilize otherwise insoluble, or suspended materials. This is an especially important factor in the case of metals which are generally insoluble at high pH levels. Metal concentrations are of particular interest to plant operators since relatively small quantities of these materials can cause operating problems. However, the metallic pollutant generally must be in solution before it can cause an upset of biological treatment processes. As a result, the practice of acidifying samples and obtaining total, rather than dissolved metal concentrations can give misleading results for samples with high pH levels. Metallic pollutants at high pH values would tend to be in the form of suspended solids, and would most likely be substantially removed prior to reaching biological treatment facilities. Consequently, the impact of a wastewater stream can greatly depend on the pH of the wastewater as it enters the treatment system.

Another similar example is the importance of the oxidation state of the constituent being measured. For example, hexavalent chromium is generally considered to have a greater impact on biological treatment processes than trivalent chromium. The impact of hexavalent chromium can be significant, but the typical environment in a sewer system would tend to reduce this material, and often ensure that only trivalent chromium reaches the treatment plant. Clearly, the analysis

of wastewaters containing materials having various impacts which depend on the conditions in the sample, must be approached prudently, considering the state of the pollutant as it enters the treatment system.

Correlation of Analytical Techniques

In determining compatible pollutant loadings, it is necessary to analyze industrial wastewater contributions for the typical oxygen demand parameters. BOD historically has been used to measure oxygen demand, but this test is time consuming and can be inaccurate. COD has been used in place of BOD, but it too can be tedious, and it also takes a significant amount of time to complete. In recent years, catalytic oxidation approaches have been developed that yield measures of oxidizable substances that can be correlated to the more standard BOD or COD tests. These analyses, which are termed total organic carbon (TOC) and total oxygen demand (TOD), are rapid and reproducible.

A large body of data has been developed showing that the more rapid TOC and TOD methods can be correlated to BOD, and therefore can act as a more efficient measurement tool for an operating facility. Other similar correlations can be developed that can increase the efficiency of laboratory operations. For example, oil and grease is usually measured by an extraction gravimetric technique. This measurement can be simplified or accelerated by utilizing a UV spectrophotometer to detect the levels of organics if this type of device is available. Substitutions of methods that are either faster, more accurate, or encompass a broader range of parameters should be considered for unofficial use, when they can be correlated to standard methods.

Standard Reporting Procedures

Laboratory data handling and reporting require two basic considerations; reliable methods for recording both laboratory and field data, and criteria for determining the significance and acceptability of the data. Without a good system in which standard procedures are used for accurate recording of analytical and field data, the usefulness of the information obtained from monitoring operations can be greatly diminished. Standard forms should be developed for recording field information, which would include the conditions at the time of sampling. All laboratory data should be recorded in bound notebooks with numbered pages. This assures a continuity in time, with a sequence for all analytical data. All forms should be completed in duplicate, with each copy being stored separately as a precaution against accidental loss of data.

Of equal importance to proper recording methods is the significance and acceptability of data collected. One must be certain that the sample being analyzed is representative, and has not been influenced by infrequent or rare laboratory or plant occurrences. Numerous statistical techniques are available that can provide a measure of the appropriate confidence that should be assigned to the data. These statistical techniques are adequately covered in several of the handbooks cited above. However, caution should be exercised when using statistical methods. Generally, statistics offer a means by which variations in a set of data can be analyzed, assuming that all of the data used in the analysis is equally valid. Although statistics can be a powerful tool, it is always preferable to evaluate the significance of data variation on the basis of first-hand knowledge of the situation during sampling and analysis. Many times, if unusual circumstances are apparent, the data can be eliminated from consideration by inspection, and the problem can be rectified without the use of more sophisticated statistical analysis.

Contracting for Analytical Services

Many of the considerations discussed above concerning laboratory aspects of a monitoring program are based on the assumption that a POTW either has an existing laboratory which will be expanded to handle industrial wastewater, or has the resources to develop such facilities. This may be true for the larger systems, but the more numerous small systems may not have the resources or capability to complete the necessary analyses required for proper monitoring of industrial wastes. In such systems, analytical work must frequently be performed by commercial laboratories. When choosing a laboratory several criteria should be considered to assure that proper services are being provided.

At the present time only a few states have developed a certification system for commercial laboratories. EPA is currently in the process of developing a guidance document for lab certification programs. As a result, for the short term, POTW's wishing to engage qualified laboratory services will be required to evaluate laboratory performance independently. For the long term, use may be made of the upcoming guidance to be supplied by EPA.

Several techniques can be used to compare the quality of analytical services provided by commercial labs:

1. Use of samples spiked with known amounts of pollutants of interest. Chemicals used in the spiked samples can be obtained from the

appropriate EPA Regional Quality Control Coordinator. Use of spiked samples is a desirable method for testing laboratory performance when analyzing complex wastewater mixtures.

2. Parallel analysis of identical samples at two or more commercial labs. This procedure can provide information on the relative performance of the laboratories in question.
3. Adherence to standard procedures is essential, and as a result should be used as a primary criteria for evaluating lab performance.
4. Competitive costs are also important, providing that an acceptable quality of analytical services is provided.

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Lead

Manganese

Mercury

Nickel

Silver

Sulfate

Sulfide

Zinc

Organic Substances

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SECTION E
POLLUTANTS WHICH INTERFERE WITH PUBLICLY
OWNED TREATMENT WORKS

Introduction

Interference with the operation of a POTW system can be caused by a wide variety of chemical, biological and physical phenomena. In a broad sense, interference consists not only of materials which inhibit biological sewage treatment processes, but also substances which cause problems in sewage collection systems, sludge disposal or utilization methods, water reuse, land application of wastewater or other operations. Collection system problems include fire and explosion hazards, corrosion and solid or viscous wastes which cause plugging of sewers, and a discussion of these problems is included herein. Interference with sludge disposal or utilization and reuse of wastewaters consists primarily of incompatible pollutants which are concentrated in sludge or by reuse techniques.

This section of the report primarily presents technical data on the various substances which inhibit biological treatment processes, including the problems caused by the excessive discharge of pollutants to a treatment facility. Consideration was given to interference with physical-chemical sewage treatment systems, employing activated carbon adsorption following primary treatment such as chemical coagulation and filtration. Although many facilities of this type are currently being designed and constructed, operating data from full scale physical-chemical plants is extremely limited at this time. In addition, the characteristics of the activated carbon adsorption process are such that there are few substances which cause interference. Consequently, although it is recognized that physical-chemical treatment facilities will become more prevalent in the future, a detailed discussion of interference with such processes has not been included in these guidelines.

Materials Which Inhibit Biological Treatment Processes

In an effort to describe inhibitory effects, treatment processes and interfering substances have been grouped into broad categories. Three basic categories of treatment processes have been delineated, including aerobic processes, anaerobic processes, and nitrification. The aerobic processes have been further subdivided into activated sludge and trickling filter operations, while anaerobic processes consist essentially of sludge digestion. Although many currently operating biological treatment plants utilize the

trickling filter process, relatively little data is available on pollutant interferences. Consequently, the information on aerobic biological treatment presented is predominantly concerned with the activated sludge process. Since both activated sludge and trickling filtration are aerobic processes, the lack of information on trickling filtration may be compensated for by cautiously drawing parallels with activated sludge data.

The general categories established for interfering substances are inorganics and organics, with acidity, alkalinity, pH, ammonia, transition metals, metals, sulfate and sulfide comprising the major components of the inorganic category. Organic substances discussed include alcohols, amines, chlorinated hydrocarbons, pesticides and herbicides, phenol, surfactants and miscellaneous organic chemicals.

Most analytical methods used for determining the concentrations of the pollutants covered in this section yield a total result, including the contribution of both the dissolved and the precipitated substances in the original sample. In most cases, a precipitated pollutant has relatively little inhibitory impact as compared to its soluble counterpart. This results from the fact that most settleable solids are removed in primary treatment, and therefore never reach the potentially inhibited biological unit process. Because the insoluble fraction of a pollutant parameter will have relatively little or no effect on biological treatment processes, most investigators have conducted their tests using only dissolved pollutants. As a consequence, unless otherwise noted, the concentration of pollutants reported in this section are only for dissolved species, not the more common total value.

Whether a substance is inhibitory depends on a number of factors, including its concentration and the presence of other chemicals which have synergistic or antagonistic effects. Some substances, such as mercury, present in wastewater at a very low concentration, can disrupt one or more functions of a biological treatment system. Other substances, such as chloride ion, are inhibitory only at relatively high concentrations. Some of the special phenomena that may alter the inhibitory nature of a substance are outlined below as a prelude to the detailed discussion of specific pollutants.

Synergism

Synergism can be generally characterized as an increase in the inhibitory effect of one substance by the presence of

another. Synergism, as well as its opposite, antagonism, is found to be most prevalent when considering combinations of transition metals or heavy metals. The inhibitory effects of these metallic constituents are also enhanced by acidity.

The synergistic effects of metals with acidity is understandable in terms of the chemistry of these metals. The transition and heavy metals tend to be insoluble by hydrolysis in the pH range of sewage influent. They therefore tend to precipitate or adsorb on solids, and interact with polyelectrolytes or various chemical species containing anionic functional groups. Acidity suppresses hydrolysis, and the hydrogen ion competes with the metal ion for adsorption sites on solids or anionic functional groups in solution.

Another type of synergism is encountered with cyanide or other complexing substances which are easily biodegradable. In these cases, it is possible for the microorganism to ingest excessive levels of complexed metal ion and then to destroy by assimilation the complexing substance which is shielding the microorganism from the metal ion. The result is the release of an excessive level of the metal within the organism, upsetting its biological life processes.

Antagonism

Antagonism is the opposite of synergism in that it is characterized as a decrease in the inhibitory effect of one substance by the presence of another. The most notable antagonistic effects occur with the combination of metallic and anionic pollutants. For example, several chelating agents, such as EDTA (Disodium salt of ethylenediamine tetraacetic acid) and HEDTA (disodium salt of hydroxyethylenediamine triacetic acid) have exhibited antagonistic properties with metals. These chelating agents are used in culturing microorganisms to regulate the level of metals needed to grow bacterial cultures. Bacteria thrive in culture solutions containing concentrations of these metals well into the inhibitory range, when chelating agents are also present.

Some ambiguity as to the inhibitory effects of metals on sludge digestion has been found in the literature. Part of the ambiguity can be explained by the antagonistic effect of the sulfide normally present in a digester. Sulfide ion precipitates metals, removing them from solution and consequently eliminating their inhibitory effect. In fact, this reduction in inhibitory effects by the addition of sulfide has been used effectively in restoring upset digestors to operation (E-35). Besides sulfide, other ions such as hydroxide

(i.e., high pH) chromate, ferro-cyanide, phosphate, carbonate, and arsenate will tend to precipitate with metals, thereby reducing the inhibitory effect.

Acclimation

In addition to chemical factors, there are significant biological factors which must be considered to understand the inhibitory effect of pollutants. In the activated sludge process, a healthy biomass contains a broad distribution of microorganisms, including many species of bacteria and protozoa. These organisms compete for the available food, oxygen and nutrients, and grow and reproduce according to the suitability of the aquatic environment to their existence. In the absence of sufficient food, reproduction slows and the microorganisms devour each other. Whenever the environment changes due to the introduction of, or omission of a given pollutant, the opportunities for reproduction and growth of different species change, so that the relative populations of different species are altered with conditions.

Therefore, the previous history of a particular activated sludge biomass, including its distribution of microorganism populations, affects how it will respond when a new pollutant enters its environment. When a new pollutant is introduced, those species which cannot tolerate this substance fail to reproduce and grow, and tend to die off, while more tolerant species consume the food supply and grow and reproduce.

When a biomass becomes accustomed to the presence of a normally inhibitory concentration of a substance, it can be characterized as acclimated to that pollutant. Sludge digestion and nitrification do not have the same flexibility of adaptation to changing environmental conditions as do other biological processes. Both nitrification and sludge digestion are biological processes that rely on particular strains of bacteria. In the case of sludge digestion, the process proceeds in two steps, using two specific bacterial strains to achieve digestion. Nitrification is also limited to particular bacterial types. As a consequence, when adverse conditions are encountered in these processes, there is no possibility of another organism taking over for the affected strain of bacteria. Consequently, neither nitrification nor sludge digestion are readily acclimated to a new pollutant and may be easily upset when new conditions are encountered.

Significance of Data on the Inhibitory Effects of Pollutants

As a result of the chemical and biological factors which affect the inhibitory impact of a pollutant, a given concentration of that pollutant may be inhibitory to a biological process under a given set of conditions and non-inhibitory under another set of conditions. Therefore, it is not surprising that a significant amount of data in the literature are apparently contradictory, in that certain concentrations have been reported as inhibitory, while higher concentrations are reported to be harmless. In most cases, these inversions of effects with concentration are not due to errors of observation, but rather to different conditions surrounding the biological processes, such as those described.

The following paragraphs summarize the current available data on the inhibitory effects of specific substances, as well as the chemistry and occurrence of the pollutant. Where applicable, special effects of each pollutant are described. Important industrial sources of many of the pollutants discussed in this section are summarized in Appendix 8 of these guidelines. Additionally, Appendix 5 contains tables summarizing the data on the effects of inorganic substances. Appendix 5 also contains graphical presentations of the data for inorganics.

Inorganic Substances

Wastewater entering a POTW may contain any combination of thousands of inorganic compounds present as major or minor constituents. Fortunately, since most inorganic substances dissolved in wastewater are present in ionic form, it is possible to reduce the number of parameters of interest to a smaller list of cations and anions which comprise these dissolved substances. In addition, a few non-ionic substances must also be considered.

The cations of interest consist of the ammonium ion and various metal ions. A few metal ions; i.e., sodium, calcium, and magnesium, are prevalent in wastewaters, but are not inhibitory except at very high concentrations (about 1000 mg/l, order of magnitude). Most metal cations, on the other hand, are beneficial or non-inhibitory at very low concentrations. However, at somewhat higher concentrations (a few mg/l, order of magnitude) they become inhibitory to biological processes.

A number of metals of interest are amphoteric; that is, they may exist in solution as a cation or anion. For example, chromium may form chromic or chromous cations or the chromate or dichromate anion. Arsenic can likewise exist as arsenic or arsenous cations or arsenate or arsenite anions.

Many anions (chloride or bicarbonate, for example) are relatively compatible with biological treatment processes. Others, such as cyanide, borate, and chlorate can pose difficulties to the biological processes. A few neutral substances are important, especially ammonia and elemental chlorine.

The significant inorganic constituents which have been identified as having inhibitory effects are discussed below, in alphabetical order. A summary of the major inhibitory effects for each inorganic pollutant is given in Table E-1.

Acidity, Alkalinity and pH

The pH of a wastewater represents the relative concentration of hydrogen ions in the fluid. Although pH is frequently used to describe the acidity or alkalinity of a sample, there are fundamental differences between these concepts. pH is reported on a scale of 0 to 14, with each pH unit representing a factor of 10 in hydrogen ion concentration. A pH of 7 is considered neutral, while a solution with a pH of less than 7 is acidic, and above 7 is alkaline.

A distinction should be made between acidity and an acidic solution, and similarly between alkalinity and an alkaline solution. As discussed above, a pH of less than 7 indicates an acidic solution. On the other hand, the acidity of the solution is a measure of its capacity to maintain its pH during the addition of an alkaline solution. For example, if an acidic solution has a pH of 6 and the addition of one drop of an alkali raises its pH to 9, it has less acidity than an equal volume of another pH 6 solution that needs ten drops of the same alkali to increase its pH to 9.

Most natural unpolluted waters have a pH value near neutral (pH 6 to 8). Excess carbonic acid gas (carbon dioxide) can result in lower (more acidic) pH values, while soluble carbonates, borates or silicates may produce higher (more alkaline) pH values.

Most bacteria favor an environment of pH 6 to 8. Rare microorganism species may tolerate or even thrive in wastes of extremely low or extremely high pH, but these are not

TABLE E-1
THRESHOLD CONCENTRATIONS OF INORGANIC POLLUTANTS
THAT ARE INHIBITORY TO BIOLOGICAL
TREATMENT PROCESSES

POLLUTANT	CONCENTRATION (mg/l)			REFERENCES
	ACTIVATED SLUDGE PROCESSES	ANAEROBIC DIGESTION PROCESSES	NITRIFICATION PROCESS	
Ammonia	480	1500		E-17,E-20,E-29
Arsenic	0.1	1.6		E-5,E-21
Borate(Boron)	0.05-100	2		E-5,E-9,E-44, E-128
Cadmium	10-100	0.02		E-21,E-29,E-104
Calcium	2500			E-26,E-37,E-120
Chromium (Hexavalent)	1-10	50	0.25	E-5,E-29,E-78, E-117,E-129
Chromium (Trivalent)	50	50-500		E-88
Copper	1.0	1.0-10	0.005-0.5	E-2,E-5,E-24, E-78,E-100,E-109,E-129
Cyanide	0.1-5	4	0.34	E-5,E-15,E-21, E-118, E-129
Iron	1000	5		A-1, E-21
Lead	0.1		0.5	E-5
Manganese	10			E-21
Magnesium		1000	50	E-26,E-37,E-100 E-120
Mercury	0.1-5.0	1365		E-21,E-28,E-70, E-118
Nickel	1.0-2.5		0.25	E-14,E-25,E-118,E-129
Silver	5			E-8,E-9,E-21
Sodium		3500		E-26,E-37,E-120
Sulfate			500	E-11,E-17
Sulfide		50		E-19,E-35
Zinc	0.08-10	5-20	0.08-0.5	E-4,E-5,E-6,E-7,E-29 E-33,E-78,E-100,E-118

Note: Concentrations shown represent influent to the unit processes.

significant in biological treatment systems. As a result, pH values outside this range can cause severe upsets in biological treatment processes. This is particularly true of acidic wastewaters with low pH values in relation to nitrification or anaerobic sludge digestion.

Of equal importance to the absolute pH level in wastewater is a sudden change in pH. Sudden swings of pH are always disruptive to an otherwise stabilized system. The effect of extreme fluctuations in pH in a waste stream can be overcome by collecting, storing, and mixing the variable waste mixture in a storage vessel or pond. The effluent from this pond will show less variability and consequently will respond to biological treatment more favorably.

Discharges of wastes from commercial manufacturing or processing industries may typically result in wastes ranging in pH from about 3 to 11. Wastes outside this range are rare and represent corrosive and dangerous levels.

Acidic contributions may be received from many industrial processes including metal cleaning, plating or treatment plants, manufacture of drugs and explosives, processing of photographic films, etc.

Alkaline contributions may be received from laundries, detergent manufacture, bottle cleaners (dairies, for example), textile processing and cement manufacturing.

Summary of Inhibitory Properties:

1. The activated sludge process can treat waste solutions ranging from about pH 3 to 11, provided that the pH level has been stabilized (E-51).

2. Another source states that inhibitory effects are related to temperature and were noted above pH 10 at 20°C and above pH 9 at 10°C (E-21).

3. It has been reported that at pH 4 the activated sludge process is 43% effective (E-51).

4. The sludge digestion process is extremely sensitive to pH, and deviations of pH outside the range 6.5 to 7.5 generally cause upset of sludge digestors.

Synergistic and Antagonistic Effects:

While high acidity (low pH) is generally inhibitory to biological treatment systems, the presence of most metal ions with excess acidity results in much more severe inhibitory effects. The reason for this phenomenon is that at

near-neutral pH values, most transition metal ions tend to precipitate out as insoluble flocs. These ions also tend to form hydroxo-complexes at neutral or alkaline pH values, and these complexes mask the inhibitory properties of the metal ions. As the pH is reduced (acidity increased), the hydroxo-complexes are decomposed, and insoluble metal hydrous oxide flocs redissolve. The result is that the full effect of the metal ion concentration is felt by the microorganism. Thus, the presence of acidity which is in itself inhibitory, causes the full release of metal ions (copper, zinc, iron, lead, etc.) which are also inhibitory, and a synergistic result occurs.

Conversely, alkalinity causes the neutralization of acidity, increases the pH, and tends to precipitate metals out of solution. Thus, alkalinity is antagonistic or decreases the effect of metals. At high pH levels, where hydroxyl ion is inhibitory, acidity is antagonistic to excess alkalinity. Therefore, substances which tend to drive the pH value of the waste toward the neutral point, tend to help the activated sludge process to operate satisfactorily.

Ammonia

Ammonia (NH_3) is a common chemical substance, which is a gas at room temperature. It is extremely soluble in water and its water solution is used as a household cleaning agent. Ammonia forms a series of salts called ammonium salts. Inasmuch as ammonia and ammonium ion occur together in solution and are transformed from one form to another by shifts in the solution pH, the two substances are usually treated as a single substance in most of the wastewater literature.

Ammonia is an important substance in wastewaters and serves as a nutrient material to supply nitrogen needed for microorganism growth. All ammonium salts encountered are completely soluble in wastewater.

Ammonia occurs naturally in most wastewaters as a result of decomposition of nitrogen containing compounds in sanitary wastes. In addition, ammonia is used extensively in chemical manufacture, water softening, agricultural fertilizers, refrigeration, metal cleaning and other diverse applications.

Summary of Inhibitory Properties:

1. At low concentration levels, ammonia serves as an important nutrient in a healthy biological oxidation system.
2. No adverse effects on oxygen consumption are noted at concentrations of up to 100 mg/l of ammonia.
3. At excessively high levels (about 480 mg/l) ammonia exhibits inhibitory effects on the activated sludge process (E-29).
4. At a concentration of 1500 to 3000 mg/l ammonia is inhibitory to anaerobic digestion (E-17, E-20).

Alkali and Alkaline Earth Metals

The common alkali metals, sodium and potassium, and alkaline earths, calcium and magnesium, are widely distributed in nature and are significant components as salts in most water supplies. Consequently, these metals are almost universally present in all wastewater flows, usually as chloride, sulfate or bi-carbonate salts.

These metal ions are well tolerated by activated sludge operations, and only at relatively high concentration levels have inhibitory effects been noted. For example, inhibitory effects on the activated sludge process were noted with slug dose concentrations of sodium chloride (common table salt) of 30,000 to 50,000 mg/l (E-5, E-22, E-49), but these inhibitions may be primarily caused by the accompanying high chloride levels (E-91). Upsets have been reported in which seafood wastewater contributions containing high chloride levels were indicated as the cause of the upset. Interference with a trickling filter was noted at 20,000 mg/l sodium chloride (E-22). At more moderate concentrations of salt, no interference with these processes were noted.

However, the anaerobic sludge digestion and nitrification processes are more sensitive to these cations, and it appears that important effects are noted when the relative concentrations and absolute concentrations of these metal cations deviate from certain beneficial values. Thus, it has been reported that calcium levels of 100 to 200 mg/l are stimulatory to anaerobic digestion; 2500 to 4500 mg/l are moderately inhibitory to the process; and a concentration level of 8000 mg/l is strongly inhibitory (E-26, E-37, E-120).

Similar relations are noted for magnesium, sodium and potassium. Also, it has been reported that various combinations of alkali and alkaline earth ions and the ammonium ion show either synergistic or antagonistic effects in the operation of the anaerobic sludge digestion process. For nitrification processes a magnesium concentration of 12.5 to 50 mg/l was found to be stimulatory, whereas 50-100 mg/l inhibited the process (E-100).

Arsenic

Arsenic is a metallic element which forms cationic salts of the arsenic and arsenous forms and anion salts of the arsenate and arsenite forms. It is well known for the poisonous properties of its compounds. Arsenic is found at very low concentration levels in most natural waters and is likewise a trace constituent in most foods.

Arsenic can enter sewage treatment systems from a number of commercial operations. A major use of arsenic compounds is agricultural pesticides, where it is used in liquid sprays and dusting powders. Other uses associated with its toxic nature are wood preservatives and medicines. Arsenic compounds also find commercial use in artists' pigments, glass manufacture, and pyrotechnics. Probably the most significant source of arsenic pollution is from agricultural pesticide use.

Summary of Inhibitory Properties:

1. A level of 0.1 mg/l sodium arsenate (arsenic concentration 0.04 mg/l) showed no effect on oxygen uptake, while a level of 1.0 mg/l of this compound depressed oxygen uptake about 50% (E-21).

2. A 0.1 mg/l concentration of arsenic trichloride (about 0.04 mg/l arsenic) likewise reduced oxygen uptake about 50% (E-21).

3. A 4 mg/l concentration of sodium arsenate (about 1.6 mg/l arsenic) resulted in a significant reduction in sludge digestion efficiency (E-5).

Borate (and other boron species)

Boron is a light metal. It forms a series of anionic salts, including borate, metaborate and tetraborate. Boron

salts are found widely distributed in natural waters and foods, and therefore are natural constituents of sewage. In addition, boron compounds are constituents of household detergents and medications which also contribute to boron in domestic wastewaters. Boron compounds find application in the manufacture of glass and ceramics, fireproofing, high energy rocket fuels and in the operation of nuclear reactors. Contributions of boron from these sources are probably small.

Summary of Inhibitory Properties:

1. Boron concentrations of 0.005 to 0.05 mg/l are reported to have had no effect on microorganism growth (E-29).
2. Levels of borate from 0.05 to 100 mg/l have been reported to interfere with the activated sludge process in various ways, such as interference with sludge settling and COD removal (E-5, E-9, E-29, E-44).
3. Boron shock loads of 2 mg/l have been reported to have affected anaerobic digestion (E-128).

Cadmium

Cadmium is a transition metal which forms divalent salts. Cadmium salts are somewhat toxic, and are found in domestic water and wastewater sources only at very low levels. Contributions to POTW's come from industrial or commercial sources, with the principal contributions of cadmium coming from metal plating processes. Cadmium also finds significant use in pigment manufacture, photographic applications, dyeing and calico printing.

Summary of Inhibitory Properties:

1. Cadmium has no adverse effects on the activated sludge process up to a concentration level of about 1 mg/l (E-21).
2. In the range of 10 to 100 mg/l, cadmium shows various deleterious effects, such as decrease in BOD removal efficiency and reduction in oxygen uptake (E-21, E-29).
3. An investigator reports that 0.02 mg/l should be considered a threshold concentration for cadmium in digestors (E-104).

Synergistic and Antagonistic Effects:

Synergistic effects have been reported on cadmium and zinc, as well as cadmium and manganese. Other heavy metals may also show synergistic effects with cadmium. There is no doubt that acidity would show a synergistic effect with cadmium.

Sulfide and high pH (8 and above) are strongly antagonistic with cadmium, since they precipitate the insoluble sulfide and hydroxide compounds.

Chromium

Chromium is a transition metal which forms two important series of salts, the trivalent chromic cation and the hexavalent chromate anion. Chromium is present as a trace constituent in domestic sewage, but the levels encountered are not significant relative to POTW operation.

Chromium is contributed to wastewater from numerous industrial and other commercial operations. Especially significant sources are the electroplating and electrofinishing industries. Another significant source is the use of soluble chromates as corrosion inhibitors in cooling towers and insoluble chromates in corrosion resistant coatings. Other sources of commercial discharge of chromium salts include leather tanning, photographic processing, and textile dyeing. Unless stated otherwise, the inhibitory properties outlined below are for hexavalent chromium.

Summary of Inhibitory Properties:

1. Effect of Chromium on the Activated Sludge Process:

a. At a concentration level of 0.005 to 0.05 mg/l, chromium has a stimulatory effect on microorganism growth (E-5).

b. Interference with biological processes is reported at the 1 mg/l concentration level (E-5).

c. Another investigator identifies 10 mg/l as the threshold level for deleterious effects (E-29, E-78).

d. In the concentration range of 1 to 50 mg/l, the published literature is quite confusing and contradictory, ranging from serious interference to insignificant effects (E-29, E-118).

e. In the range of 50 to 500 mg/l, the published results describe various deleterious effects. These include synergistic effects of chromium with acidity, iron and copper (E-5, E-29, E-21, E-118).

f. Slug doses up to 500 mg/l of chromium have been reported to result in relatively minor disturbances to the activated sludge process (E-29, E-12, E-36).

g. Up to 50 mg/l of trivalent chromium was reported to have an adverse effect on activated sludge processes (E-88).

2. Sludge Digestion

a. Chromium levels of up to 500 mg/l in the plant influent do not affect digestion of the resultant sludge. This result may be due to precipitation of the insoluble chromic hydroxous oxide (E-118).

b. The addition of up to 50 mg/l of chromium directly to a sludge digester had a serious effect on digestion (E-78), and the addition of 500 mg/l to the digester stopped the process completely (E-118).

c. The effect of trivalent chromium on digester operation has been reported to be dependent on the digestion period. 500 mg/l trivalent chromium is tolerated in digestors with 20 day digestion periods, 100 mg/l with 17 days of digestion, and 50 mg/l with 14 days (E-88).

3. Nitrification

a. It has been reported that 0.25 mg/l of chromium will inhibit nitrification to some extent (E-119).

b. From 2 to 5 mg/l of chromium completely inhibits the nitrification process (E-29, E-117, E-13).

4. Sludge Settling

a. Concentrations ranging from 7 to 500 mg/l of chromium interferes with sludge settling (E-29).

Copper

Copper is a transition metal which forms salts and other compounds in two valence forms. Monovalent copper, copper (I), forms a series of chemical salts called "cuprous",

while divalent copper, copper (II), forms a series of "cupric" compounds. The cuprous compounds are all relatively insoluble and uncommon, and are not significant in water pollution or water treatment chemistry. Therefore, in this document, attention has been focused on cupric compounds only, and references to "copper" below signify the cupric form only.

The majority of common copper compounds are insoluble, and therefore do not pose a problem to sewage systems in that form. However, copper nitrate, sulfate, chloride salts, and a number of copper complexes are soluble and these may pose problems when discharged to sewage treatment plants.

Copper compounds occur naturally in surface and ground waters, usually at relatively low concentration levels, and are natural constituents of domestic drinking water supplies. Copper also enters domestic sewage flows as a result of routine household activities, such as washing and preparing of foods, cleaning of copper utensils, and use of garbage disposal units to macerate waste foods. In addition, copper salts discharge to sanitary sewers as a result of corrosion of copper and brass plumbing fixtures and pipes. Also, corrosion of copper roofing and surface run-off leads to additional discharge of copper to combined sewage systems.

Finally, copper compounds are discharged from a number of industrial operations such as metal cleaning and electroplating operations. Engraving, jewelry, electrical manufacturing, chemical industrial processes, and algicide and insecticide uses all add copper to industrial wastewaters.

Copper is an essential nutritional food element for man and lower organisms, and is no doubt essential to the proper operation of biological waste treatment systems at some undetermined trace level. At extremely high concentration levels (about 1000 mg/l and above) essentially all forms of living species are destroyed and essentially sterile water results (E-121).

The sewage plant operator is concerned with intermediate concentration levels, at which copper-bearing wastewater may be processed through the system without causing significant plant upset. Above this safe copper concentration, he may be interested in the various inhibitory effects which may result. It is expected that the various biological treatment systems may respond differently to the same level of copper in wastewater.

Summary of Inhibitory Properties:

1. Synergism of copper with the following substances has been identified: cyanide, acidity (low pH) and other heavy metals.

2. Antagonism of copper with the following substances has been identified: sulfide, high pH, and certain chelating agents such as EDTA (E-100).

3. Effect of Copper and Copper Complexes on Activated Sludge Plants

a. One mg/l of copper has been reported to be the threshold limit for continuous feed of copper to the activated sludge process (E-5, E-2, E-109, E-24, E-78).

b. A pilot plant study showed an effect on the process at 1.2 mg/l, while at 10 mg/l a small reduction of plant efficiency of about 4% or less was reported (E-4, E-24, E-78, E-118).

c. The combination of 3.6 mg/l of copper with 8.6 mg/l of cyanide caused a serious upset of the process (E-16).

d. Another reference cites 0.1 mg/l as the recommended upper limit of copper ion in sewage feed (E-2).

e. For slug doses, it has been reported that doses above 50 mg/l for 4 hours show a severe effect (E-21); a 64 mg/l dose for 4 hours showed a slight effect (E-118); a 75 mg/l dose for 4 hours "affected" the system (E-29); and 100 to 400 mg/l showed a severe effect in which plant efficiency dropped to about 50% for 48 hours as a result of the slug dose (E-118, E-2).

f. Ten mg/l of copper in the presence of cyanide caused a severe effect (E-29), while 25 mg/l of copper in the presence of cyanide caused a very severe effect for 24 hours (E-118).

g. It has been reported that there is an approximate one-to-one relationship between copper concentration and effluent COD. A one mg/l increase in copper will result in a one mg/l increase in effluent COD (E-60).

Note that the severity of effects reported for slug doses of copper does not correspond quite proportionally with the concentrations of these doses. Nevertheless, it may be concluded that slug doses of copper from 50 to 400 mg/l result in serious upset conditions with the activated sludge process.

4. Effect of Copper on Sludge Digestion

a. Data reported on the effect of continuous dosages of from 0.1 to 10 mg/l of copper in influent wastewater on sludge digester operation vary widely.

b. Two investigators recommend 1.0 mg/l as the maximum concentration of copper in influent wastewater to avoid digester operating difficulty (E-5, E-15).

c. For direct feed to a combined sludge digester, a 5 mg/l copper dosage is recommended as an upper limit. For primary sludge digestion, 10 mg/l copper is the recommended upper limit (E-78).

d. Various copper concentrations in digestors greater than 10 mg/l have been found to be inhibitory (E-1, E-2, E-118).

These data may be summarized by stating that over the range of copper concentration from 0.1 to 10 mg/l, there are reports of digester problems attributed to the presence of copper, and other reports of digester tolerance to these same levels. These discrepancies are no doubt explicable in terms of differences in operating conditions, and antagonistic or synergistic effects.

5. Nitrification - One investigator reports that 0.005 to 0.03 mg/l of copper is stimulatory to nitrifying bacteria, concentrations above 0.05 mg/l copper were found to be inhibitory (E-100), and 0.5 mg/l of copper as copper sulfate has been reported as inhibitory to nitrification (E-2).

Cyanide

The cyanide ion (CN^-) is a pollutant parameter of significant interest in POTW influent and effluent, as well as in rivers, streams and lakes. Its poisonous character is universally known, and accounts for the interest in this pollutant. The poisonous nature of cyanide is actually associated more with hydrogen cyanide, which generally is more prevalent below pH 7, than with the free cyanide ion. Therefore, cyanide toxicity is directly tied

to the pH of the wastewater. Another interesting aspect of its poisonous character is that its toxicity is principally applicable to higher life forms. Microorganisms present in sewage treatment plants can adapt to the presence of cyanide, and metabolize and destroy it even at fairly high concentration levels.

An important property of the cyanide ion is that it is a powerful complexing agent and can bind with transition and other heavy metal ions to form metal cyanide complexes. These complexes exhibit neither the properties of the metal ion nor the cyanide ion, and thus are actually different chemical substances.

Cyanide is not a normal constituent of domestic sewage, and its presence in wastewaters is almost exclusively a result of manufacturing processes and commercial operations. Principal sources of cyanide in wastewater are the electroplating, coke, petroleum gas, steel, plastics, and chemical industries. The electroplating industry is particularly noteworthy because it combines cyanide wastes with transition and heavy metal ion wastes.

Summary of Inhibitory Properties:

1. Wastewaters containing 0.01 to 0.05 mg/l of cyanide have no deleterious effect on an activated sludge plant (E-118). At levels of from 0.3 to 3 mg/l of cyanide, some adverse effects are reported (E-21).

2. Recommended maximum limits of 0.1 to 2 mg/l of cyanide have been reported in the literature (E-5, E-118).

3. 5 mg/l of cyanide in raw wastewater has been found to interfere with activated sludge processes (E-15).

4. A slug dose of 40 mg/l of cyanide upset an activated sludge plant for two days (E-29). On the other hand, after acclimation, 60 mg/l was tolerated in an activated sludge plant (E-21) and 200 mg/l was tolerated in a trickling filter plant (E-29).

5. It has been reported that the toxicity of copper and nickel are enhanced by the presence of cyanide (E-16, E-118).

6. It was reported that cyanide levels of 4 to 100 mg/l upset the sludge digestion process from four days to complete retardation (E-5).

7. Trickling filter operations have been impaired by 30 mg/l of cyanide (E-7), but 10 mg/l were destroyed by trickling filter operations.

8. The nitrification process was reported to be inhibited by about 75% by 0.65 mg/l of sodium cyanide (0.34 mg/l of cyanide) (E-129). Other reports indicate that 2 to 72 mg/l of cyanide as HCN interfered with nitrification, the upper value completely inhibiting the process (E-5).

9. The cyanide ion shows a remarkable range of behavior with biological processes, from interference at low concentrations with non-acclimated systems, to tolerance at high levels in acclimated systems.

Iron

Iron is a transition metal forming two groups of salts, the divalent ferrous salt series and the trivalent ferric salt series. Both the ferrous ion and the ferric ion are precipitated from solution at neutral pH values as hydroxides.

Iron salts are natural constituents of both domestic and commercial wastewaters. While the levels in domestic sewage are always low, the levels in certain industrial or commercial wastes may be excessive. Major industrial sources include metal pickling and cleaning processes, chemical manufacturing, electric utilities, etc.

Summary of Inhibitory Properties:

1. Iron is a necessary element for microbiological growth and its absence causes a reduction in metabolic activity (E-39, E-112).

2. The activated sludge process appears to be rather insensitive to iron concentration except for very high concentration levels. It is reported that 100 mg/l causes little adverse effect, but 1000 mg/l stops oxygen uptake (E-21).

3. The sludge digestion process is more sensitive to soluble iron concentration. It is reported that 5 mg/l is a maximum level, as higher iron levels cause interference with the process, due to hydrolysis of the iron and release of acidity (A-1). As has been previously emphasized, the sludge digestion process is very sensitive to pH values outside the optimum range of 6.5 to 7.5. Therefore, the inhibitory effect

of iron is no doubt due to the acidity released (E-5, E-118).

4. A technique to control metal interference with sludge digestion is to add iron sulfide directly to the digester. Iron sulfide, although very insoluble, is more soluble than most other metal sulfides. When a metal, e.g., copper, enters the digester, it reacts with the iron sulfide to precipitate the copper sulfide, and thus removes the copper from solution. The less "toxic" iron is solubilized as a result. If the pH is stabilized in the optimum range, the iron is largely precipitated out as the hydroxide, and the digester is protected from the effect of the copper. The selection of iron sulfide for this use is a result of its inherent low "toxicity" to microorganisms.

Synergistic and Antagonistic Effects:

Synergistic effects occur between pairs of transition metal ions present in a wastewater. A specific effect of iron synergism with chromium has been reported and synergism with other metals may also occur (E-29).

Antagonistic effects may be anticipated with sulfide ion and hydroxyl ion (high pH), due to precipitation of the sulfides and hydroxides of iron. An antagonistic effect should be expected with cyanide, since the ferrocyanide complex is very stable and no doubt non-inhibitory to biological processes.

Lead

Lead is found in natural waters at trace levels as the divalent ion. It occurs in domestic sewage as a result of its presence in the water supply and also as a result of corrosion of lead plumbing. It is present in industrial wastewaters from storage battery manufacture, tetraethyl lead production, and pigment, paint and cement industries. It also is contributed to wastewater flow as a result of manufacture and use of lead-containing pesticides.

Summary of Inhibitory Properties:

1. At concentration levels of 0.005 to 0.05 mg/l, lead has no effect on the activated sludge process. A moderate "toxicity" of lead to microorganisms has been reported above 0.1 mg/l and also above 1 mg/l (E-5).

2. In apparently contradictory results, one paper states that a significant effect on oxygen uptake is noted

in the presence of lead from 10 to 100 mg/l (E-29), while a second paper states that no significant change in oxygen consumption is noted at up to 50 mg/l (E-21).

3. Lead concentrations of up to 0.05 mg/l have been reported to have no effect on the nitrifying bacteria nitrosonomas (E-100).

Manganese

Manganese is found in domestic sewage in trace amounts. The significant aqueous form is the divalent ion. Manganese is contributed in the wastewaters from storage battery manufacture, paint manufacture, chemical manufacture, etc.

Summary of Inhibitory Properties:

1. It has been reported that a concentration of 7 mg/l of manganese has no adverse effect on the activated sludge process. However, two reports indicate that at 10 mg/l of manganese, a severe adverse reaction occurred with the activated sludge process, and a severe inhibition of oxygen uptake was experienced. Oxygen uptake was completely inhibited at 50 mg/l of manganese (E-21).

2. Manganese salts in the concentration range of 12.5 to 50 mg/l have the unusual property of stimulating the growth of the microorganism nitrosonomas (E-29).

Synergistic and Antagonistic Effects:

Synergistic effects of manganese with zinc and cadmium have been reported (E-29). It is probable that similar synergistic effects may occur with other transition and heavy metals, and with acidity.

Although no data have been found on antagonistic effects with manganese, it may be presumed that hydroxide and sulfide, which can precipitate manganese, will act in this manner.

Mercury

Mercury forms two series of salts, the monovalent mercurous salts and the divalent mercuric salts. Most mercury salts (of either valence form) are considered to be insoluble or sparingly soluble. However, because of the severe toxicity of mercury to man, fish, wildlife, and lower organisms, even the slight solubility poses a substantial threat.

Mercury is found in typical domestic wastewaters at extremely low levels. Commercial contributions occur principally from the chlor-alkali industry (chlorine-caustic soda manufacture). Other sources include chemical, drug, herbicide, fungicide, and paper products from these industries.

Summary of Inhibitory Properties:

1. At a concentration level of 0.1 mg/l of mercury, one paper reports no effect on the activated sludge process (E-21); another paper reports a 10% reduction in oxygen uptake (E-28).
2. A threshold level for adverse effects of mercury on the activated sludge process is reported at about 2.5 mg/l (E-21).
3. An investigator reports that at less than 2.5 mg/l, mercury has little effect on aerobic processes, but at above 5.0 mg/l, aerobic processes are definitely inhibited (E-70).
4. In the concentration range of 1 to 200 mg/l there are numerous reports of different degrees of inhibitory effects on the activated sludge process (E-122, E-29, E-21).
5. A study of mercury behavior in the sludge digestion process indicated that 43 mg/l of mercury in the digester had no adverse effect, and that 1365 mg/l had an adverse effect (E-18).

Nickel

Nickel is a transition metal which forms a series of divalent (nickelous) salts and trivalent (nickelic) salts. Only the divalent salts are of interest in wastewater management. Nickel is present as a trace constituent in domestic wastewaters. Nickel is contributed from some commercial sources at much higher levels, which could disrupt the operation of a POTW if no control were used.

The major source of nickel contribution to wastewaters is from electroplating and related metal finishing processes. Other minor sources of nickel in wastewater arise from corrosion of alloys, dyeing, and printing operations.

Summary of Inhibitory Properties:

1. Activated Sludge Process
 - a. There appears to be no significant adverse effect

from nickel concentrations of less than one mg/l (E-118).

b. A threshold effect of nickel on the activated sludge process is reported between one and 2.5 mg/l (E-118).

c. Various adverse effects on the activated sludge process are reported for nickel influent concentrations of 2.5 to 200 mg/l (E-19, E-21, E-25). These include reduced oxygen uptake between 10 to 50 mg/l of nickel and interference with solids settling between 2.5 and 10 mg/l of nickel (E-14).

2. Sludge Digestion - The data available on sludge digestion in the presence of nickel show little or no effect of nickel (from 10 to 500 mg/l) on the sludge digestion process (E-1, E-3, E-4, E-19, E-21, E-29, E-118). In view of the sensitivity of microorganisms to nickel ions, it is clear that the reason no effect was noted (except in one instance (A-1), with up to 500 mg/l of nickel, is because sulfide and perhaps hydroxide have precipitated the nickel out of solution, rendering it harmless. In the absence of adequate sulfide (or sulfate) in the digester one would expect lower levels of nickel to interfere with the process.

3. Nitrification - It is reported that a level of one-half to three mg/l of nickel has an adverse effect, and 10 mg/l has a very adverse effect on the nitrification process (E-25, E-118).

Silver

Silver is a transition metal which forms a series of monovalent salts. It has few soluble salts. Silver is not normally a significant constituent of domestic wastewaters. Because of its relatively high cost, commercial contributors usually make an effort to recover as much silver as is economically practical.

The principal source of silver in wastewaters is the photo processing industry. Silver salts are removed from photographic film with sodium thiosulfate (hypo), and the films are rinsed free of the hypo. In large photoprocessing installations, the silver is recovered from the hypo. Residual traces in rinse water are not economical to recover, and these residuals result in contributions to the waste load.

Silver ion is extremely toxic to microorganisms, being one of the most reliable disinfectants known. Therefore, it would be anticipated that silver discharges to a POTW

could cause interferences with its operation. However, in the case of contributions from the photoprocessing industry, the sterilizing effect of silver is generally not encountered. The reason for this anomaly is that virtually all of the silver released from a photoprocessing plant is in the form of the thiosulfate complex. This complex does not display any of the "toxic" properties of silver ion.

Summary of Inhibitory Properties:

1. Free silver ion at the 5 mg/l level causes an 84% inhibition of the activated sludge process (E-8, E-9). At the 25 mg/l level, inhibition is complete (E-21).
2. In contrast, silver present as the thiosulfate complex, at levels of from 2 mg/l to greater than 250 mg/l of silver had no effect (E-8, E-9).

Sulfate

The sulfate radical is a common constituent of natural water supplies and, as a result, is also a common constituent of domestic and commercial wastewater streams. Numerous industries release sulfates; for example, metal cleaning or "pickling" is carried out with sulfuric acid, which may be neutralized and contributed to a municipal sewer. Similarly, air pollution scrubbers collect abundant quantities of sulfates and sulfites which may be released to the sewers.

Summary of Inhibitory Properties:

1. No data have been found on inhibitory effects of sulfate on the activated sludge process but presumably, adverse effects would occur at some elevated concentrations.
2. Inhibitory effects have been noted in sludge digestion. At greater than 500 mg/l, an adverse effect of sulfate in sludge digesters is reported (E-11, E-17). At a level of 2400 mg/l of sulfate, it is reported that the gas generation was reduced by less than 12% from that without high sulfate level. At a sulfate level greater than 2400 mg/l, there is a report of complete cessation of gas production (E-19).

Sulfide

The sulfide ion is a common constituent of domestic wastewater, especially when anaerobic conditions occur. Sulfides may be discharged in wastes from petroleum refining,

the leather tanning industry, and chemical manufacturing industries.

Summary of Inhibitory Properties:

1. Excessive levels of sulfide would interfere with the activated sludge process by depleting the dissolved oxygen transferred in the aeration process. One investigator reports that 25 to 50 mg/l of sulfide, is tolerable for about one week (E-29).

2. Sulfide is beneficial to the anaerobic digestion process at low concentrations because of its ability to precipitate transition and heavy metals out of solution. At higher concentrations, and subject to conditions in the digester, sulfide becomes inhibitory.

3. Reports of tolerance to sulfide in the sludge digestion process include the following reports: 50 to 100 mg/l of sulfide can be tolerated (E-120); 200 mg/l causes less than 12% loss in gas generation (E-19); and up to 200 mg/l of sulfide can be tolerated (E-120).

4. Sulfide concentrations of 150 to 200 mg/l in the digester feed reduced gas production considerably (E-35, E-19).

5. Reports of inhibitory effects include the following conclusions: Greater than 50 mg/l of sulfide reduces gas production considerably; 100 mg/l of sulfide causes from a 33% to 50% loss in gas generation; no methane forms with more than 165 mg/l of sulfide; 200 mg/l of sulfide causes an 80% loss of gas generation; greater than 200 mg/l of sulfide is quite toxic, causing complete cessation of gas generation; and 400 mg/l of sulfide causes 95% loss of gas generation (E-19).

It is clear that the effect of a given level of sulfide ion may be quite variable, depending on specific process conditions. The reported contradictory effects of sulfide on anaerobic digestion, points to the dependence of inhibition or tolerance on other factors.

Zinc

Zinc is a transition metal which forms a series of divalent salts. It has amphoteric behavior; i.e., it forms zinc cations and zincate anions. Zinc has a rather widespread occurrence, and is a normal constituent of domestic

wastewaters. Zinc is contributed to sewage flow from a number of industries, including electroplating, dye and pigment manufacture, rubber processing, and electrical generation.

Summary of Inhibitory Properties:

1. Activated Sludge Process

a. A number of reports cite tolerance of the activated sludge process to zinc, up to concentration levels of 10 mg/l (E-4, E-6, E-21).

b. There is a report of an adverse effect in the 0.08 to 0.5 mg/l range and a report that the threshold level is between 5 and 10 mg/l (E-29, E-33).

c. Reports of inhibitory effects are given over the range of 20 to 160 mg/l (E-118, E-29, E-6, E-5, E-67).

d. Synergistic effects are noted between one mg/l of zinc with 10 mg/l of cadmium, between 10 mg/l of zinc and 100 mg/l of manganese, and between 10 mg/l of zinc and 10 mg/l of cadmium.

2. Sludge Digestion

a. Two references cite no adverse effects of zinc with the sludge digestion process for 10 mg/l and 10 to 20 mg/l of zinc, respectively (E-3, E-6).

b. Two references cite adverse effects of zinc on the sludge digestion process at 20 mg/l and 1000 mg/l respectively (E-118, E-5). Other investigators indicate 5 mg/l zinc as the upper limit to prevent decreases in digester gas production (E-7, A-1), and 10 mg/l as the highest continuous dosage that will allow satisfactory digestion (E-78).

3. Solids Settling

a. Adverse effects on solids settling have been reported for 7.5 and 15 mg/l slug doses of zinc solution over a half hour period (E-29).

4. Nitrification - Inhibition of nitrifying bacteria by 0.08 to 0.5 mg/l of zinc has been reported (E-100).

Organic Substances

Organic chemicals may be characterized as those compounds made up of carbon in combination with hydrogen, oxygen, nitrogen, sulfur or phosphorus. The following list is representative of some of the categories of organic compounds with biological and/or commercial importance.

- Petroleum products
- Perfumes and flavors
- Antibiotics and vitamins
- Insecticides and fertilizers
- Plastics and synthetics
- Dyes and pigments
- Sugars
- Paint and coatings
- Explosives and propellants

Wastewaters reaching a POTW may contain any number of organic substances.

Although most organic compounds appear to be compatible with aerobic biological treatment systems, some have been known to cause treatment plant upsets.

It appears to be generally true that anaerobic digestion is the biological treatment process which is most susceptible to upset by inhibitory substances, especially chlorinated hydrocarbons (E-109). Nitrification is also sensitive to organics, although acclimation is possible. Autotrophic bacteria which are involved in nitrification are more readily inhibited than are the heterotrophic bacteria which are involved in the oxidation of carbon compounds. Organic sulfur compounds, especially those with sulfur-carbon-nitrogen linkage are inhibitors of nitrification (E-109).

The significant organic constituents which have been identified as having inhibitory effects are discussed below, and are summarized in Table E-2.

Alcohols

An alcohol is a hydrocarbon in which one of the hydrogens is replaced by a hydroxy (-OH) group. The lower molecular weight alcohols are relatively polar substances and are completely miscible with water. With increasing size of the hydrocarbon group the alcohols become increasingly insoluble in water. Polyhydroxy alcohols contain more than one hydroxy group per molecule. One of these, ethylene glycol, is used

TABLE E-2

THRESHOLD CONCENTRATIONS OF ORGANIC POLLUTANTS
THAT ARE INHIBITORY TO BIOLOGICAL
TREATMENT PROCESSES

<u>POLLUTANT</u>	<u>CONCENTRATION (mg/l)</u>			<u>REFERENCE</u>
	<u>ACTIVATED SLUDGE PROCESSES</u>	<u>ANAEROBIC DIGESTION PROCESSES</u>	<u>NITRIFI- CATION PROCESSES</u>	
<u>Alcohols</u>				
Allyl		100	19.5	E-11, E-
Crotonyl		500		E-11
Heptyl		500		E-11
Hexyl		1000		E-11
Octyl		200		E-11
Propargyl		500		E-11
<u>Phenols</u>				
Phenol	200		4-10	E-23, E-
Creosol			4-16	E-102,
2-4 Dinitrophenol			150	E-129
<u>Chlorinated Hydro- carbons</u>				
Chloroform		10-16		E-11, E
Carbon Tetrachloride		10-20		E-51, E
				E-109,
Methylene Chloride		100-500		E-51, E
1-2 Dichloroethane		1		E-109
Dichlorophen*		1		E-109
Hexachlorocyclohexane		48		E-109
Pentachlorophenol*		0.4		E-109
Tetrachloroethylene		20		E-109
1,1,1,-Trichloroethane		1		E-109
Trichloroethylene		20		E-109
Trichlorofluoromethane*		0.7		E-109
Trichlorotriflouroethane (Freon)		5		E-109
Allyl Chloride			180	E-129
Dichlorophen			50	E-129
<u>Organic Nitrogen Compounds</u>				
Acrylonitrile		5		E-109

TABLE E-2 (Continued)

	<u>CONCENTRATION (mg/l)</u>			
	<u>ACTIVATED</u>	<u>ANAEROBIC</u>	<u>NITRIFI-</u>	
	<u>SLUDGE</u>	<u>DIGESTION</u>	<u>CATION</u>	
<u>POLLUTANT</u>	<u>PROCESSES</u>	<u>PROCESSES</u>	<u>PROCESSES</u>	<u>REFERENCES</u>
<u>Organic Nitrogen Compounds</u>				
(Continued)				
Thiourea			0.075	E-109, E-129
Thioacetamid			0.14	E-109, E-129
Analine			0.65	E-129
Trinitrotoluene (TNT)	20-25			E-33
EDTA	25		300	E-93, E-129
Pyridine			100	E-102
<u>Surfactants</u>				
Nacconol	200			E-63
Ceepryn	100			E-63
<u>Miscellaneous Organic Compounds</u>				
Benzidine	500	5		E-10
Thiosemicarbazide			0.18	E-129
Methyl isothiocyanate			0.8	E-129
Allyl isothiocyanate			1.9	E-129
Dithio-oxamide			1.1	E-129
Potassium thiocyanate			300	E-129
Sodium methyl dithiocarbamate			0.9	E-129
Sodium dimethyl dithiocarbamate			13.6	E-129
Dimethyl ammonium dimethyl dithiocarbamate			19.3	E-129
Sodium cyclopentamethylene dithiocarbamate			23	E-129
Piperidinium cyclopentamethylene dithiocarbamate			57	E-129
Methyl thiuronium sulphate			6.5	E-129
Benzyl thiuronium chloride			49	E-129

TABLE E-2 (Continued)

<u>POLLUTANT</u>	<u>CONCENTRATION (mg/l)</u>			<u>REFERENCES</u>
	<u>ACTIVATED</u>	<u>ANAEROBIC</u>	<u>NITRIFI-</u>	
	<u>SLUDGE</u>	<u>DIGESTION</u>	<u>CATION</u>	
	<u>PROCESSES</u>	<u>PROCESSES</u>	<u>PROCESSES</u>	
<u>Miscellaneous Organic Compounds (Contd.)</u>				
Tetramethyl thiuram momosulphide			50	E-129
Tetramethyl thiuram disulphide			30	E-129
Diallyl Ether			100	E-129
Dimethyl-paranitrosoaniline			7.7	E-129
Guanidine carbonate			19	E-129
Skatole			16.5	
			7.0	E-129
Strychnine hydrochloride			175	E-129
2 chloro-6 trichloromethyl-pyridine			100	E-129
Ethyl urethane			250	E-129
Hydrazine			58	E-129
Methylene blue			100	E-129
Carbon disulphide			35	E-129
Acetone			840	E-129
8-hydroxyquinoline			73	E-129
Streptomycin			400	E-129

Note: Concentrations shown represent influent to the unit process. Where indicated with a *, the concentration represents total plant influent.

extensively as an antifreeze. Alcohols may be found in the effluents from the pharmaceuticals, alcoholic beverages, anti-freeze chemicals and plastics manufacturing industries. One investigator reports that 19.5 mg/l of alkyl alcohol inhibits nitrification by 75% (E-129).

Effect of Some Alcohols on Anaerobic Digestion

<u>Alcohol</u>	<u>Use</u>	<u>Water Solubility</u>	<u>Inhibitory Concentration (mg/l)</u>
Allyl ($\text{CH}_2=\text{CH}-\text{CH}_2\text{OH}$)	Plastics	Miscible	100
Propargyl ($\text{CH}=\text{C}-\text{CH}_2\text{OH}$)		Miscible	50
Crotonyl ($\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_2\text{OH}$)		Partly Soluble	500
Hexyl ($\text{C}_6\text{H}_{13}\text{OH}$)	Antiseptic	Slight	1000
Heptyl ($\text{C}_7\text{H}_{15}\text{OH}$)		Slight	500
Octyl ($\text{C}_8\text{H}_{17}\text{OH}$)	Perfume	Insoluble	200

Phenols

Phenols are aromatic hydrocarbons with a hydroxy (-OH) group substituted for a hydrogen in the ring. Cresols are phenols with a methyl group substituted for a second hydrogen in the benzene ring. Domestic wastewaters do not generally contain significant amounts of phenols. Phenols can cause significant problems if present in domestic water supplies since the chlorophenols that may be produced during chlorination can be odorous.

Phenols are basic organic chemicals used in many industrial syntheses, including plastics production, dyes, and

pharmaceuticals. Phenolic wastewater is also produced as a by-product of petroleum refining.

Summary of Inhibitory Properties:

There is an extremely diverse reaction to phenolic wastes in the activated sludge process depending upon whether the sludge has been acclimated to phenol. Relatively small amounts of phenol can be inhibitory to unacclimated sludge. However, with acclimation, and use of the complete mixing mode of operation, high concentrations of phenol can be tolerated. The following results taken from the literature substantiate this conclusion (E-23).

1. Phenol slug doses of 200 mg/l can deactivate aerobic treatment plants by killing the biomass (E-23).

2. One investigator reports a progressive inhibition of nitrification between 4 and 10 mg/l of phenol or creosol. 5.6 mg/l of phenol has been found to inhibit nitrification by 78% (E-129). Cresol at concentrations of 4-5 mg/l inhibits nitrification (E-102). 12.6 mg/l of *o*-cresol, 11.4 mg/l of *m*-cresol and 16.5 mg/l of *p*-cresol were found to inhibit nitrification by 75% (E-129).

3. 150 mg/l of 2-4 dinitrophenol also decreased nitrification by 75% (E-129).

4. A particular bacteria found in the activated sludge biomass (*Bacillus cerus*) is capable of metabolizing phenol. Concentrations of up to 1000 mg/l of phenol are not harmful to this species (E-32).

Chlorinated Hydrocarbons

Hydrocarbons in which one or more hydrogen atom is replaced by a chlorine atom can be classified as chlorinated hydrocarbons. These materials do not occur in nature but can be found in domestic water supplies as a result of chlorine disinfection and the consequent chlorination of trace hydrocarbons. Chlorinated hydrocarbons are known for their persistence in the environment and are considered especially dangerous because of their ability to be accumulated in the tissues of higher life forms. As a result, many chlorinated hydrocarbons, particularly pesticides, have been banned from environmental use, or their use has been curtailed.

Chlorinated hydrocarbons are employed in a broad range of industrial applications including use as solvents and

degreasing agents, agricultural chemicals, disinfectants, dry cleaning agents, soaps and shampoos, wood preservatives, propellants and refrigerants, as well as in chemical manufacturing. The inhibitory properties of several important chlorinated hydrocarbons are detailed below.

Chloroform

Chloroform (CHCl_3) is a low boiling point liquid which is only slightly soluble in water. It is used as a solvent for fats, oils, rubber, alkaloids, waxes, resins, as a cleansing agent, in fire extinguishers, and in the rubber manufacturing industry.

Summary of Inhibitory Properties:

1. Continuous doses of chloroform at 16 mg/l or more in the raw sludge feed caused inhibition of anaerobic digestion. Continuous doses at concentrations of 10 and 11 mg/l produced a noticeable drop in gas yield (E-110, E-11).
2. At 1.5 mg/l of chloroform there is no inhibition of sludge digestion, while at 14.9 mg/l inhibition is complete (E-51).
3. One investigator reported slight reduction in digester gas production caused by chloroform at a concentration of 0.1 mg/l. Also included in this report is a reference to an investigation that reported a 50% gas reduction due to 0.96 mg/l of chloroform (E-107).
4. The effect of shock dosing with chloroform was determined in laboratory digesters. The table shows the average percentage inhibition of gas production for each shock dose in the raw sludge (E-110):

<u>Shock Dose of CHCl_3 in Raw Sludge Feed (mg/l)</u>	<u>Average % Inhibition</u>
1	3.1
5	10
10	16.9
16	42.3
20	54.3

Carbon Tetrachloride

Carbon tetrachloride (CCl_4) is a colorless nonflammable

liquid which is insoluble in water and has a characteristic odor. It is very toxic to humans. It is a general purpose solvent with broad industrial applications. Carbon tetrachloride has been used as a fire extinguisher, a drying agent, a chemical intermediate, and as an exterminating agent.

Summary of Inhibitory Properties:

1. Carbon tetrachloride at levels of 10 mg/l in sludge has been found to be toxic to anaerobic digestion (E-109).
2. Carbon tetrachloride is reported to inhibit digestion as follows (E-51):

<u>Concentration Level</u> <u>(mg/l)</u>	<u>Percent Inhibition</u>
0.8	0
7.9	40
19.7	90
159.4	100

3. 50% reduction in methane production occurred at 2.2 mg/l (E-107).

4. Another investigator showed that 100% inhibition of gas production during anaerobic digestion required a carbon tetrachloride dosage of 16 mg/l (E-103).

Methylene Chloride

Methylene chloride (CH_2Cl_2) is a colorless, nonflammable, liquid which is slightly water² soluble. It is used as a solvent for cellulose acetate, as a degreasing agent, cleaning fluid and anesthetic.

Summary of Inhibitory Properties:

1. Methane production in anaerobic digestion was reduced by 50% in the presence of 100 mg/l of methylene chloride (E-107).
2. Methylene chloride showed the following reduction in gas production during anaerobic digestion for each dosage in the raw sludge (E-51):

Concentration (mg/l)Percent Inhibition

1.3	0
3.3	40
9.9	60
132.6	80
530.4	100

Chlorobenzenes

Chlorobenzenes are used as solvents, chemical intermediates, for moth control and as deodorants.

Summary of Inhibitory Properties:

1. The following table presents data on the inhibitory effect of chlorobenzenes in batch digestion tests (E-107) :

<u>Material</u>	<u>Time from start of Test (days)</u>	<u>Concentration (% wt/wt dry sludge solids) in digester contents</u>			
		<u>% Reduction in Gas Production</u>			
		20	35	50	80
Chlorobenzene	2	1.3	1.7	2.1	3.4
	4	1.0	1.4	1.9	3.4
	6	0.94	1.3	1.7	3.0
Orthodichloro- benzene	2	1.1	1.6	2.4	5.4
	4	0.88	1.4	2.0	4.7
	6	0.73	1.2	1.6	3.8
Paradichloro- benzene	2	2.1	2.6	3.0	8
	4	1.8	2.4	3.1	7-8
	6	1.4	2.1	2.7	5.3
Certi-chlor*	2	0.7	1.6	2.5	4.9
	4	0.62	1.3	2.1	4.9
	6	0.54	1.1	2.0	4.3

* A proprietary material similar to ortho-dichlorobenzene and consisting largely of that material.

Miscellaneous Chlorinated Hydrocarbons

1. The following table was developed by an investigator to describe the concentrations of various chlorinated hydrocarbons that have exhibited inhibitory effects on anaerobic treatment processes (E-109).

Toxicity of Some Chlorinated Hydrocarbons to Anaerobic Digestion

<u>Chlorinated Hydrocarbon</u>	<u>Inhibitory Concentrations</u> (mg/l)	
	<u>In Sewage</u>	<u>In Sludge</u>
Carbon tetrachloride		10
1,2 Dichloroethane		1
Dichlorophen	1	
Hexachlorocyclohexane		48
Methylene Chloride	1	
Pentachlorophenol	0.4	
Tetrachloroethylene		20
1,1,1-Trichloroethane		1
Trichloroethylene		20
Trichlorofluoromethane	0.7	
Trichlorotrifluoroethane		5

2. A slight reduction in digester gas production was observed as a result of a concentration of 0.1 mg/l of 1,1,1-trichloroethane (E-107).

3. A 75% reduction in nitrification was reported in the presence of 180 mg/l of allyl chloride (E-129).

Agricultural Chemicals

Insecticides, pesticides, and herbicides are manufactured from chlorinated hydrocarbons and from organo-phosphorus compounds. Some of these materials are damaging to sewage treatment processes and to fish and wildlife in very small concentrations (DDT, aldrin, dieldrin). Whereas most other chlorinated hydrocarbons enter the wastewater stream as a result of industrial manufacturing processes, agricultural chemicals usually enter wastewater and natural streams by means of runoff.

Summary of Inhibitory Properties:

1. One laboratory test revealed that two pesticides, aldrin and simazine, were not inhibitory to the growth of nitrifying bacteria, Nitrobacter, whereas five other pesticides including chlordane, heptachlor, lindane, CIPC, and DDD prevented growth. Heptachlor was the most deleterious compound (E-99).

Organic Nitrogen Compounds

Many organic compounds contain nitrogen, commonly in the form of a carbon-nitrogen bond. Because of the numerous nitrogen oxidation levels, the chemistry of organic nitrogen substances is quite diverse. At its lowest oxidation state nitrogen forms amines. The most common amine is ammonia. Amines are classified according to the number of hydrocarbon groups attached to the nitrogen atom. Thus one substitution gives a primary amine, two substitutions give a secondary amine, three yields a tertiary amine, and four produces quaternary ammonium salts. Amines are generally soluble in water, and ionize, exhibiting varying pH dependent properties. At its highest oxidation state, nitrogen forms nitro compounds. These materials are chemically unstable, and are easily, and sometimes violently reduced (Trinitrotoluene, TNT, is a typical example). Nitrogen exists at intermediate oxidation states, each producing compounds with differing properties.

This plethora of nitrogen compounds exerts a wide range of environmental effects. While some nitrogen compounds are compatible with biological treatment, others are inhibitory. Some nitrogen is required for satisfactory treatment plant operation and a nitrogen source must be added to those trade wastes which are nitrogen deficient. Some organic nitrogen compounds are completely biodegradable, whereas others are toxic to wildlife and some are carcinogenic to man.

Organic nitrogen is contributed to sewage from domestic wastewaters which contain complex proteinaceous materials, from agricultural runoff, and from a variety of industrial operations.

Specifically, this class of compounds is used in the textile, dye, pharmaceutical, plastics, varnishes, perfume, insecticide, tanning, synthetic fibers, and solvents industries.

Summary of Inhibitory Properties:

1. One investigator reports that 5 mg/l of acrylonitrile in sludge has an inhibitory effect on anaerobic digestion (E-109).
2. Another investigator reports that more than 20 mg/l of acrylonitrile in sludge is not harmful to anaerobic digestion (E-47).
3. 0.075 and 0.076 mg/l of thiourea have been reported by two investigators as inhibiting nitrification (E-109, (E-129).
4. 0.14 and 0.18 mg/l of thioacetamide have been reported as inhibiting nitrification (E-109, E-129).
5. Analine at a concentration of 0.65 mg/l was found to inhibit nitrification by 75% (E-129).
6. At concentrations of 20-25 mg/l of TNT, aerobic processes were severely inhibited (E-33).
7. Increasing amounts of EDTA adversely effect settleability of secondary sludge and increases surface scum. At greater than 10 mg/l there is a decreased utilization of oxygen. At more than 25 mg/l there is a toxic effect on coliform bacteria (E-93). A concentration of 300 mg/l of EDTA has been found to inhibit nitrification by 75% (E-129).
8. Pyridine and the methylpyridines which occur in coke oven liquors are varied in the ability to inhibit nitrification (E-102) as follows:

	<u>Concentration (mg/l)</u>	<u>% Inhibition of Nitrification</u>
Pyridine	100	100
4-Methylpyridine	100	100
3-methylpyridine	100	No Effect
2-methylpyridine	100	40

Surfactants

This group of chemicals comprises those substances which have surface active properties. This includes synthetic detergents, emulsifiers, foaming agents, and wetting agents. These substances comprise normal constituents in domestic

sewage, mostly associated with laundry detergents and commercial cleaning formulations. In addition, they are contributed by numerous industrial and commercial sources, including commercial laundries, wool scouring plants, dyeing, and rubber processing.

Surfactants may interfere with operation of a POTW in a number of ways. The surfactant may be inhibitory to biological processes because of its chemical properties. The surfactant may also interfere through various physical effects by causing excessive foaming, interfering with oxygen transfer or dispersing the biomass floc and causing loss of solids.

Summary of Inhibitory Properties:

1. Laboratory tests with the anionic surfactant Nacconol (at 100 mg/l) showed a stimulatory effect on the activated sludge process. At concentration levels greater than 200 mg/l, inhibitory effects were noted. These effects were worse at low pH (about 5) and low sludge loadings (E-63).
2. In another laboratory test with the cationic surfactant Ceepryn, 100 mg/l of this material suppressed oxygen uptake. The effect was more deleterious at high pH (about 9) (E-63).
3. In a pilot plant study, it was noted that 10 mg/l of an alkyl benzene sulfonate (ABS) surfactant had a negligible effect on the activated sludge process. It was reported that higher concentrations can be very inhibitory (E-61).
4. In another test, 10 and 20 mg/l levels of ABS caused minor losses (5 to 8%) in BOD removal efficiency in the activated sludge process. In the same study, a linear alkyl sulfate (LAS) at 10 and 20 mg/l caused a loss of only one to two percent BOD removal in the activated sludge process (E-50).
5. A laboratory study determined that a surface active agent at concentration levels from near zero to 50 mg/l interfered with oxygen transfer to water (E-92).
6. Digestion is likely to be seriously affected if the detergent concentration exceeds 2% of the weight of suspended solids. Initiation of digestion processes may be difficult at a detergent concentration of only 1% (E-109).

Miscellaneous Organic Chemicals

Benzidine

A laboratory experiment is reported which showed that 500 mg/l of benzidine inhibited oxygen uptake for 144 hours. At 5 mg/l, sludge activity decreased (E-10).

t-butyl Borane

In laboratory tests 500 mg/l of t-butyl borane was found to be inhibitory to activated sludge processes.

Formaldehyde

A level of 500 mg/l of formaldehyde was found to be stimulatory to activated sludge processes.

Benzene, Toluene, Xylene

Benzene and Xylene at the 1000 mg/l level are reported to seriously retard sludge digestion. Toluene at the 500 mg/l level has no appreciable effect on the process.

Oil and Grease

The term oil and grease covers a wide variety of substances that might be found in the influent to a POTW. Unlike other constituents, which usually have well defined chemical forms, oil and grease characteristics are usually dependent on the method by which the material is analyzed. Instead of oil and grease representing a specific chemical species, it is best defined as those organic substances with similar solubilities in a particular extracting solvent.

The most commonly used solvents for oil and grease analysis are hexane, petroleum ether and freon. These solvents will extract a broad spectrum of organic materials, including fatty acids, soaps, esters, fats, waxes and various petroleum products (E-131). Freon is specifically recommended by EPA as the solvent for oil and grease extractions. Consequently, it is essential that all oil and grease measurements be completed utilizing the freon method to assure uniformity of results.

Oil and grease is a natural constituent of sewage. It has been reported that fecal material contains more than 25%

grease (E-129). Additionally, domestic kitchen wastes contribute a large quantity of solvent extractable materials. Commercial or industrial sources of oil and grease include slaughter houses, food processors and restaurants, as well as automobile service stations and petroleum refineries or storage depots. Although oil and grease from all of these sources may be extracted by the same solvent, and therefore considered a single constituent, the substances included in the analysis may or may not be biodegradeable.

In general, the delineation between biodegradeable oil and grease and the more refractory extractable substances, corresponds to the distinction between oil and grease of animal and vegetable origin versus that of petroleum origin. Oil and grease of animal and vegetable origin has been reported to be more biodegradeable than that of petroleum origin (E-13). Nevertheless, many municipalities limit only total oil and grease (C-98). Traditionally, oil and grease concentration limits were focused on the prevention of sewer clogging and coating of pumping stations and treatment facilities, in which case the type of extractable material present was not important. However, distinguishing between petroleum and animal origin oil and grease can yield information on both oil and grease treatability and source.

In addition to partially passing through a biological treatment plant, petroleum oil at concentrations ranging between 50 and 100 mg/l has been reported to interfere with the aerobic processes in a POTW (E-23). It is believed that the principal interference is caused by attachment of oil, which has a density less than water, to the bacterial floc particles, which are to be gravity settled. The result is a slower settling rate, loss of solids by carryover out of the settling basin, and excessive release of BOD from the POTW to the environment (E-108). Additionally, in activated sludge units, oil and grease may coat the biomass, interfering with oxygen transfer. As a consequence of this "smothering" action, a lower degree of treatment may be achieved (E-130). Oil and grease may also interfere with the operation of physical-chemical treatment facilities by coating the activated carbon and thus diminishing the adsorption of organic pollutants.

Oil and grease may also cause other problems in POTW operation. Actual operating problems have been reported in which oil and grease have clogged screens and interfered with skimming operations. Large quantities of oil and grease may block screens, scum draw-off systems and sludge pumps, causing excessive loads on mechanical scraping and cleaning devices. Excessive oil and grease may also cause serious

problems in pumping station operation by fouling float systems so that pumps fail to operate, and by blocking pump intakes. Additionally, oil and grease may foul electrodes used for monitoring volatile and explosive mixtures, causing a serious hazard. Since wetwells are seldom pumped dry, the accumulation of floating oil and grease can cause operational problems in this portion of the system (E-130).

Among the more troublesome operational problems caused by oil and grease are those associated with anaerobic digester operation. Oil and grease can be responsible for foaming throughout the plant and especially in digester vessels. If oil and grease reaches a covered digester, a crust may form on the underside of the cover, causing serious maintenance problems, and reducing the available digester volume. Scum layers in digestors may also interfere with effective mixing, temperature control and gas separation (E-130).

Discharge of Excessive Levels of Pollutants

Introduction

Sewage plant operations may be impaired by various types of shock loads. Shock loading has been defined as any rapidly occurring change in the chemical or physical environment of a plant's biomass caused by the introduction of a new pollutant, or a change in the rate of flow of a pollutant (E-73). Four specific types of shock loads are commonly encountered in POTW's:

1. Materials Deleterious at Trace Levels

The introduction of specifically deleterious materials such as metallic pollutants (copper, zinc, chromium, etc.) at trace levels has a well defined impact on treatment plant operation. These materials interfere with the metabolic activities within the biomass cells. Because of the precise nature of this type of shock load, it is possible to set down in advance the maximum acceptable concentration for such pollutants.

2. Qualitative Shock Loads

It has been reported that if a treatment system has become acclimated to a pollutant, the introduction of a new type of organic load can block the assimilation of the waste that the system was treating (E-89). This type of shock load is termed Qualitative (E-73), and may be caused by the introduction of a new waste to a system which would normally be biologically treatable.

3. Quantitative Shock Loads

Quantitative shock loads may be characterized as any sudden change in the BOD loading that a plant receives. Since the type of BOD loading is not changed, as in the case of qualitative shocks, the result is an inability of the POTW to treat all of the increased amount of organic matter entering the plant. Quantitative shock loads are often called Excessive Discharge to the POTW, and generally refer to the introduction of unusually large amounts of BOD to the system. Other oxygen demand parameters such as COD or TOC may be used to describe quantitative shock loads, but BOD is the most common measure of organic loading and therefore its use offers the most general description of the phenomenon.

4. Hydraulic Shock Loads

Hydraulic shock loads are characterized by a rapid decrease in the concentration of the waste or the organic loading of the system (E-73). Such a decrease in loading may result from the sudden introduction of stormwater into the system, as is common with combined sewer systems.

Impact of Excessive Discharge and Shock Loading on POTW Operation

Contributions of trace deleterious materials and qualitative shock loads pose a relatively small, although significant, problem to the POTW operation. These two types of treatment interference can be controlled if the municipality places an upper limit on the quantity of the material that would be acceptable. However, for quantitative shock loading and hydraulic shock loading, setting limits is not straightforward. Several specific problems arise when trying to define an approach to controlling these two types of plant disruption. Each POTW is designed to treat a specific maximum amount of loading. Most POTW's are operating at levels which are either above or below design capacity, and each may be designed to handle differing diurnal flow patterns. Because of the heterogeneous nature of POTW operations and waste flows it becomes very difficult to predict in advance what kind of transient loads a POTW can handle. Some work has been completed in this area, and one investigator states that hydraulic shock loads of up to 100% above normal flow can be accepted without serious disruption of plant operations (E-71). Another researcher has presented a kinetic model that may enable some operators to predict the response of treatment plants to quantitative shock loads (E-72).

The apparent lack of data on approaches to handling excessive discharges points out that more research into this area is needed. A first order of priority should be the development of a firm definition of what constitutes excessive discharge or shock loading, and how differing plant conditions alter the effects of these types of plant upsets. For the short term, certain remedial steps can be taken by plant operators that will reduce the impact of excessive discharge. Wherever possible, industrial contributors should be required to implement equalization of concentrated organic wastes so that they can be released at low flow periods. Additionally, an effort should be made to regulate industrial sources of stormwater. Quite often, industrial facilities discharge stormwater, collected on their plant property, to sanitary systems that otherwise do not carry stormwater.

To avoid hydraulic overloading, the municipality should discourage this type of activity when practiced indiscriminately. However, the typical industrial stormwater may be contaminated, and consequently not of high enough quality to be discharged to a navigable water directly. Industries should be required to segregate runoff within the plant, providing for the direct discharge of clean stormwater. Contaminated runoff should be collected and stored for subsequent discharge to the sewer. Equalization of contaminated stormwater for discharge during low flow periods should decrease the possibility of hydraulically overloading the POTW, and should be strongly encouraged as a solution to this problem.

Other Substances Which Interfere with POTW Facilities

This category includes those substances which may interfere with the operation of a sewage treatment system, but which are not necessarily inhibitory to biological processes. Typical substances of this class include corrosive materials, substances which cause blockages in sewer lines and flammable or explosive materials. Although these materials may not inhibit biological processes, they can cause serious disruptions of treatment system operations. In the case of corrosive or explosive substances, severe damage to collection or treatment facilities may result from their introduction into the system. Consequently, corrosive or explosive materials, as well as substances that may cause sewer line blockages, are generally totally excluded from POTW systems by ordinance. Unlike trace inhibitory materials that may be tolerable, or even beneficial at low levels, the prohibited materials included in this section should be closely regulated because of the severity of their effect on treatment and collection systems.

Corrosive Materials

Corrosion in relation to sewerage systems can be defined as the phenomenon in which a pipe, conduit, or piece of equipment is gradually deteriorated by the fluid with which it comes in contact.

For sewage collection systems, one of the most prevalent types of corrosion is a deterioration of concrete pipe called "crown" corrosion. In this process, sulfates in wastewater are reduced under anaerobic conditions to sulfides, which hydrolyze to hydrogen sulfide. In addition, an industry such as an oil refinery or textile manufacturer may discharge sulfides directly to the sewer. If the concrete pipe is only partially filled, the H_2S formed may diffuse into the air above the fluid, where the bacteria Thiobacillus can convert it to sulfuric acid. Sulfuric acid then reacts with the calcium oxide in the concrete, forming calcium sulfate or gypsum. This material is structurally unsound, and will eventually crumble.

Coating the interior of concrete pipes with an inert material can avoid crown corrosion, but an equally effective preventative measure is the exclusion of sulfides from the collection system. Chlorinating sulfide carrying industrial wastewater is one way of achieving this goal. However, when the wastewater contains sulfate, which may be present as a result of non-carbonate hardness in the water supply, anaerobic conditions in the sewer should be avoided since they provide the necessary atmosphere for the creation of H_2S . Nevertheless, anaerobic conditions may be unavoidable in many instances. In those cases, proper sewer ventilation is necessary not only to provide a measure of safety from potentially lethal hydrogen sulfide, but also to avoid the oxidation of H_2S to sulfuric acid. Although sulfide may be beneficial in terms of precipitating metals, its presence should be closely monitored to avoid crown corrosion.

The second type of corrosion is the dissolution of metallic pipes and structures. This commonly occurs when wastewater has a low pH, or contains some other oxidizing agent. Generally, waste mixtures should be pretreated to fall in the pH range of 6 to 9. Lower pH (acidic) discharges will attack and disintegrate metal and concrete pipes and structures. Higher pH values are more tolerable, and enforcement of the high pH restriction should be at the discretion of the POTW operator. High fluoride levels, especially in acidic solutions, are a potential corrosion threat. High

concentrations of chlorine, hypochlorites and chlorides are all corrosive to metals.

Many other products, when reacted with water will form acidic products which are detrimental to sewer systems. For example, acetic anhydride will hydrolyze to form acetic acid; acetyl chloride will form acetic and hydrochloric acids, and ferric chloride will release hydrochloric acid upon hydrolysis. Sulfur dioxide and sulfurous acid are also common materials corrosive to sewers and sewage treatment plants.

Materials Which Cause Sewer Blockages

Discharges from commercial and industrial establishments must be controlled to prohibit materials which will clog sewers or treatment plants, or form deposits that adversely affect a sewer's hydraulic characteristics. Precipitates such as ferric hydrous oxide can interfere with the activated sludge system by inhibiting oxygen or food transfer between sludge particles and the surrounding liquids. Sulfates and carbonates can react with calcium salts to form a scale which can coat and ultimately block pipes. Fatty acids similarly react with calcium salts to form a curdy scum which can coat and block sewer lines.

Very high levels of suspended solids can cause blockages in sewer lines and overload primary settling tanks. Small fibers from textile industry operations may interfere with screens and filters by matting and blocking the passage of wastewaters.

Grease accumulation can cause sewer line clogging both in the collection system and in the interconnecting sewers within the POTW. Collection systems with restaurant connections are especially prone to blockages, unless suitable grease collection facilities are provided at the contributing source. Sewer clogging is most prevalent in small sewer lines, such as laterals, with 12 inch or smaller diameters. To cause a blockage problem, oil and grease which is typically discharged in a liquid or emulsion form, must congeal or solidify. Generally, the temperatures encountered in sewers are high enough to prevent solidification of oil and grease of petroleum origin (hydrocarbon type). However, oil and grease of animal or vegetable origin can exhibit a broad range of congealing temperatures. Some oils and greases of animal or vegetable origin will congeal at the highest temperatures encountered in sewers, while others may remain fluid at the lowest temperatures. The probability that oil

and grease will congeal in a sewer pipe depends on a number of factors including the type of oil and grease involved, temperature and the fluid velocity in the pipe. A sufficiently high velocity in the sewer can prevent clogging by keeping all congealed material in suspension, even if all other conditions are appropriate for solidification.

Explosive and Flammable Materials

The discharge of potentially explosive or flammable materials to sewer lines must be strictly controlled. A serious hazard can be created by hydrocarbon solvents, which float on the surface of water, and exert their full vapor pressure on the air space above. Such substances as gasoline, kerosene, naphtha, benzene, toluene and xylene therefore, are particularly hazardous. Ethers, alcohols, ketones, aldehydes and organic peroxides similarly pose fire or explosion hazards.

Powerful oxidizing substances such as peroxides, chlorates, perchlorates and bromates are potentially dangerous and should be restricted. Substances which can liberate flammable or explosive gases such as carbides, hydrides, and sulfides must also be carefully controlled.

Many of the above chemicals originate from facilities that manufacture or use organic chemicals. POTW's with such facilities among their contributors should give special attention to the control of explosive or flammable materials.

The production of methane in sewers resulting from anaerobic conditions also presents a well known potential explosion hazard. Because of the potential hazards caused by the presence of explosive materials in sewers, extreme care should be taken whenever entering a sewer manhole.

Environmental Considerations

Sludge Disposal or Utilization

Interference with the biological unit processes of a POTW may not represent the only impact of industrial contributions. The sludges produced during the course of biological treatment will generally contain, in a concentrated form, many of the pollutants contributed to the POTW that may be considered inhibitory. Likewise, if pretreatment of industrial wastes is practiced, many of the undesirable industrial constituents undoubtedly will be concentrated in the industrial sludge. Those responsible for disposing of

these sludges should be aware of the potential impact of industrial wastes (A-20). Of most concern are those pollutants that are generally considered deleterious to the environment. Specifically, the so called "heavy metals" and various chlorinated hydrocarbons, such as polychlorinated biphenyls are of major concern.

Depending on the sludge disposal or utilization method employed, potentially harmful materials in sludges may have varying effects. Four methods of sludge disposal or utilization are currently in common practice. These methods include (1) land application, (2) disposal in sanitary landfills, (3) ocean dumping and (4) incineration (A-20, E-132, E-134).

Spreading sludges on land is generally considered a sludge utilization method, since the sludge acts as a source of nutrients or as a soil conditioner. Using sludge from municipal wastewaters containing incompatible pollutants requires a certain degree of caution. Because the wastewaters from certain industries contain concentrations of potentially harmful elements such as zinc, copper, nickel, cadmium, boron, lead or mercury which are concentrated in the sludge, it is important to be aware of the possible effect of these substances on the environment (E-133). Trace levels of many of these elements are essential to plant growth, although higher concentrations may have deleterious effects.

High concentrations of many of the substances mentioned above have been noted in sludges derived from purely domestic wastewaters. Undoubtedly, metals in such systems originate from relatively uncontrolled sources. Corrosion of metallic plumbing elements in soft water areas may be such a source, as is storm water runoff in urban areas having combined sewer systems. Consequently, the introduction of industrial wastewater containing incompatible pollutants may intensify the problem. Special attention must be paid to details such as the cation exchange capacity of the soils upon which the sludge is placed, and the general chemistry of the runoff and ground water likely to be encountered. Additionally, each crop has a different affinity for these elements, and crops, therefore, should be chosen accordingly.

Sanitary landfill operations pose similar problems for disposal of sludges from POTW's with significant industrial wastewater components. Proper precautions must be taken to adequately protect the environment from the impact of such sludges when applied to a landfill. The principal consideration in this regard is the leachate that is created by rainfall and runoff interacting with the sludge in the landfill.

Metals and other substances present in the sludge are transferred to the leachate which in turn can adversely affect surface and ground water in the area. Consequently, control of leachate in landfills handling sludges with industrial waste components is of prime importance in the protection of the aquatic environment.

Incineration of sludges containing incompatible pollutants can also cause environmental problems. Incineration of such sludges may create a serious air pollution problem. This situation is not limited only to the volatilization of heavy metals or chlorinated hydrocarbons, but to other substances as well. The increasing use of incineration for sludge disposal in the recent past highlights the importance of proper consideration of potential air pollution problems. The design of such facilities must provide adequate safeguards to assure that the stack gases will comply with Federal, State and local air quality and emission standards and will not cause an adverse impact on the environment.

Sludge may also be disposed of in the ocean. This method has been practiced on both the east and west coasts of the United States. East coast POTW's have utilized barges to transport sludge to areas in the ocean designated for dumping by the EPA and the Corps of Engineers. West coast POTW's have utilized long pipelines for ocean disposal of sludge. Ocean disposal of sewage sludge is currently regulated by the EPA, with permits being required for this operation. The environmental impact on the ocean of sludges from POTW's has been the subject of many studies in the recent past. The effect on the ocean of incompatible pollutants in sludge has been an integral part of these studies, which have led to the close control of ocean disposal currently being exercised.

Reuse of Wastewaters

Environmental considerations relating to the reuse of wastewaters from POTW's containing industrial contributions are similar to the factors involved in sludge disposal or utilization. The primary concern in the reuse of such wastewaters is the presence of incompatible pollutants from industrial wastes which may be deleterious to the environment. The variety of wastewater reuse practices currently employed result in a wide variation of associated environmental considerations.

The major categories of wastewater reuse are land application, in which either raw or treated wastewater is spread over a specific land area, and reuse involving recycle for domestic or industrial purposes. In the case of land application, reuse generally involves utilization of the wastewater for agricultural purposes. In addition, it also implies completion of the hydrologic cycle by return of the wastewater to the ground water aquifer. Consequently, the land application of raw or treated wastewater containing incompatible pollutants to a large degree involves the same basic concerns as delineated above for the land application of sludge.

In the case of direct land application of wastewater, particularly treated wastewater, the concentration of incompatible pollutants from industrial wastes being applied to the land may be lower than with sludge. In sludge, there is generally a concentration of such pollutants that occurs through removal in the wastewater treatment process and dewatering steps. However, many incompatible pollutants may only experience incidental removal in the treatment process, so that the quantity passing through the POTW is greater than that being removed. Additionally, the volume of treated effluent from a POTW greatly exceeds the volume of sludge generated. These two factors suggest that in many cases the net quantity of incompatible pollutants from industrial wastes being applied to the land may be greater with treated wastewater than with sludge. In any event, careful evaluation of all environmental factors must be made prior to embarking on a program of wastewater reuse by land application.

The recycling of treated wastewater varies from reuse for industrial purposes, to the return of the treated effluent to the domestic water supply either directly or indirectly. Concerns associated with the presence of incompatible pollutants in wastewater being reused in industrial facilities vary widely depending upon the specific circumstances of the application. Many such recycle schemes involve reuse of the wastewater for cooling purposes or for make-up to a closed cooling system. In most industrial situations, environmental considerations are more closely related to the ultimate disposition of the wastewater rather than the factors involved in the industrial reuse application.

The recycling of treated wastewaters to domestic water supplies by both direct and indirect methods is the area of greatest concern regarding the presence of incompatible

pollutants from industrial wastes. In these applications the principal concern is public health, so that even trace quantities of many incompatible pollutants may be intolerable. The methods utilized for recycling vary from direct return to water supply impoundments, to indirect return via injection into the groundwater aquifer or discharge to a water course used for domestic purposes. In either case, the treated effluent is diluted so that trace quantities of incompatible pollutants may become undetectable. Nevertheless, it is possible that a build-up of refractory pollutants may occur with such recycling over an extended period of time. Consequently, it is imperative that POTW's with industrial wastewater components contemplating or practicing wastewater reuse for domestic purposes, exercise careful control over the incompatible pollutants present to avoid any possibility of a public health hazard.

SECTION F
REMOVAL AND PASS THROUGH OF POLLUTANTS
IN PUBLICLY OWNED TREATMENT WORKS

Introduction

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 Characterization of Primary and Biological Plant
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SECTION F
REMOVAL AND PASS THROUGH OF POLLUTANTS IN
PUBLICLY OWNED TREATMENT WORKS

Introduction

The purpose of this section of the report is to summarize available information on removal and effluent concentrations, or pass-through of pollutants in POTW's. It is intended to be responsive to the portion of Section 304(f) of PL 92-500 which states, "Guidelines under this subsection shall be established to control and prevent the discharge....(either directly or through publicly owned treatment works) of any pollutant which interferes with, passes through, or otherwise is incompatible with such works".

The information contained herein was obtained from a survey of POTW's having analytical data for influent and effluent concentrations of incompatible pollutants. Specific emphasis was placed on obtaining data on the concentration of metals in POTW systems. Data was obtained from a total of 269 treatment facilities for 61 pollutant parameters. Wastewater flow in the POTW's represented by the survey varied from less than 0.05 MGD to more than 110 MGD. The major portion of plants in the survey, a total of 101 POTW's, were in the range of 1.0 to 5.5 MGD, representing 38 percent of the total number of facilities reporting data. Computer facilities were utilized to summarize and analyze the data obtained. The summary computer reports are presented in Appendix 6 of these guidelines.

The discussion which follows describes data sources, procedures used in data compilation, limitations of the reported data, and plant performance evaluation for primary, trickling filter and activated sludge plants. A limited discussion of biological treatment plants with chemical addition and tertiary plants is also presented, along with the results of correlation and regression analyses for selected pollutant parameters. A characterization of the performance of primary and biological treatment plants (trickling filter and activated sludge) is presented in terms of percent removal and effluent concentration (pass through) for the 17 most significant pollutant parameters.

The performance characterization results contained in this section, are presented only to provide guidance in determining pretreatment requirements where sufficient operational data is not available at a specific POTW. The data is not intended to serve as a substitute for detailed influent and effluent sampling of the treatment plant, which will provide

the most reliable removal and pass through information for the system in question. However, the data does present removal and pass through information which may be considered typical of many conventional primary and biological treatment plants.

Data Collection

In accumulating data, an attempt was made to compile a broad base of valid removal and pass through information on various sewage treatment processes. An extensive search was undertaken covering data in the published literature and unpublished data collected by Federal, State and interstate agencies, and individual sewerage system operators. With the cooperation of the EPA Region II office, NPDES permit applications from publicly owned treatment works were evaluated as a potential source of removal and pass through data. It was concluded that permit applications were generally not a good source for this information.

However, another data source from the EPA regional offices, compliance monitoring reports, was identified as a significant source of removal and pass through information. Compliance monitoring reports are prepared by the EPA regional enforcement or State enforcement programs for POTW's with NPDES permits. These reports summarize the results of on-site monitoring, usually performed on a continuous basis for 24 or 48 hours. In some EPA regions, monitoring encompasses both influent and effluent streams, while in other regions only the plant effluent is sampled. In the regions where influent and effluent data were available, these reports were found to be an excellent data source in that they usually covered a wide range of pollutant parameters and were generally uniform in format.

Although the compliance monitoring program has just recently begun, these reports nevertheless represent about 40 percent of the total data base compiled. Most of the reports obtained were from EPA Regions V and VII, as their programs are well advanced, and both plant influent and effluent are sampled.

Interstate pollution control agencies, river basin commissions, State agencies, and individual sewer system operators were contacted in the data collection phase of the work. Most of the governmental agencies contacted did not compile removal or effluent data on parameters other than those normally associated with domestic sewage, except where it was known or suspected that industrial wastewater was interfering with or passing through the system. However,

those State agencies and interstate commissions which did provide valid comprehensive data comprised about 50 percent of the total data base compiled. Individual POTW's and the published literature constituted only an estimated 10 percent of the compiled data. Most POTW's contacted were not sampling for comprehensive removal parameters on a routine basis. The literature was found to contain very little specific plant removal or pass through data on parameters other than those normally used for the analysis of domestic sewage.

Altogether, removal and pass through data was obtained from 269 plants, geographically distributed according to Report No. 1 of Appendix 6.

Data Compilation

Reported data was categorized according to treatment process, treatment flow rate, and percent industrial flow. Report No. 2 of Appendix 6 summarizes the treatment process and flowrate categories, most of which were used in grouping the data reported. Plant processes were categorized into five major classes as follows:

- A - Primary Sedimentation Treatment Process
- B - Trickling Filter
- C - Activated Sludge
- D - Filtration
- J - Miscellaneous

Additional plant and sampling information was also collected. Report No. 3 of Appendix 6 details the sampling procedure, sampling date, major industrial contributors, and level of POTW control over industrial contributors. The sampling procedure is indicated as either flow proportioned composite (FC), time composite (C), or grab (G). If a composite sample was taken the sampling duration is then indicated. The final item shown under sampling procedure is (S) for simultaneous sampling at influent and effluent, or (R) for sampling performed with plant retention time taken into account. The sampling date is indicated as Year/Month/Day, and under the remarks column, the composite interval, or the method of data summary is indicated. Where the information was readily available, major industrial contributors and the level of POTW control over industry is also shown. The level of control is a subjective measure ranging from no control (0) to very tight control (10) with surveillance and monitoring.

Data was compiled according to STORET numbers for 61 parameters as indicated in Report No. 7 of Appendix 6. Computer processing was utilized in data handling and analysis,

resulting in the reports shown in Appendix 6, and the correlation and regression analyses which follow.

Data Analysis

Analysis of accumulated data includes a discussion of the limitations of the data reported, analysis of 6 hour simultaneous sampling results, evaluation of plant performance data, and correlation and regression analyses for statistical relationships within the reported data.

Limitations of Data Reported

There are three major areas in which the data reported is limited; selection of plants, sampling variation, and plant performance variation. One governmental source of reported data indicated that in most cases their basis for selecting POTW's for sampling was that the plant was having, or was suspected of having, operating problems. This type of data has been excluded from the data compilation insofar as it could be recognized. However, the possibility of data bias toward malfunctioning plants should be noted. This could be particularly true with regard to data obtained from enforcement or compliance activities. Nevertheless, significant differences on a broad basis between data from compliance monitoring and that obtained from other sources was not noted.

Since the reported data was not obtained from a controlled survey, the method of sampling was therefore not consistent. It was suspected that data from 6 hour simultaneous sampling procedures might not be valid, because plant detention time was not taken into account. Report No. 4 of Appendix 6 was prepared to compare sampling results from 24 hour composites and 6 hour simultaneous composites for similar plants. It was expected that this comparison might show a higher level of removal with 6 hour sampling. This was not confirmed by the comparison, and, in fact, an opposite trend was exhibited in some instances. It was therefore concluded that the 6 hour, and all simultaneous sampling results, should be included in the reported data. However, since sampling methods could not be compared at a single plant, a potential data misrepresentation still exists due to sampling variation.

Plant performance variation is the greatest single area of data limitation. A single day's sample from what may be a highly variable plant operation may not accurately characterize the removal effectiveness of the plant in question. Much of the data obtained in the survey is of this type and therefore may be open to question on the basis of representativeness.

Insofar as possible, the reported data is for typical plant operation, and where more than one sampling was

available, average values were reported. In several instances, a great deal of data was available for specific plants where specialized test programs are underway or thorough monitoring is performed on a routine basis. Average values for these facilities were utilized and entered as one data point for each pollutant parameter in the computer analysis. Consequently, several of the data points in the analysis are extremely representative of plant performance, but were compared on an equal basis with data far less representative. This is a possible additional limitation of the results reported. Nevertheless, a broad spectrum of plants was covered by this analysis and significant variation between the average results obtained and values reported for the plants with significant quantities of data was not noted.

Plant Performance

Report No. 5 of Appendix 6 is a summary of removal data for 40 parameters grouped by plant treatment process as follows: conventional primary plants (A1), other primary plants (A02), conventional trickling filter plants (B1), other trickling filter plants (B02, B04, B05), conventional activated sludge plants (C1), other activated sludge plants (C02, C05, C06, C09, C19, C20), and miscellaneous plants (D, J). It was concluded from this report that the conventional primary, trickling filter, and activated sludge plant groups could be expanded by incorporating the specialized categories of these processes into a summary type of analysis. Similarly, Report No. 7 of Appendix 6 is a summary of effluent or pass through data for all 61 parameters for plant groups as outlined above for Report No. 5.

In addition to the regrouping of plants under the expanded headings of primary, trickling filter, and activated sludge plants, upon review of Reports 5 and 7, it was also decided that the miscellaneous and "other" plants should be grouped as biological treatment plants with chemical addition, and tertiary plants. The following table summarizes the various treatment plant groups as discussed above, and defines the plant categories included in each group for further reference.

Report No. 6 of Appendix 6 is a summary of removal data for all primary, trickling filter and activated sludge plants not utilizing chemical addition. Additional plant groups also included in this report defined as "biological plants" include the sum of trickling filter and activated sludge plants; "secondary plants", those plants meeting the EPA definition of secondary treatment (an effluent BOD and SS less than or equal to 30 mg/l, and a removal of 85% or greater for both parameters); and "total all plants", the

TABLE F-1
DISTRIBUTION OF POTW DATA BY PLANT PROCESS

	<u>Category</u>	<u>No. of Plants</u>	
(PP)	Primary Plants	A01, A02	79
(TFP)	Trickling Filter Plants	B01,B02,B04,B05	81
(ASP)	Activated Sludge Plants	C01,C02,C05,C06,C09, C19,C20	83
		<hr/>	243
(BPCD)	Biological Plants with Chemical addition	B03,C03,C04,C14	8
		<hr/>	8
(TP)	Tertiary Plants	C07,C08,C10 D01,D02,D03,D04,D05, D06,D07	3
		8	
		<hr/>	11
	Other Plants	A03,A04,A05	3
		J01,J02	4
		<hr/>	7
		<hr/>	<hr/>
	TOTAL		269

sum of all 269 plants' data. The number of plants reporting, the maximum and minimum percent removal, the mean removal, and the standard deviation of the removal data are given for each parameter under the plant groups discussed above. It should be pointed out that the number of secondary plants can not be related as a percentage of the number of biological plants because not all biological plants reported the data required for secondary plant selection. Report No. 8 of Appendix 6 is a summary of effluent or pass through data in a format similar to the removal report discussed above.

The removal and effluent data summary reports were utilized in a selection of parameters for more detailed examination. The criteria used in this selection were twofold; the importance of the parameter in the context of project objectives, and the number of plants for which data was reported. On this basis the following parameters were selected:

- Cadmium (CD)
- Chromium (CR)
- Lead (PB)
- Mercury (HG)
- Copper (CU)
- Nickel (NI)
- Zinc (ZN)
- Iron (FE)
- Manganese (MN)
- Phosphorus-Total (P-TOTAL)
- Total Kjeldahl Nitrogen (TKN)
- Ammonia (NH₃)
- Phenolics (PHEN)
- Total Organic Carbon (TOC)
- Chemical Oxygen Demand (COD)
- Suspended Solids (SS)
- Biochemical Oxygen Demand, 5 Day (BOD)

All the metallic parameters represent total concentrations rather than the soluble fraction of the metal. COD data represents the sum of COD values obtained by the three methods of analysis listed in Reports 6 and 8 of Appendix 6. Tables F-2 and F-3 are summaries of the removal and effluent or pass through data for the selected parameters. Figures F-1 thru F-17 are cumulative distribution curves of the removal and effluent data for the same parameters. The data utilized for these curves is presented in Tables 6-1 and 6-2 of Appendix 6.

Characterization of Primary and Biological Plant Performance

Table F-4 summarizes the removal and effluent or pass through data reported for primary and biological treatment

TABLE F-2
REMOVAL DATA SUMMARY
FOR PRIMARY, TRICKLING FILTER
AND ACTIVATED SLUDGE PLANTS (SELECTED PARAMETERS)

Parameter	Primary Plants (PP)				Trickling Filter Plants (TFP)				Activated Sludge Plants (ASP)			
	Mean	Standard Deviation	Max/Min	No. of Plants	Mean	Standard Deviation	Max/Min	No. of Plants	Mean	Standard Deviation	Max/Min	No. of Plants
CD	8	17	76/0	31	20	25	75/0	35	17	27	88/0	44
CR	26	26	80/0	36	37	30	99/0	48	46	34	98/0	54
PB	24	26	88/0	34	37	31	93/0	41	39	32	95/0	49
HG	27	29	75/0	21	30	23	67/0	20	39	32	99/0	34
CU	26	24	77/0	44	54	24	95/0	49	57	24	95/0	63
NI	6	18	92/0	28	21	23	86/0	32	20	21	80/0	44
ZN	31	22	88/0	38	46	22	89/0	52	58	25	99/0	58
FE	40	22	89/0	27	50	26	90/0	30	63	27	98/8	35
MN	15	20	81/0	16	31	23	72/0	21	38	32	93/0	19
P-TOTAL	13	8	24/0	7	26	22	99/0	24	42	25	92/0	36
TKN	22	20	60/0	7	50	27	94/7	20	34	26	92/5	11
NH ₃	20	16	64/0	42	41	30	99/0	48	49	31	99/4	47
PHENOL	38	-	50/25	2	50	28	85/0	12	69	31	98/0	16
TOC	24	19	56/0	30	64	18	84/8	23	73	12	89/42	13
COD	26	-	82/0	18	71	-	95/34	36	75	-	94/24	40
SS	51	18	92/17	47	75	19	97/20	66	75	22	99/9	62
BOD	30	22	89/0	52	77	18	96/5	60	84	15	99/18	65

Notes:

1. PP = A01, A02 plants (Ref. Appendix 6, Report No. 2)
2. TFP = B01, B02, B04, B05 (Ref. Appendix 6, Report No. 2)
3. ASP = C01, C02, C05, C06, C09, C19, C20 (Ref. Appendix 6, Report No. 2)

TABLE F-3
EFFLUENT DATA SUMMARY
FOR PRIMARY, TRICKLING FILTER
AND ACTIVATED SLUDGE PLANTS (SELECTED PARAMETERS)

Parameter	Primary Plants (PP)				Trickling Filter Plants (TFP)				Activated Sludge Plants (ASP)			
	Mean	Standard Deviation	Max/Min	No. of Plants	Mean	Standard Deviation	Max/Min	No. of Plants	Mean	Standard Deviation	Max/Min	No. of Plants
CD (µg/l)	14	9	40/3	35	11	10	66/1	41	50	277	1970/1	48
CR "	188	406	2600/6	40	235	563	3200/3	52	202	515	2520/5	60
PB "	156	272	1700/10	37	116	276	1800/5	45	67	68	350/3	51
HG "	1.0	1.3	5.0/0.1	23	1.0	2.0	10.0/0.1	22	6.0	32	200/0.1	37
CU "	191	278	1700/10	48	133	283	1800/3	54	92	195	1600/8	68
NI "	165	387	1700/6	33	198	336	1533/7	38	165	387	1700/6	56
ZN "	550	658	3600/30	49	316	464	2800/40	57	238	257	1400/10	66
FE "	1520	1020	5000/400	30	2910	11000	65600/100	34	747	1170	6800/100	37
MN "	176	112	390/30	22	136	130	580/20	28	144	200	940/10	23
P-TOTAL (mg/l)	12.9	22	77/1.3	10	9.02	3.8	18.3/3.3	27	5.2	2.7	10.4/1.0	40
TKN "	24.4	11.6	47/8.5	-	16.8	11.9	47.8/1.2	21	19.0	9.6	34/1.5	12
NH ₃ "	20.2	34.6	256/2.1	63	16.6	17.2	115/0.03	65	11.1	7.6	27.5/0.07	63
PHENOL (µg/l)	16	23	53/0.1	-	209	772	3000/0.03	13	135	473	2000/0.02	16
TOC (mg/l)	142	84.2	539/52	35	54.3	26.3	129/23	23	35.3	22.4	95.0/10	14
COD "	346	-	768/58	19	133	-	361/18	38	86	-	275/14	42
SS "	93	62	314/15	54	43	37	228/5	66	37	39	185/2	64
BOD "	167	111	650/20	58	48.6	47.3	245/4.0	61	28.3	40.7	230/2.0	65

Notes:

1. PP = A01, A02 Plants (Ref. Appendix 6, Report No. 2)
2. TFP = B01, B02, B04, B05 (Ref. Appendix 6, Report No. 2)
3. ASP = C01, C02, C05, C06, C09, C19, C20 (Ref. Appendix 6, Report No. 2)

TABLE F-4
CHARACTERIZATION OF PRIMARY AND BIOLOGICAL
PLANT PERFORMANCE

<u>Parameter</u>	<u>Primary Plants (PP)</u>		<u>Biological Plants (BP)</u>	
	<u>Percent Removal</u> (50% \geq)/(mean)	<u>Effluent Concentration</u> (50% \leq)/(mean)	<u>Percent Removal</u> (50% \geq)/(mean)	<u>Effluent Concentration</u> (50% \leq)/(mean)
CD ($\mu\text{g/l}$)	7/8	11/14	9/19	10/30
CR "	16/26	90/188	41/42	50/218
PB "	20/24	110/156	41/38	60/92
HG "	22/27	0.6/1.0	38/35	0.6/3.5
CU "	18/26	110/191	56/56	50/113
NI "	6/6	75/165	16/21	65/182
ZN "	26/31	300/550	52/52	160/277
FE "	35/40	1300/1518	59/57	600/1827
MN "	8/15	160/176	28/35	90/140
P-TOT (mg/l)	ID/13	10/13	32/34	6/7
TKN "	ID/22	ID/24	40/42	17/18
NH ₃ "	17/20	13/20	37/45	12/14
PHEN ($\mu\text{g/l}$)	ID/38	ID/16	68/60	2.5/175
TOC (mg/l)	20/24	125/142	71/69	45/25
COD "	18/26	340/346	75/73	100/110
SS "	50/51	78/93	80/75	30/40
BOD "	28/30	140/167	85/81	28/39

Notes:

1. ID = Insufficient data reported.
2. PP = A01, A02 (Ref. Appendix 6, Report No. 2)
3. BP = TFP + ASP = B01, B02, B04, B05, C01, C02, C05, C06, C09, C19, C20.

plants. Removal data has been reported as the mean and the removal equalled or exceeded by 50% of the plants reporting, as estimated from Figures F-1 thru F-17. This latter value is in some cases also the median. Similarly, effluent data has been reported as the mean and the effluent concentration which has not been equalled or exceeded by 50% of the plants reporting, as estimated from Figures F-1 thru F-17. Again, this latter value is in some cases also the median.

Table F-4 and the figures show that the removal of metals in primary plants was generally low, with cadmium, nickel and manganese having the lowest removals. Maximum effluent concentrations were 14 µg/l for cadmium, 165 µg/l for nickel and 176 µg/l for manganese. Removal of chromium, lead, copper and mercury was somewhat higher, while zinc and iron removals were the highest of the metals in primary plants. Maximum effluent concentrations were 550 µg/l for zinc, and 1518 µg/l for iron.

In biological treatment plants, cadmium, nickel and manganese were removed least, with chromium, lead, copper and mercury removals being slightly higher. Effluent concentrations of up to 30 µg/l for cadmium, 182 µg/l for nickel, and 140 µg/l for manganese were reported. Zinc, iron, and copper had a relatively high percentage of removal in biological treatment plants. Effluent concentrations of up to 277 µg/l for zinc, 1827 µg/l for iron, and 113 µg/l for copper were reported. These data would tend to indicate that iron, zinc and copper are most susceptible to removal in conventional treatment facilities, while cadmium, nickel and manganese are the least susceptible of the metals to removal.

The removal of pollutant parameters related to organic pollution, total phosphorus, kjeldahl nitrogen, ammonia, and phenolics in primary plants was on the order of 13 to 38 percent. Maximum reported effluent concentrations were 13 mg/l for P-TOT, 22 mg/l for TKN, 20 mg/l for NH₃ and 16 µg/l for phenolics. In biological plants, the removals for these parameters ranged from 32 to 65 percent. Maximum reported effluent concentrations were 7 mg/l for P-TOT, 18 mg/l for TKN, 14 mg/l for NH₃, and 2.5 to 175 µg/l for phenolics. Mean values for biological treatment plants' effluent phenolics concentration is distorted by some extremely high concentrations for a few plants.

The removal of the more general parameters of pollution, TOC, COD, SS, and BOD in primary plants was 18 to 51 percent. Effluent concentrations of up to 142 mg/l for TOC, 346 mg/l

for COD, 93 mg/l for SS, and 167 mg/l for BOD were reported. Removals of these parameters in biological plants ranged from 69 to 81 percent, with effluent concentrations of up to 45 mg/l for TOC, 11 mg/l for COD, 40 mg/l for SS, and 39 mg/l for BOD.

Evaluation of Limited Data

Table F-5 is a summary of removal and effluent data for oil and grease, cyanide (total), and hexavalent chromium in primary and biological treatment plants. The data presented for oil and grease is a combination of the original oil and grease data obtained by three distinct analytical methods.

Of these parameters, oil and grease removal was most significant, with approximately 50 percent removal achieved in primary plants, and 68-83 percent removal obtained in biological plants. It was noted that for the limited number of plants reporting oil and grease data, a high level of BOD and suspended solids removal was also achieved in these facilities. Consequently, the oil and grease removal data presented is indicative of a well operated and efficient biological treatment system. For the plants reporting oil and grease data, pass through was 25.0 - 27.8 mg/l in primary plants, and 9.0-21.0 mg/l in biological treatment plants.

Removal of cyanide and hexavalent chromium was reported only by biological treatment facilities. Removal varied from 3 to 29 percent and 0 to 18 percent respectively, thus indicating only incidental removal of these pollutants in biological treatment plants. Corresponding effluent values were 0.01 to 3.7 mg/l for cyanide and 10 to 15 µg/l for hexavalent chromium. As a result of the limited number of plants reporting oil and grease, cyanide and hexavalent chromium data, this information should not be considered conclusive, but rather indicative of the performance of similar treatment facilities.

A limited amount of data was also reported on biological treatment plants with chemical addition, and tertiary plants. Table F-6 summarizes this data with mean and median values for removal reported, along with the number of plants reporting data. Again, no attempt was made to characterize the performance of these plants due to the limited extent of the data base. Nevertheless, the table confirms the expected general improved removal of metals experienced in plants utilizing chemical addition.

TABLE F-5
REMOVAL AND EFFLUENT DATA SUMMARY
FOR OIL AND GREASE, CYANIDE AND
HEXAVALENT CHROMIUM

	Primary Plants (PP)				Biological Treatment Plants (BP)			
	Percent Removal		Effluent Concentration		Percent Removal		Effluent Concentration	
	Median/Mean	N	Median/Mean	N	Median/Mean	N	Median/Mean	N
O&G (mg/l)	52/48	6	25.0/27.8	6	83/68	13	9.0/21.0	25
CYN (mg/l)	0/0	1	0.055/0.075	4	3/29	14	0.010/3.672	28
HEX. CR. (µg/l)	0/0	3	20/17	3	0/18	19	10/15	20

Notes:

1. PP = A01, A02 (Ref. Appendix 6, Report No. 2)
2. BP = TFP + ASP = B01, B02, B04, B05, C01, C02, C05, C06, C09, C19, C20.
3. N = Number of plants reported.

TABLE F-6
REMOVAL IN BIOLOGICAL PLANTS WITH CHEMICAL
ADDITION, AND TERTIARY PLANTS

	Biological w/Chem Addition		Tertiary	
	Median/Mean	No. of Plants	Median/Mean	No. of Plants
CD	0/0	4	0/6	5
CR	67/70	6	14/32	7
PB	38/39	6	31/44	10
HG	33/34	5	17/22	4
CU	80/75	5	79/73	9
NI	75/62	7	13/18	5
ZN	79/72	8	77/63	7
FE	84/84	3	94/82	8
MN	39/39	2	47/53	5
P-TOTAL	80/78	6	41/43	6
TKN	51/57	6	88/88	2
NH ₃	45/56	5	89/80	9
PHENOL	82/82	2	85/65	4
TOC	79/79	3	75/74	3
COD	87/78	5	88/84	10
SS	83/78	8	93/90	11
BOD	93/86	6	95/90	11

Note:

1. Biological plants with chemical addition are as follows: BO3, CO3, CO4, C14.
(Reference Appendix 6, Report No. 2).
2. Tertiary Plants are as follows: CO7, CO8, C10, D01, D02, D06, D07. (Reference Appendix 6, Report No. 2).

Correlation Analyses

Correlation analyses were performed to determine the degree of linear relationship for influent concentration versus percent removal, suspended solids removal versus percent removal, influent pH versus percent removal, and influent concentration versus effluent concentration for nine metal parameters. Table F-7 is a summary of the correlation coefficients obtained. Of the four relationships investigated, only influent concentration versus effluent concentration exhibited a consistently high degree of correlation. This relationship was therefore pursued further in the regression analyses which follow.

The possibility of a linear relationship with log combinations for influent concentration versus percent removal, suspended solids removal versus percent removal, and influent pH versus percent removal for cadmium, chromium, and lead was investigated in Table F-8. No consistent high degree of correlation was exhibited in this analysis.

Regression Analyses

Polynomial regression analyses were performed to determine the line of best fit for the reported data in the relationship of influent concentration to effluent concentration. The regression equation along with the standard error of estimate (Se), the standard deviation for effluent concentrations reported (Ys), and the maximum and minimum reported influent concentrations (X max, X min) is presented in Table F-9 for nine total metals' parameters. Three to six degrees of polynomial regression were examined for each parameter, with the selection of regression equations based on the minimum reasonable Se/Ys ratio.

Taking into account the standard error of estimate, and within the limits of influent concentrations X max, and X min, the regression equations in Table F-9 may be utilized to estimate an effluent concentration from a given influent concentration, or conversely to estimate an influent concentration from a given effluent limitation.

TABLE F-7
CORRELATION COEFFICIENT

Parameter	Influent Conc. vs. % Removal				SS % Removal vs. % Removal				pH - Influent vs. % Removal				Influent Conc. vs. Effluent Conc.			
	PP	TFP	ASP	N (PP/TFP/ASP)	PP	TFP	ASP	N (PP/TFP/ASP)	PP	TFP	ASP	N (PP/TFP/ASP)	PP	TFP	ASP	N (PP/TFP/ASP)
CD	-0.02	0.33	0.22	31/25/44	-0.25	0.06	0.27	17/28/30	0.19	-0.29	0.37	13/25/21	0.97	0.83	1.00	31/35/44
CR	0.19	0.38	0.22	26/48/54	-0.02	0.18	0.43	19/37/40	0.12	-0.07	-0.13	18/34/27	0.98	0.81	0.84	36/48/54
PB	0.63	0.40	0.41	34/41/49	0.03	0.07	0.17	21/32/41	0.17	-0.41	0.07	17/30/32	0.58	0.67	0.77	34/41/49
HG	0.03	0.22	0.26	21/20/34	0.54	0.32	0.41	11/16/28	-0.69	0.01	0.10	9/11/20	0.89	1.00	0.76	21/20/34
CU	-0.03	0.21	-0.01	44/49/63	-0.17	0.36	0.30	20/36/43	-0.27	-0.13	-0.25	27/36/37	0.97	0.87	0.67	44/49/63
NI	0.23	0.52	-0.14	28/32/49	-0.26	-0.04	0.06	19/26/36	0.01	0.05	-0.01	15/20/25	0.94	0.60	1.00	28/32/49
ZN	0.02	0.15	0.40	38/52/58	0.06	0.50	0.56	18/40/44	0.03	0.11	-0.07	21/38/34	0.96	0.93	0.61	38/52/58
FE	0.45	-0.15	0.13	27/30/35	0.56	0.56	0.56	12/25/32	0.07	-0.02	0.33	22/29/33	0.67	0.99	0.57	27/30/35
MN	0.06	0.31	0.12	16/21/19	-0.08	0.18	0.11	14/21/18	-0.32	0.18	-0.29	12/20/16	0.92	0.85	0.95	16/21/19

Notes:

1. PP = A01, A02 plants (Ref. Appendix 6, Report No. 2)
2. TFP = B01, B02, B04, B05 (Ref. Appendix 6, Report No. 2)
3. ASP = C01, C02, C05, C06, C09, C19, C20 (Ref. Appendix 6, Report No. 2)
4. N = Number of plants reported.

TABLE F-8
CORRELATION COEFFICIENT (LOG)

<u>Parameter</u>	<u>Log Inf. Conc.</u> <u>vs. Log % Rem.</u>			<u>Log Inf. Conc.</u> <u>vs. % Removal</u>			<u>Influent Conc.</u> <u>vs. Log % Rem.</u>		
	PP	TFP	ASP	PP	TFP	ASP	PP	TFP	ASP
CD	-0.13	-0.001	0.33	-0.05	0.05	0.38	-0.04	0.24	0.23
CR	0.62	0.50	0.62	0.45	0.61	0.67	0.28	0.22	0.20
PB	0.51	0.38	0.32	0.59	0.58	0.43	0.43	0.21	0.30

	<u>Log SS % Rem.</u> <u>vs. Log % Rem.</u>			<u>Log SS % Rem.</u> <u>vs. % Rem.</u>			<u>SS % Rem.</u> <u>vs. Log % Rem.</u>		
	PP	TFP	ASP	PP	TFP	ASP	PP	TFP	ASP
CD	-0.38	0.11	0.30	-0.23	0.08	0.26	-0.37	0.08	0.33
CR	0.57	0.20	0.44	0.63	0.18	0.42	0.54	0.18	0.41
PB	0.02	-0.10	0.09	0.09	0.06	0.17	-0.03	-0.10	0.05

<u>pH - Influent</u> <u>vs. Log % Rem.</u>			
PP	TFP	ASP	
CD	0.32	-0.36	0.27
CF	0.35	-0.09	-0.11
PB	0.34	-0.32	-0.02

Notes:

1. PP = A01, A02 plants (Ref. Appendix 6, Report No. 2)
2. TFP = B01, B02, B04, B05 (Ref. Appendix 6, Report No. 2)
3. ASP = C01, C02, C05, C06, C09, C19, C20 (Ref. Appendix 6, Report No. 2)

TABLE F-9
REGRESSION ANALYSES - INFLUENT CONC. (X) vs. EFFLUENT CONC. (Y)

PRIMARY PLANTS (PP)						TRICKLING FILTER PLANTS (TFP)						ACTIVATED SLUDGE PLANTS (ASP)					
Parameter	Regression Equation	S _e	Y _s	X _{Max}	X _{Min}	Regression Equation	S _e	Y _s	X _{Max}	X _{Min}	Regression Equation	S _e	Y _s	X _{Max}	X _{Min}		
		(µg/l)					(µg/l)					(µg/l)					
CD	Y = 0.39 + 0.99 x	1.7	7.3	30	3	Y = 5.08 + 0.34 x	-	6	90	2	Y = 3.16 + 0.48 x	9	295	4130	3		
CR	Y = 14.6 + 0.69 x	90	442	3600	6	Y = -26.2 + 0.53 x - 2(10 ⁻⁵)x ³	215	546	14000	4	Y = -1.30 + 0.36 x	211	389	5600	5		
PB	Y = 16.3 + 0.73 x - 0.001x ²	54	79	1040	10	Y = -5.33 + 0.53 X - 0.0001x ²	147	287	7750	5	Y = 25.6 + 0.26 x	34	52	930	5		
HG	Y = -0.13 + 0.81 x	0.7	1.4	5	0.1	Y = 0.09 + 0.52 x	0.1	2.1	19	0.2	Y = 2.72 - 1.02x + 0.01x ²	15	34	300	0.2		
CU	Y = -10.2 + 0.79 x	73	289	1900	30	Y = 64.9 + 0.15 x	148	301	12000	20	Y = 7.48 + 0.38 x	53	71	620	30		
NI	Y = -8.00 + 0.90 x	108	312	1700	9	Y = 14.9 + 0.88x - 0.0001x ²	63	365	8300	12	Y = -29.5 + x	61	5706	40000	9		
ZN	Y = -56.9 + 0.76 x	194	685	4300	40	Y = -10.7 + 0.51 x	165	440	4800	94	Y = 73.1 + 0.19 x	136	169	2200	60		
FE	Y = 650 - 0.01x + 0.0002x ² - 2(10 ⁻⁸)x ³	713	1055	9000	620	Y = -829 + 0.76 x	1376	11894	85700	160	Y = -927 + 2.15 x - 0.001 x ² + 8 (10 ⁻⁸) x ³	641	1200	7367	250		
MN	Y = 3.97 + 0.82 x	37	91	370	46	Y = 5.85 + 0.60 x	43	81	426	30	Y = 24.7 + 0.47 x	69	215	2020	35		

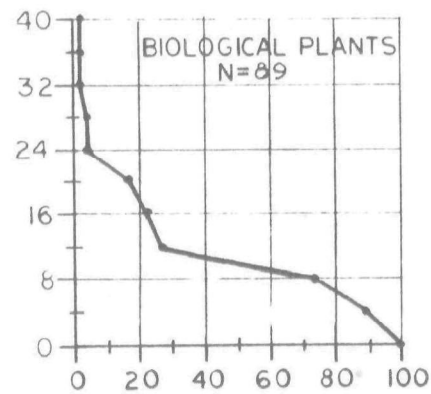
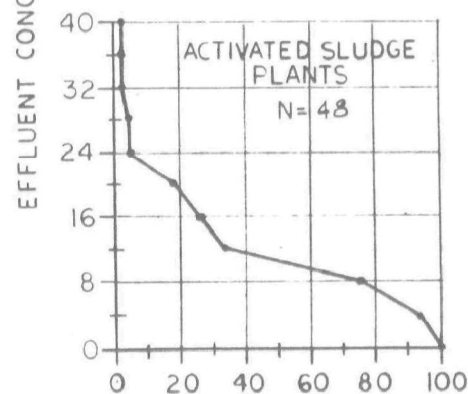
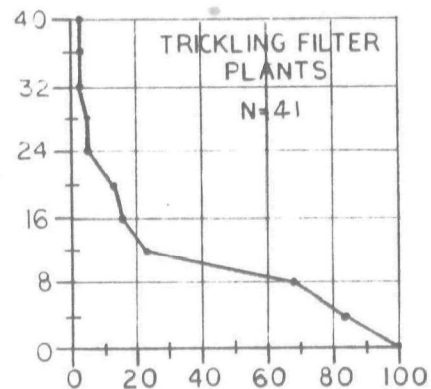
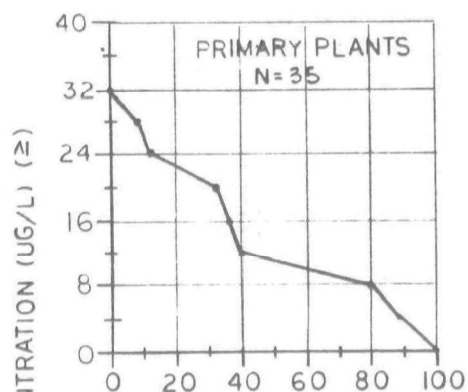
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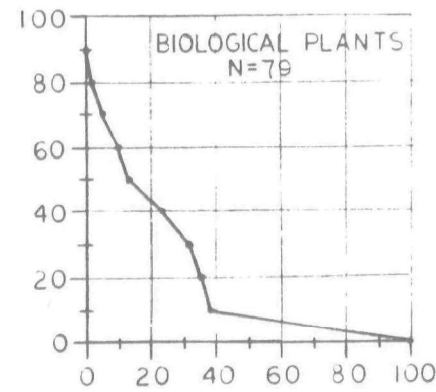
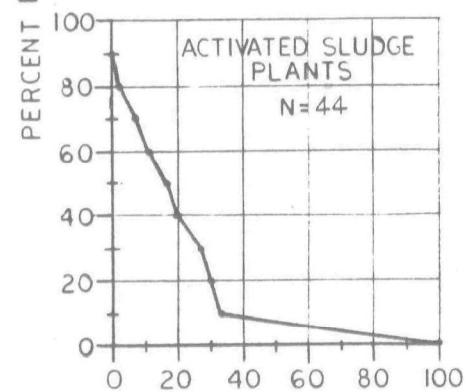
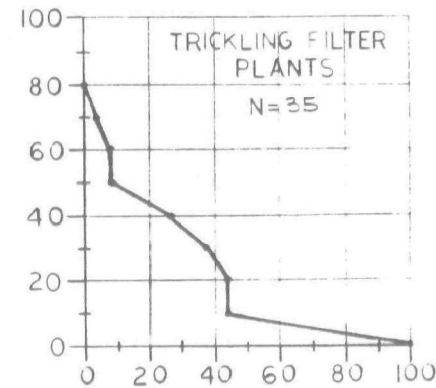
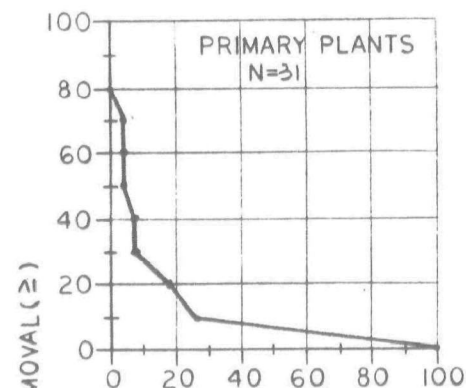
1. Y_s = Standard deviation (of effluent concentration reported)
2. S_e = Standard error of estimate
3. X_{Max} = Maximum reported influent concentration
4. X_{Min} = Minimum reported influent concentration
5. PP = A01, A02 plants (Ref. Appendix 6, Report No. 2)
6. TFP = B01, B02, B04, B05 (Ref. Appendix 6, Report No. 2)
7. ASP = C01, C02, C05, C06, C09, C19, C20 (Ref. Appendix 6, Report No. 2)

CUMULATIVE DISTRIBUTION OF EFFLUENT DATA



PERCENT OF PLANTS

CUMULATIVE DISTRIBUTION OF REMOVAL DATA



PERCENT OF PLANTS

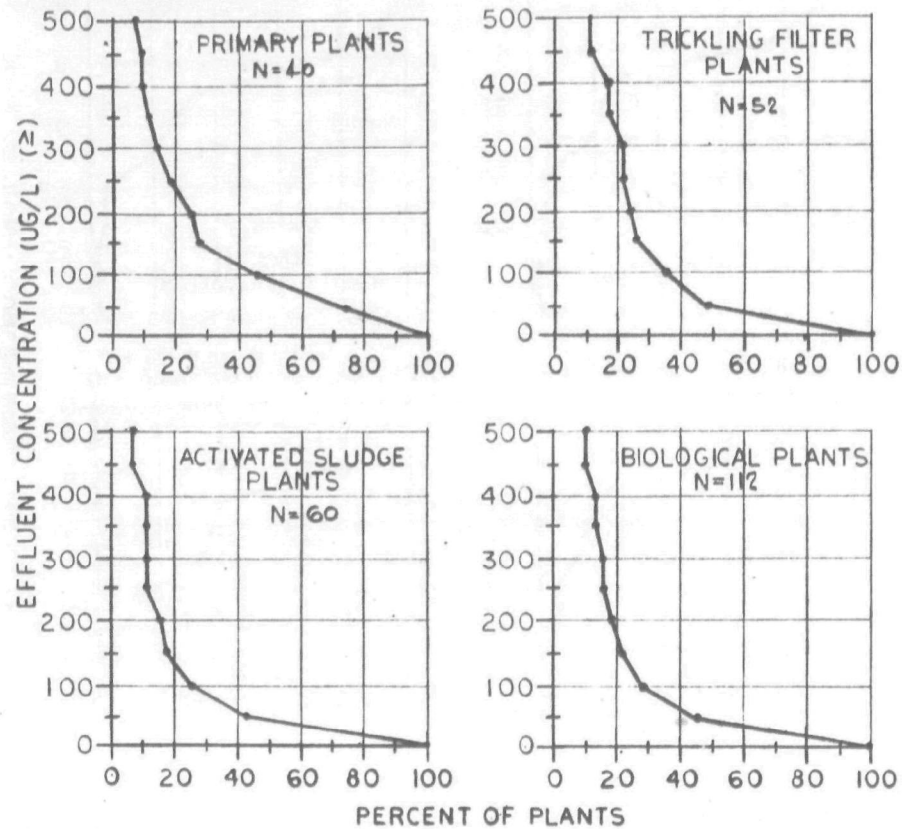
NOTES:-1-"N" IS THE NUMBER OF PLANTS REPORTED

2-"BIOLOGICAL PLANTS" IS THE TOTAL OF TRICKLING FILTER & ACTIVATED SLUDGE PLANTS

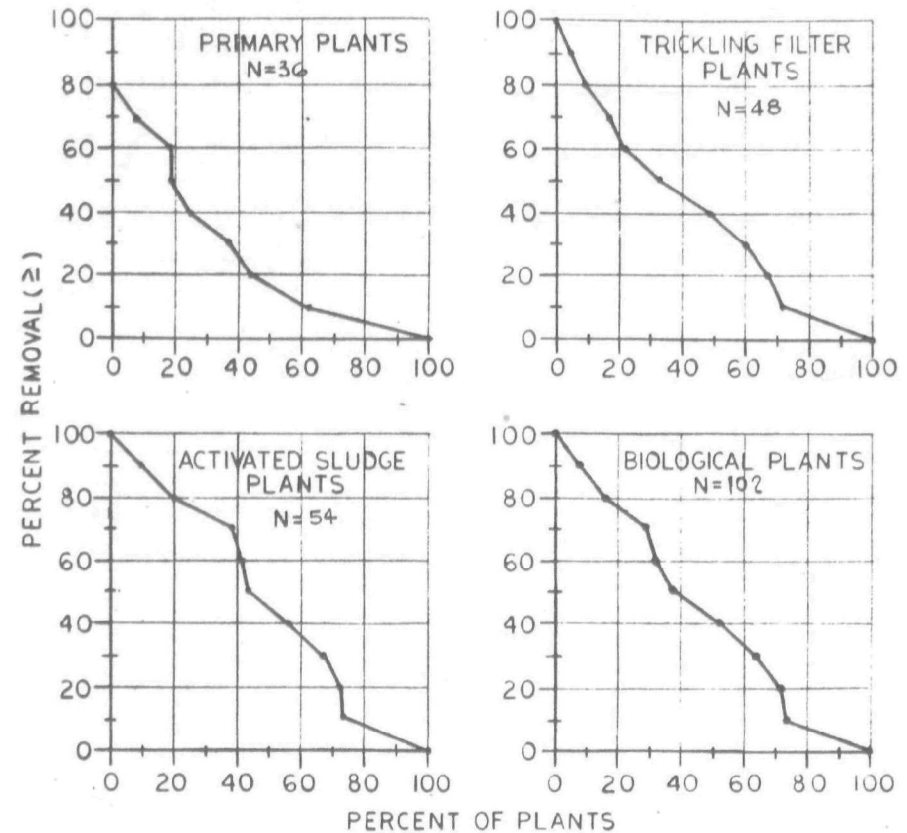
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FIGURE F-2
CHROMIUM

CUMULATIVE DISTRIBUTION OF EFFLUENT DATA

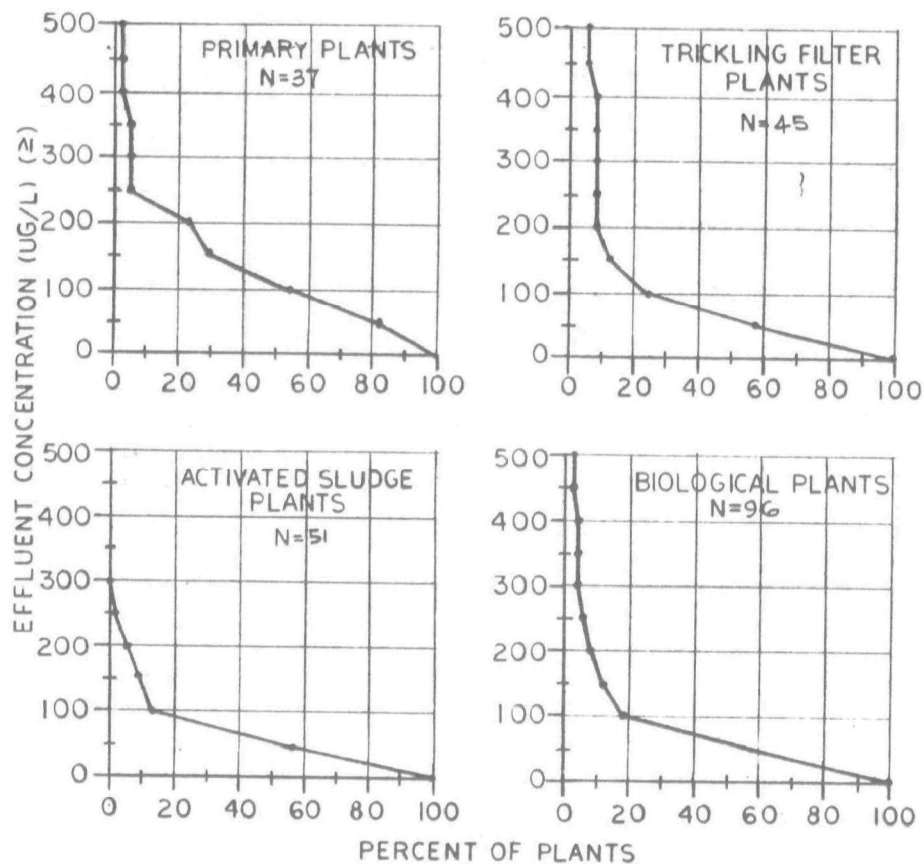


CUMULATIVE DISTRIBUTION OF REMOVAL DATA

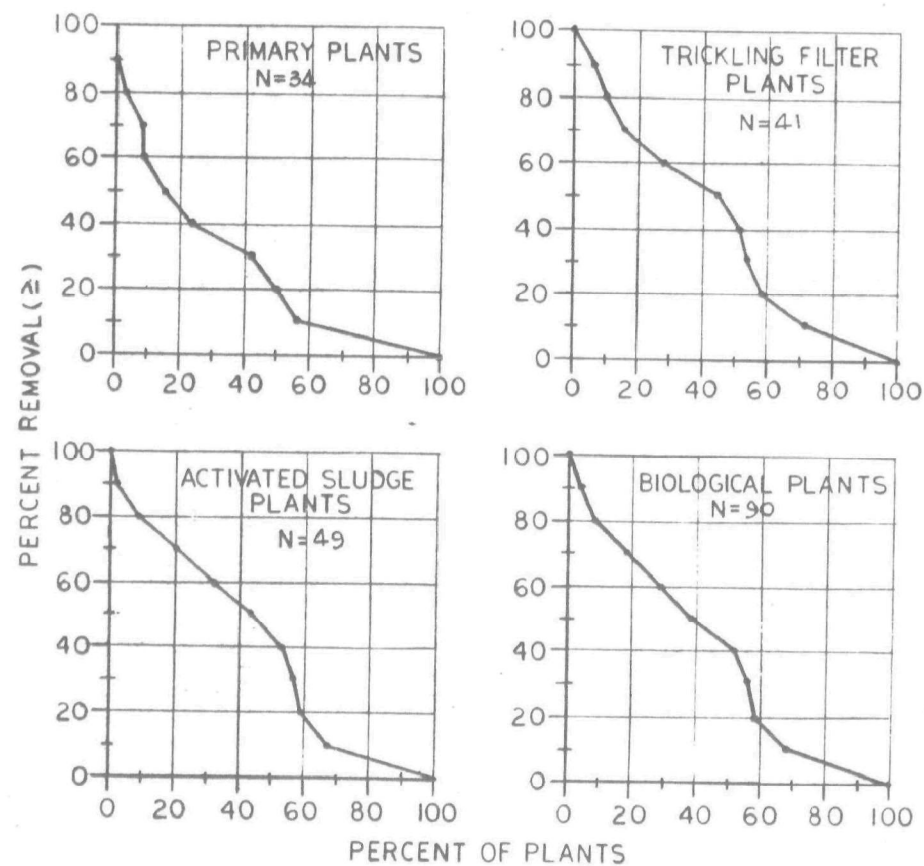


NOTES:-1-"N" IS THE NUMBER OF PLANTS REPORTED
2-"BIOLOGICAL PLANTS" IS THE TOTAL OF TRICKLING FILTER & ACTIVATED SLUDGE PLANTS
3-CHROMIUM REPORTED AS CR, TOTAL

CUMULATIVE DISTRIBUTION OF EFFLUENT DATA



CUMULATIVE DISTRIBUTION OF REMOVAL DATA



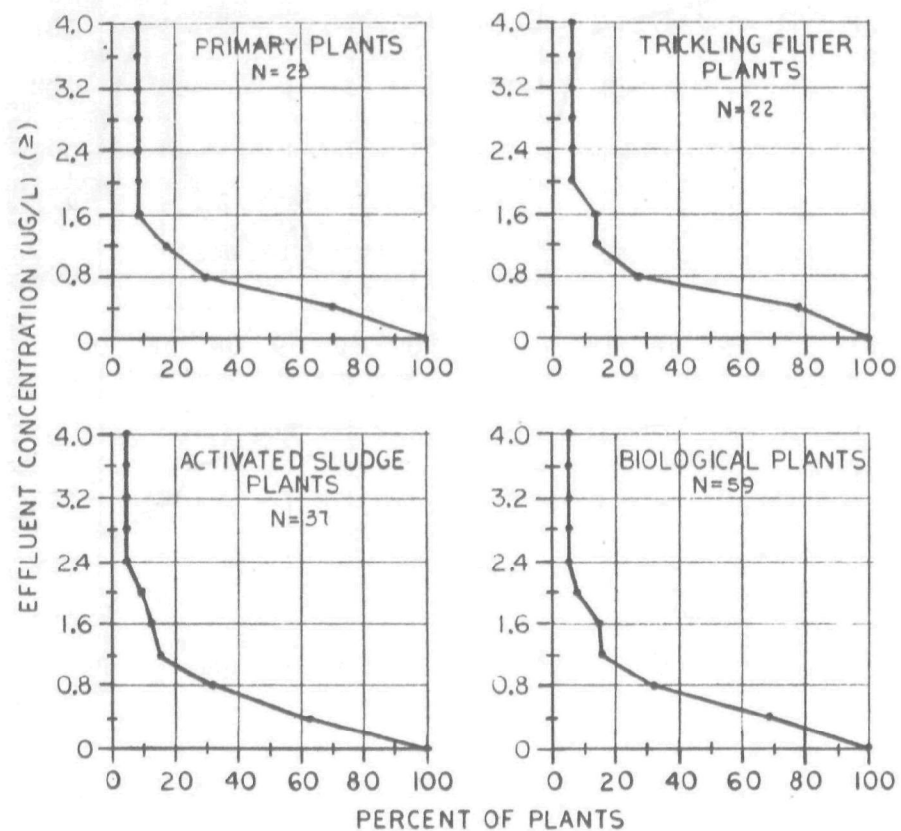
NOTES:-1-"N" IS THE NUMBER OF PLANTS REPORTED

2-"BIOLOGICAL PLANTS" IS THE TOTAL OF TRICKLING FILTER & ACTIVATED SLUDGE PLANTS

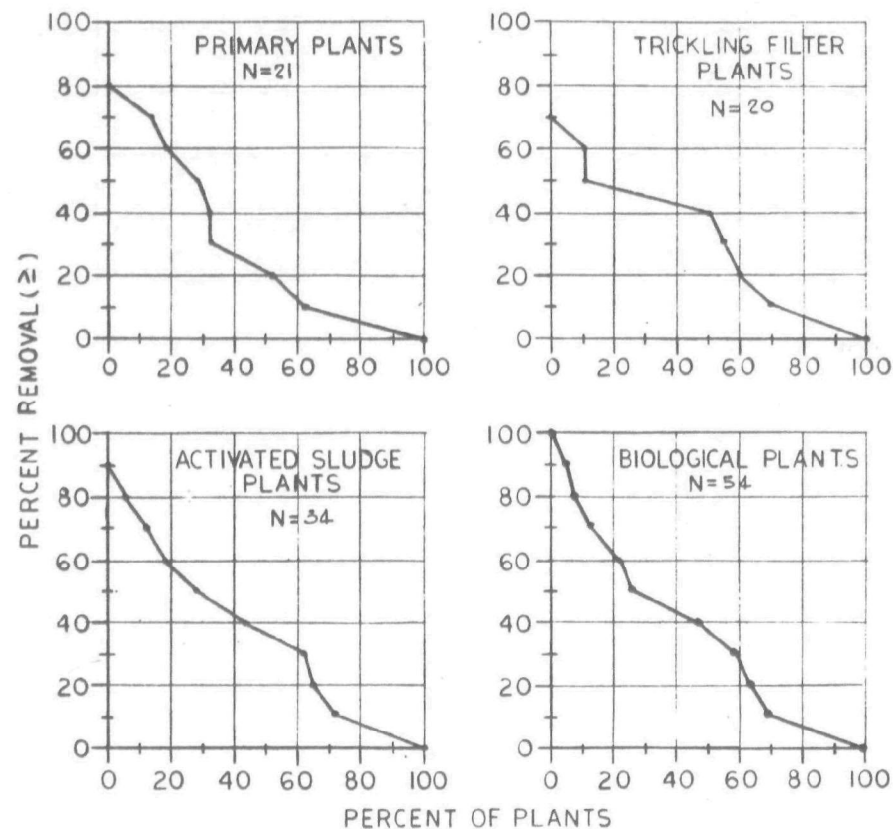
3-LEAD REPORTED AS PB, TOTAL

FIGURE F-4
MERCURY

CUMULATIVE DISTRIBUTION OF EFFLUENT DATA

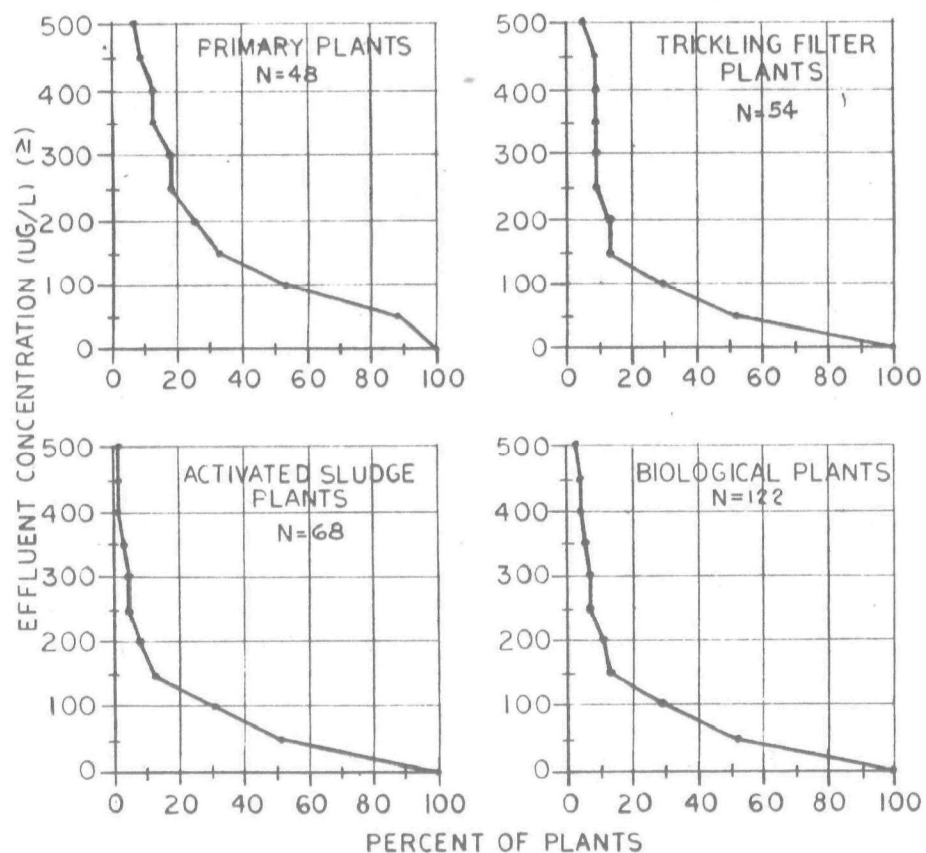


CUMULATIVE DISTRIBUTION OF REMOVAL DATA

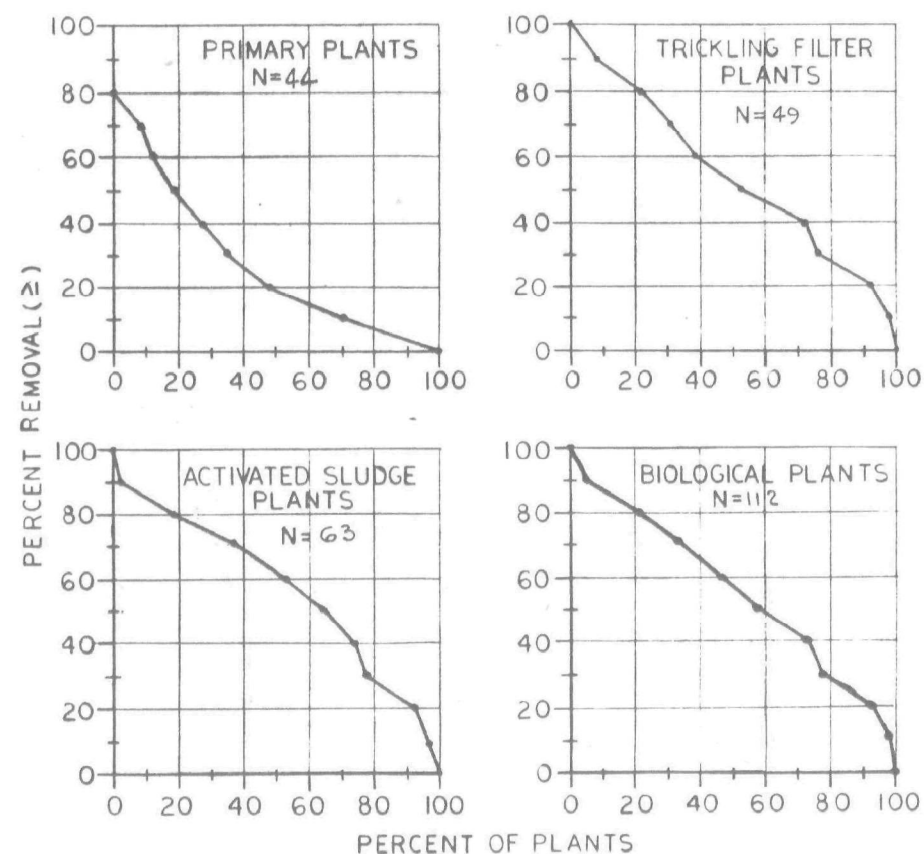


NOTES:-1-"N" IS THE NUMBER OF PLANTS REPORTED
2-"BIOLOGICAL PLANTS" IS THE TOTAL OF TRICKLING FILTER & ACTIVATED SLUDGE PLANTS
3-MERCURY REPORTED AS HG, TOTAL.

CUMULATIVE DISTRIBUTION OF EFFLUENT DATA



CUMULATIVE DISTRIBUTION OF REMOVAL DATA



NOTES:-1-"N" IS THE NUMBER OF PLANTS REPORTED

2-"BIOLOGICAL PLANTS" IS THE TOTAL OF TRICKLING FILTER & ACTIVATED SLUDGE PLANTS

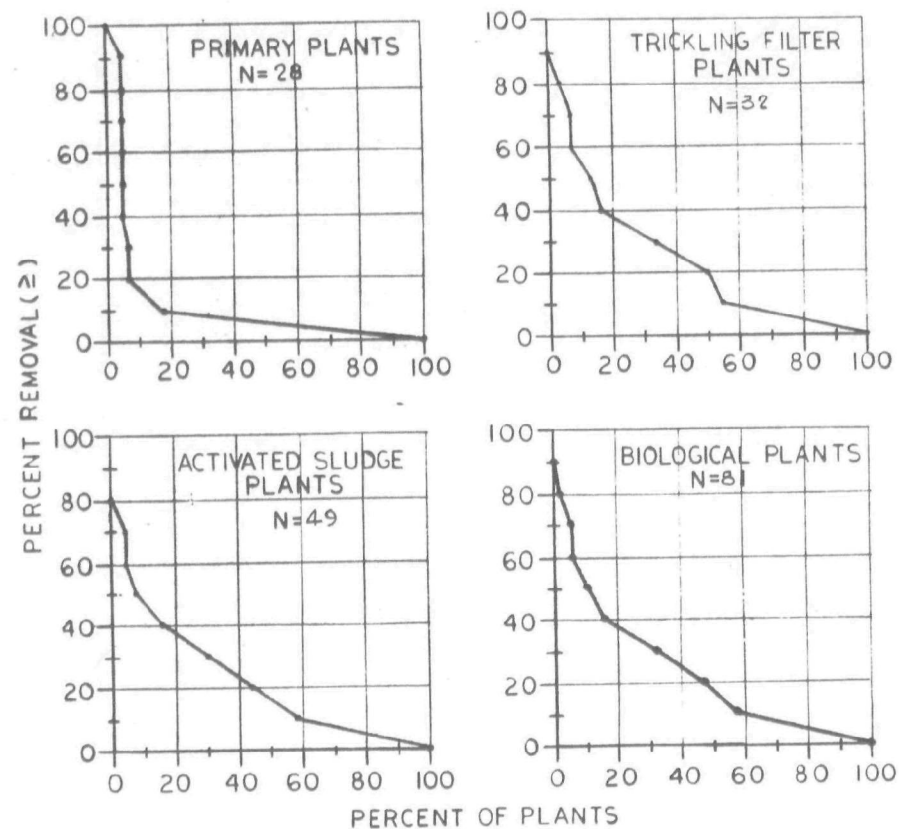
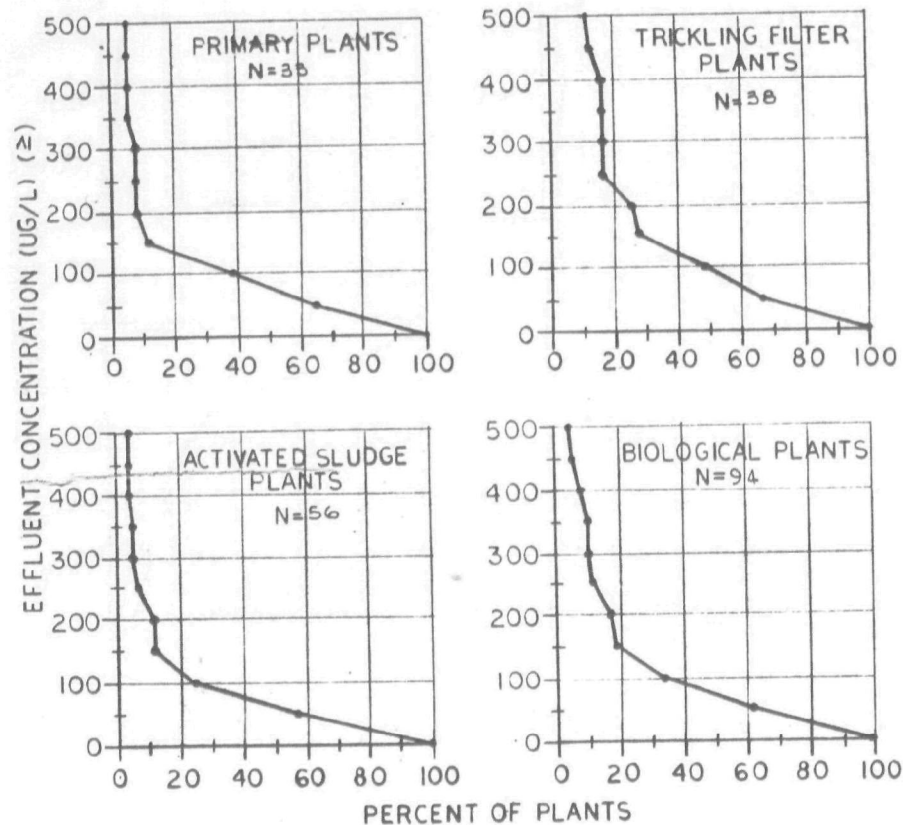
3-COPPER REPORTED AS CU, TOTAL

FIGURE F-6
NICKEL

CUMULATIVE DISTRIBUTION OF EFFLUENT DATA

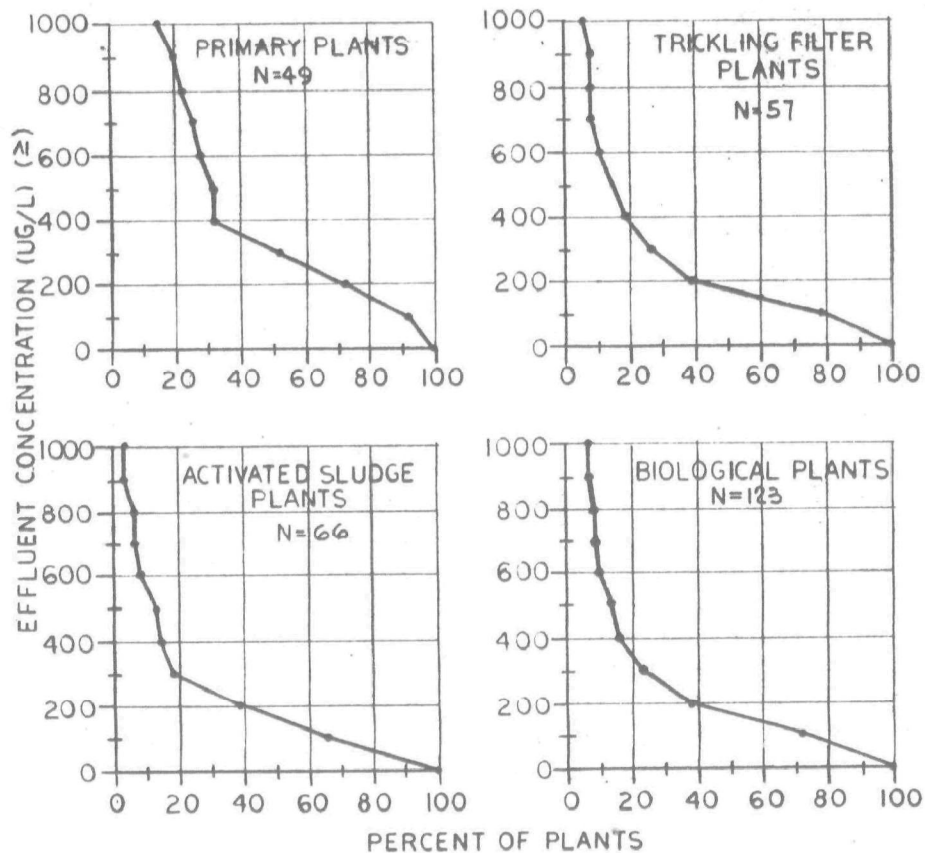
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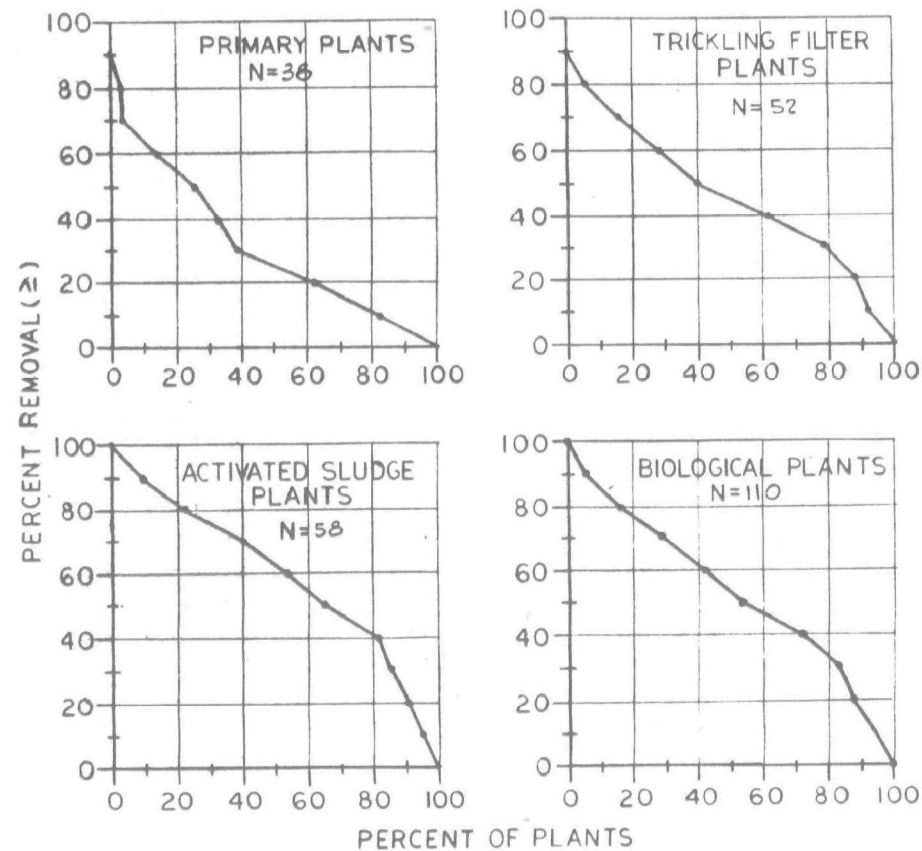


NOTES:-1-"N" IS THE NUMBER OF PLANTS REPORTED
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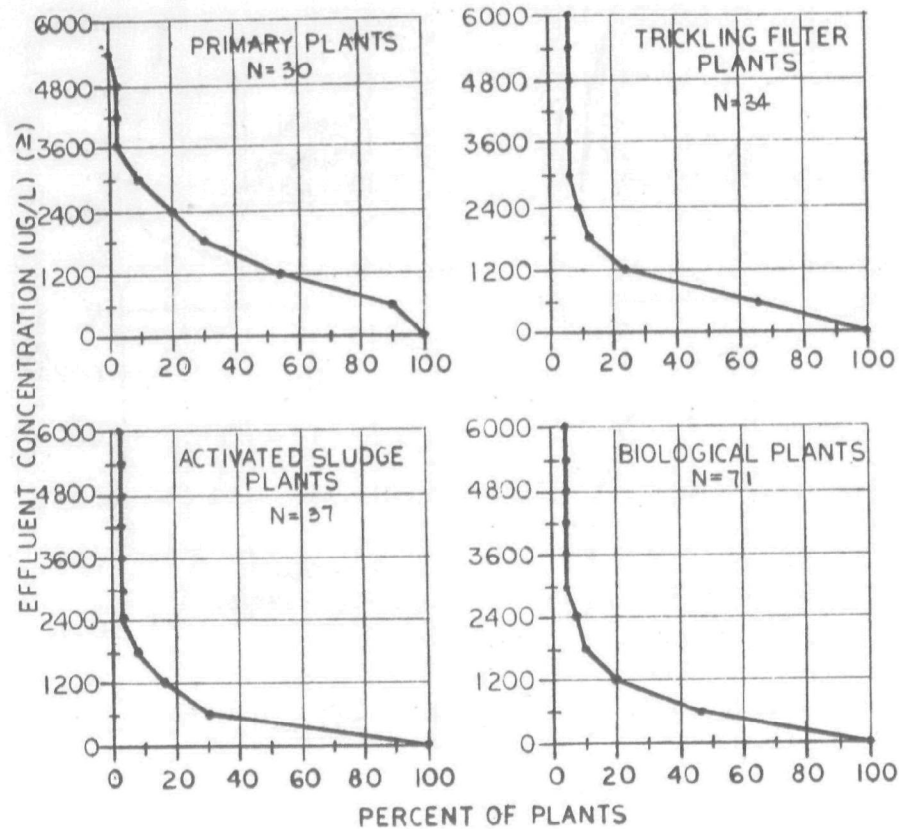
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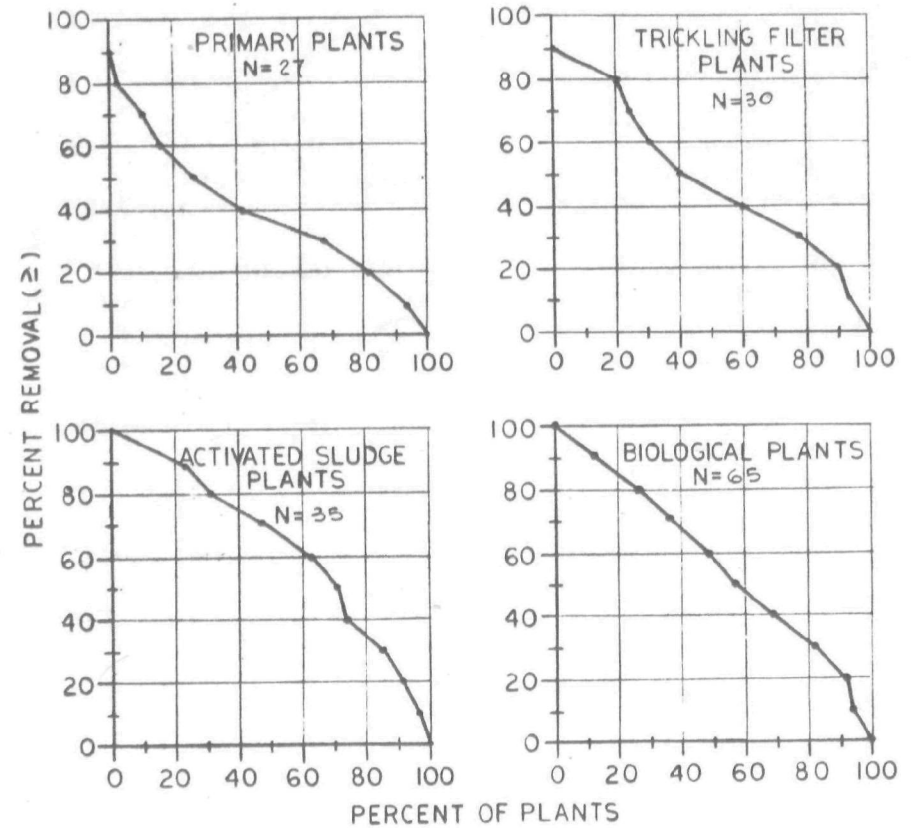
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FIGURE F-8
IRON

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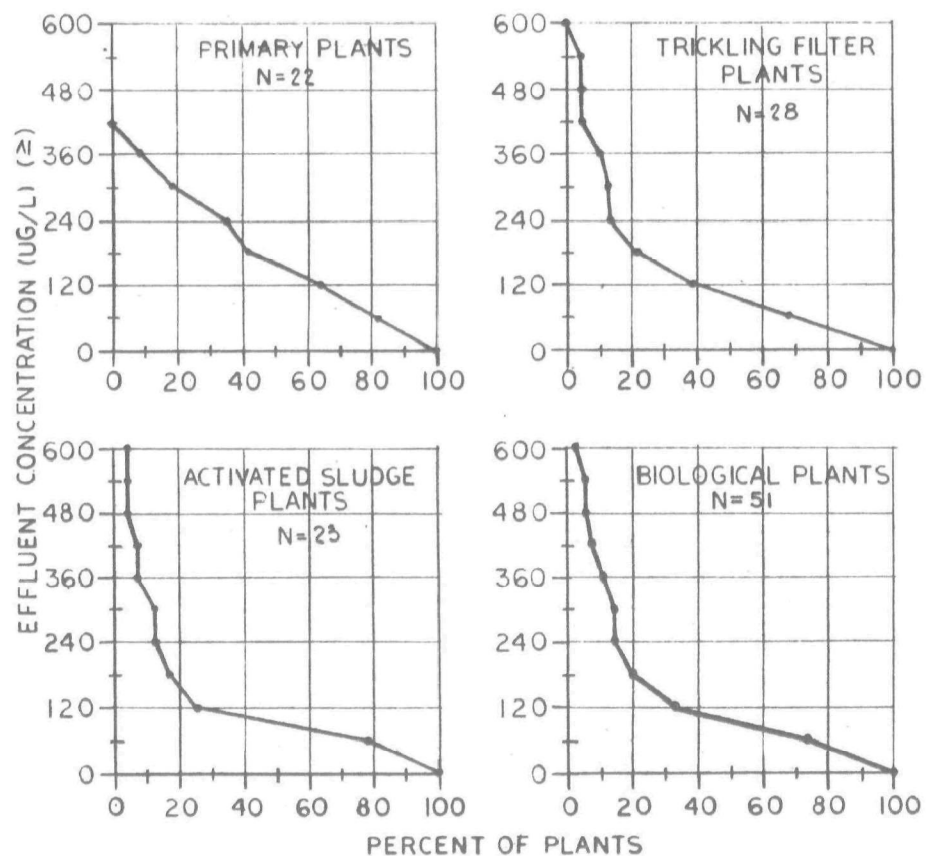


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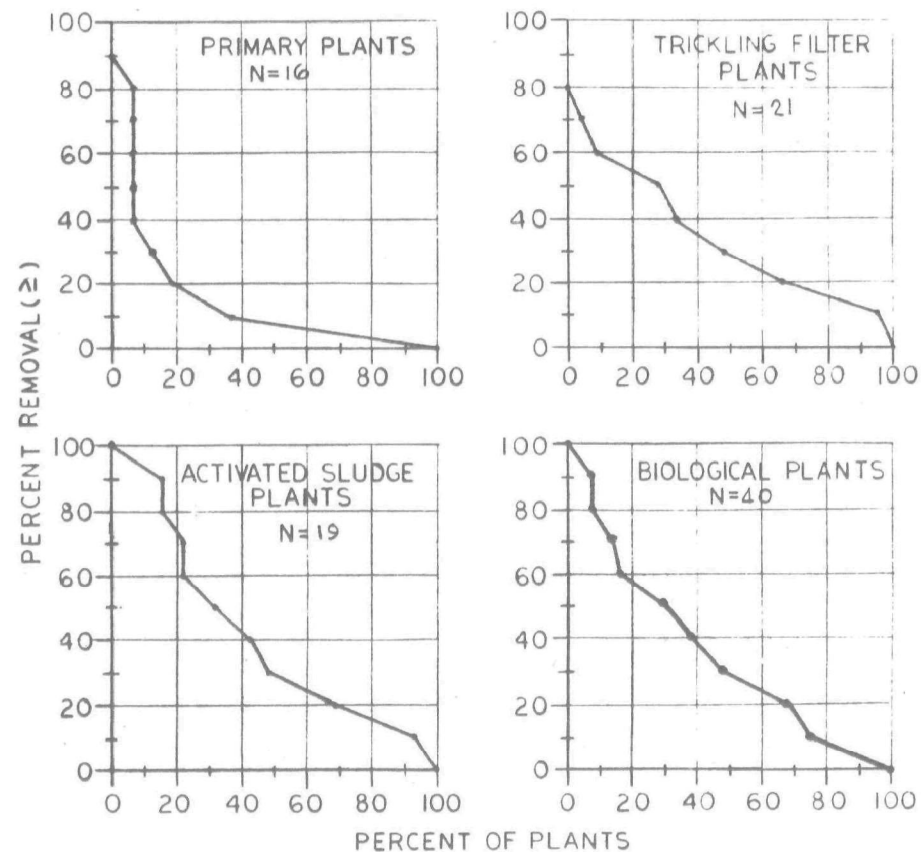


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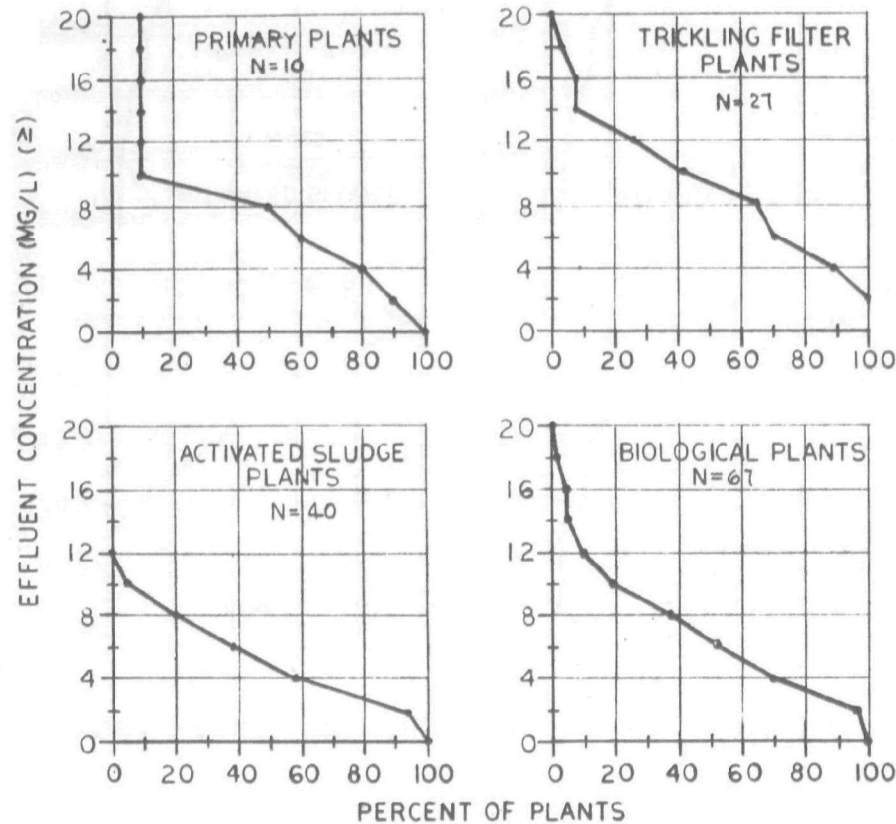
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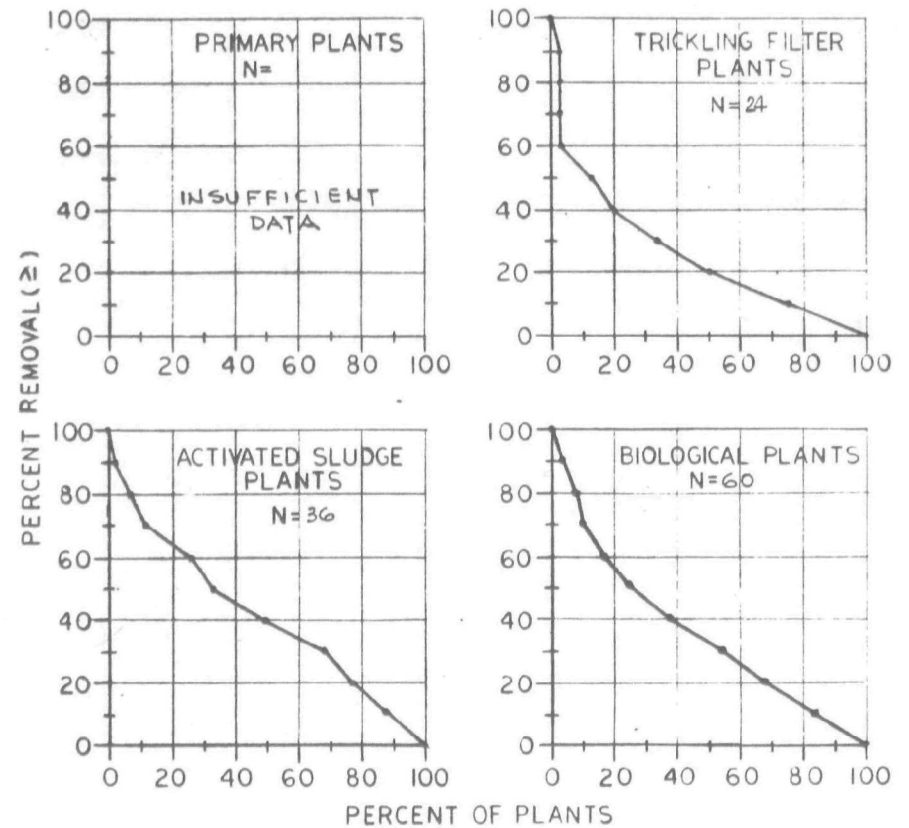
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FIGURE F-10
PHOSPHORUS

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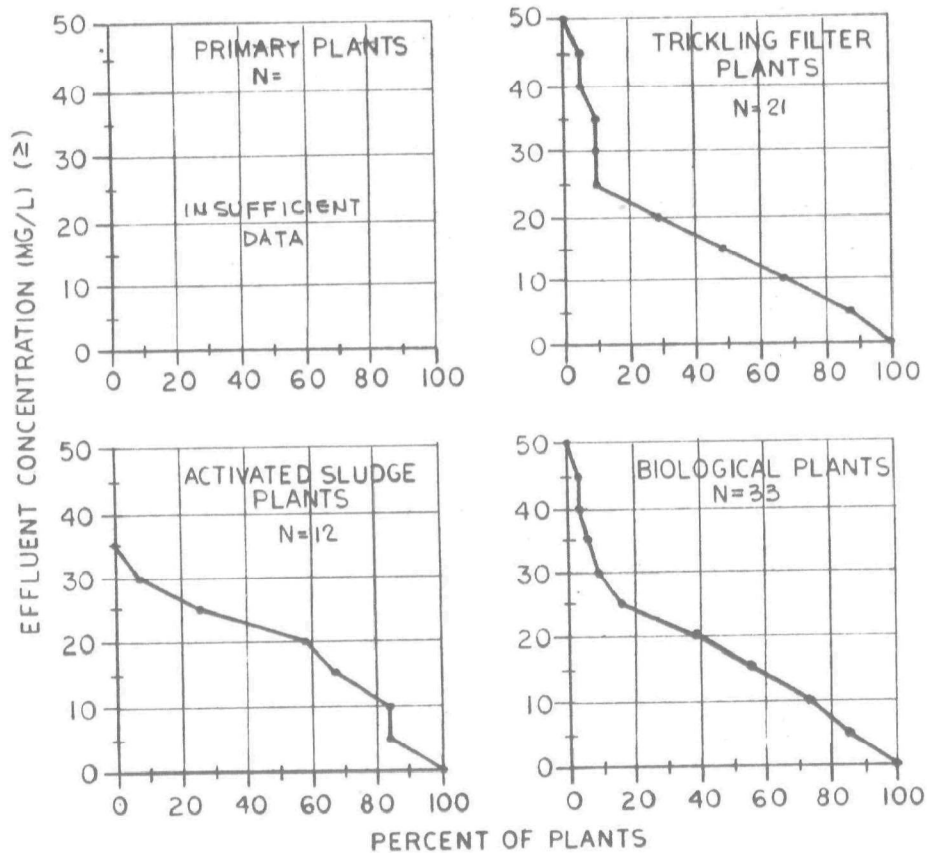


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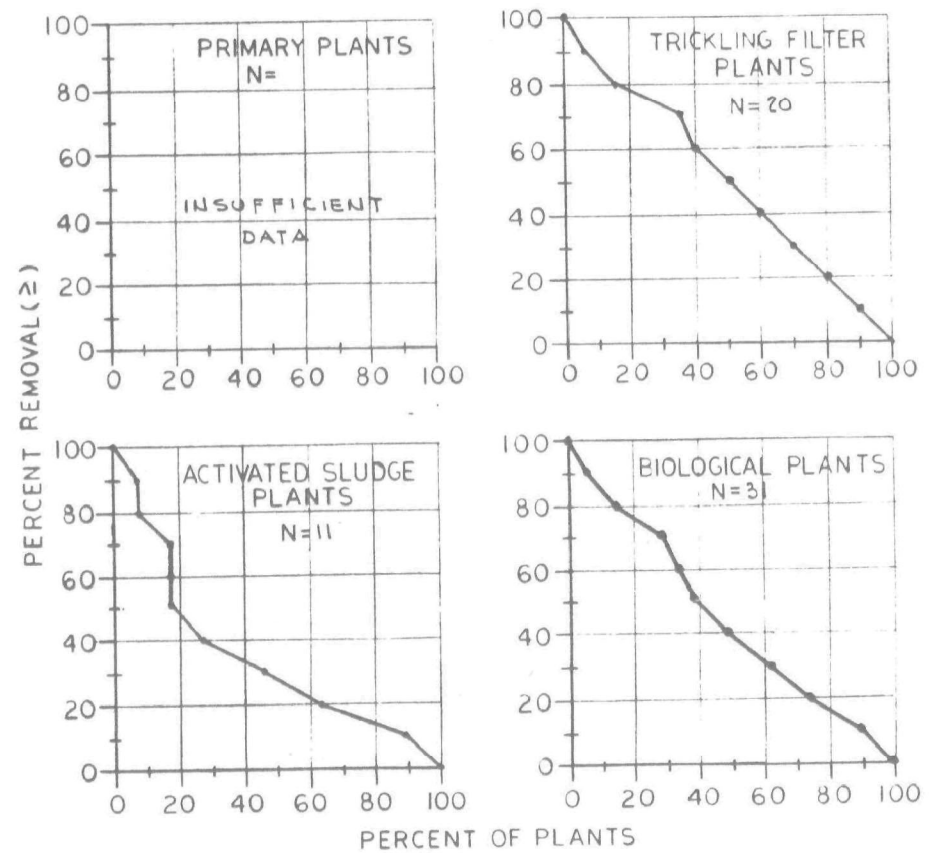


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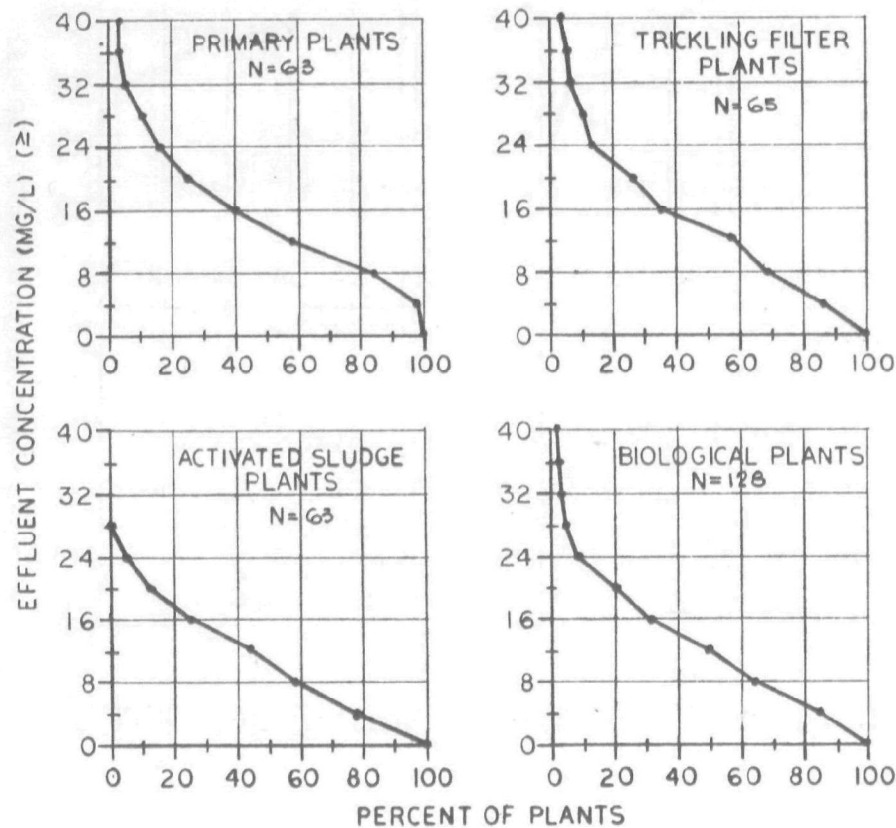
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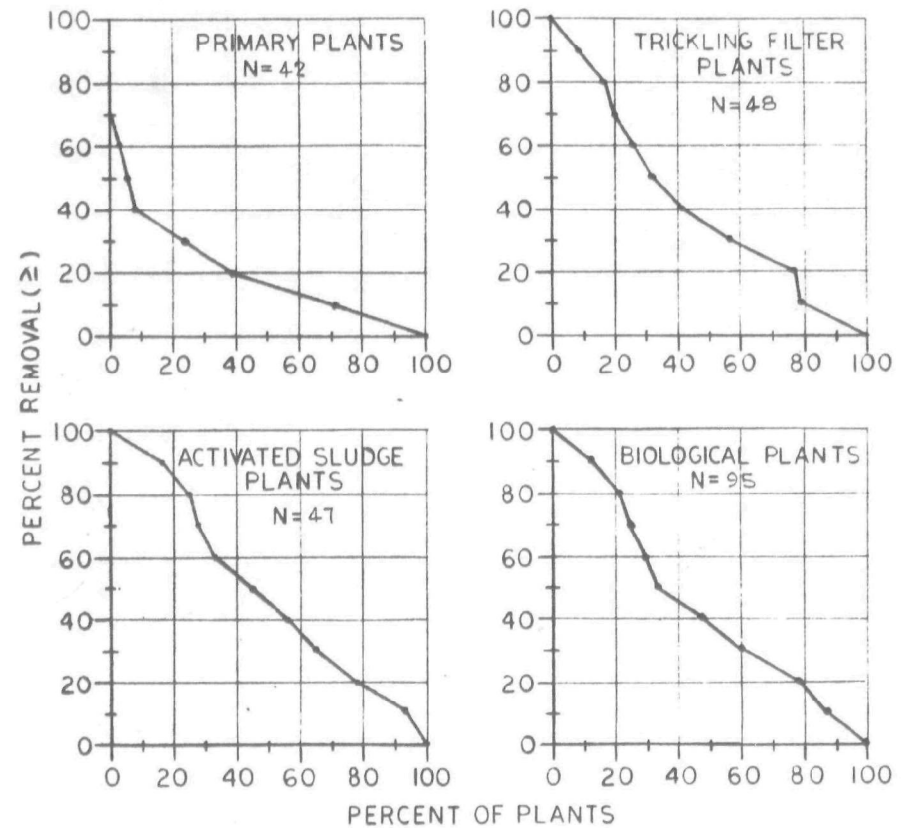
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FIGURE F-12
AMMONIA

CUMULATIVE DISTRIBUTION OF EFFLUENT DATA

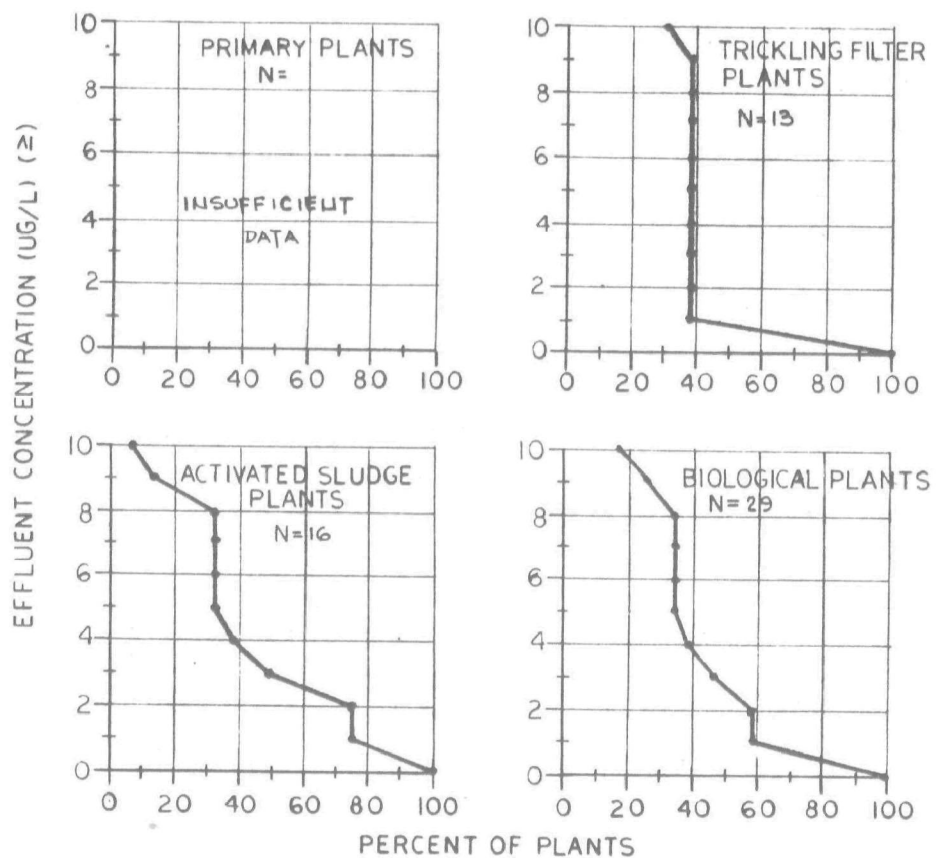


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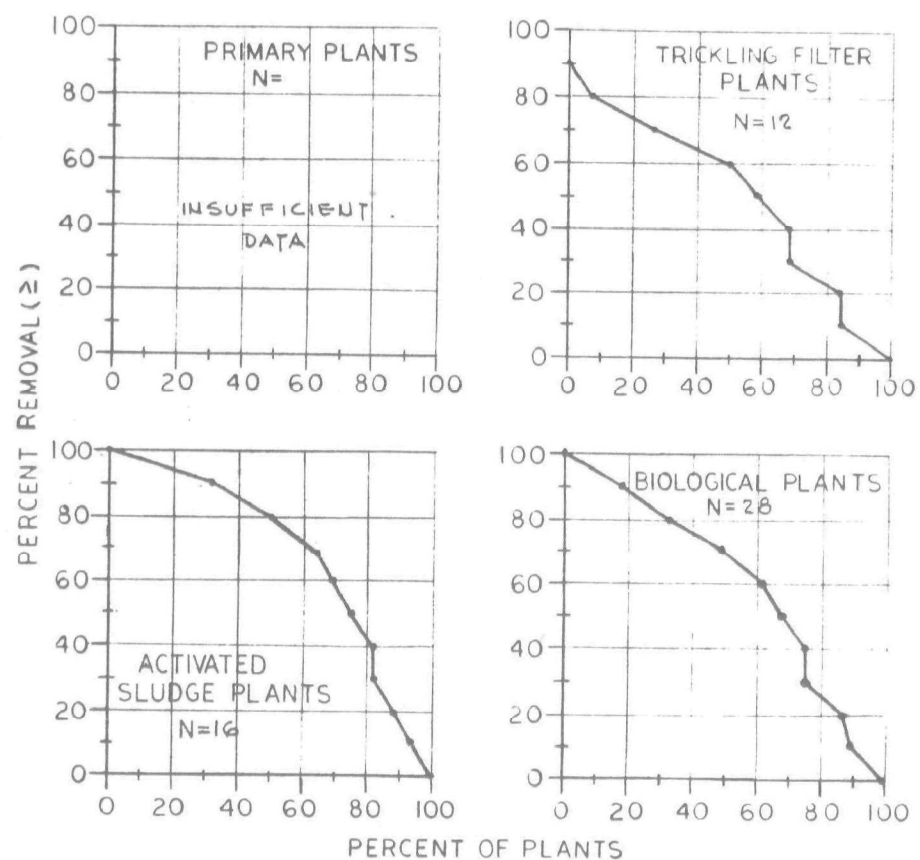


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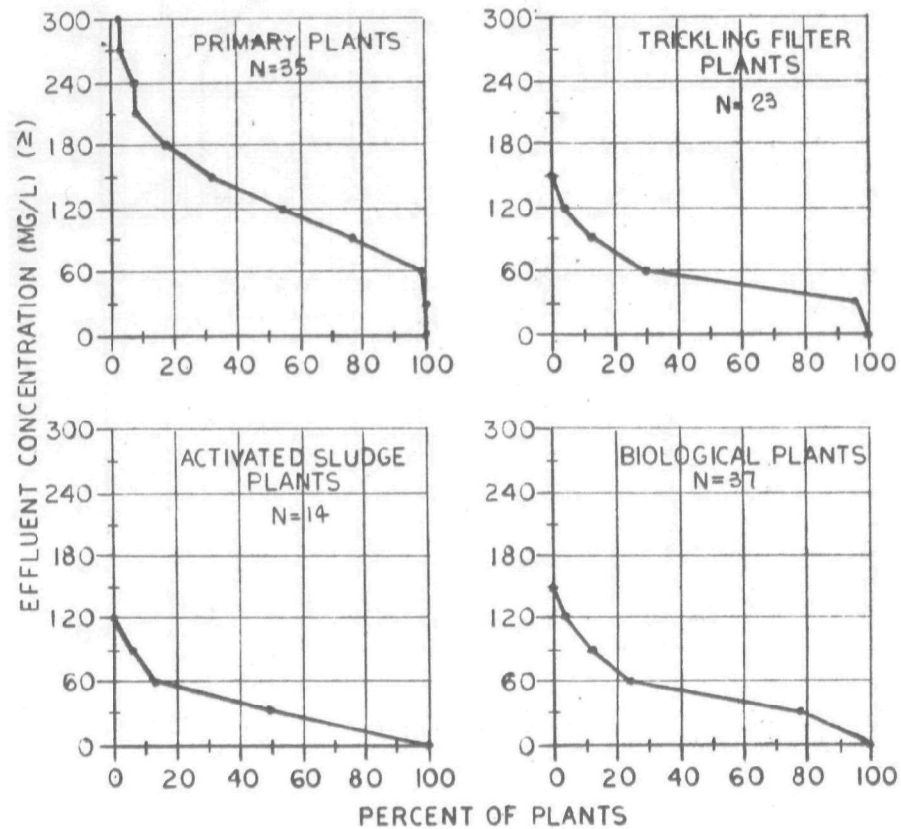


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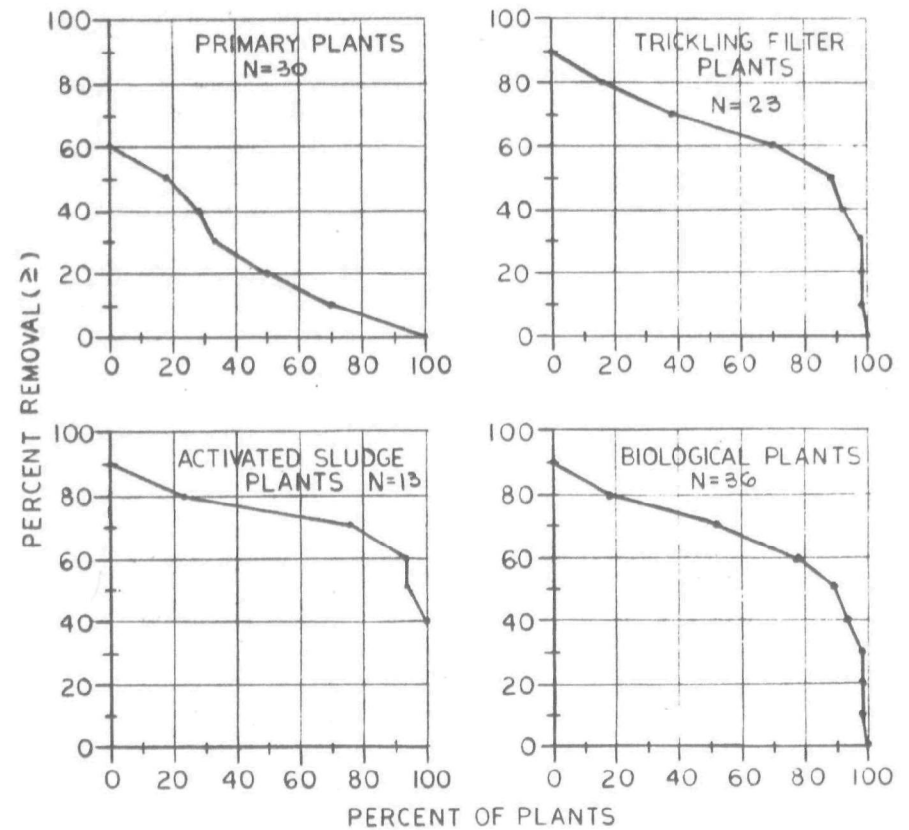
2-"BIOLOGICAL PLANTS" IS THE TOTAL OF TRICKLING FILTER & ACTIVATED SLUDGE PLANTS

FIGURE F-14
TOTAL ORGANIC CARBON

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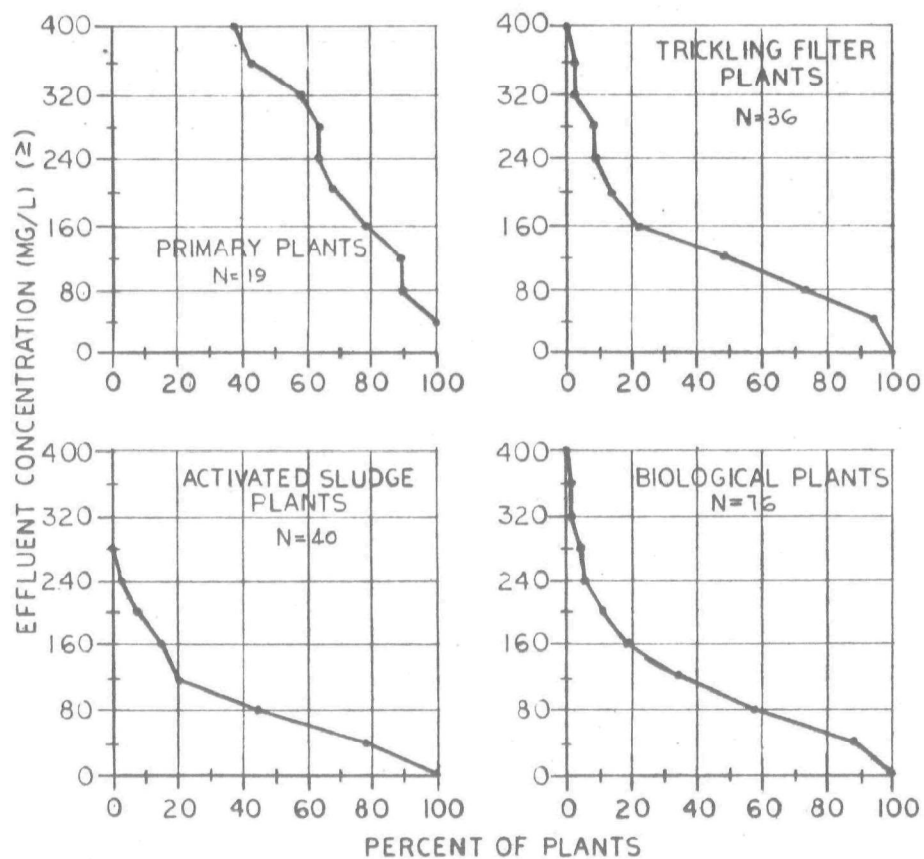


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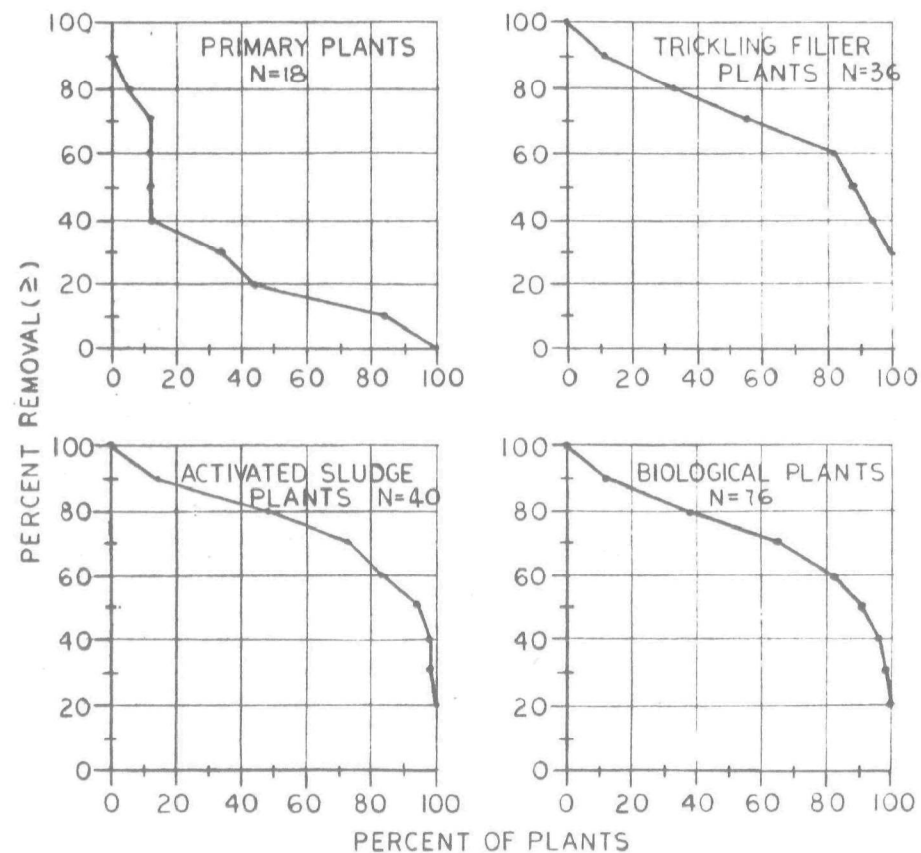


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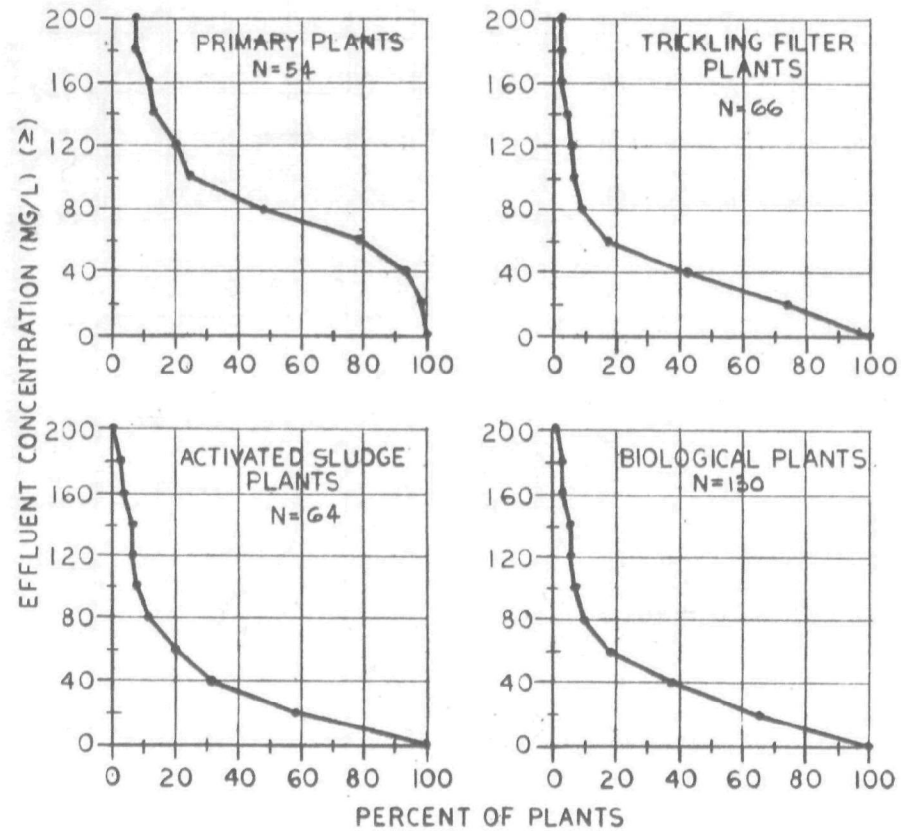


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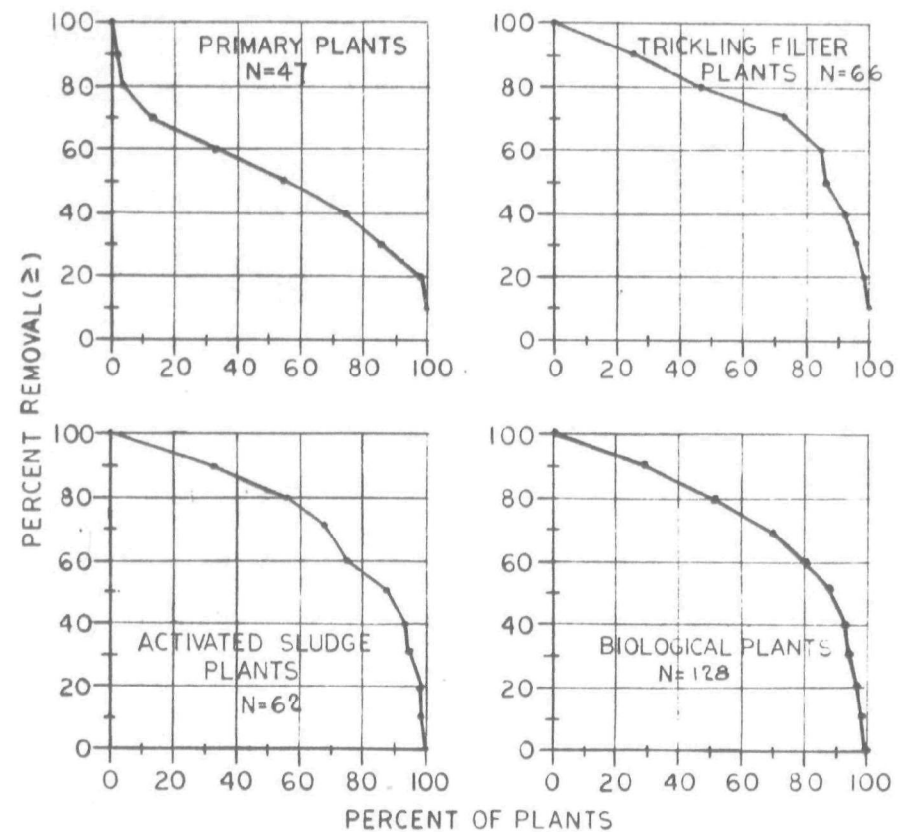
2-"BIOLOGICAL PLANTS" IS THE TOTAL OF TRICKLING FILTER & ACTIVATED SLUDGE PLANTS

FIGURE F-16
SUSPENDED SOLIDS

CUMULATIVE DISTRIBUTION OF EFFLUENT DATA

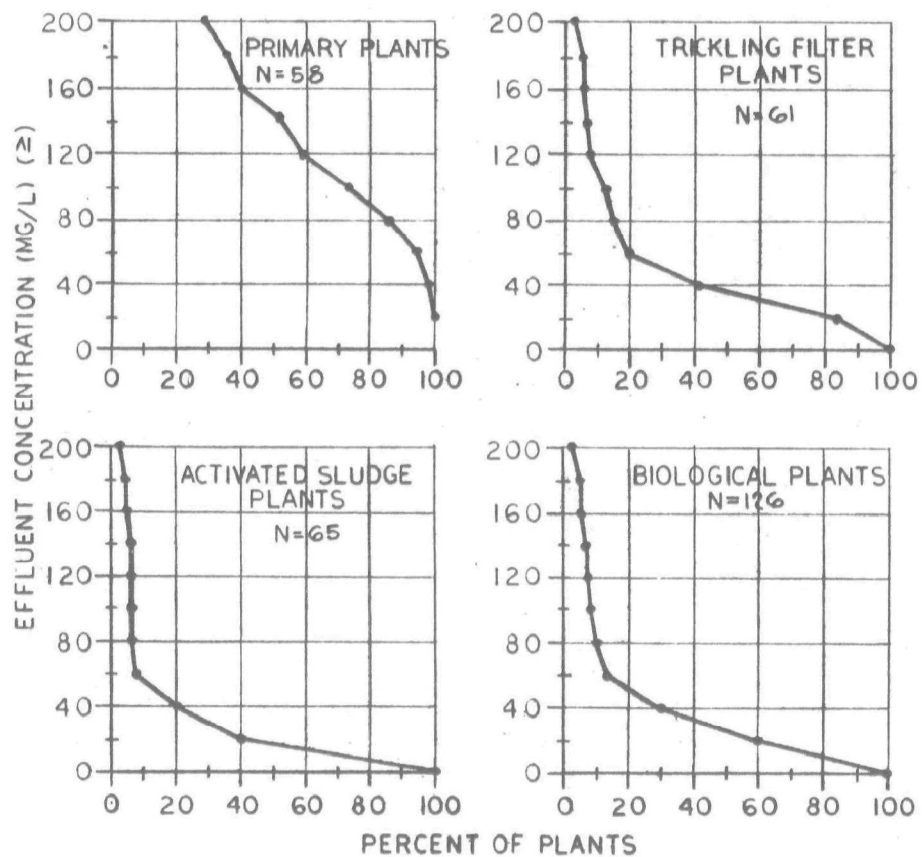


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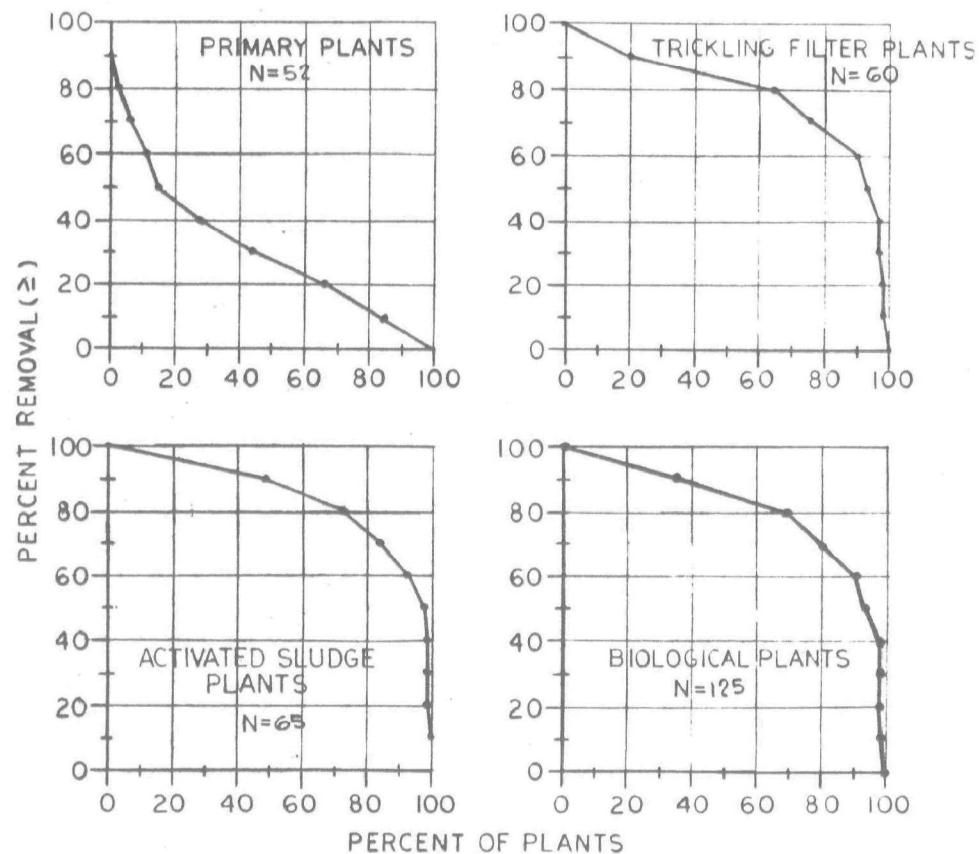


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CUMULATIVE DISTRIBUTION OF EFFLUENT DATA



CUMULATIVE DISTRIBUTION OF REMOVAL DATA



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2-"BIOLOGICAL PLANTS" IS THE TOTAL OF TRICKLING FILTER & ACTIVATED SLUDGE PLANTS

SECTION G

GLOSSARY

Acclimatization (Acclimation) - A process by which the biological organisms in a biological treatment system develop the capability of maintaining normal life cycles in the presence of concentrations of pollutants that would normally inhibit their activity.

Antagonism - Reduction of the inhibitory effect of one substance by the presence of another.

Compatible Pollutant - A pollutant which is normally treated by conventional biological sewage treatment processes.

Contribution (Contributors) - A point source originating within the area served by a sewerage system and treatment works.

Existing Source - Any wastewater source, which was contributing to a sewerage system, (or a potential source that was under construction), at the time of publication of proposed regulations.

Federal Water Pollution Control Act Amendments of 1972 - Public Law 92-500 which provides the legal authority for current EPA water pollution abatement projects, regulations and policies.

Incompatible Pollutant - Any pollutant which is not normally treated by conventional biological sewage treatment processes.

Industrial Waste Ordinance - An enforceable local law which establishes rules, regulations, limitations and prohibitions to be adhered to by wastewater sources within the service area of a publicly owned sewer system.

Inhibition - A contribution that decreases the pollution removal efficiency of a biological treatment facility.

Interference - A contribution that hinders in any way the operation of a wastewater collection and treatment system. Inhibition can be considered a type of interference.

Joint Treatment - The treatment of a wastewater consisting of a combination of domestic and industrial flows in a single treatment system which has been specifically designed to handle the combined wastewater.

Limited Waste - A waste, which by either local ordinance or Federal regulation, cannot be present in a contribution or direct discharge above a certain concentration.

Major Contributing Industry (MCI) - A major source of industrial wastewater within a POTW system, as defined in the Federal pretreatment standards.

Monitoring - The practice of investigating, surveying and/or sampling wastewater sources in an effort to obtain information on the quality or quantity of the wastewater flow.

National Pollutant Discharge Elimination System (NPDES) - A system of permits to discharge wastewaters to navigable waters developed under the authority of Section 402 of Public Law 92-500. The permit system has as its objectives the achievements of the goal of that law, the elimination of the discharge of pollutants by 1985.

New Source - A wastewater source for which construction began after the publication of proposed regulations.

Pass Through - The discharge to the receiving waters from a publicly owned treatment works of a pollutant without substantial modification or removal.

Pretreatment - The treatment of a wastewater contribution, at the point of origin, prior to release to a publicly owned treatment system.

Prohibited Waste - A material which must be excluded from any discharge of wastewater to a collection system in any concentration. Prohibited wastes include, among others, explosive or corrosive materials.

Publicly Owned Treatment Works (POTW) - A sewerage facility which collects, treats or otherwise disposes of wastewaters, owned and operated by a village, town, county, authority or other public agency.

Synergism - An increase in the inhibitory effect of one substance caused by the presence of another.

Upset - A substantial decrease in the treatment efficiency of a biological treatment system caused by changes in the life cycles of the biological organisms comprising the system.

SECTION H ACKNOWLEDGMENTS

The following members of the Burns and Roe technical staff made significant contributions to the overall project effort and the development of these guidelines:

John L. Rose, P.E.	Manager, Environmental Engineering
Arnold S. Vernick, P.E.	Project Manager
Jameel Ahmad, PhD	Senior Civil Engineer
Howard D. Feiler	Environmental Engineer
William A. Foy, P.E.	Senior Environmental Engineer
Benjamin J. Intorre, PhD	Engineering Specialist
Edgar G. Kaup, P.E.	Senior Chemical Engineer
Barry S. Langer	Environmental Engineer
Paul D. Lanik, P.E.	Environmental Engineer
Judith Liebeskind	Environmental Engineer
Paul J. Storch	Environmental Engineer

The assistance of Mrs. Marilyn Moran of Burns and Roe in the physical preparation of this document is specifically noted.

The support of all Environmental Protection Agency personnel contributing to this effort is specifically noted. The development of the Guidelines was under the direction of Gary F. Otakie, the Project Officer; William A. Whittington, Chief, Municipal Technology Branch, Municipal Construction Division; and Charles H. Sutfin, Deputy Director, Municipal Construction Division.

The following organizations within the Environmental Protection Agency were extremely helpful and enthusiastic in providing all assistance and information requested:

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Region II Office,	New York, New York
Region III Office,	Philadelphia, Pennsylvania
Region IV Office	Atlanta, Georgia
Region V Office,	Chicago, Illinois
Region VI Office	Dallas, Texas
Region VII Office	Kansas City, Missouri
Region VIII Office	Denver, Colorado
Region IX Office	San Francisco, California
Region X Office	Seattle, Washington
National Environmental Research Center,	Cincinnati, Ohio
Quality Assurance and Methods Development Laboratory,	Cincinnati, Ohio
Edison Water Quality Research Laboratory,	Edison, New Jersey
Effluent Guidelines Division,	Office of Planning and Standards

Criteria and Standards Division, Office of Planning
and Standards
Office of Research and Development
Office of Planning and Evaluation
Office of Enforcement
Office of General Counsel

Representatives of the following city, county, regional,
State and interstate agencies are specifically acknowledged
for their cooperation and assistance in meeting with EPA and
Burns and Roe representatives, and furnishing requested data
and information:

Bureau of Pollution Control
Atlanta, Georgia

Department of Natural Resources
State of Georgia

Sewer Utility
Boulder, Colorado

Department of Water and Pollution Control
Wichita, Kansas

Water Pollution Control Department
Topeka, Kansas

Department of Environmental Protection
State of Connecticut

Department of Public Works
Wilmington, Delaware

Maryland Water Resources Administration
Havre De Grace, Maryland

Department of Public Works
Fitchburg, Massachusetts

Department of Environmental Protection
State of Massachusetts

Department of Water Resources
New York, New York

Township of Towamencin, Pennsylvania

Interstate Sanitation Commission
New York, New York

County Sanitation Districts of Los Angeles County
Whittier, California

Department of Ecology
State of Washington

Municipality of Metropolitan Seattle
Seattle, Washington

Regional Water Quality Control Board
State of California

Delaware River Basin Commission
Trenton, New Jersey

Metropolitan Sewer District of Greater Cincinnati
Hamilton County, Ohio

Division of Water Quality
Muncie, Indiana

East Bay Municipal Utility District
Oakland, California

Dallas Water Utilities
Dallas, Texas

Water Reclamation Research Center
Dallas, Texas

Metropolitan Sanitary District of Greater Chicago
Chicago, Illinois

Department of Natural Resources
State of Wisconsin

Department of Natural Resources
State of Michigan

Department of Environmental Resources
State of Pennsylvania

Department for Natural Resources and
Environmental Pollution
State of Kentucky

New England Interstate Water Pollution
Control Commission
Boston, Massachusetts

Cleveland Regional Sewer District
Cleveland, Ohio

Sanitary District of Rockford, Illinois

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Boston, Massachusetts

Soap and Detergent Association
New York, New York

McPhee, Smith, Rosenstein Engineers
Buffalo, New York

National Canners Association
Washington, D. C.

Diamond Crystal Salt Company
Akron, Ohio

Rohm and Haas Company
Spring House, Pennsylvania

APPENDIX 1
PRETREATMENT STANDARDS

Pretreatment Standards (40CFR128)

Pretreatment Standards for Certain Categories

federal register

THURSDAY, NOVEMBER 8, 1973

WASHINGTON, D.C.

Volume 38 ■ Number 215



PART III

ENVIRONMENTAL PROTECTION AGENCY

■

WATER PROGRAMS

Pretreatment Standards

Title 40—Protection of the Environment

CHAPTER I—ENVIRONMENTAL
PROTECTION AGENCY

SUBCHAPTER D—WATER PROGRAMS

PART 128—PRETREATMENT STANDARDS

On July 19, 1973, notice was published in the *FEDERAL REGISTER* that the Environmental Protection Agency was proposing standards for pretreatment of pollutants introduced into publicly owned treatment works pursuant to section 307(b) of the Federal Water Pollution Control Act Amendments of 1972 (the Act). Written comments on the proposed rulemaking were invited and received from interested parties and the public. In addition, a public hearing was held in Washington, D.C., on September 26, 1973. The Environmental Protection Agency has carefully considered all comments received and the record of the public hearing. All written comments and a transcript of the public hearing are on file with the Agency. As indicated below, the regulation has been modified in response to some of the comments. The following discussion also outlines the reasons why other suggested changes were not made.

Under section 307(b) of the Act, Federal pretreatment standards are designed to achieve two purposes: (1) To protect the operation of publicly owned treatment works, and (2) to prevent the discharge of pollutants which pass through such works inadequately treated.

Section 128.131 sets forth a number of prohibitions designed to protect the operation of publicly owned treatment works. The prohibitions are self-explanatory. One commenter suggested that § 128.131 is deficient in that it fails to impose specific numerical limitations on the discharge of pollutants that interfere with the operation of publicly owned treatment works. However, the Agency has been unable to formulate such specific numerical limitations. In the first place, the data that are presently available are not considered sufficient to support uniform national standards prescribing permissible concentrations of particular pollutants in publicly owned treatment works. Moreover, the degree that any pollutant interferes with the operation of a publicly owned treatment works depends on the concentration of pollutant in the treatment works itself, rather than the concentration in each user's effluent. But for a national pretreatment standard to be workable and enforceable, it must prescribe the quality of the user's effluent; otherwise, the user will not know what steps he must take to comply with the standard. It is impossible in a uniform national pretreatment standard to relate the quality of the user's effluent to the concentration of various pollutants in the publicly owned treatment works, since this relationship will vary in each sewer system depending on the quantity of the user's effluent as compared with the quantity of other effluents in the system.

Section 128.133 is based on the premise that pollutants which pass through publicly owned treatment works in amounts greater than would be permitted as a minimum treatment requirement for similar industrial sources discharging directly to navigable waters should be considered adequately treated. The fact that a discharger chooses to use a municipal sewer system, rather than discharging his wastes directly to the navigable waters, should not as a matter of general principle involve a penalty to the environment.

On the basis of this premise, § 128.133 requires users in industrial categories subject to effluent guidelines issued under section 304(b) of the Act, which are discharging incompatible pollutants to publicly owned treatment works, to adopt best practicable control technology currently available, as defined by the Administrator pursuant to section 304(b) of the Act.

During the public comment period, questions were raised as to whether the effluent limitations guidelines would be appropriate in all cases for application to users of publicly owned treatment works. The Agency recognizes that for some industrial categories it may be necessary to further refine the effluent limitations guidelines to deal with problems that may arise in the application of such guidelines to users of publicly owned treatment works. However, the Agency believes that any adjustments required for particular industrial categories should be considered in connection with the promulgation of the individual effluent guidelines, rather than in the national pretreatment standard. Accordingly, when effluent limitations guidelines are promulgated for individual industrial categories, the Agency will also propose a separate provision for their application to users of publicly owned treatment works. Additional language has been added to § 128.133 to clarify this intent.

It was unclear whether § 128.133 as proposed covered sources that would be new sources if they were discharging directly into the navigable waters. Section 307(c) of the Act requires promulgation of separate pretreatment standards for such sources. Pursuant to section 307(c), the Agency has proposed pretreatment standards for such sources in connection with its proposal of new source performance standards under Section 306 of the Act. Accordingly, § 128.133 has been modified to make it clear that it covers only sources that are not subject to section 307(c) of the Act.

Section 128.133 allows a credit for the percentage removal of an incompatible pollutant to which the publicly owned treatment works is committed in its permit. To insure the basis for allowing such credit, a commitment with respect to a percentage removal of an incompatible pollutant will be included in the permit at the request of a municipality where a basis for such commitment can be demonstrated.

Some commenters suggested that the credit in § 128.133 for removal at the

joint treatment works, where there is a commitment to such removal in the NPDES permit, is unrealistic, since municipalities will be unwilling to enter into such commitments. However, in order to achieve the goal of preventing the discharge of incompatible pollutants through municipal systems in amounts greater than the minimum requirements if the discharge were directly into the navigable waters, it is necessary that the required reduction be contained in an enforceable commitment either on the part of the industrial user or the joint treatment works. The industrial user should not be relieved of the commitment to achieve the required degree of reduction except to the extent that the joint treatment works is able to assume a commitment to remove the pollutant.

One commenter suggested that users should be required to comply with toxic effluent standards under section 307(a) of the Act, as well as the requirement of best practicable control technology currently available under section 301(b) and 304(b) of the Act. However, toxic effluent standards will be designed to protect aquatic life in the receiving body of water from both acute and chronic effects. Acute effects will be covered by concentration standards while chronic effects will be covered by weight limitations. Both types of standards will be applicable to the discharge from the publicly owned treatment works. Toxic effluent standards will not be designed to protect sewer systems, and thus it would not be appropriate to apply them to discharges into the system. To the extent that toxic materials in the users' discharges interfere with the operation of publicly owned treatment works, the problem can be otherwise addressed under these standards (§ 128.131) or under local standards using the pretreatment guidelines issued under section 304(f) of the Act. While toxic materials in the users' discharge may appear in the sludge generated by the publicly owned treatment works, the Agency has no basis for making a national determination that the resultant sludge disposal problem is any worse than the problem that would be created if the individual users removed the toxics from their effluent and disposed of the resultant materials individually. This is a factor which must be determined by State and local authorities, taking into account the capabilities of their sludge disposal system and the pollutants present in the wastes from industrial users.

The presence of toxic pollutants in toxic amounts is utilized in the regulation in order to identify "major contributing industries" for purposes of the pretreatment requirements for incompatible pollutants. The purpose here is to identify industrial users whose effluent is significant enough to warrant the imposition of controls based on best practicable control technology currently available without undue administrative burden, rather than to indicate that it is appropriate to impose toxic effluent standards on industrial users.

The definition of "compatible pollutant" has been broadened to recognize the fact that some joint treatment works are designed to achieve substantial removal of pollutants other than the four pollutants listed in the definition in the proposed regulation (BOD, suspended solids, pH, and fecal coliform bacteria). Where the joint treatment works was designed to and does achieve substantial removal of a pollutant, it is not appropriate to require the industrial user to achieve best practicable control technology currently available, since this would lead to an uneconomical duplication of treatment facilities. While the term "substantial removal" is not subject to precise definition, it generally contemplates removals in the order of 80 percent or greater. Minor incidental removals in the order of 10 to 30 percent are not considered "substantial".

There was a diversity of comments on the length of the time for compliance and its relation to the promulgation of the definition of best practicable control technology currently available. The Act requires that pretreatment must specify a time for compliance not to exceed three years from the date of promulgation. The Agency has concluded that a period not greater than three years from the date of promulgation is appropriate for compliance for § 128.131. For Section 128.133 the same period is also considered an appropriate time for compliance. However, the standard set forth in § 128.133 will not be complete until promulgation of the separate provision, as required by Section 128.133, setting forth the application to pretreatment of the effluent limitations guideline for a given industrial category.

Accordingly, § 128.140 provides that the period of compliance with § 128.133 will not commence for any particular category of user until promulgation of that separate provision. Section 128.140 has been further modified to establish an interim requirement for commencement of construction, and a requirement for compliance reports. It was concluded that without such requirements, timely compliance with the pretreatment standard might be unenforceable as a practical matter.

Some commenters questioned the need for these pretreatment standards or the relationship between these standards and local pretreatment programs. It is important to note the clear requirements in the Act that there be both national pretreatment standards, Federally enforceable, and EPA pretreatment guidelines to assist States and municipalities in developing local pretreatment programs. The Agency recognizes that in some cases, these pretreatment standards may not be sufficient to protect the operation of a publicly owned treatment works or to enable the treatment works to comply with the terms of its NPDES permit. This may be the case, for example, when the terms of the permit for the publicly owned treatment works are dictated by water quality standards or toxic standards. In such cases, the State or municipality may have to impose more stringent

pretreatment standards under State or local laws than are specified in these regulations to enable compliance with NPDES permits issued to publicly owned treatment works. The agency considers it essential that such local pretreatment requirements be established for each system where necessary to ensure compliance with the NPDES permit.

Pretreatment guidelines will be published, pursuant to section 304(f) of the Act, to assist the States and municipalities in establishing their own pretreatment requirements.

Effective date. This regulation will become effective December 10, 1973.

JOHN QUARLES,
Acting Administrator.

NOVEMBER 1, 1973.

NOTE.—The EPA pamphlet, Pretreatment of Discharges to Publicly Owned Treatment Work, is filed as part of the original document.

Sec.	Purpose.
128.100	128.100 Purpose.
128.101	128.101 Applicability.
128.110	128.110 State or local law.
128.120	128.120 Definitions.
128.121	128.121 Compatible pollutant.
128.122	128.122 Incompatible pollutant.
128.123	128.123 Joint treatment works.
128.124	128.124 Major contributing industry.
128.125	128.125 Pretreatment.
128.130	128.130 Pretreatment standards.
128.131	128.131 Prohibited wastes.
128.132	128.132 Pretreatment for compatible pollutants.
128.133	128.133 Pretreatment for incompatible pollutants.
128.140	128.140 Time for compliance.

AUTHORITY: Sec. 307(b) Pub. L. 92-500; 86 Stat. 857 (33 U.S.C. 1317).

§ 128.100 Purpose.

The provisions of this part implement section 307(b) of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) hereinafter referred to as "the Act".

§ 128.101 Applicability.

The standards set forth in § 128.131 apply to all non-domestic users of publicly owned treatment works. The standard set forth in § 128.133 applies only to major contributing industries.

§ 128.110 State or local law.

Nothing in this part shall affect any pretreatment requirement established by any State or local law not in conflict with any standard established pursuant to this Part. In particular cases, a State or municipality, in order to meet the effluent limitations in a NPDES permit for a publicly owned treatment works may find it necessary to impose pretreatment requirements stricter than those contained herein.

§ 128.120 Definitions.

Definitions of terms used in this part are as follows:

§ 128.121 Compatible pollutant

For purposes of establishing Federal requirements for pretreatment, the term "compatible pollutant" means biochemical oxygen demand, suspended solids,

pH and fecal coliform bacteria, plus additional pollutants identified in the NPDES permit if the publicly owned treatment works was designed to treat such pollutants, and in fact does remove such pollutants to a substantial degree. Examples of such additional pollutants may include:

Chemical oxygen demand.
Total organic carbon.
Phosphorus and phosphorus compounds.
Nitrogen and nitrogen compounds.
Fats, oils, and greases of animal or vegetable origin except as prohibited under § 128.131 (c).

§ 128.122 Incompatible pollutant.

The term "incompatible pollutant" means any pollutant which is not a compatible pollutant as defined in § 128.121.

§ 128.123 Joint treatment works.

Publicly owned treatment works for both non-industrial and industrial wastewater.

§ 128.124 Major contributing industry.

A major contributing industry is an industrial user of the publicly owned treatment works that; (a) Has a flow of 50,000 gallons or more per average work day; (b) has a flow greater than five percent of the flow carried by the municipal system receiving the waste; (c) has in its waste, a toxic pollutant in toxic amounts as defined in standards issued under section 307(a) of the Act; or (d) is found by the permit issuance authority, in connection with the issuance of an NPDES permit to the publicly owned treatment works receiving the waste, to have significant impact, either singly or in combination with other contributing industries, on that treatment works or upon the quality of effluent from that treatment works.

§ 128.125 Pretreatment.

Treatment of wastewaters from sources before introduction into the joint treatment works.

§ 128.130 Pretreatment standards.

The following sections set forth pretreatment standards for pollutants introduced into publicly owned treatment works.

§ 128.131 Prohibited wastes.

No waste introduced into a publicly owned treatment works shall interfere with the operation or performance of the works. Specifically, the following wastes shall not be introduced into the publicly owned treatment works:

(a) Wastes which create a fire or explosion hazard in the publicly owned treatment works.

(b) Wastes which will cause corrosive structural damage to treatment works, but in no case wastes with a pH lower than 5.0, unless the works is designed to accommodate such wastes.

(c) Solid or viscous wastes in amounts which would cause obstruction to the flow in sewers, or other interference with the proper operation of the publicly owned treatment works.

RULES AND REGULATIONS

(d) Wastes at a flow rate and/or pollutant discharge rate which is excessive over relatively short time periods so that there is a treatment process upset and subsequent loss of treatment efficiency.

§ 128.132 Pretreatment for compatible pollutants.

Except as required by § 128.131, pretreatment for removal of compatible pollutants is not required by these regulations. However, States and municipalities may require such pretreatment pursuant to section 307(b)(4) of the Act.

§ 128.133 Pretreatment for incompatible pollutants.

In addition to the prohibitions set forth in § 128.131, the pretreatment standard for incompatible pollutants introduced into a publicly owned treatment works by a major contributing industry not subject to section 307(c) of the Act shall be, for sources within the corresponding industrial or commercial category, that established by a promulgated effluent limitations guideline defining best practicable control technology currently available pursuant to sections 301(b) and 304(b) of the Act: *Provided*, That, if the publicly owned treatment works which receives the pollutants is committed, in its NPDES permit, to re-

move a specified percentage of any incompatible pollutant, the pretreatment standard applicable to users of such treatment works shall be correspondingly reduced for that pollutant; and provided further that when the effluent limitations guideline for each industry category is promulgated, a separate provision will be proposed concerning the application of such guideline to pretreatment.

§ 128.140 Time for compliance.

(a) Any owner or operator of any source to which the pretreatment standards required by this Part are applicable, shall be in compliance with such standards within the shortest reasonable time but not later than three years from the date of their promulgation; except that for § 128.133, the three year compliance period for any user shall commence with the date of promulgation of a provision, as required by § 128.133, setting forth the application to pretreatment of the effluent limitations guidelines for the applicable industrial category.

(b) In order to ensure such compliance, each such owner or operator shall commence construction of any required pretreatment facilities within 18 months from the date of final promulgation of the provision required by § 128.133, set-

ting forth the application to pretreatment of the effluent limitations guidelines. By the time construction is required to be commenced, each such owner or operator shall furnish to the Regional Administrator (or to any State agency with an approved NPDES permit program) a report, on a form to be prescribed by the Administrator, which shall set forth the effluent limits to be achieved by such pretreatment facilities and a schedule for the achievement of compliance with such limits by the required date. A copy of such report shall be furnished to the municipality or agency operating the publicly owned treatment works into which such pollutants are discharged. Thereafter, each such owner or operator shall furnish the Regional Administrator or his designee with such additional information or reports (including information relating to compliance with effluent limits and schedules for completion of pretreatment facilities) as he may request.

(c) Nothing contained herein shall prevent any municipality or other agency from requiring more stringent pretreatment standards or a more stringent compliance schedule, than as set forth in this part.

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PART II



ENVIRONMENTAL PROTECTION AGENCY



EFFLUENT GUIDELINES AND STANDARDS

**Pretreatment Standards for Certain
Categories**

Title 40—Protection of the Environment
CHAPTER I—ENVIRONMENTAL
PROTECTION AGENCY
SUBCHAPTER N—EFFLUENT GUIDELINES
AND STANDARDS
[FRL 331-8]

PRETREATMENT STANDARDS

On May 28, 1974; March 20, 1974; March 21, 1974; June 26, 1974; January 31, 1974; March 20, 1974; February 20, 1974, February 14, 1974; April 25, 1974; April 12, 1974; February 14, 1974; February 26, 1974; May 29, 1974; May 9, 1974 and February 28, 1974, notices were published in the proposed rules section of the *FEDERAL REGISTER* (39 FR 18610, 39 FR 15019, 39 FR 10869, 39 FR 23154, 39 FR 4039, 39 FR 10527, 39 FR 6595, 39 FR 5709, 39 FR 14684, 39 FR 13394, 39 FR 5720, 39 FR 7534, 39 FR 6666, 39 FR 16582, and 39 FR 7907 respectively), that the Environmental Protection Agency (EPA or Agency) was proposing regulations concerning the application of effluent limitations guidelines for existing sources to pretreatment standards.

The purpose of this notice is to establish final pretreatment standards for selected subcategories of existing sources within the dairy products processing industry point source category (40 CFR Part 405); grain mills point source category (40 CFR Part 406); canned and preserved fruits and vegetables processing point source category (40 CFR Part 407); canned and preserved seafood processing point source category (40 CFR Part 408); beet sugar processing point source subcategory (40 CFR Part 409); liquid and crystalline cane sugar refining subcategory (40 CFR Part 409); cement manufacturing point source category (40 CFR Part 411); feedlots point source category (40 CFR Part 412); organic chemicals manufacturing point source category (40 CFR Part 414); soap and detergent manufacturing point source category (40 CFR Part 417); glass manufacturing point source categories (40 CFR Part 426); asbestos manufacturing point source category (40 CFR Part 427); pulp, paper and paperboard point source category (40 CFR Part 430); builders paper and roofing felt segment of the builders paper and board mills point source category (40 CFR Part 431); and the meat products point source category (40 CFR Part 432) which discharge to publicly owned treatment works.

Pending further study, final pretreatment standards for existing sources for the following industrial subcategories will be promulgated by the Agency in the near future: In the organic chemicals manufacturing point source category (40 CFR Part 414), product-process subcategory groups C2 (phenol and acetone—cumene process), C3 (bisphenol A), and C4 (p-cresol); in the soap and detergent manufacturing point source category (40 CFR Part 417), manufacture of spray dried detergents, manufacture of liquid detergents, manufacture of detergents by dry blending, and manufacture of drum dried detergents sub-

categories; and in the glass manufacturing point source categories (40 CFR Part 426), automotive glass laminating and float glass manufacturing subcategories.

This final rulemaking is promulgated pursuant to section 307(b) of The Federal Water Pollution Control Act, as amended (The Act); 33 U.S.C. 1317(b); 86 Stat. 816 et seq.; Public Law 92-500. This regulation is intended to be complementary to the general regulation for pretreatment standards set forth in 40 CFR 128. The general regulation was proposed July 19, 1973 (38 FR 19236), and published in final form on November 8, 1973 (38 FR 30982).

The general pretreatment standard considers pollutants discharged by users of publicly owned treatment works in the two broad categories compatible and incompatible. Compatible pollutants generally are not subject to Federal pretreatment standards; however 40 CFR 128.131 (prohibited wastes) may be applicable to compatible pollutants. Additionally, local pretreatment requirements may apply (see 40 CFR 128.110). Incompatible pollutants generally are subject to pretreatment pursuant to 40 CFR Part 128.

Operators of publicly owned treatment works and other interested persons should refer to the Federal Guidelines: Pretreatment of Pollutants Introduced into Publicly Owned Treatment Works, published Oct. 1973 pursuant to section 304(f) of the Act, for guidance as to local pretreatment requirements and to provide supplementary information on pretreatment.

Interested persons were invited to participate in the proposed rulemaking by submitting written comments within 30 days from the date of publication of the notices. Prior public participation in the form of solicited comments and responses from the states, Federal agencies, and other interested parties were described in the preamble to the proposed regulation. EPA has considered carefully all of the comments received and a discussion of these comments with the agencies response thereto follows:

(A) SUMMARY OF COMMENTS

The following responded to one or more of the requests for written comments contained in the preambles to the proposed regulations: Great Western Sugar Company; National Independent Meat Packers Association; American Meat Institute; The Soap and Detergent Association; Rohm and Haas Company; and the Metropolitan Sanitary District of Greater Chicago. Each of the comments received was carefully reviewed and analyzed. A summary of the significant comments and the Agency's response to those comments for each of the industries follows.

DAIRY PRODUCTS PROCESSING INDUSTRY POINT SOURCE CATEGORY (40 CFR PART 405)

(1) A commenter indicated that high concentrations of BOD₅ in the two whey subcategories may upset treatment works.

Difficulty may be experienced in maintaining normal treatment efficiencies without special operational procedures when the BOD₅ concentration attributable to whey becomes extremely high. This is especially true when there is not sufficient equalization present to prevent shock loading. Thus, it may be that there are situations where whey may not be amenable to treatment depending on the relative quality and quantity of influent to the municipal system and the design and operating characteristics of the publicly owned treatment works. Any discharger whose waste causes an upset or interferes with the operation or performance of the works shall be in violation of the prohibited wastes section (§ 128.131) of the general pretreatment regulation (40 CFR Part 128).

GRAIN MILLS POINT SOURCE CATEGORY (40 CFR PART 406)

(2) No comments were received concerning this industry.

CANNED AND PRESERVED FRUITS AND VEGETABLES PROCESSING POINT SOURCE CATEGORY (40 CFR PART 407)

(3) One commenter advised the Agency that this is a seasonal industry which results in peak loading of treatment works.

The operator of publicly owned treatment works is advised that peak loading or slugging of the treatment facility is possible. All precautions must be taken to prevent this type of discharge from upsetting the treatment works. Any discharger whose waste causes an upset or interferes with the operation or performance of the works shall be in violation of the prohibited wastes section (§ 128.131) of the general pretreatment regulation (40 CFR Part 128).

CANNED AND PRESERVED SEAFOOD PROCESSING POINT SOURCE CATEGORY (40 CFR PART 408)

(4) One commenter indicated that excessive discharges of oil and grease may pass through or interfere with the operation of a publicly owned treatment works.

Oil and grease, particularly from animal and vegetable sources, can be treated by biological techniques in a properly operated municipal treatment plant. Excessive discharges of oil and grease which would upset or interfere with the operation or performance of such publicly owned treatment works would be in violation of the prohibited wastes section (128.131) of the general pretreatment regulation (40 CFR 128).

BEET SUGAR PROCESSING POINT SOURCE SUBCATEGORY (40 CFR PART 409)

(5) A comment was received concerning the temperature parameter for this industry.

The discharges from the beet sugar industry generally range between 55–65°C. If a facility discharges to a municipal treatment works, dilution and heat losses in the interceptor system will normally prevent these discharges from adversely affecting the treatment works. During

cold weather these warm discharges can actually prove beneficial to the biological systems in the treatment plant.

(6) Several commenters had no objections to the pretreatment standards for existing sources proposed.

LIQUID AND CRYSTALLINE CANE SUGAR REFINING SUBCATEGORY (40 CFR PART 402)

(7) One commenter expressed concern regarding the extremely high concentrations of BOD5 and TSS in the filter cake slurry waste water.

Although the filter cake slurry waste water stream is considered to be highly amenable to treatment, the extremely high concentrations of BOD5 and TSS therein could, in some cases, interfere with the operation of publicly owned treatment works. These special situations should be controlled by the operators of the treatment works involved. Such control should not pose undue difficulty since the highly concentrated waste can be dry handled and disposed of as solid waste by the publicly owned treatment works. Any discharger whose waste causes an upset or interferes with the operation or performance of the publicly owned treatment works shall be in violation of the prohibited wastes section (128.131) of the general pretreatment regulation (40 CFR 128).

CEMENT MANUFACTURING POINT SOURCE CATEGORY (40 CFR PART 411)

(8) A comment was received concerning the temperature parameter for this industry.

Heat losses and dilution in the interceptor systems will generally effectively reduce any thermal discharges from these plants. Those discharges which may reach a treatment facility at a slightly higher than ambient temperature will enhance the biological activity in the treatment works. This is a highly desirable effect during cold weather.

FEEDLOTS POINT SOURCE CATEGORY (40 CFR PART 412)

(9) No comments were received.

ORGANIC CHEMICALS MANUFACTURING POINT SOURCE CATEGORY (40 CFR PART 414)

(10) Some commenters indicated that there may be other pollutants in the waste water from this industry besides BOD5, TSS and pH.

The Agency is aware that the waste water from this industry is composed of many varied and complex compounds. The operators of municipal treatment works are warned that though these wastes are usually organic in nature, caution should be exercised in treating these waste waters to assure that they do not interfere with the operation or performance of the publicly owned treatment works.

SOAP AND DETERGENT MANUFACTURING POINT SOURCE CATEGORY (40 CFR PART 417)

(11) Several commenters expressed their belief that the oil and grease discharged by this industry is amenable to

treatment in publicly owned treatment works.

The Agency concurs that the oils and greases of animal or vegetable origin can be treated in a properly operated publicly owned treatment works. Excessive discharges of oil and grease may upset or interfere with the operation or performance of the publicly owned treatment works. Such excessive discharges would be in violation of the prohibited wastes section (§ 128.131) of the general pretreatment regulation (40 CFR Part 128).

GLASS MANUFACTURING POINT SOURCE CATEGORIES (40 CFR PART 426)

(12) No comments were received concerning the subcategories being considered for promulgation.

ASBESTOS MANUFACTURING POINT SOURCE CATEGORY (40 CFR PART 427)

(13) One commenter was concerned with the disposal of sludges containing asbestos fibers.

Waste from this industry category can contain large amounts of asbestos fibers. These wastes should not be introduced into (1) publicly-owned treatment works whose effluents could affect a potable water supply or (2) publicly-owned treatment works that dispose of sludges without adequate safeguards to prevent land migration of contaminants to ground or surface waters. Sites should be selected that have natural soil and geographical conditions to prevent such contamination or, if such conditions do not exist, artificial means (e.g. liners) must be provided to insure long-term protection. Where such control is not provided for sludges containing significant quantities of asbestos fibers, they should be excluded from the municipal sludge and disposed of separately under controlled conditions.

PULP, PAPER AND PAPERBOARD POINT SOURCE CATEGORY (40 CFR PART 430)

(14) No comments were received.

BUILDERS PAPER AND ROOFING FELT SEGMENT OF THE BUILDERS PAPER AND BOARD MILLS POINT SOURCE CATEGORY (40 CFR PART 431)

(15) Several comments were received questioning the necessity of a settleable solids limitation in addition to a suspended solids limitation.

Settleable solids are those suspended solids which settle out in one hour or less. Since this type of solids is present in all municipal and domestic wastes, they are readily treated in the primary units of a municipal treatment facility and therefore no limitation is established for this parameter in this regulation. The necessity of both a suspended solids and a settleable solids limitation is aimed primarily at direct dischargers to prevent the build-up of delta like formations in navigable waters at the point of discharge. Any discharger whose waste causes an upset or interferes with the operation or performance of the publicly owned treatment works shall be in violation of the prohibited wastes sec-

tion (§ 128.131) of the general pretreatment regulation (40 CFR Part 128).

MEAT PRODUCTS POINT SOURCE CATEGORY (40 CFR PART 432)

(16) Several commenters indicated that excessive discharges of oil and grease may pass through or interfere with the operation of a publicly owned treatment works.

Oil and grease, particularly of animal and vegetable origin, can be treated by biological techniques in a publicly owned treatment works. Operators are warned that excessive discharges of oil and grease which would upset or interfere with the operation or performance of a publicly owned treatment works would be in violation of the prohibited waste section (§ 28.131) of the general pretreatment regulation (40 CFR Part 128).

(B) REVISION OF THE PROPOSED REGULATION PRIOR TO PROMULGATION

No substantive changes have been made from the proposed regulations except the format has been changed for clarification of the pretreatment standards.

(C) FINAL RULEMAKING

In consideration of the foregoing, 40 CFR Chapter I, Subchapter N is hereby amended by adding to Part 405, dairy products processing industry point source category, §§ 405.14, 405.24, 405.34, 405.44, 405.54, 405.64, 405.74, 405.84, 405.94, 405.104, 405.144, 405.124; Part 406, grain mills point source category, §§ 406.14, 406.24, 406.34, 406.44, 406.54, 406.64; Part 407, canned and preserved fruits and vegetables processing point source category, §§ 407.14, 407.24, 407.34, 407.44, 407.54; Part 408, canned and preserved seafood processing point source category, §§ 408.14, 408.24, 408.34, 408.44, 408.54, 408.64, 408.74, 408.84, 408.94, 408.104, 408.114, 408.124, 408.134, 408.144; Part 409, beet sugar processing point source subcategory, § 409.14; Part 409, Liquid and crystalline cane sugar refining subcategory, §§ 409.24, 409.34; Part 411, cement manufacturing point source category, §§ 411.14, 411.24, 411.34; 412, feedlots point source category, §§ 412.14, 412.24; Part 414, organic chemicals manufacturing point source category, §§ 414.14, 414.24, 414.34; Part 417, soap and detergent manufacturing point source category, §§ 417.14, 417.24, 417.34, 417.44, 417.54, 417.64, 417.74, 417.84, 417.94, 417.104, 417.114, 417.124, 417.134, 417.144, 417.194; Part 426, glass manufacturing point source categories, §§ 426.24, 426.34, 426.44, 426.64; Part 427, asbestos manufacturing point source category, §§ 427.14, 427.24, 427.34, 427.44, 427.54, 427.64, 427.74; Part 430, pulp, paper and paperboard point source category, §§ 430.14, 430.24, 430.34, 430.44, 430.54; Part 431, builders paper and roofing felt segment of the builders paper and board mills point source category, § 431.14; Part 432, meat products point source category, §§ 432.14, 432.24, 432.34, and 432.44 to read as set forth below. This final regulation is promulgated as set forth below and shall be effective March 13, 1976.

(Secs. 301, 304 (b), (c), 306 (b), (c), 307(b). Federal Water Pollution Control Act, as amended; 33 U.S.C. 1251, 1311, 1314 (b), (c), 1316 (b) and (c), 1317(b); 86 Stat. 816 et seq.; Pub. L. 92-500)

Dated: January 29, 1975.

JOHN QUARLES,
Acting Administrator.

The following parts of 40 CFR Chapter I are amended as set forth below:

PART 405—DAIRY PRODUCTS PROCESSING POINT SOURCE CATEGORY

The table of contents to Part 405 is amended by adding the following new entries to the indicated subparts:

- Subpart A—Receiving Stations Subcategory**
Sec.
405.14 Pretreatment standards for existing sources.
- Subpart B—Fluid Products Subcategory**
405.24 Pretreatment standards for existing sources.
- Subpart C—Cultured Products Subcategory**
405.34 Pretreatment standards for existing sources.
- Subpart D—Butter Subcategory**
405.44 Pretreatment standards for existing sources.
- Subpart E—Cottage Cheese and Cultured Cream Cheese Subcategory**
405.54 Pretreatment standards for existing sources.
- Subpart F—Natural and Processed Cheese Subcategory**
405.64 Pretreatment standards for existing sources.
- Subpart G—Fluid Mix for Ice Cream and Other Frozen Desserts Subcategory**
405.74 Pretreatment standards for existing sources.
- Subpart H—Ice Cream, Frozen Desserts, Novelties and Other Dairy Desserts Subcategory**
405.84 Pretreatment standards for existing sources.
- Subpart I—Condensed Milk Subcategory**
405.94 Pretreatment standards for existing sources.
- Subpart J—Dry Milk Subcategory**
405.104 Pretreatment standards for existing sources.
- Subpart K—Condensed Whey Subcategory**
405.114 Pretreatment standards for existing sources.
- Subpart L—Dry Whey Subcategory**
405.124 Pretreatment standards for existing sources.

Part 405 is amended as follows:

1. Subpart A is amended by adding § 405.14 as follows:

§ 405.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the receiving stations subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the

standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH-----	No limitation.
BOD ₅ -----	Do.
TSS-----	Do.

2. Subpart B is amended by adding § 405.24 as follows:

§ 405.24 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the fluid products subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH-----	No limitation.
BOD ₅ -----	Do.
TSS-----	Do.

3. Subpart C is amended by adding § 405.34 as follows:

§ 405.34 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the cultured products subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH-----	No limitation.
BOD ₅ -----	Do.
TSS-----	Do.

4. Subpart D is amended by adding § 405.44 as follows:

§ 405.44 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the butter subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132 and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH-----	No limitation.
BOD ₅ -----	Do.
TSS-----	Do.

5. Subpart E is amended by adding § 405.54 as follows:

§ 405.54 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the cottage cheese and cultured cream cheese subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132 and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH-----	No limitation.
BOD ₅ -----	Do.
TSS-----	Do.

6. Subpart F is amended by adding § 405.64 as follows:

§ 405.64 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the natural and processed cheese subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this

section, 40 CFR 128.121, 128.122, 128.132 and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

7. Subpart G is amended by adding § 405.74 as follows:

§ 405.74 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the fluid mix for ice cream and other frozen desserts subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132 and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

8. Subpart H is amended by adding § 405.84 as follows:

§ 405.84 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the ice cream, frozen desserts, novelties, and other dairy desserts subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

9. Subpart I is amended by adding § 405.94 as follows:

§ 405.94 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the condensed milk subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

10. Subpart J is amended by adding § 405.104 as follows:

§ 405.104 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the dry milk subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

11. Subpart K is amended by adding § 405.114 as follows:

§ 405.114 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the condensed whey subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the

purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

12. Subpart L is amended by adding § 405.124 as follows:

§ 405.124 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the dry whey subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

PART 406—GRAIN MILLS POINT SOURCE CATEGORY

The table of contents is amended by adding the following new sections to the indicated subparts:

- Subpart A—Corn Wet Milling Subcategory
 - Sec. 406.14 Pretreatment standards for existing sources.
- Subpart B—Corn Dry Milling Subcategory
 - 406.24 Pretreatment standards for existing sources.
- Subpart C—Normal Wheat Flour Milling Subcategory
 - 406.34 Pretreatment standards for existing sources.
- Subpart D—Bulgar Wheat Flour Milling Subcategory
 - 406.44 Pretreatment standards for existing sources.
- Subpart E—Normal Rice Milling Subcategory
 - 406.54 Pretreatment standards for existing sources.
- Subpart F—Parboiled Rice Processing Subcategory
 - 406.64 Pretreatment standards for existing sources.

Part 406 is amended as follows:

1. Subpart A is amended by adding § 406.14 as follows:

§ 406.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the corn wet milling subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD ₅	Do.
TSS	Do.

2. Subpart B is amended by adding § 406.24 as follows:

§ 406.24 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the corn dry milling subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD ₅	Do.
TSS	Do.

3. Subpart C is amended by adding § 406.34 as follows:

§ 406.34 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the normal wheat flour milling subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this

section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
BOD ₅	No limitation.
TSS	Do.

4. Subpart D is amended by adding § 406.44 as follows:

§ 406.44 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the bulgur wheat flour milling subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD ₅	Do.
TSS	Do.

5. Subpart E is amended by adding § 406.54 as follows:

§ 406.54 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the normal rice milling subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
BOD ₅	No limitation.
TSS	Do.

6. Subpart F is amended by adding § 406.64 as follows:

§ 406.64 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the parboiled rice processing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD ₅	Do.
TSS	Do.

PART 407—CANNED AND PRESERVED FRUITS AND VEGETABLES PROCESSING POINT SOURCE CATEGORY

The table of contents is amended by adding the following sections to the indicated subparts:

Sec.	Subpart A—Apple Juice Subcategory
407.14.	Pretreatment standards for existing sources.
Sec.	Subpart B—Apple Products Subcategory
407.24	Pretreatment standards for existing sources.
Sec.	Subpart C—Citrus Products Subcategory
407.34	Pretreatment standards for existing sources.
Sec.	Subpart D—Frozen Potato Products Subcategory
407.44	Pretreatment standards for existing sources.
Sec.	Subpart E—Dehydrated Potato Products Subcategory
407.54	Pretreatment standards for existing sources.

Part 407 is amended as follows:

1. Subpart A is amended by adding § 407.14 as follows:

§ 407.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the apple juice subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of

pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

2. Subpart B is amended by adding § 407.24 as follows:

§ 407.24 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the apple products subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

3. Subpart C is amended by adding § 407.34 as follows:

§ 407.34 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the citrus products subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

4. Subpart D is amended by adding § 407.44 as follows:

§ 407.44 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within

the frozen potato products subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

5. Subpart E is amended by adding § 407.54 as follows:

§ 407.54 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the dehydrated potato products subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

PART 408—CANNED AND PRESERVED SEAFOOD PROCESSING POINT SOURCE CATEGORY

The Table of contents is amended by adding the following new sections to the indicated subparts:

Subpart A—Farm-Raised Catfish Processing Subcategory
Sec. 408.14 Pretreatment standards for existing sources.

Subpart B—Conventional Blue Crab Processing Subcategory
408.24 Pretreatment standards for existing sources.

Subpart C—Mechanized Blue Crab Processing Subcategory
408.34 Pretreatment standards for existing sources.

Subpart D—Non-Remote Alaskan Crab Meat Processing Subcategory
408.44 Pretreatment standards for existing sources.

Subpart E—Remote Alaskan Crab Meat Processing Subcategory
Sec. 408.54 Pretreatment standards for existing sources.

Subpart F—Non-Remote Alaskan Whole Crab and Crab Section Processing Subcategory
408.64 Pretreatment standards for existing sources.

Subpart G—Remote Alaskan Whole Crab and Crab Section Processing Subcategory
408.74 Pretreatment standards for existing sources.

Subpart H—Dungeness and Tanner Crab Processing in the Contiguous States Subcategory
408.84 Pretreatment standards for existing sources.

Subpart I—Non-Remote Alaskan Shrimp Processing Subcategory
408.94 Pretreatment standards for existing sources.

Subpart J—Remote Alaskan Shrimp Processing Subcategory
408.104 Pretreatment standards for existing sources.

Subpart K—Northern Shrimp Processing in the Contiguous States Subcategory
408.114 Pretreatment standards for existing sources.

Subpart L—Southern Non-Breaded Shrimp Processing in the Contiguous States Subcategory
408.124 Pretreatment standards for existing sources.

Subpart M—Breaded Shrimp Processing in the Contiguous States Subcategory
408.134 Pretreatment standards for existing sources.

Subpart N—Tuna Processing Subcategory
408.144 Pretreatment standards for existing sources.

Part 408 is amended as follows:
1. Subpart A is amended by adding § 408.14 as follows:

§ 408.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the farm raised catfish processing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil and grease	Do.
TSS	Do.

2. Subpart B is amended by adding § 408.24 as follows:

§ 408.24 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the conventional blue crab processing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil and grease	Do.
TSS	Do.

3. Subpart C is amended by adding § 408.34 as follows:

§ 408.34 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the mechanized blue crab processing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil and grease	Do.
TSS	Do.

4. Subpart D is amended by adding § 408.44 as follows:

§ 408.44 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the non-remote Alaskan crab meat processing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the

purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil and grease	Do.
TSS	Do.

5. Subpart E is amended by adding § 408.54 as follows:

§ 408.54 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the remote Alaskan crab meat processing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil and grease	Do.
TSS	Do.

6. Subpart F is amended by adding § 408.64 as follows:

§ 408.64 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the non-remote Alaskan whole crab and crab section processing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil and grease	Do.
TSS	Do.

7. Subpart G is amended by adding § 408.74 as follows:

§ 408.74 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the remote Alaskan whole crab and crab section processing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil and grease	Do.
TSS	Do.

8. Subpart H is amended by adding § 408.84 as follows:

§ 408.84 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the dungeness and tanner crab processing in the contiguous states subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil and grease	Do.
TSS	Do.

9. Subpart I is amended by adding § 408.94 as follows:

§ 408.94 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the non-remote Alaskan shrimp processing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were

to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil and grease	Do.
TSS	Do.

10. Subpart J is amended by adding § 408.104 as follows:

§ 408.104 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the remote Alaskan shrimp processing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil and grease	Do.
TSS	Do.

11. Subpart K is amended by adding § 408.114 as follows:

§ 408.114 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the Northern shrimp processing in the contiguous states subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil and grease	Do.
TSS	Do.

12. Subpart L is amended by adding § 408.124 as follows:

§ 408.124 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the Southern non-breaded shrimp processing in the contiguous states subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil and grease	Do.
TSS	Do.

13. Subpart M is amended by adding § 408.134 as follows:

§ 408.134 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the breaded shrimp processing in the contiguous states subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following treatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil and grease	Do.
TSS	Do.

14. Subpart N is amended by adding § 408.144 as follows:

§ 408.144 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the tuna processing subcategory which is a user of a publicly owned treat-

ment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and grease	Do.

PART 409—BEET AND LIQUID AND CRYSTALLINE CANE SUGAR PROCESSING POINT SOURCE SUBCATEGORY

The table of contents is amended by adding the following sections to the indicated subparts:

Subpart A—Beet Sugar Processing Subcategory
Sec. 409.14 Pretreatment standards for existing sources.

Subpart B—Crystalline Cane Sugar Refining Subcategory
409.24 Pretreatment standards for existing sources.

Subpart C—Liquid Cane Sugar Refining Subcategory
409.34 Pretreatment standards for existing sources.

Part 409 is amended as follows:
1. Subpart A is amended by adding § 409.14 as follows:

§ 409.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the beet sugar processing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Fecal coliform	Do.
Temperature (heat)	Do.

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Part 409 is amended as follows:

1. Subpart B is amended by adding § 409.24 as follows:

§ 409.24 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the crystalline cane sugar refining subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD ₅	Do.
TSS	Do.

2. Subpart C is amended by adding § 409.34 as follows:

§ 409.34 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the liquid cane sugar refining subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD ₅	Do.
TSS	Do.

PART 411—CEMENT MANUFACTURING POINT SOURCE CATEGORY

The table of contents is amended by adding the following new sections to the indicated subparts:

Subpart A—Nonleaching Subcategory

Sec.
411.14 Pretreatment standards for existing sources.

Subpart B—Leaching Subcategory

411.24 Pretreatment standards for existing sources.

Subpart C—Materials Storage Piles Runoff Subcategory

Sec.
411.34 Pretreatment standards for existing sources.

Part 411 is amended as follows:

1. Subpart A is amended by adding § 411.14 as follows:

§ 411.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the nonleaching subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Temperature (heat)	Do.
TSS	Do.

2. Subpart B is amended by adding § 411.24 as follows:

§ 411.24 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the leaching subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD ₅	Do.
TSS	Do.

3. Subpart C is amended by adding § 411.34 as follows:

§ 411.34 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the materials storage piles runoff subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an

existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
TSS	Do.

PART 412—FEEDLOTS POINT SOURCE CATEGORY

The table of contents is amended by adding the following sections to the indicated subparts:

Subpart A—All Subcategories Except Ducks

Sec.
412.14 Pretreatment standards for existing sources.

Subpart B—Ducks Subcategory

412.24 Pretreatment standards for existing sources.

Part 412 is amended as follows:

1. Subpart A is amended by adding § 412.14 as follows:

§ 412.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within all subcategories except ducks which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
Fecal coliform	No limitation.
BOD ₅	Do.

2. Subpart B is amended by adding § 412.24 as follows:

§ 412.24 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the ducks subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth

in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
Fecal coliform	No limitation.
BOD5	Do.

PART 414—ORGANIC CHEMICALS MANUFACTURING POINT SOURCE CATEGORY

The table of contents is amended by adding the following new sections to the indicated subparts:

Subpart A—Nonaqueous Processes Subcategory

Sec.
414.14 Pretreatment Standards for Existing Sources.

Subpart B—Processes With Process Water Contact as Steam Diluent or Absorbent

414.24 Pretreatment Standards for Existing Sources.

Subpart C—Aqueous Liquid Phase Reaction Systems (Except Product-Processes C2, C3, C4)

414.34 Pretreatment Standards for Existing Sources.

Part 414 is amended as follows:

1. Subpart A is amended by adding § 414.14 as follows:

§ 414.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the nonaqueous processes subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged into a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

2. Subpart B is amended by adding § 414.24 as follows:

§ 414.24 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the processes with process water contact as steam diluent or absorbent subcategory which is a user of a publicly owned treatment works and a major con-

tributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

3. Subpart C is amended by adding § 414.34 as follows:

§ 414.34 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the aqueous liquid phase reaction systems (for C1 product-process only) subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.

PART 417—SOAP AND DETERGENT MANUFACTURING POINT SOURCE CATEGORY

The table of contents is amended by adding the following new sections to the indicated subparts:

Subpart A—Soap Manufacturing by Batch Kettle Subcategory

417.14 Pretreatment standards for existing sources.

Subpart B—Fatty Acid Manufacturing by Fat Splitting Subcategory

417.24 Pretreatment standards for existing sources.

Subpart C—Soap Manufacturing by Fatty Acid Neutralization Subcategory

417.34 Pretreatment standards for existing sources.

Subpart D—Glycerine Concentration Subcategory

Sec.
417.44 Pretreatment standards for existing sources.

Subpart E—Glycerine Distillation Subcategory

417.54 Pretreatment standards for existing sources.

Subpart F—Manufacture of Soap Flakes and Powders Subcategory

417.64 Pretreatment standards for existing sources.

Subpart G—Manufacture of Bar Soaps Subcategory

417.74 Pretreatment standards for existing sources.

Subpart H—Manufacture of Liquid Soaps Subcategory

417.84 Pretreatment standards for existing sources.

Subpart I—Oleum Sulfonation and Sulfation Subcategory

417.94 Pretreatment standards for existing sources.

Subpart J—Air—SO3 Sulfation and Sulfonation Subcategory

417.104 Pretreatment standards for existing sources.

Subpart K—SO3 Solvent and Vacuum Sulfonation Subcategory

417.114 Pretreatment standards for existing sources.

Subpart L—Sulfamic Acid Sulfation Subcategory

417.124 Pretreatment standards for existing sources.

Subpart M—Chlorosulfonic Acid Sulfation Subcategory

417.134 Pretreatment standards for existing sources.

Subpart N—Neutralization of Sulfuric Acid Esters and Sulfonic Acids Subcategory

417.144 Pretreatment standards for existing sources.

Subpart S—Manufacture of Detergent Bars and Cakes Subcategory

417.194 Pretreatment standards for existing sources.

Part 417 is amended as follows:

(1) Subpart A is amended by adding § 417.14 as follows:

§ 417.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the soap manufacturing by batch kettle subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
BOD5 -----	Do.
TSS -----	Do.
Oil and Grease -----	Do.
COD -----	Do.

(2) Subpart B is amended by adding § 417.24 as follows:

§ 417.24 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the fatty acid manufacturing by fat splitting subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
BOD5 -----	Do.
TSS -----	Do.
Oil and Grease -----	Do.
COD -----	Do.

(3) Subpart C is amended by adding § 417.34 as follows:

§ 417.34 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the soap manufacturing by fatty acid neutralization subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
BOD5 -----	Do.
TSS -----	Do.
Oil and Grease -----	Do.
COD -----	Do.

(4) Subpart D is amended by adding § 417.44 as follows:

§ 417.44 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the glycerine concentration subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
BOD5 -----	Do.
TSS -----	Do.
Oil and Grease -----	Do.
COD -----	Do.

(5) Subpart E is amended by adding § 417.54 as follows:

§ 417.54 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the glycerine distillation subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
BOD5 -----	Do.
TSS -----	Do.
Oil and Grease -----	Do.
COD -----	Do.

(6) Subpart F is amended by adding § 417.64 as follows:

§ 417.64 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the manufacture of soap flakes and powders subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge

pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
BOD5 -----	Do.
TSS -----	Do.
Oil and Grease -----	Do.
COD -----	Do.

(7) Subpart G is amended by adding § 417.74 as follows:

§ 417.74 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the manufacture of bar soaps subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
BOD5 -----	Do.
TSS -----	Do.
Oil and Grease -----	Do.
COD -----	Do.

(8) Subpart H is amended by adding § 417.84 as follows:

§ 417.84 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the manufacture of liquid soaps subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and Grease	Do.
COD	Do.

(9) Subpart I is amended by adding § 417.94 as follows:

§ 417.94 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the oleum sulfonation and sulfation subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and Grease	Do.
COD	Do.
Surfactants	Do.

(10) Subpart J is amended by adding § 417.104 as follows:

§ 417.104 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the air-SO₃ sulfation and sulfonation subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and Grease	Do.
COD	Do.
Surfactants	Do.

(11) Subpart K is amended by adding § 417.114 as follows:

§ 417.114 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the SO₃ solvent and vacuum sulfonation subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and Grease	Do.
COD	Do.
Surfactants	Do.

(12) Subpart L is amended by adding § 417.124 as follows:

§ 417.124 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the sulfamic acid sulfation subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and Grease	Do.
COD	Do.
Surfactants	Do.

(13) Subpart M is amended by adding § 417.134 as follows:

§ 417.134 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the chlorosulfonic acid sulfation subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would

be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and grease	Do.
COD	Do.
Surfactants	Do.

(14) Subpart N is amended by adding § 417.144 as follows:

§ 417.144 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the neutralization of sulfuric acid esters and sulfonic acids subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and grease	Do.
COD	Do.
Surfactants	Do.

(15) Subpart S is amended by adding § 417.194 as follows:

§ 417.194 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the manufacture of detergent bars and cakes subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

trolled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD ₅	Do.
TSS	Do.
Oil and grease	Do.
COD	Do.
Surfactants	Do.

PART 426—GLASS MANUFACTURING POINT SOURCE CATEGORIES

The table of contents is amended by inserting the following new sections in the indicated subparts:

Subpart B—Sheet Glass Manufacturing Subcategory

Sec.
426.24 Pretreatment standards for existing sources.

Subpart C—Rolled Glass Manufacturing Subcategory

426.34 Pretreatment standards for existing sources.

Subpart D—Plate Glass Manufacturing Subcategory

426.44 Pretreatment standards for existing sources.

Subpart F—Automotive Glass Tempering Subcategory

426.64 Pretreatment standards for existing sources.

Part 426 is amended as follows:

1. Subpart B is amended by adding § 426.24 as follows:

§ 426.24 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the sheet glass manufacturing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
TSS	Do.

2. Subpart C is amended by adding § 426.34 as follows:

§ 426.34 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the rolled glass manufacturing subcategory which is a user of a publicly owned treatment works and a major contrib-

uting industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
TSS	Do.

3. Subpart D is amended by adding § 426.44 as follows:

§ 426.44 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the plate glass manufacturing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
TSS	Do.

4. Subpart F is amended by adding § 426.64 as follows:

§ 426.64 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the automotive glass tempering subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
Oil	Do.
TSS	Do.

PART 427—ASBESTOS MANUFACTURING POINT SOURCE CATEGORY

The table of contents is amended by adding the following new sections to the indicated subparts:

Subpart A—Asbestos-Cement Pipe Subcategory

Sec.
427.14 Pretreatment standards for existing sources.

Subpart B—Asbestos-Cement Sheet Subcategory

427.24 Pretreatment standards for existing sources.

Subpart C—Asbestos Paper (Starch Binder) Subcategory

427.34 Pretreatment standards for existing sources.

Subpart D—Asbestos Paper (Elastomeric Binder) Subcategory

427.44 Pretreatment standards for existing sources.

Subpart E—Asbestos Millboard Subcategory

427.54 Pretreatment standards for existing sources.

Subpart F—Asbestos Roofing Subcategory

427.64 Pretreatment standards for existing sources.

Subpart G—Asbestos Floor Tile Subcategory

427.74 Pretreatment standards for existing sources.

Part 427 is amended as follows:

1. Subpart A is amended by adding § 427.14 as follows:

§ 427.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the asbestos-cement pipe subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
TSS	Do.

2. Subpart B is amended by adding § 427.24 as follows:

§ 427.24 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source

within the asbestos-cement sheet subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132 and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
TSS -----	Do.

3. Subpart C is amended by adding § 427.34 as follows:

§ 427.34 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the asbestos paper (starch binder) subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
TSS -----	Do.

4. Subpart D is amended by adding § 427.44 as follows:

§ 427.44 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the asbestos paper (elastomeric binder) subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned

treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
TSS -----	Do.

5. Subpart E is amended by adding § 427.54 as follows:

§ 427.54 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the asbestos millboard subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
TSS -----	Do.

6. Subpart F is amended by adding § 427.64 as follows:

§ 427.64 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the asbestos roofing subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
COD -----	Do.
TSS -----	Do.

7. Subpart G is amended by adding § 427.74 as follows:

§ 427.74 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the asbestos floor tile subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point

source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
COD -----	Do.
TSS -----	Do.

PART 430—PULP, PAPER, AND PAPERBOARD POINT SOURCE CATEGORY

The table of contents is amended by adding the following new section to the indicated subparts:

Subpart A—Unbleached Kraft Subcategory
Sec.

430.14 Pretreatment standards for existing sources.

Subpart B—Sodium Based Neutral Sulfite Semi-Chemical Subcategory

430.24 Pretreatment standards for existing sources.

Subpart C—Ammonia Base Neutral Sulfite Semi-Chemical Subcategory

430.34 Pretreatment standards for existing sources.

Subpart D—Unbleached Kraft—Neutral Sulfite Semi-Chemical (Cross Recovery) Subcategory

430.44 Pretreatment standards for existing sources.

Subpart E—Paperboard From Waste Paper Subcategory

430.54 Pretreatment standards for existing sources.

Part 430 is amended as follows:

1. Subpart A is amended as adding § 430.14 as follows:

§ 430.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the unbleached kraft subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR Parts 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH -----	No limitation.
BOD ₅ -----	Do.
TSS -----	Do.

2. Subpart B is amended by adding § 430.24 as follows:

§ 430.24 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the sodium based neutral sulfite semi-chemical subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH.....	No limitation.
BOD ₅	Do.
TSS.....	Do.

3. Subpart C is amended by adding § 430.34 as follows:

§ 430.34 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the ammonia base neutral sulfite semi-chemical subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH.....	No limitation.
BOD ₅	Do.
TSS.....	Do.

4. Subpart D is amended by adding § 430.44 as follows:

§ 430.44 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the unbleached kraft-neutral sulfite semi-chemical (cross recovery) subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to sec-

tion 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of the pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
BOD ₅	No limitation.
TSS.....	Do.
pH.....	Do.

§ 430.54 Pretreatment standards for existing sources.

5. Subpart E is amended by adding § 430.54 as follows:

The pretreatment standards under section 307(b) of the Act for a source within the paperboard from waste paper subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH.....	No limitation.
BOD ₅	Do.
TSS.....	Do.

PART 431—BUILDERS PAPER AND ROOFING FELT SEGMENT OF THE BUILDERS PAPER AND BOARD MILLS POINT SOURCE CATEGORY

Part 431 is amended as follows:

1. Subpart A is amended by adding § 431.14 as follows:

§ 431.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the builders paper and roofing felt subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant prop-

erties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH.....	No limitation.
BOD ₅	Do.
TSS.....	Do.
Settleable solids.....	Do.

PART 432—MEAT PRODUCTS POINT SOURCE CATEGORY

The table of contents is amended by adding the following new section to the indicated subparts:

Subpart A—Simple Slaughterhouse Subcategory

Sec.
432.14 Pretreatment standards for existing sources.

Subpart B—Complex Slaughterhouse Subcategory

432.24 Pretreatment standards for existing sources.

Subpart C—Low Processing Packinghouse Subcategory

432.34 Pretreatment standards for existing sources.

Subpart D—High Processing Packinghouse Subcategory

432.44 Pretreatment standards for existing sources.

Part 432 is amended as follows:

1. Subpart A is amended by adding § 432.14 as follows:

§ 432.14 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the simple slaughterhouse subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH.....	No limitation.
BOD ₅	Do.
TSS.....	Do.
Oil and grease.....	Do.
Fecal coliform.....	Do.

2. Subpart B is amended by adding § 432.24 as follows:

§ 432.24 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the complex slaughterhouse subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40

CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and grease	Do.
Fecal coliform	Do.

3. Subpart C is amended by adding § 432.34 as follows:

§ 432.34 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within

the low-processing packinghouse subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and grease	Do.
Fecal coliform	Do.

4. Subpart D is amended by adding § 432.44 as follows:

§ 432.44 Pretreatment standards for existing sources.

The pretreatment standards under section 307(b) of the Act for a source within the high-processing packinghouse subcategory which is a user of a publicly owned treatment works and a major contributing industry as defined in 40 CFR Part 128 (and which would be an existing point source subject to section 301 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.121, 128.122, 128.132, and 128.133 shall not apply. The following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property:	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and grease	Do.
Fecal coliform	Do.

[FR Doc.75-3620 Filed 2-10-75; 8:45 am]

APPENDIX 2
SECONDARY TREATMENT INFORMATION

federal register

FRIDAY, AUGUST 17, 1973
WASHINGTON, D.C.

Volume 38 ■ Number 159

PART II



ENVIRONMENTAL PROTECTION AGENCY

■

WATER PROGRAMS

Secondary Treatment Information

Title 40—Protection of Environment
CHAPTER I—ENVIRONMENTAL
PROTECTION AGENCY
SUBCHAPTER D—WATER PROGRAMS
PART 133—SECONDARY TREATMENT
INFORMATION

On April 30, 1973, notice was published in the *FEDERAL REGISTER* that the Environmental Protection Agency was proposing information on secondary treatment pursuant to section 304(d)(1) of the Federal Water Pollution Control Act Amendments of 1972 (the Act). Reference should be made to the preamble of the proposed rulemaking for a description of the purposes and intended use of the regulation.

Written comments on the proposed rulemaking were invited and received from interested parties. The Environmental Protection Agency has carefully considered all comments received. All written comments are on file with the Agency.

The regulation has been reorganized and rewritten to improve clarity. Major changes that were made as a result of comments received are summarized below:

(a) The terms "1-week" and "1-month" as used in § 133.102 (a) and (b) of the proposed rulemaking have been changed to 7 consecutive days and 30 consecutive days respectively (See § 133.102 (a), (b), and (c)).

(b) Some comments indicated that the proposed rulemaking appeared to require 85 percent removal of biochemical oxygen demand and suspended solids only in cases when a treatment works would treat a substantial portion of extremely high strength industrial waste (See § 133.102(g) of the proposed rulemaking). The intent was that in no case should the percentage removal of biochemical oxygen demand and suspended solids in a 30 day period be less than 85 percent. This has been clarified in the regulation. In addition, it has been expressed as percent remaining rather than percent removal calculated using the arithmetic means of the values for influent and effluent samples collected in a 30 day period (See § 133.102(a) and (b)).

(c) Comments were made as to the difficulty of achieving 85 percent removal of biochemical oxygen demand and suspended solids during wet weather for treatment works receiving flows from combined sewer systems. Recognizing this, a paragraph was added which will allow waiver or adjustment of that requirement on a case-by-case basis (See § 133.103(a)).

(d) The definition of a 24-hour composite sample (See § 133.102(c) of the proposed rulemaking) was deleted from the regulation. The sampling requirements for publicly owned treatment works will be established in guidelines issued pursuant to sections 304(g) and 402 of the Act.

(e) In § 133.103 of the proposed rulemaking, it was recognized that secondary

treatment processes are subject to upsets over which little or no control may be exercised. This provision has been deleted. It is no longer considered necessary in this regulation since procedures for notice and review of upset incidents will be included in discharge permits issued pursuant to section 402 of the Act.

(f) Paragraph (f) of § 133.102 of the proposed rulemaking, which relates to treatment works which receive substantial portions of high strength industrial wastes, has been rewritten for clarity. In addition, a provision has been added which limits the use of the upwards adjustment provision to only those cases in which the flow or loading from an industry category exceeds 10 percent of the design flow or loading of the treatment works. This intended to reduce or eliminate the administrative burden which would be involved in making insignificant adjustments in the biochemical oxygen demand and suspended solids criteria (See § 133.103(b)).

The major comments for which changes were not made are discussed below:

(a) Comments were received which recommended that the regulation be written to allow effluent limitations to be based on the treatment necessary to meet water quality standards. No change has been made in the regulations because the Act and its legislative history clearly show that the regulation is to be based on the capabilities of secondary treatment technology and not ambient water quality effects.

(b) A number of comments were received which pointed out that waste stabilization ponds alone are not generally capable of achieving the proposed effluent quality in terms of suspended solids and fecal coliform bacteria. A few commenters expressed the opposite view. The Agency is of the opinion that with proper design (including solids separation processes and disinfection in some cases) and operation, the level of effluent quality specified can be achieved with waste stabilization ponds. A technical bulletin will be published in the near future which will provide guidance on the design and operation of waste stabilization ponds.

(c) Disinfection must be employed in order to achieve the fecal coliform bacteria levels specified. A few commenters argued that disinfectant is not a secondary treatment process and therefore the fecal coliform bacteria requirements should be deleted. No changes were made because disinfection is considered by the Agency to be an important element of secondary treatment which is necessary for protection of public health (See § 133.102(c)).

Effective date. These regulations shall become effective on August 17, 1973.

JOHN QUARLES,
 Acting Administrator

AUGUST 14, 1973.

Chapter I of title 40 of the Code of Federal Regulations is amended by adding a new Part 133 as follows:

Sec.

133.100 Purpose.

133.101 Authority.

133.102 Secondary treatment.

133.103 Special considerations.

133.104 Sampling and test procedures.

AUTHORITY: Secs. 304() (1), 301(b) (1) (B), Federal Water Pollution Control Act Amendments, 1972, P.L. 92-500.

§ 133.100 Purpose.

This part provides information on the level of effluent quality attainable through the application of secondary treatment.

§ 133.101 Authority.

The information contained in this Part is provided pursuant to sections 304(d) (1) and 301(b) (1) (B) of the Federal Water Pollution Control Act Amendments of 1972, P.L. 92-500 (the Act).

§ 133.102 Secondary treatment.

The following paragraphs describe the minimum level of effluent quality attainable by secondary treatment in terms of the parameters biochemical oxygen demand, suspended solids, fecal coliform bacteria and pH. All requirements for each parameter shall be achieved except as provided for in § 133.103.

(a) **Biochemical oxygen demand (five-day).** (1) The arithmetic mean of the values for effluent samples collected in a period of 30 consecutive days shall not exceed 30 milligrams per liter.

(2) The arithmetic mean of the values for effluent samples collected in a period of seven consecutive days shall not exceed 45 milligrams per liter.

(3) The arithmetic mean of the values for effluent samples collected in a period of 30 consecutive days shall not exceed 15 percent of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period (85 percent removal).

(b) **Suspended solids.** (1) The arithmetic mean of the values for effluent samples collected in a period of 30 consecutive days shall not exceed 30 milligrams per liter.

(2) The arithmetic mean of the values for effluent samples collected in a period of seven consecutive days shall not exceed 45 milligrams per liter.

(3) The arithmetic mean of the values for effluent samples collected in a period of 30 consecutive days shall not exceed 15 percent of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period (85 percent removal).

(c) **Fecal coliform bacteria.** (1) The geometric mean of the value for effluent samples collected in a period of 30 consecutive days shall not exceed 200 per 100 milliliters.

(2) The geometric mean of the values for effluent samples collected in a period of seven consecutive days shall not exceed 400 per 100 milliliters.

(d) *pH*. The effluent values for pH shall remain within the limits of 6.0 to 9.0.

§ 133.103 Special considerations.

(a) *Combined sewers*. Secondary treatment may not be capable of meeting the percentage removal requirements of paragraphs (a)(3) and (b)(3) of § 133.102 during wet weather in treatment works which receive flows from combined sewers (sewers which are designed to transport both storm water and sanitary sewage). For such treatment works, the decision must be made on a case-by-case basis as to whether any attainable percentage removal level can be defined, and if so, what that level should be.

(b) *Industrial wastes*. For certain industrial categories, the discharge to navigable waters of biochemical oxygen demand and suspended solids permitted under sections 301(b)(1)(A)(i) or 306 of the Act may be less stringent than the values given in paragraphs (a)(1) and (b)(1) of § 133.102. In cases when wastes would be introduced from such an industrial category into a publicly owned treatment works, the values for biochemical oxygen demand and suspended solids in paragraphs (a)(1) and (b)(1) of § 133.102 may be adjusted upwards provided that: (1) the permitted discharge of such pollutants, attributable to the industrial category, would not be greater than that which would be permitted under sections 301(b)(1)(a)(i) or 306 of the Act if such industrial category were to discharge directly into the navigable waters, and (2) the flow or loading

of such pollutants introduced by the industrial category exceeds 10 percent of the design flow or loading of the publicly owned treatment works. When such an adjustment is made, the values for biochemical oxygen demand or suspended solids in paragraphs (a)(2) and (b)(2) of § 133.102 should be adjusted proportionally.

§ 133.104 Sampling and test procedures.

(a) Sampling and test procedures for pollutants listed in § 133.102 shall be in accordance with guidelines promulgated by the Administrator pursuant to sections 304(g) and 402 of the Act.

(b) Chemical oxygen demand (COD) or total organic carbon (TOC) may be substituted for biochemical oxygen demand (BOD) when a long-term BOD:COD or BOD:TOC correlation has been demonstrated.

[FR Doc. 73-17194 Filed 8-16-73; 8:45 am]

APPENDIX 3
RECOMMENDED ORDINANCE FOR INDUSTRIAL USE OF
PUBLICLY OWNED SEWERAGE FACILITIES

APPENDIX 3
RECOMMENDED ORDINANCE FOR INDUSTRIAL
USE OF PUBLICLY OWNED SEWERAGE FACILITIES

An ordinance establishing rules and regulations for the discharge of wastewaters from industrial users into the publicly owned sewerage facilities of (_____), including provisions for sampling and flow measurement of such wastewaters, prohibitions and limitations on the use of the publicly owned sewerage facilities, requirements for pretreatment where necessary to meet the prohibitions and limitations set forth herein, and where applicable, procedures for obtaining permits for the discharge of wastewaters by industrial users into the publicly owned sewerage system and reporting by industry on the use of the publicly owned facilities.

1.0 Purpose

The purpose of this ordinance is to provide for the use of the publicly owned sewerage facilities by industries located within the area served by the (_____) (enter applicable designation - City, County, District, Authority, etc.) without damage to the physical facilities, without impairment of their normal function of collecting, treating and discharging domestic wastewaters from the area served by the (_____), and without the discharge by the publicly owned treatment works of pollutants which would be in violation of its permitted discharge under the applicable rules and regulations of state and federal regulatory agencies.

1.1 Legislative Background

The publicly owned treatment works of the (_____) are operating under a permit issued by the (_____) (enter EPA or State Agency) under the National Pollution Discharge Elimination System as provided for in Section 402 of Public Law 92-500. The permit requires discharges from the treatment works of the (_____) to conform to certain specific limitations as to the quantity of pollutants which may be discharged by the treatment works. Wastewaters from industrial users conveyed into the publicly owned sewerage facilities are further provided for under Section 307 of PL 92-500 and under rules and regulations contained in the Code of Federal Regulations promulgated in implementation of that Section.

The operation of the publicly owned treatment works is also under the jurisdiction of the (_____) (enter State or interstate agency) with regard to water quality standards established by that agency.

2.0 Definitions

Unless the context specifically indicates otherwise, the meaning of terms used in these regulations shall be as follows:

2.1 "Authority" (optional) shall mean the agency which is responsible for the administration of this ordinance.

2.2 "Cooling Water" shall mean the water discharged from any use such as air conditioning, cooling or refrigeration, during which the only pollutant added to the water is heat.

2.3 "District" (optional) shall mean the area served by the Authority.

2.4 "EPA" shall mean the United States Environmental Protection Agency.

2.5 "Garbage" shall mean solid wastes from the domestic and commercial preparation, cooking and dispensing of food, and from the handling, storage and sale of food.

2.6 "Industrial Wastewater" shall mean the discharge of a liquid resulting from the processes employed in industrial establishments.

2.7 "Major Contributing Industry" shall mean a major source of industrial wastewater, as defined in the Federal pretreatment standards.

2.8 "Manager" shall mean the Chief Executive Officer of the (_____) or his authorized deputy, agent or representative.

2.9 "May" is permissive; "shall" is mandatory.

2.10 "NPDES" shall mean the National Pollutant Discharge Elimination System as defined in Section 402 of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500).

2.11 "Person" shall mean any individual, firm, company, association, society, corporation or group including a city, county, town, village or sewer district.

2.12 "pH" shall mean the negative logarithm or the log of the reciprocal of the concentration of hydrogen ions in gram moles per liter of solution as determined by acceptable laboratory procedures.

2.13 "Pretreatment" shall mean the treatment of wastewater by the user before introduction into the publicly owned system.

2.14 "Pretreatment Standards" shall mean all applicable rules and regulations contained in the Code of Federal Regulations as published in the Federal Register, under section 307 of Public Law 92-500.

2.15 "Properly Shredded Garbage" shall mean the waste from the preparation, cooking and dispensing of food that has been shredded to such a degree that all particles will be carried freely under the flow conditions normally prevailing in public sewers, with no particle greater than one-half (1/2) inch (1.27 centimeters) in any dimension.

2.16 "Sewer" shall mean a pipe or conduit for carrying sewage.

2.17 "Sewage" shall mean a combination of the water-carried wastes from residences, business buildings, institutions and industrial establishments, together with such ground, surface and stormwaters as may be present.

2.18 "Sewerage Facilities" includes intercepting sewers, sewage treatment works, pumping stations, outfall sewers, and appurtenances constructed, operated and maintained by the (_____) for sewage disposal purposes.

2.19 "Standard Methods" shall mean "Standard Methods for the Examination of Water and Wastewater" prepared and published jointly by the American Public Health Association, American Water Works Association and the Water Pollution Control Federation.

2.20 "Storm Water" shall mean any flow occurring during or immediately following any form of natural precipitation and resulting therefrom.

2.21 "Unpolluted Water" is water not containing any pollutants limited or prohibited by the effluent standards in effect, or water whose discharge will not cause any violation of receiving water quality standards.

2.22 "User" means any person discharging wastes to the (_____) sewers.

2.23 "Wastewater" shall mean domestic sewage and industrial wastewaters discharged to the (_____) sewers.

2.24 "Wastewater Discharge Permit" (optional) shall mean a permit to convey or discharge industrial wastewater into any sewer under jurisdiction of the (_____).

3.0 Prohibitions and Limitations on Wastewater Discharges

3.1 Prohibitions on Wastewater Discharges

No person shall discharge or cause or allow to be discharged into the (_____) sewerage facilities or any connected treatment facilities any waste which contains any of the following:

3.1.1 Oils and Grease

Fats, wax, grease or oils of more than () (optional) mg/l, whether emulsified or not, or containing substances which may solidify or become viscous at temperatures between 32° and 150° F (0° and 65° C) at the point of discharge into the system.

3.1.2 Explosive Mixtures

Liquids, solids, or gases which by reason of their nature or quantity are, or may be, sufficient to cause fire or explosion or be injurious in any other way to the sewerage facilities or to the operation of the system. At no time shall two successive readings on an explosion hazard meter, at the point of discharge into the sewer system, be more than five percent (5%) nor any single reading over 10 percent (10%) of the Lower Explosive Limit (L.E.L.) of the meter. Prohibited materials include, but are not limited to, gasoline, kerosene, naphtha, benzene, toluene, xylene, ethers, alcohols, ketones, aldehydes, peroxides, chlorates, perchlorates, bromates, carbides, hydrides and sulfides.

3.1.3 Noxious Material

Noxious or malodorous solids, liquids or gases, which either singly or by interaction with other wastes, are capable of creating a public nuisance or hazard to life, or are or may be sufficient to prevent entry into a sewer for its maintenance and repair.

3.1.4 Improperly Shredded Garbage

Garbage that has not been ground or comminuted to such a degree that all particles will be carried freely in suspension under flow conditions normally prevailing in the

public sewers, with no particle greater than one-half inch (1/2) in any dimension.

3.1.5 Radioactive Wastes

Radioactive wastes or isotopes of such half-life or concentration that they are in noncompliance with regulations issued by the appropriate authority having control over their use and which will or may cause damage or hazards to the sewerage facilities or personnel operating the system.

3.1.6 Solid or Viscous Wastes

Solid or viscous wastes which will or may cause obstruction to the flow in a sewer, or other interference with the proper operation of the sewerage facilities. Prohibited materials include, but are not limited to, grease, uncomminuted garbage, animal guts or tissues, paunch manure, bones, hair, hides or fleshings, entrails, whole blood, feathers, ashes, cinders, sand, spent lime, stone or marble dust, metal, glass, straw, shavings, grass clippings, rags, spent grains, spent hops, waste paper, wood, plastic, tar, asphalt residues, residues from refining or processing of fuel or lubricating oil, and similar substances.

3.1.7 Excessive Discharge Rate

Wastewaters at a flow rate which is excessive relative to the capacity of the treatment works and which would cause a treatment process upset and subsequent loss of treatment efficiency; or wastewaters containing such concentrations or quantities of pollutants that their introduction into the treatment works over a relatively short time period, (sometimes referred to as slug discharges) would cause a treatment process upset and subsequent loss of treatment efficiency.

3.1.8 Toxic Substances

Any toxic substances, chemical elements or compounds, phenols or other taste- or odor-producing substances, or any other substances which may interfere with the biological processes or efficiency of the treatment works, or that will pass through the treatment works.

3.1.9 Unpolluted Waters

Any unpolluted water including, but not limited to, water from cooling systems or of stormwater origin, which

will increase the hydraulic load on the sewerage facilities.

3.1.10 Discolored Material

Wastes with objectionable color not removable by the treatment process.

3.1.11 Corrosive Wastes

Any waste which will cause corrosion or deterioration of the sewerage facilities. All wastes discharged to the public sewer system must have a pH value in the range of () to (). Prohibited materials, include, but are not limited to, acids, sulfides, concentrated chloride and fluoride compounds and substances which will react with water to form acidic products.

3.2 Limitations on Wastewater Discharges

Use either Option A or Option B.

3.2.1 General Limitations on the Discharge of Pollutants (Option A)

It is prohibited to discharge or convey to the public sewer any wastewater containing pollutants of such character or quantity that will:

A. Not be amenable to treatment or interfere with the sewerage facilities.

B. Constitute a hazard to human or animal life, or to the stream or water course receiving the treatment plant effluent.

C. Violate the Federal Pretreatment Standards.

D. Cause the treatment plant to violate its NPDES permit or applicable receiving water standards.

3.2.1 Specific Limitations on the Discharge of Pollutants (Option B)

The following are the maximum concentrations of pollutants allowable in wastewater discharges to the sewerage facilities. Dilution of any wastewater discharge for the purpose of satisfying these requirements shall be considered a violation of the ordinance.

<u>Pollutant</u>	<u>Concentration (mg/l)</u>
Arsenic	Options: See Volume I, Section C
Barium	
Boron	
Cadmium	
Chromium (total)	
Chromium (Trivalent)	
Chromium (Hexavalent)	
Chlorinated Hydrocarbons	
Copper	
Cyanide	
Iron	
Lead	
Manganese	
Mercury	
Nickel	
Phenolic Compounds	
Phosphorus	
Selenium	
Silver	
Surfactants	
Zinc	
pH	
Temperature	Not over 150°F (except where higher temperatures are permitted by law)

3.3 Special Agreements

No statement contained in this section shall be construed as preventing any special agreement between the () and any user of the sewerage facilities, whereby a wastewater of unusual strength or character may be accepted into the system subject to any payments as may be agreed upon by the two parties.

4.0 Control of Prohibited Wastes

4.1 Regulatory Actions

If wastewaters containing any substance described in section 3 of this Ordinance are discharged or proposed to be discharged into the sewer system of the () or to any sewer system tributary thereto, the () may take any action necessary to:

A. Prohibit the discharge of such wastewater.

B. Require a discharger to demonstrate that in-plant modifications will eliminate the discharge of such substances to a degree as to be acceptable to the (_____).

C. Require pretreatment including storage facilities, or flow equalization necessary to reduce or eliminate the objectionable characteristics or substances so that the discharge will not violate these rules and regulations.

D. Require the person or local government unit making, causing or allowing the discharge to pay any added cost of handling and treating excess loads imposed on the sewerage facilities.

E. Take such other remedial action as may be deemed to be desirable or necessary to achieve the purpose of this ordinance.

4.2 Submission of Plans

Where pretreatment or equalization of wastewater flows prior to discharge into any part of its sewerage facilities is required by the (_____), plans, specifications and other pertinent data or information relating to such pretreatment or flow-control facilities shall be submitted to the (_____) for review and approval. Approval shall in no way exempt the discharge or such facilities from compliance with any applicable code, ordinance, rule or regulation of any governmental unit or the (_____). Any subsequent alterations or additions to such pretreatment or flow-control facilities shall not be made without due notice to, and approval of the (_____).

4.3 Pretreatment Facilities Operations

If pretreatment or control of waste flows is required, such facilities shall be effectively operated and maintained by the owner at his expense, subject to the requirements of these rules and regulations and all other applicable codes, ordinances, and laws.

4.4 Admission to Property

Whenever it shall be necessary for the purposes of these rules and regulations, the Manager may immediately enter upon any property upon presentation of credentials, for the purpose of obtaining information or conducting surveys or investigations. Entry shall normally be made during daylight or operating hours. However, the Manager reserves the

right to enter upon the property at any hour of any day the Manager deems necessary as a result of abnormal or emergency circumstances.

4.5 Reporting of Accidental Discharges

If an accidental discharge of prohibited or regulated pollutants to the sewerage facilities should occur, the industrial facility responsible for such discharge shall immediately notify the Manager so that corrective action may be taken to protect the sewerage facilities. In addition, a written report addressed to the Manager detailing the date, time and cause of the accidental discharge, the quantity and characteristics of the discharge and corrective action taken to prevent future discharges, shall be filed by the responsible industrial facility within (30) (optional) days of the occurrence of the accidental discharge.

5.0 Industrial Wastewater Sampling and Analysis

5.1 Basis of Compliance Determination

5.1.1 Type of Sample

Compliance determinations with respect to section 3 prohibitions and limitations may be made on the basis of either instantaneous grab samples or composite samples of industrial wastewater at the discretion of the Manager. Composite samples may be taken over a 24 hour period, or over a longer or shorter duration of time, as determined by the Manager to meet the needs of specific circumstances.

5.2 Control Manhole

Where required by the (_____), industrial dischargers shall install a suitable control manhole, together with such necessary samplers, meters, recorders and other appurtenances to adequately sample and measure the wastes discharged. The control manhole shall be constructed and operated so as to permit accurate sampling and flow measurements of all wastes discharged. Where conditions do not permit measurement of all discharges from one industrial facility at a single control manhole, multiple control manholes shall be provided. The control manhole shall be located so as to permit unrestricted access by (_____) representatives, provide sufficient space for storage of

samples and equipment and allow for accurate sampling. The control manhole shall be situated on the discharger's premises, but the () may, when such a location would be impractical or cause undue hardship on the discharger, allow the control manhole to be constructed in the public street or sidewalk area and located so that it will not be obstructed by landscaping or parked vehicles. If the control manhole is located within the discharger's fence, there shall be accommodation to allow for access by () personnel, such as a gate secured with an () lock.

5.3 Analysis of Industrial Wastewaters

Laboratory analysis of industrial wastewater samples shall be performed in accordance with the current edition of "Standard Methods", "Methods for Chemical Analysis of Water and Waste" published by the U. S. Environmental Protection Agency or the "Annual Book of Standards, Part 23, Water, Atmospheric Analysis" published by the American Society for Testing and Materials. Analysis of those pollutants not covered by these publications shall be performed in accordance with procedures established by the ().

5.4 Sampling Frequency (Optional)

Sampling of industrial wastewater for the purpose of compliance determination with respect to section 3 prohibitions and limitations will be done at such random intervals as the () may designate. However, it is the intention of the () to conduct compliance sampling for all major contributive industries at least once in every (1 year) (optional) period.

5.5 Cost of Sampling and Analysis (optional)

Costs incurred in connection with the first sampling and analysis performed during any (1 year) (optional) period for the purpose of compliance determination with respect to section 3 prohibitions and limitations will be paid by the discharger. The cost of any additional sampling and analysis during this interval will be paid by the ().

6.0 Industrial Discharge Permit System (optional)

6.1 Wastewater Discharge Permits

All major contributing industries proposing to connect or to discharge into any () sewer must obtain a discharge

permit from the (_____). All existing major contributing industries connected to or discharging to a (_____) sewer must obtain a wastewater discharge permit within 90 days of the effective date of this ordinance.

6.2 Permit Application

Users seeking a wastewater discharge permit shall complete and file with the Manager an application on the form prescribed by the Manager, and accompanied by the applicable fee. In support of this application, the user shall submit the following information:

- A. Name, address, and SIC number of applicant
- B. Volume of wastewater to be discharged
- C. Wastewater constituents and characteristics including, but not limited to, those mentioned in section 3 as determined by a laboratory approved by the (_____).
- D. Time and duration of discharge
- E. Average and (30) (optional) minute peak wastewater flow rates, including daily, monthly and seasonal variations if any
- F. Site plans, floor plans, mechanical and plumbing plans and details to show all sewers and appurtenances by size, location and elevation
- G. Description of activities, facilities and plant processes on the premises including all materials and types of materials which are, or could be, discharged
- H. Each product produced by type, amount, and rate of production
- I. Number and type of employees, and hours of work
- J. Any other information as may be deemed by the Manager to be necessary to evaluate the permit application

The Manager will evaluate the data furnished by the user and may require additional information. After evaluation and acceptance of the data furnished, the Manager may issue

a wastewater discharge permit subject to terms and conditions provided herein.

6.3 Permit Conditions

Wastewater discharge permits shall be expressly subject to all provisions of this Ordinance and all other regulations, user charges and fees established by the (_____). The conditions of wastewater discharge permits shall be uniformly enforced by the Manager in accordance with this Ordinance, and applicable State and Federal regulations. Permit conditions will include the following:

A. The unit charge or schedule of user charges and fees for the wastewater to be discharged to the (_____).

B. The average and maximum wastewater constituents and characteristics

C. Limits on rate and time of discharge or requirements for flow regulations and equalization

D. Requirements for installation of inspection and sampling facilities

E. Pre-treatment requirements

F. Requirements for maintaining plant records relating to wastewater discharges as specified by the (_____), and affording the (_____) access thereto

G. Mean and maximum mass emission rates, or other appropriate limits when pollutants subject to limitations and prohibitions are proposed or present in the user's wastewater discharge

H. Other conditions as deemed appropriate by the (_____) to insure compliance with this Ordinance

6.4 Duration of Permits

Permits shall be issued for a specified time period, not to exceed (five) (optional) years. A permit may be issued for a period of less than (one) (optional) year, or may be stated to expire on a specific date. If the user is not notified by the (_____) (30) (optional) days prior to the expiration of the permit, the permit shall automatically

be extended for () months. The terms and conditions of the permit may be subject to modification and change by the () during the life of the permit, as limitations or requirements as identified in section 3 are modified and changed. The user shall be informed of any proposed changes in his permit at least (30) (optional) days prior to the effective date of change. Any changes or new conditions in the permit shall include a reasonable time schedule for compliance.

6.5 Transfer of a Permit

Wastewater discharge permits are issued to a specific user for a specific operation. A wastewater discharge permit shall not be reassigned or transferred or sold to a new owner, new user, different premises, or a new or changed operation.

6.6 Revocation of Permit

Any user who violates the following conditions of his permit or of this Ordinance, or of applicable State and Federal regulations, is subject to having his permit revoked. Violations subjecting a user to possible revocation of his permit include:

A. Failure of a user to factually report the wastewater constituents and characteristics of his discharge

B. Failure of the user to report significant changes in operations, or wastewater constituents and characteristics

C. Refusal of reasonable access to the user's premises for the purpose of inspection or monitoring; or,

D. Violation of conditions of the permit

7.0 Enforcement Procedures

7.1 Notification of Violation

Any person found in violation of this Ordinance or of any prohibition, limitation or requirement contained herein, will be served by the Manager with a written notice stating the nature of the violation and providing a reasonable time limit for the satisfactory correction thereof. The Manager will endeavor to the full extent possible to eliminate or remedy such violation without resorting to further administrative proceedings.

7.2 Show Cause Hearing

If those efforts have been unsuccessful, the Manager may order any person who causes or allows an unauthorized discharge to show cause before the (_____) why such discharge should not be discontinued. A notice shall be served on the offending party, specifying the time and place of a hearing to be held by the (_____) regarding the violation, and directing the offending party to show cause before the (_____) why an order should not be made directing the discontinuance of such discharge. The notice of the hearing shall be served personally or by Registered or Certified Mail at least (ten) (optional) days before the hearing; service may be made on any agent or officer of a corporation.

The (_____) may itself conduct the hearing and take the evidence, or may designate any of its members of any officer or employee of the (_____) to:

A. Issue in the name of the (_____) notices of hearings requesting the attendance and testimony of witnesses and the production of evidence relevant to any matter involved in any such hearings

B. Take the evidence

C. Transmit a report of the evidence and hearing, including transcripts and other evidence, together with recommendations to the (_____) for action thereon.

At any public hearing, testimony taken before the (_____) or any person designated by it, must be under oath and recorded stenographically. The transcript so recorded, will be made available to any member of the public or any party to the hearing upon payment of the usual charges therefor.

After the (_____) has reviewed the evidence, it may issue an order to the party responsible for the discharge, directing that within a specified time period, the discharge be discontinued unless adequate treatment works, facilities or devices shall have been installed or existing adequate treatment works, facilities or devices are properly operated, and any other such orders as the (_____) may deem necessary.

7.3 Court Proceedings

A violation of an Order of the (_____) shall be considered a nuisance. If any person discharges sewage, industrial wastes or other wastes into the sewerage facilities under the jurisdiction of the (_____) contrary to any Order of the (_____), the (_____), acting through the Manager, may commence an action by proceeding in the Circuit Court in and for the County in which the (_____) is located, or operates facilities, for the purpose of having the discharge stopped either by mandamus or injunction.

7.4 Penalties

Whoever fails to comply with any provisions of this Ordinance or with an Order of the (_____) issued in pursuance of this Ordinance, shall be fined not less than (\$100) (optional) nor more than (\$10,000) (optional) for each offense. Each day's continuance of such failure is a separate offense. The penalties so imposed, plus reasonable attorneys' fees, court costs and other expenses of litigation, are recoverable by the (_____) upon its suit as debts are recoverable at law.

7.5 Injunctive Relief

In addition to the penalties provided in the foregoing Section, wherever a person violates any provision of this Ordinance or fails to comply with any Order of the (_____), the (_____), acting through the Manager, may apply to the Circuit Court of the County for the issuance of an injunction restraining the person violating the Ordinance or failing to comply with the Order, from making any further discharges into the sewerage facilities under the jurisdiction of the (_____).

8.0 Industrial Self-Monitoring Requirements (optional)

In order to effectively administer and enforce the provisions of these regulations, the Manager may ask any discharger to comply with any or all of the following requirements:

8.1 Discharge Reports

The Manager may require discharge reports, including but not limited to questionnaires, technical reports, sampling reports, test analyses, and periodic reports of wastewater discharge.

When a report filed by a user pursuant to this section is not adequate in the judgment of the Manager, he may require the user to supply such additional information as the Manager deems necessary.

The discharge report may include, but not be limited to, nature of the process, volume and rates of wastewater flow, elements, constituents, and characteristics of the wastewater, together with any information required in an application for a wastewater discharge permit.

8.2 Monitoring Programs

The Manager may require of users such technical or monitoring programs, including the submission of periodic reports, as he deems necessary, provided that the burden, including costs, of such programs and reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained therefrom. The discharger shall pay the applicable (_____) charge for the monitoring program, in addition to the sewage disposal and other charges established by the (_____).

The monitoring program may require the discharger to conduct a sampling and analysis program of a frequency and type specified by the Manager to demonstrate compliance with prescribed wastewater discharge limits. The discharger may either:

A. Conduct his own sampling and analysis program provided he demonstrates to the Manager that he has the necessary qualifications and facilities to perform the work; or

B. Engage a private laboratory, approved by the Manager.

8.3 Trade Secrets

When requested by the user furnishing a report or permit application or questionnaire, the portions of the report, or other document, which might disclose trade secrets or secret processes shall not be made available for inspection by the public but shall be made available to governmental agencies for use in making studies; provided, however, that such portions of a report, or other document, shall be available for use by the (_____) or the State or any State agency in judicial review or enforcement proceedings involving the person furnishing the report.

9.0 Procedural Clauses

9.1 Authority of the Manager

 The Manager is charged with the responsibility for the (_____) industrial discharge control program and enforcement of the provisions of this Ordinance.

9.2 Savings Clause

 If the provisions of any paragraph, section or article of this Ordinance are declared unconstitutional or invalid by the final decision of any court of competent jurisdiction, the provisions of the remaining paragraphs, sections or articles shall continue in full force and effect.

9.3 Other Regulations

 This Ordinance supplements other regulations now in force in the (_____). These include the (Plumbing Code and the Sewer Surcharge Ordinance) (optional). All parts of these existing ordinances which are in conflict herewith are hereby rescinded. All other parts of these existing ordinances remain in full effect.

9.4 Effective Date

 This Ordinance shall become effective on (January 1, 1976) (optional).

APPENDIX 4
TEST PROCEDURES FOR ANALYSIS OF POLLUTANTS

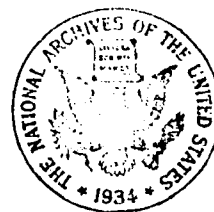
Guidelines Establishing Test Procedures
for Analysis of Pollutants (October 16, 1973)

Analysis of Pollutants - Proposed Guidelines
for Establishing Test Procedures (June 9, 1975)

TUESDAY, OCTOBER 16, 1973
WASHINGTON, D.C.

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PART II



ENVIRONMENTAL PROTECTION AGENCY



WATER PROGRAMS

Guidelines Establishing Test Procedures
for Analysis of Pollutants

Title 40—Protection of Environment
CHAPTER I—ENVIRONMENTAL
PROTECTION AGENCY

SUBCHAPTER D—WATER PROGRAMS

PART 136—GUIDELINES ESTABLISHING
TEST PROCEDURES FOR THE ANALY-
SIS OF POLLUTANTS

Notice was published in the *FEDERAL REGISTER* issue of June 29, 1973 (38 FR 17318) at 40 CFR 130, that the Environmental Protection Agency (EPA) was giving consideration to the testing procedures required pursuant to section 304(g) of the Federal Water Pollution Control Act Amendments of 1972 (86 Stat. 816, et seq., Pub. L. 92-500 (1972)) hereinafter referred to as the Act. These considerations were given in the form of proposed guidelines establishing test procedures.

Section 304(g) of the Act requires that the Administrator shall promulgate guidelines establishing test procedures for the analysis of pollutants that shall include factors which must be provided in: 1, any certification pursuant to section 401 of the Act, or 2, any permit application pursuant to section 402 of the Act. Such test procedures are to be used by permit applicants to demonstrate that effluent discharges meet applicable pollutant discharge limitations, and by the States and other enforcement activities in routine or random monitoring of effluents to verify effectiveness of pollution control measures.

These guidelines require that discharge measurements, including but not limited to the pollutants and parameters listed in Table I, be performed by the test procedures indicated; or under certain circumstances by other test procedures for analysis that may be more advantageous to use, when such other test procedures have the approval of the Regional Administrator of the Region where such discharge will occur, and when the Director of an approved State National Pollutant Discharge Elimination System (NPDES) Program (hereinafter referred to as the Director) for the State in which such discharge will occur has no objection to such approval.

The list of test procedures in Table I is published herein as final rulemaking and represents major departures from the list of proposed test procedures which was published in 38 FR 17318, dated June 29, 1973. These revisions were made after carefully considering all written comments which were received pertaining to the proposed test procedures. All written comments are on file and available for public review with the Quality Assurance Division, Office of Research and Development, EPA, Washington, D.C.

The principal revisions to the proposed test procedures are as follows:

1. Where several reliable test procedures for analysis are available from the given references for a given pollutant or parameter, each such test procedure has been approved for use for making the measurements required by sections 401 and 402 and related sections of the Act. Approved test procedures have been

selected to assure an acceptable level of intercomparability of pollutants discharge data. For several pollutants and parameters it has still been necessary to approve only a single test procedure to assure this level of acceptability. This is a major departure from the proposed test procedures which would have required the use of a single reference method for each pollutant or parameter.

2. Under certain circumstances a test procedure not shown on the approved list may be considered by an applicant to be more advantageous to use. Under guidelines in §§ 136.4 and 136.5 it may be approved by the Regional Administrator of the Region where the discharge will occur, providing the Director has no objections. Inasmuch as there is no longer a single approved reference method against which a comparison can be made, the procedures for establishing such comparisons that were required by the proposed test procedures in § 130.4(b) have been deleted from this final guideline for test procedures for the analysis of pollutants.

3. A mechanism is also provided to assure national uniformity of such approvals of alternate test procedures for the analysis of pollutants. This is achieved through a centralized, internal review within the EPA of all applications for the use of alternate testing procedures. These will be reviewed and approved or disapproved on the basis of submitted information and other available information and laboratory tests which may be required by the Regional Administrator.

As deemed necessary, the Administrator will expand or revise these guidelines to provide the most responsive and appropriate list of test procedures to meet the requirements of sections 304(g), 401 and 402 of the Act, as amended.

These final guidelines establishing test procedures for the analysis of pollutants supersede the interim list of test procedures published in the *FEDERAL REGISTER* on April 19, 1973 (38 FR 9740) at 40 CFR Part 126 and subsequent procedures published on July 24, 1973 (38 FR 19894) at 40 CFR Part 124. Those regulations established interim test procedures for the submittal of applications under section 402 of the Act. Because of the importance of these guidelines for test procedures for the analysis of pollutants to the National Pollution Discharge Elimination System (NPDES), the Administrator finds good cause to declare that these guidelines shall be effective October 16, 1973.

JOHN QUARLES,
 Acting Administrator.

OCTOBER 3, 1973.

PART 136—TEST PROCEDURES FOR THE
ANALYSIS OF POLLUTANTS

Sec.	
136.1	Applicability.
136.2	Definitions.
136.3	Identification of test procedures.
136.4	Application for alternate test procedures.
136.5	Approval of alternate test procedures.

AUTHORITY: Sec. 304(g) of Federal Water Pollution Control Act Amendments of 1972 (86 Stat. 816, et seq., Pub. L. 92-500).

§ 136.1 Applicability.

The procedures prescribed herein shall, except as noted in § 136.5, be used to perform the measurements indicated whenever the waste constituent specified is required to be measured for:

(a) An application submitted to the Administrator, or to a State having an approved NPDES program, for a permit under section 402 of the Federal Water Pollution Control Act as amended (FWPCA), and,

(b) Reports required to be submitted by dischargers under the NPDES established by Parts 124 and 125 of this chapter, and,

(c) Certifications issued by States pursuant to section 401 of the FWPCA, as amended.

§ 136.2 Definitions.

As used in this part, the term:

(a) "Act" means the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1314, et seq.

(b) "Administrator" means the Administrator of the U.S. Environmental Protection Agency.

(c) "Regional Administrator" means one of the EPA Regional Administrators.

(d) "Director" means the Director of the State Agency authorized to carry out an approved National Pollutant Discharge Elimination System Program under section 402 of the Act.

(e) "National Pollutant Discharge Elimination System (NPDES)" means the national system for the issuance of permits under section 402 of the Act and includes any State or interstate program which has been approved by the Administrator, in whole or in part, pursuant to section 402 of the Act.

(f) "Standard Methods" means *Standard Methods for the Examination of Water and Waste Water*, 13th Edition, 1971. This publication is available from the American Public Health Association, 1015 18th St. NW., Washington, D.C. 20036.

(g) "ASTM" means *Annual Book of Standards, Part 23, Water, Atmospheric Analysis*, 1972. This publication is available from the American Society for Testing and Materials, 1916 Race St., Philadelphia, Pennsylvania 19103.

(h) "EPA Methods" means *Methods for Chemical Analysis of Water and Wastes*, 1971, Environmental Protection Agency, Analytical Quality Control Laboratory, Cincinnati, Ohio. This publication is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (Stock Number 5501-0067).

§ 136.3 Identification of test procedures.

Every parameter or pollutant for which an effluent limitation is now specified pursuant to sections 401 and 402 of the Act is named together with test descriptions and references in Table I. The discharge parameter values for which reports are required must be de-

terminated by one of the standard analytical methods cited and described in Table I. or under certain circumstances by other methods that may be more advantageous to use when such other methods have been previously approved by the Regional Administrator of the Region in which the discharge will occur, and providing that the Director of the State in which such discharge will occur does not object to the use of such alternate test procedures.

Under certain circumstances the Re-

gional Administrator or the Director in the Region or State where the discharge will occur may determine for a particular discharge that additional parameters or pollutants must be reported. Under such circumstances, additional test procedures for analysis of pollutants may be specified by the Regional Administrator or Director upon the recommendation of the Director of the Methods Development and Quality Assurance Research Laboratory.

TABLE I—LIST OF APPROVED TEST PROCEDURES

Parameter and units	Method	References		
		Standard methods	ASTM	EPA methods
General analytical methods:				
1. Alkalinity as CaCO ₃ mg/liter.	Titration: electrometric, manual or automated method—methyl orange.	p. 370	p. 143	p. 6. p. 8.
2. R.O.D. five day mg/liter.	Modified winkler or probe method.	p. 489		
3. Chemical oxygen demand (C.O.D.) mg/liter.	Dichromate reflux.	p. 495	p. 219	p. 17.
4. Total solids mg/liter.	Gravimetric 103-105° C.	p. 535		p. 280.
5. Total dissolved (filterable) solids mg/liter.	Glass fiber filtration 180° C.			p. 278.
6. Total suspended (non-filterable) solids mg/liter.	Glass fiber filtration 103-105° C.	p. 537		p. 278.
7. Total volatile solids mg/liter.	Gravimetric 550° C.	p. 536		p. 282.
8. Ammonia (as N) mg/liter.	Distillation—nesslerization or titration automated phenolate.			p. 134. p. 141.
9. Kjeldahl nitrogen (as N) mg/liter.	Digestion + distillation—nesslerization or titration automated digestion phenolate.	p. 469		p. 143. p. 157.
10. Nitrate (as N) mg/liter.	Cadmium reduction; brucine sulfate, automated cadmium or hydrazine reduction.	p. 458 p. 461	p. 124	p. 170. p. 175. p. 185.
11. Total phosphorus (as P) mg/liter.	Persulfate digestion and single reagent (ascorbic acid), or manual digestion, and automated single reagent or stannous chloride.	p. 526 p. 532	p. 42	p. 235. p. 246. p. 269.
12. Acidity mg CaCO ₃ /liter.	Electrometric end point or phenolphthalein end point.		p. 148	
13. Total organic carbon (TOC) mg/liter.	Combustion—infrared method ¹ .	p. 257	p. 702	p. 221.
14. Hardness—total mg CaCO ₃ /liter.	EDTA titration; automated colorimetric atomic absorption.	p. 179	p. 170	p. 76. p. 78.
15. Nitrite (as N) mg/liter.	Manual or automated colorimetric diazotization.			p. 185. p. 195.
Analytical methods for trace metals:				
16. Aluminum—total ² mg/liter.	Atomic absorption.	p. 210		p. 98.
17. Antimony—total ² mg/liter.	Atomic absorption ⁴ .			
18. Arsenic—total mg/liter.	Digestion plus silver diethyldithiocarbamate; atomic absorption. ³	p. 65 p. 62		p. 13.
19. Barium—total ² mg/liter.	Atomic absorption ⁴ .	p. 210		
20. Beryllium—total ² mg/liter.	Aluminum; atomic absorption.	p. 67 p. 210		
21. Boron—total mg/liter.	Curcumin.	p. 69		
22. Cadmium—total ² mg/liter.	Atomic absorption; colorimetric.	p. 210 p. 422	p. 692	p. 101.
23. Calcium—total ² mg/liter.	EDTA titration; atomic absorption.	p. 84	p. 692	p. 102.
24. Chromium VI mg/liter.	Extraction and atomic absorption; colorimetric.	p. 429		p. 94.

Parameter and units	Method	References		
		Standard methods	ASTM	EPA methods
25. Chromium—total ² mg/liter.	Atomic absorption; colorimetric.	p. 210 p. 426	p. 692 p. 463	p. 191.
26. Cobalt—total ² mg/liter.	Atomic absorption ⁴ .		p. 463	
27. Copper—total ² mg/liter.	Atomic absorption; colorimetric.	p. 210 p. 139	p. 692 p. 610	p. 106.
28. Iron—total ² mg/liter.	do.	p. 210 p. 433	p. 692 p. 157	p. 106.
29. Lead—total ² mg/liter.	do.	p. 210 p. 436	p. 692 p. 692	p. 110.
30. Magnesium—total ² mg/liter.	Atomic absorption; Gravimetric.	p. 210 p. 416 p. 201	p. 692	p. 112.
31. Manganese—total ² mg/liter.	Atomic absorption.	p. 210	p. 692	p. 114.
32. Mercury—total mg/liter.	Flameless atomic absorption ⁴ .			
33. Molybdenum—total ² mg/liter.	Atomic absorption ⁴ .			
34. Nickel—total ² mg/liter.	Atomic absorption; colorimetric ⁴ .	p. 413 p. 233	p. 692 p. 326	p. 116.
35. Potassium—total ² mg/liter.	Atomic absorption; colorimetric; flame photometric.	p. 285		
36. Selenium—total mg/liter.	Atomic absorption ⁴ .			
37. Silver—total ² mg/liter.	Atomic absorption ⁴ .	p. 210		
38. Sodium—total ² mg/liter.	Flame photometric; atomic absorption.	p. 317	p. 326	p. 118.
39. Thallium—total ² mg/liter.	Atomic absorption ⁴ .			
40. Tin—total ² mg/liter.	do.			
41. Titanium—total ² mg/liter.	do.			
42. Vanadium—total ² mg/liter.	Atomic Absorption; ⁴ Colorimetric.	p. 157		
43. Zinc—total ² mg/liter.	Atomic Absorption; Colorimetric.	p. 210 p. 444	p. 692	p. 120.
Analytical methods for nutrients, anions, and organics:				
44. Organic nitrogen (as N) mg/liter.	Kjeldahl nitrogen minus ammonia nitrogen.	p. 468		p. 140.
45. Ortho-phosphate (as P) mg/liter.	Direct single reagent; automated single reagent or stannous chloride.	p. 532	p. 42	p. 235. p. 216. p. 259.
46. Sulfate (as SO ₄) mg/liter.	Gravimetric; turbidimetric; automated colorimetric—barium chloranilate.	p. 331 p. 334	p. 51 p. 52	p. 286. p. 288.
47. Sulfide (as S) mg/liter.	Titrimetric—iodine.	p. 551		p. 294.
48. Sulfite (as SO ₃) mg/liter.	Titrimetric; iodide-iodate.	p. 337	p. 261	
49. Bromide mg/liter.	do.		p. 216	
50. Chloride mg/liter.	Silver nitrate; mercuric nitrate; automated colorimetric—ferricyanide.	p. 96 p. 97	p. 23 p. 21	p. 29. p. 31.
51. Cyanide—total mg/liter.	Distillation—silver nitrate titration or pyridine pyrazolone colorimetric.	p. 397	p. 556	p. 41.
52. Fluoride mg/liter.	Distillation—SPADNS.	p. 171 p. 174	p. 191	p. 64.
53. Chlorine—total residual mg/liter.	Colorimetric; amperometric titration.	p. 382	p. 223	
54. Oil and grease mg/liter.	Liquid-Liquid extraction with trichlorotrifluoroethane.	p. 254		
55. Phenols mg/liter.	Colorimetric, 4 AAP.	p. 502	p. 445	p. 232.
56. Surfactants mg/liter.	Methylene blue colorimetric.	p. 509	p. 619	p. 131.
57. Aldehydes mg/liter.	Gas chromatography ⁴ .			
58. Benzidine mg/liter.	Diazotization—colorimetric ⁴ .			
59. Chlorinated organic compounds (except pesticides) mg/liter.	Gas chromatography ⁴ .			
60. Pesticides mg/liter.	Gas chromatography ⁴ .			
Analytical methods for physical and biological parameters:				
61. Color platinum-cobalt units or down invariant wave-length, hue, luminance, purity.	Colorimetric; spectrophotometric.	p. 180 p. 392		p. 28.
62. Specific conductance mho/cm at 25° C.	Wheatstone bridge.	p. 323	p. 163	p. 234.
63. Turbidity Jackson units.	Turbidimeter.	p. 350	p. 467	p. 308.

See Note at end of Table I

Parameter and units	Method	References		
		Standard methods	ASTM	EPA methods
64. Fecal streptococcal bacteria number/100 ml.	MPN; membrane filter; plate count.....	p. 689 p. 690 p. 691	.....	.....
65. Coliform bacteria (fecal) number/100 ml.	MPN; Membrane filter.....	p. 689 p. 694	.....	.....
66. Coliform bacteria (total) number/100 ml.	.....do.....	p. 664 p. 679	.....	.....
Radiological parameters:				
67. Alpha—total pCi/liter.	Proportional counter; scintillation counter	p. 598	p. 509	.....
68. Alpha—counting error pCi/liter.	.....do.....	p. 598	p. 512	.....
69. Beta—total pCi/liter.	Proportional counter.....	p. 598	p. 478	.....
70. Beta—counting error pCi/liter.	.....do.....	p. 598	p. 478	.....
71. Radium—total pCi/liter.	Proportional counter; scintillation counter.....	p. 611 p. 617	p. 674	.....

¹ A number of such systems manufactured by various companies are considered to be comparable in their performance. In addition, another technique, based on Combustion-Methane Detection, is also acceptable.

² For the determination of total metals the sample is not filtered before processing. Choose a volume of sample appropriate for the expected level of metals. If much suspended material is present, as little as 50-100 ml of well-mixed sample will most probably be sufficient. (The sample volume required may also vary proportionally with the number of metals to be determined.)

³ Transfer a representative aliquot of the well-mixed sample to a Griffin beaker and add 3 ml of concentrated distilled HNO₃. Place the beaker on a hotplate and evaporate to dryness making certain that the sample does not boil. Cool the beaker and add another 3 ml portion of distilled concentrated HNO₃. Cover the beaker with a watch glass and return to the hotplate. Increase the temperature of the hotplate so that a gentle reflux action occurs. Continue heating, adding additional acid as necessary until the digestion is complete, generally indicated by a light colored residue. Add (1:1 with distilled water) distilled concentrated HCl in an amount sufficient to dissolve the residue upon warming. Wash down the beaker walls and the watch glass with distilled water and filter the sample to remove silicates and other insoluble material that could clog the atomizer. Adjust the volume to some predetermined value based on the expected metal concentrations. The sample is now ready for analysis. Concentrations so determined shall be reported as "total".

⁴ See D. C. Manning, "Technical Notes", Atomic Absorption Newsletter, Vol. 10, No. 6 p. 123, 1971. Available from Perkin-Elmer Corporation, Main Avenue, Norwalk, Connecticut 06852.

⁵ Atomic absorption method available from Methods Development and Quality Assurance Research Laboratory, National Environmental Research Center, USEPA, Cincinnati, Ohio 45268.

⁶ For updated method, see: Journal of the American Water Works Association 64, No. 1, pp. 20-25 (Jan. 1972) or ASTM Method D 3223-73, American Society for Testing and Materials Headquarters, 1916 Race St., Philadelphia, Pa. 19103.

⁷ Interim procedures for aldehydes, chlorinated organic compounds, and pesticides can be obtained from the Methods Development and Quality Assurance Research Laboratory, National Environmental Research Center, USEPA, Cincinnati, Ohio 45268.

⁸ Benzidine may be estimated by the method of M.A. El-Dib, "Colorimetric Determination of Aniline Derivatives in Natural Waters", El-Dib, M.A., Journal of the Association of Official Analytical Chemists, Vol. 54, No. 6, Nov., 1971, pp. 1383-1387.

⁹ As a prescreening measurement.

§ 136.4 Application for alternate test procedures.

(a) Any person may apply to the Regional Administrator in the Region where the discharge occurs for approval of an alternative test procedure.

(b) When the discharge for which an alternative test procedure is proposed occurs within a State having a permit program approved pursuant to section 402 of the Act, the applicant shall submit his application to the Regional Administrator through the Director of the State agency having responsibility for issuance of NPDES permits within such State.

(c) Unless and until printed application forms are made available, an appli-

cation for an alternate test procedure may be made by letter in triplicate. Any application for an alternate test procedure under this subchapter shall:

(1) Provide the name and address of the responsible person or firm making the discharge (if not the applicant) and the applicable ID number of the existing or pending permit, issuing agency, and type of permit for which the alternate test procedure is requested, and the discharge serial number.

(2) Identify the pollutant or parameter for which approval of an alternate testing procedure is being requested.

(3) Provide justification for using testing procedures other than those specified in Table I.

(4) Provide a detailed description of the proposed alternate test procedure, together with references to published studies of the applicability of the alternate test procedure to the effluents in question.

§ 136.5 Approval of alternate test procedures.

(a) The Regional Administrator of the region in which the discharge will occur has final responsibility for approval of any alternate test procedure.

(b) Within thirty days of receipt of an application, the Director will forward such application, together with his recommendations, to the Regional Administrator. Where the Director recommends rejection of the application for scientific and technical reasons which he provides, the Regional Administrator shall deny the application, and shall forward a copy of the rejected application and his decision to the Director of the State Permit Program and to the Director of the Methods Development and Quality Assurance Research Laboratory.

(c) Before approving any application for an alternate test procedure, the Regional Administrator shall forward a copy of the application to the Director of the Methods Development and Quality Assurance Laboratory for review and recommendation.

(d) Within ninety days of receipt by the Regional Administrator of an application for an alternate test procedure, the Regional Administrator shall notify the applicant and the appropriate State agency of approval or rejection, or shall specify the additional information which is required to determine whether to approve the proposed test procedure. Prior to the expiration of such ninety day period, a recommendation providing the scientific and other technical basis for acceptance or rejection will be forwarded to the Regional Administrator by the Director of the Methods Development and Quality Assurance Research Laboratory. A copy of all approval and rejection notifications will be forwarded to the Director, Methods Development and Quality Assurance Research Laboratory, for the purposes of national coordination.

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emission limit and the expected size of new plants, the 25 pounds per hour criterion would be exceeded. Where the affected facility or facilities could exceed this criterion, the proposal of the new source performance standard will also include a proposal to add such plants to the list of sources subject to the significant deterioration review; however, only those size plants which will exceed the 25 pounds per hour emission limitation will be required to undergo the preconstruction review.

Only ferroalloy production facilities are proposed to be added at this time, since they are the only sources not already subject to the significant deterioration regulation which meet the above criteria. No restrictions are placed on the size ferroalloy production facility subject to the review, since all plants from this source category affected by the new source performance standard are expected to be of sufficient size to exceed the emission limitation criterion.

Consideration was given to several other source selection criteria, including not combining the selection of additional sources with establishment of new source performance standards. However, a review of more than 150 candidate sources revealed that the Agency's vigorous ongoing new source performance standard program is orientated toward those sources capable of having major impacts on the air quality increments. In view of the requirement for sources affected by the significant deterioration regulation to use best available control technology, and since meeting a new source performance standard satisfies this requirement, the Administrator has concluded the most logical approach for future addition of sources would be through combining the addition of sources subject to the significant deterioration review with proposals for new source performance standards. The proposed approach will provide a clear and uniform definition of best available control technology for sources which become subject to the significant deterioration regulation in the future.

The Administrator also considered various emission rate limitations as a cut-off criteria for adding sources to the preconstruction requirements of the regulation. A cut-off criterion of 25 pounds per hour was selected to preclude numerous preconstruction reviews of well-controlled sources which have only minor impact on the specified air quality increments. Also, the focus on major sources essentially regulates the basic economic structure or framework of an area. Therefore, if the major sources are restricted or prohibited in an area, the growth of smaller sources, which often depend to a certain extent on the existence of the major sources, will likewise be restricted. Consequently, it is the Administrator's judgement that reasonable protection of the deterioration increments can be obtained by continuing to focus on major sources.

The Administrator recognizes that future air quality may require a change in the proposed selection criteria; such changes will be adopted as necessary to ensure that the provisions and intent of

the December 5th regulations are complied with.

Comments on the proposed changes and the Administrator's plan for subjecting additional sources to the preconstruction review requirements are solicited, and should be forwarded (in triplicate) to the Office of Air Quality Planning and Standards, Environmental Protection Agency, Research Triangle Park, N.C. 27711, attn: Mr. Kent Berry. All relevant comments received on or before July 9, 1975, will be considered. Comments received will be available for public inspection at the Office of Public Affairs, 401 M Street, SW., Washington, D.C., 20460.

(Secs. 110(c), 301(a) of the Clean Air Act as amended (42 U.S.C. 1857c-5(c) 1857g(a))

Dated: June 2, 1975.

RUSSELL E. TRAIN,
Administrator.

It is proposed to amend Part 52 of Chapter I, Title 40 of the Code of Federal Regulations as follows:

1. In § 52.21, paragraph (d) is revised to read as follows:

§ 52.21 Prevention of significant deterioration.

(d)
(1)

(xix) Ferroalloy production facilities.

[FR Doc.75-14906 Filed 6-6-75; 8:45 am]

[40 CFR Part 136]

[FRL 366-2]

ANALYSIS OF POLLUTANTS

Proposed Guidelines for Establishing Test Procedures

The Environmental Protection Agency is considering amendments to Part 136 of Title 40, Code of Federal Regulations, setting forth Guidelines Establishing Test Procedures for the Analysis of Pollutants. These amendments would correct minor errors and include additional parameters and analytical methods in § 136.3, "Identification of Test Procedures." The guidelines were published in the FEDERAL REGISTER on Tuesday, October 16, 1973 (38 FR 28757).

Interested persons may participate in this proposed rule making by submitting written comments, suggestions, or objections to the Office of Research and Development, Quality Assurance Division (RD-687, EPA, Washington, D.C. 20460 on or before July 24, 1975. All comments which are received within this time period will be considered before final action is taken on this proposed amendment. Copies of all comments received will be available for examination by interested persons in Room 3100D, Waterside Mall Building, 401 M Street, SW., Washington, D.C. 20460. The proposed amendment may be changed in light of the comments received.

Section 136.3 identified the test procedures which must be used in any certification pursuant to section 401 or permit application pursuant to section 402

of the Federal Water Pollution Control Act Amendments of 1972 (86 Stat. 816 et seq., Pub. L. 92-500 (1972)). It is proposed to make minor wording changes and correct typographical errors in entries numbered 1, 2, 9, 14, 37, 53, and 62. These changes do not affect the nature of the parameter measured or the method to be used, but simply serve to clarify the meaning of the entries listed.

Certain parameters not included in the original list have been determined to be significant in the control of pollutants for which the Agency has established effluent limitations. For these parameters, test procedures have been selected which will provide reliable data when they are employed with an adequate quality control program. The additional parameters are: 2(a)-Dissolved Oxygen, 6(a)-Settleable Solids, 11(a)-Elemental Phosphorus, 12(a)-pH, 36(b)-Dissolved Silica, 51(a)-Cyanide Amenable to Chlorination, 62(a)-Temperature, 65(a)-Coliform Bacteria (fecal) in the presence of chlorine, a separate test for the dissolved moiety of each of the twenty-nine trace metals on the list, and tests for the noble metals Gold-27(b), Iridium-27(c), Osmium-31(b), Palladium-34(c), Platinum-34(d), Rhodium-35(b), and Ruthenium-35(c). It is recognized that the method specified for elemental phosphorus may be unreliable under some circumstances; it will be considered an "Interim" method. Hydrogen ion concentration will be measured electrometrically, and for purposes of this regulation will be defined as "the pH indicated by such measuring systems. Note that the table also includes entries for acidity and alkalinity; these are separate parameters from pH and are determined by titrating samples under specified conditions.

Certain entries on the list will be changed in the interest of obtaining more consistent, accurate data. Item 8, Ammonia, will be changed to permit use of an electrometric probe. Item 51, Cyanide, will be expanded to allow barbituric acid as a reagent in the test. The Fluoride test procedure (Item 52) will be relaxed to allow use of electrometric or automated methods after a manual distillation step. This distillation is considered to be vital in obtaining complete, accurate measurements. Oil and grease, Item 54, will be measured either gravimetrically or spectrophotometrically, thus allowing a better selectivity when desired. The method for Benzidine, Item 58, is being changed to a revised chloramine-T procedure which is believed to be the most selective and sensitive one available at this time.

It is recognized that improvements are possible and desirable in the methods for cyanide amenable to chlorination, oil and grease, and benzidine. Constructive, well-documented suggestions and comments regarding analytical procedures for these parameters are solicited.

In consideration of the foregoing, it is proposed to amend Chapter I of Title 40, Code of Federal Regulations, as follows:

§ 136.3 [Amended]

1. In § 136.3, Table I is amended to read as follows:

PROPOSED RULES

TABLE I.—List of approved test procedures

Parameter and units	Method	References (page Nos.)		
		Standard methods	ASTM	EPA methods
General analytical methods:				
1. Alkalinity as CaCO ₃ milligrams CaCO ₃ per liter.	Electrometric titration, manual or automated (to pH 4.5) or automated methyl orange titration.	370	143	8, 8
2. Biological oxygen demand, 5-day (BOD ₅), milligrams per liter.	Modified winkler or probe method.	489		
2(a). Dissolved oxygen milligrams per liter.	Modified (azide) winkler or electrode probe.	477, 484	350	53, 60
3. Chemical oxygen demand (COD), milligrams per liter.	Dichromate reflux.	495	219	17
4. Total solids, milligrams per liter.	Gravimetric 103 to 105° C.	535		280
5. Total dissolved (filterable) solids milligrams per liter.	Glass fiber filtration 180° C.			275
6. Total suspended (nonfilterable) solids, milligrams per liter.	Glass fiber filtration, 103 to 105° C.	537		278
6(a). Settleable solids, milliliter per liter or milligrams per liter.	Imhoff cone or graduated cylinder or gravimetric.	539		
7. Total volatile solids, milligrams per liter.	Gravimetric, 550° C.	536		282
8. Ammonia (as N) ¹ , milligrams per liter.	Manual distillation and nesslerization, or titration, or automated phenolate, or electrode.			134, 141
9. Kjeldahl nitrogen (as N), milligrams per liter.	Digestion and distillation—nesslerization or titration; automated digestion, phenolate.	469		149, 157
10. Nitrate (as N), milligrams per liter.	Cadmium reduction; brucine sulfate; automated cadmium or hydrazine reduction.	458, 461	124	170, 175, 185
11. Total phosphorous (as P), milligrams per liter.	Persulfate digestion and single reagent (ascorbic acid), or manual digestion, and automated single reagent or stannous chloride.	526, 532	42	235, 246, 259
11(a). Phosphorus (elemental) ² milligrams per liter.	Gas chromatography.			
12. Acidity milligrams CaCO ₃ per liter.	Electrometric end point or phenolphthalein end point.		148	
12(a). Hydrogen ion (pH), pH units.	Electrometric measurement.	500	248	230
13. Total organic carbon (TOC), milligrams per liter.	Combustion—infrared method ³ .	257	702	221
14. Hardness—total, milligrams CaCO ₃ per liter.	EDTA titration; automated colorimetric; atomic absorption.	179	170	76, 78
15. Nitrite (as N), milligrams per liter.	Manual or automated colorimetric diazotization.			185, 195
Analytical methods for trace metals:				
16. Aluminum—total, ⁴ milligrams per liter.	Atomic absorption.	210		98
16(a). Aluminum—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total aluminum.			86
17. Antimony—total, ⁴ milligrams per liter.	Atomic absorption ⁵ .			
17(a). Antimony—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total antimony.			86
18. Arsenic—total milligrams per liter.	Digestion plus silver diethyldithiocarbamate; atomic absorption. ⁶	65, 62		13
18(a). Arsenic—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total arsenic.			86
19. Barium—total, ⁴ milligrams per liter.	Atomic absorption ⁷ .	210		
19(a). Barium—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total barium.			86
20. Beryllium—total, ⁴ milligrams per liter.	Aluminum; atomic absorption.	67, 210		
20(a). Beryllium—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total beryllium.			86
21. Boron—total, milligrams per liter.	Curcumin.	69		
21(a). Boron—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total boron.			86
22. Cadmium—total ⁴ , milligrams per liter.	Atomic absorption; colorimetric.	210, 422	692	101
22(a). Cadmium—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total cadmium.			86
23. Calcium—total ⁴ , milligrams per liter.	EDTA titration; atomic absorption.	84	602	102
23(a). Calcium—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total calcium.			86
24. Chromium VI, milligrams per liter.	Extraction and atomic absorption; colorimetric.	429		94
24(a). Chromium VI—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total chromium VI.			86
25. Chromium—total ⁴ , milligrams per liter.	Atomic absorption; colorimetric.	210, 426	692, 403	104
25(a). Chromium—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total chromium.			86
26. Cobalt—total ⁴ , milligrams per liter.	Atomic absorption ⁸ .		692	
26(a). Cobalt—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total cobalt.			86
27. Copper—total ⁴ , milligrams per liter.	Atomic absorption; colorimetric.	210, 430	692, 410	106
27(a). Copper—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total copper.			86
27(b). Gold—total ⁴ , milligrams per liter.	Atomic absorption ⁹ .			
27(c). Iridium—total ⁴ , milligrams per liter.	do ⁹ .			
28. Iron—total ⁴ , milligrams per liter.	Atomic absorption; colorimetric.	210, 433	692, 152	108
28(a). Iron—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total iron.			86
29. Lead—total ⁴ , milligrams per liter.	Atomic absorption; colorimetric.	210, 436	692	110
29(a). Lead—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total lead.			86
30. Magnesium—total ⁴ , milligrams per liter.	Atomic absorption; gravimetric.	210, 416, 201	692	112

TABLE I.—List of approved test procedures—Continued

Parameter and units	Method	References (page Nos.)		
		Standard methods	ASTM	EPA methods
30(a). Magnesium—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total magnesium.			86
31. Manganese—total, ⁴ milligrams per liter.	Atomic absorption.	210	602	114
31(a). Manganese—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total manganese.			86
32. Mercury—total, milligrams per liter.	Flameless atomic absorption. ⁵			
32(a). Mercury—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total mercury.			86
33. Molybdenum—total, ⁴ milligrams per liter.	Atomic absorption. ⁶			
33(a). Molybdenum—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total molybdenum.			86
34. Nickel—total, ⁴ milligrams per liter.	Atomic absorption; colorimetric. ⁷	443	602	
34(a). Nickel—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total nickel.			86
34(b). Osmium—total, ⁴ milligrams per liter.	Atomic absorption. ⁸			
34(c). Palladium—total, ⁴ milligrams per liter.	do. ⁸			
34(d). Platinum—total, ⁴ milligrams per liter.	do. ⁸			
35. Potassium—dissolved, milligrams per liter.	Atomic absorption; colorimetric; flame photometric.	283, 285	326	115
35(a). Potassium—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total potassium. ⁹			86
35(b). Rhodium—total, ⁴ milligrams per liter.	Atomic absorption. ⁹			
35(c). Ruthenium—total, ⁴ milligrams per liter.	do. ⁹			
36. Selenium—total, ⁴ milligrams per liter.	do. ⁹			
36(a). Selenium—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total selenium.			86
36(b). Silica—dissolved, milligrams per liter.	0.45 micron filtration and molybdosilicate colorimetric.	303	83	86, 273
37. Silver—total, ⁴ milligrams per liter.	Atomic absorption. ⁹	210		
37(a). Silver—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total silver.			86
38. Sodium—total, ⁴ milligrams per liter.	Flame photometric; atomic absorption.	317	326	118
38(a). Sodium—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total sodium.			86
39. Thallium—total, ⁴ milligrams per liter.	Atomic absorption. ⁹			
39(a). Thallium—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total thallium.			86
40. Tin—total, ⁴ milligrams per liter.	Atomic absorption. ⁹			
40(a). Tin—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total tin.			86
41. Titanium—total, milligrams per liter.	Atomic absorption. ⁹			
41(a). Titanium—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total titanium.			86
42. Vanadium—total, ⁴ milligrams per liter.	Atomic absorption; ⁹ colorimetric.	357		
42(a). Vanadium—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total vanadium.			86
43. Zinc—total, ⁴ milligrams per liter.	Atomic absorption; colorimetric.	210, 444	602	120
43(a). Zinc—dissolved, milligrams per liter.	0.45 micron filtration and reference method for total zinc.			86
<i>Analytical Methods for Nutrients, Anions, and Organics</i>				
44. Organic nitrogen (as N), milligrams per liter.	Kjeldahl nitrogen minus ammonia nitrogen.	468		140
45. Ortho-phosphate (as P),	Direct single reagent; automated single reagent or stannous chloride.	532	42	235, 246, 250
46. Sulfate (as SO ₄),	Gravimetric; turbidimetric; automated colorimetric—barium chloranilate.	331, 334	51, 52	286, 288
47. Sulfide (as S), milligrams per liter.	Titrimetric—iodine.	551		204
47(a). Sulfide (as S), milligrams per liter.	Methylene blue photometric for levels less than 1 mg per liter.	558		
48. Sulfite (as SO ₃), milligrams per liter.	Titrimetric; iodine-iodate.	337	261	
49. Bromide, milligrams per liter.	do.		216	
50. Chloride, milligrams per liter.	Silver nitrate; mercuric nitrate; automated colorimetric—ferricyanide.	90, 97	23, 21	20, 31
51. Cyanide, total, milligrams per liter.	Distillation—silver nitrate titration or pyridine pyrazolone (or barbituric acid) colorimetric.	307	556	41

TABLE I.—List of approved test procedures—Continued

Parameter and units	Method	References (page Nos.)		
		Standard methods	ASTM	EPA methods
51(a). Cyanide amenable to chlorination, milligrams per liter.	Colorimetric		558	
52. Fluoride, milligrams per liter.	Distillation—probe or SPADNS after distillation; automated complexone.	171, 174	191, 194	64, 66, 72
53. Chlorine—total, residual milligrams per liter.	Iodometric; amperometric titration.	173	223	
54. Oil and grease,* milligrams per liter.	Liquid-liquid extraction with trichlorotrifluoroethane-gravimetric or spectrophotometric (I.R.).	254		
55. Phenols, milligrams per liter.	Colorimetric, 4 AAP.	502	445	232
56. Surfactants, milligrams per liter.	Methylene blue; colorimetric.	339	619	131
57. Aldehydes, milligrams per liter.	Gas chromatography ¹ .			
58. Benzidine, milligrams per liter.	Oxidation—colorimetric ¹⁰ .			
59. Chlorinated organic compounds (except pesticides), milligrams per liter.	Gas chromatography ² .			
60. Pesticides, milligrams per liter.	Gas chromatography ³ .			
Analytical methods for physical and biological parameters:				
61. Color, platinum-cobalt units or dominant wavelength, hue, luminance, purity.	Colorimetric; spectrophotometric.	160, 302		28
62. Specific conductance, micromhos per centimeter at 25° C.	Wheatstone bridge.	323	163	284
62(a). Temperature degrees C.	Calibrated glass or electrometric thermometer.	318		296
63. Turbidity Jackson units.	Turbidimeter.	350	467	308
64. Fecal streptococci bacteria number per 100 ml.	MPN; membrane filter; plate count.	689, 690		
65. Coliform bacteria (fecal) number per 100 ml.	MPN; membrane filter.	691		
65(a). Coliform bacteria (fecal) in presence of chlorine number per 100 ml.	MPN.	689, 684		
66. Coliform bacteria (total) number per 100 ml.	MPN; membrane filter.	669		
66(a). Coliform bacteria (total) in presence of chlorine number per 100 ml.	MPN; membrane filter with enrichment.	664, 679		
Radiological parameters:				
67. Alpha—total, pCi per liter.	Proportional counter; scintillation counter.	664, 682, 683		
68. Alpha—counting error, pCi per liter.	do.	508	509	
69. Beta—total, pCi per liter.	Proportional counter.	508	512	
70. Beta—counting error, pCi per liter.	do.	508	478	
71. Radium—total, pCi per liter.	Proportional counter; scintillation counter.	611, 617	674	

¹ Robert F. Thomas and Robert L. Booth, "Selective Electrode Measurement of Ammonia in Water and Wastes," "Environmental Science and Technology," Vol. 7, No. 6, pp. 523-526, 1973. A detailed method description is also available from the Methods Development and Quality Assurance Research Laboratory (MDQARL), National Environmental Research Center (NERC), USEPA, Cincinnati, Ohio 45268.

² R. F. Addison and R. G. Ackman, "Direct Determination of Elemental Phosphorus by Gas-Liquid Chromatography," "Journal of Chromatography," Vol. 47, No. 3, pp. 421-426, 1970.

³ A number of such systems manufactured by various companies are considered to be comparable in their performance. In addition, another technique, based on Combustion-Methane Detection, is also acceptable.

⁴ For the determination of total metals the sample is not filtered before processing. Choose a volume of sample appropriate for the expected level of metals. If much suspended material is present, as little as 50-100 ml of well-mixed sample will most probably be sufficient. (The sample volume required may also vary proportionally with the number of metals to be determined.)

Transfer a representative aliquot of the well-mixed sample to a Griffin beaker and add 3 ml of concentrated distilled HNO₃. Place the beaker on a hotplate and evaporate to dryness making certain that the sample does not boil. Cool the beaker and add another 3 ml portion of distilled concentrated HNO₃. Cover the beaker with a watch glass and return to the hotplate. Increase the temperature of the hotplate so that a gentle reflux action occurs. Continue heating, adding additional acid as necessary until the digestion is complete, generally indicated by a light colored residue. Add (1:1 with distilled water) distilled concentration HCl in an amount sufficient to dissolve the residue upon warming. Wash down the beaker walls and the watch glass with distilled water and filter the sample to remove silicates and other insoluble material that could clog the atomizer. Adjust the volume to some predetermined value based on the expected metal concentrations. The sample is now ready for analysis. Concentrations so determined shall be reported as "total." For a more complete discussion of sample handling and preparation for atomic absorption analysis, see pp. 81-92 of EPA Methods.

For the measurement of the noble metal series (gold, iridium, osmium, palladium, platinum, rhodium and ruthenium), an aqua regia digestion is to be substituted for the nitric acid digestion in the paragraph above as follows:

Transfer a representative aliquot of the well-mixed sample to a Griffin beaker and add 3 ml of conc. redistilled HNO₃. Place the beaker on a steam bath and evaporate to dryness. Cool the beaker and cautiously add a 5 ml portion of aqua regia. (See below for preparation of aqua regia.) Cover the beaker with a watch glass and return to the steam bath. Continue heating the covered beaker for 50 minutes. Remove cover and evaporate to dryness. Cool and take up the residue in a small quantity of 1:1 HCl. Wash down the beaker walls and wash glass with distilled water and filter the sample to remove silicates and other insoluble material that could clog the atomizer. Adjust the volume to some predetermined value based on the expected metal concentration. The sample is now ready for analysis.

⁵ Aqua regia—prepare immediately before use by carefully adding three volumes of conc. HCl to one volume of conc. HNO₃.

⁶ Atomic absorption method available from Methods Development and Quality Assurance Research Laboratory, National Environmental Research Center, USEPA, Cincinnati, Ohio 45268.

⁷ See D.C. Mumford, "Technical Notes," "Atomic Absorption Newsletter," Vol. 10, No. 6, p. 123, 1971. Available from Perkin-Elmer Corporation, Main Avenue, Norwalk, Connecticut 06852.

Footnotes continued on next page.

* For updated method, see: "Journal of the American Water Works Association 61," No. 1, pp. 20-25 (Jan. 1973) or ASTM Method D 3223-73, American Society for Testing and Materials Headquarters, 1916 Race Street, Philadelphia, Pennsylvania 19103.

* Method for infrared spectrophotometric determination of oil and grease is available from the MDQARL, NERC, USEPA, Cincinnati, Ohio 45268.

* Interim procedures for aldehydes, chlorinated organic compounds, and pesticides can be obtained from the Methods Development and Quality Assurance Research Laboratory, National Environmental Research Center, USEPA, Cincinnati, Ohio 45268.

* Adequately tested methods for benzidine are not available. Until approved methods are available, the following interim method can be used for the estimation of benzidine: 1. "Method for Benzidine and its salts in wastewaters." Method available from Methods Development and Quality Assurance Research Laboratory, National Environmental Research Center, USEPA, Cincinnati, Ohio 45268.

Note.—Dissolved metals are defined as those constituents which will pass through a 0.45 micron membrane filter. A prefiltration is permissible to free the sample from larger suspended solids.

Dated: May 30, 1975.

RUSSELL E. TRAIN,
Administrator.

[FR Doc.75-14776 Filed 6-6-75;8:45 am]

[40 CFR Part 180]

[OPP-280002; FRL 384-7]

PINE OIL

Proposed Exemption From Requirement of a Tolerance

Section 408(e) of the Federal Food, Drug, and Cosmetic Act provides that the Administrator may at any time, upon his own initiative, propose the issuance of a regulation exempting a pesticide chemical from the requirement of a tolerance. It is proposed that pine oil, used as a deodorant, be exempted from the requirement of a tolerance when used in accordance with good agricultural practice as an inert ingredient in formulation with the bee repellent butanoic anhydride. Based on available data, it is concluded that the proposed regulation will protect the public health.

Any person who has registered or submitted an application for the registration of a pesticide under the Federal Insecticide, Fungicide, and Rodenticide Act which contains any of the ingredients listed herein may request, within 30 days after publication of this notice, that this proposal be referred to an advisory committee in accordance with section 408(e) of the Federal Food, Drug, and Cosmetic Act.

Interested persons are invited to submit written comments on the proposed regulation to the Federal Register Section, Technical Services Division (WH-569), Office of Pesticide Programs, Environmental Protection Agency, Room 401, East Tower, 401 M Street, SW, Washington, DC 20460. Three copies of the comments should be submitted to facilitate the work of the Agency and others interested in inspecting them. The comments must be received on or before July 9, 1975 and should bear a notation indicating the subject (OPP-280002). All written comments filed pursuant to this notice will be available for public inspection in the office of the Federal Register Section from 8:30 a.m. to 4 p.m. Monday through Friday.

It is proposed that Part 180, Subpart D, be amended by adding § 180.1035.

Dated: June 2, 1975.

JOHN B. RITCH, Jr.,
Director,
Registration Division.

(Sec. 408(e) Federal Food, Drug, and Cosmetic Act (21 U.S.C. 346(a) (6)))

It is proposed that Part 180, Subpart D, be amended by adding § 180.1035 to read as follows.

§ 180.1035 Pine oil; exemption from the requirement of a tolerance.

Pine oil is exempted from the requirement of a tolerance when used as a deodorant at no more than 12 percent in formulation with the bee repellent butanoic anhydride applied in an absorbent pad over the hive.

[FR Doc.75-14876 Filed 6-6-75;8:45 am]

[40 CFR Part 421]

[FRL 384-7]

NONFERROUS METALS MANUFACTURING POINT SOURCE CATEGORY

Effluent Limitations and Guidelines

The purpose of this notice is to propose amendments to Subpart A—Bauxite Refining, and Subpart C—Secondary Aluminum Smelting, of 40 CFR Part 421—Nonferrous Metals Manufacturing Point Source Category. On April 8, 1974, the Environmental Protection Agency published a notice of final rulemaking establishing effluent limitations guidelines for existing sources and standards of performance and pretreatment standards for new sources for three subcategories of the nonferrous metals category—bauxite refining, primary aluminum smelting and secondary aluminum smelting. 40 CFR Part 421. The Agency has continued to review the regulations, both in the context of litigation filed on these particular regulations (Reynolds Metals Co. v. EPA, C.A. 4, Civ. No. 74-1760) and in considering the impact of issues raised in other guideline reviews on Part 421. As a result of this review, it has been determined that certain amendments would be appropriate. These amendments are the subject of this notice.

In Part 421 the Administrator established for the bauxite refining subcategory an effluent limitation for existing plants of "no discharge of process waste water pollutants to navigable waters." The treatment technology relied upon in defining the effluent limitations was total impoundment. Recognizing the difficulty in achieving "no discharge" in the face of significant rainfall, the regulations allow for discharge of excess rainfall that

falls within the impoundment. Under the circumstances, precise definition of the term "within the impoundment" is important. While the Agency is not prepared to define the impoundment area to include the entire countryside draining into the plant area, some expansion of the area beyond the impoundment dam itself appears to be appropriate. It is therefore proposed that a definition similar to that proposed for inclusion in the hydrochloric acid subcategory of the inorganic chemicals industry (40 FR 1712, January 9, 1975) be adopted for the bauxite refining subcategory. The proposed definition would make it clear that the term "within the impoundment" refers to the water surface area within the impoundment dam at maximum capacity, the area of the inside and outside slopes of the dam, the surface area between the outside edge of the seepage ditches and the bottom of the outside slope of the dam. The effect of the proposed definition is to give credit for all rainfall within this extended drainage area, in the calculation of the volume of water which may be discharged from the impoundment.

With regard to the regulations for the secondary aluminum smelting subcategory (40 CFR Part 421, Subpart C), an issue was raised during litigation concerning a possible ambiguity as to the applicability of the regulations to various waste streams. In developing the guidelines and standards of performance applicable to these sources, the Agency concentrated on wastes in fume-scrubbing wastewaters where aluminum fluoride is used in the magnesium removal process and wastewaters from metal cooling, establishing a limitation of "no discharge," and on wastes in fume-scrubbing wastewaters where chlorine is used in the magnesium removal process and in wet residue milling wastewaters, establishing numerical limitations for these two waste streams. It was not intended that the regulations apply at this time to wastes in a fourth, less significant, waste stream including waste from furnace wet scrubbers. In reviewing the regulations, however, some ambiguity as to the intent to exclude this latter waste stream from coverage of the regulations appears to exist. An amendment to Subpart C of the regulations is therefore proposed, to clarify the applicability of the regulations to the various waste streams.

Interested persons may participate in the rulemaking by submitting written comments in triplicate to the EPA Office of Public Affairs, Environmental Protection Agency, Washington, D.C. 20460, Attention: Ms. Ruth Brown, A-107. Comments on all aspects of the proposed regulations are solicited. In the event comments are in the nature of criticisms as to the adequacy of data available, or which may be relied upon by the Agency, comments should identify and if possible provide any additional data which may be available and indicate why such data are essential to the development of the regulations. In the event comments address the approach taken by the Agency,

APPENDIX 5
POLLUTANT INTERFERENCE DATA

Effect on Biological Treatment Processes

<u>Table & Figure No.</u>	<u>Pollutant</u>
5-1	Ammonia
5-2	Arsenic
5-3	Borate (Boron)
5-4	Cadmium
5-5	Chromium
5-6	Copper
5-7	Cyanide
5-8	Iron
5-9	Lead
5-10	Manganese
5-11	Mercury
5-12	Nickel
5-13	Silver
5-14	Sulfate
5-15	Sulfide
5-16	Zinc

TABLE 5-1
DATA SUMMARY
EFFECT OF AMMONIA
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
10	N				E-29
100	N				E-29
5-200		B			E-29
480	I				E-29
200-1000		N			E-29
1500-3000		I			E-17, E-20
3000		U			E-11

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-1
EFFECT OF AMMONIA
ON BIOLOGICAL TREATMENT PROCESSES

5-2

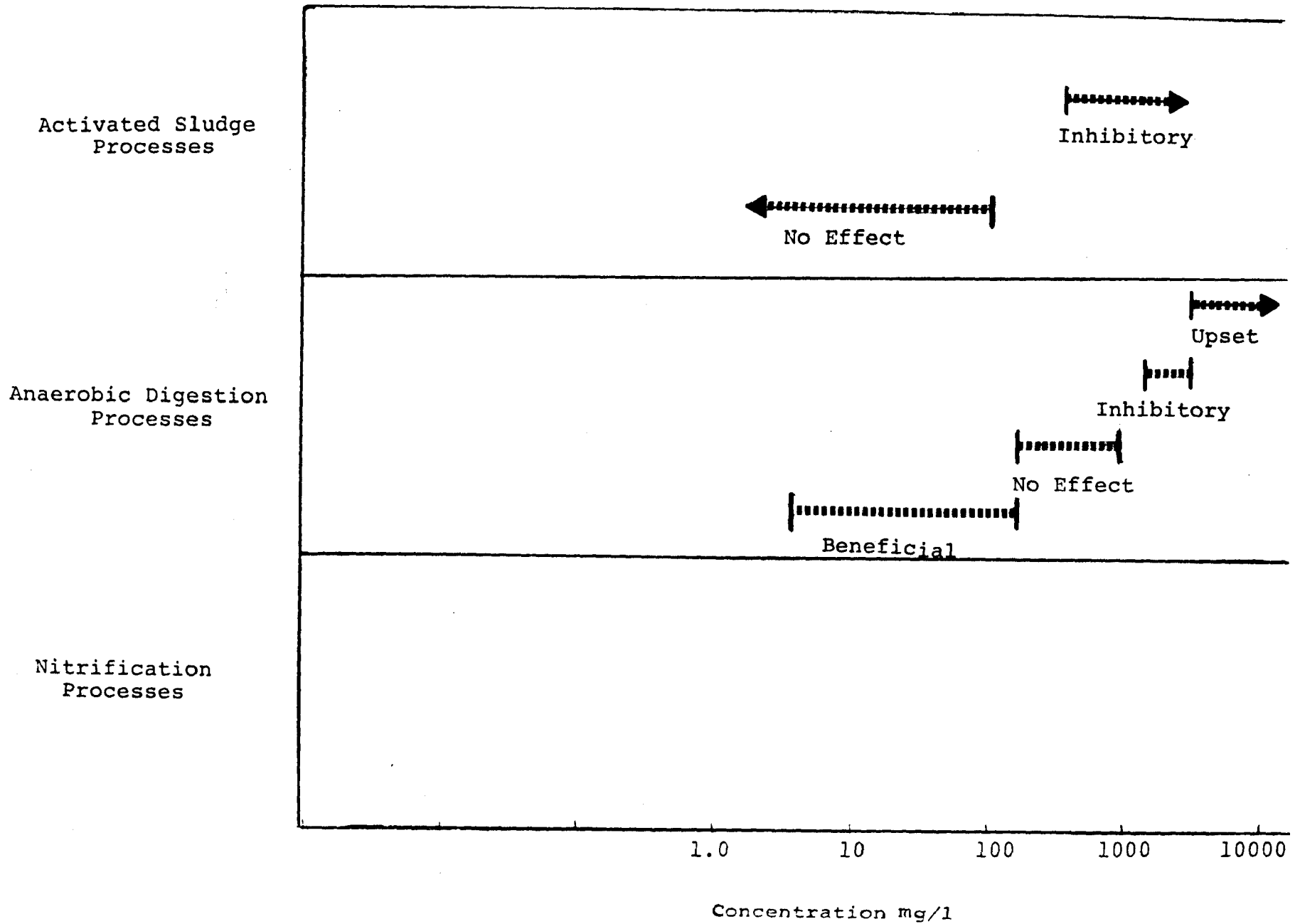


TABLE 5-2
DATA SUMMARY
EFFECT OF ARSENIC
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
0.1	N			Meta-Arsenate	E-29
0.1	I			AsCl ₃	E-21
1.0	I				E-21
1.6		I		4 mg/l Sodium Arsenate	E-5

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-2
EFFECT OF ARSENIC
ON BIOLOGICAL TREATMENT PROCESSES

5-4

Activated Sludge
Processes

Inhibitory

No Effect

Anaerobic Digestion
Processes

Inhibitory

Nitrification
Processes

0 0.001 0.01 0.1 1.0 10 100 1000

Concentration mg/l

TABLE 5-3
DATA SUMMARY

EFFECT OF BORATE (BORON)
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
0.005 - 0.05	N				E-29
0.05	I				E-5, E-29
0.4	N				E-8, E-9
2		I			E-128
7.4	N			50 mg/l Sodium Tetra-Borate	E-8
10	I				E-9, E-29, E-44
50	I				E-29
74	I			500 mg/l Sodium Tetra-Borate	E-8
100	I				E-44
740	U			5000 mg/l Sodium Tetra-Borate	E-8

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-3
EFFECT OF BORON
ON BIOLOGICAL TREATMENT PROCESSES

9-5
5-6

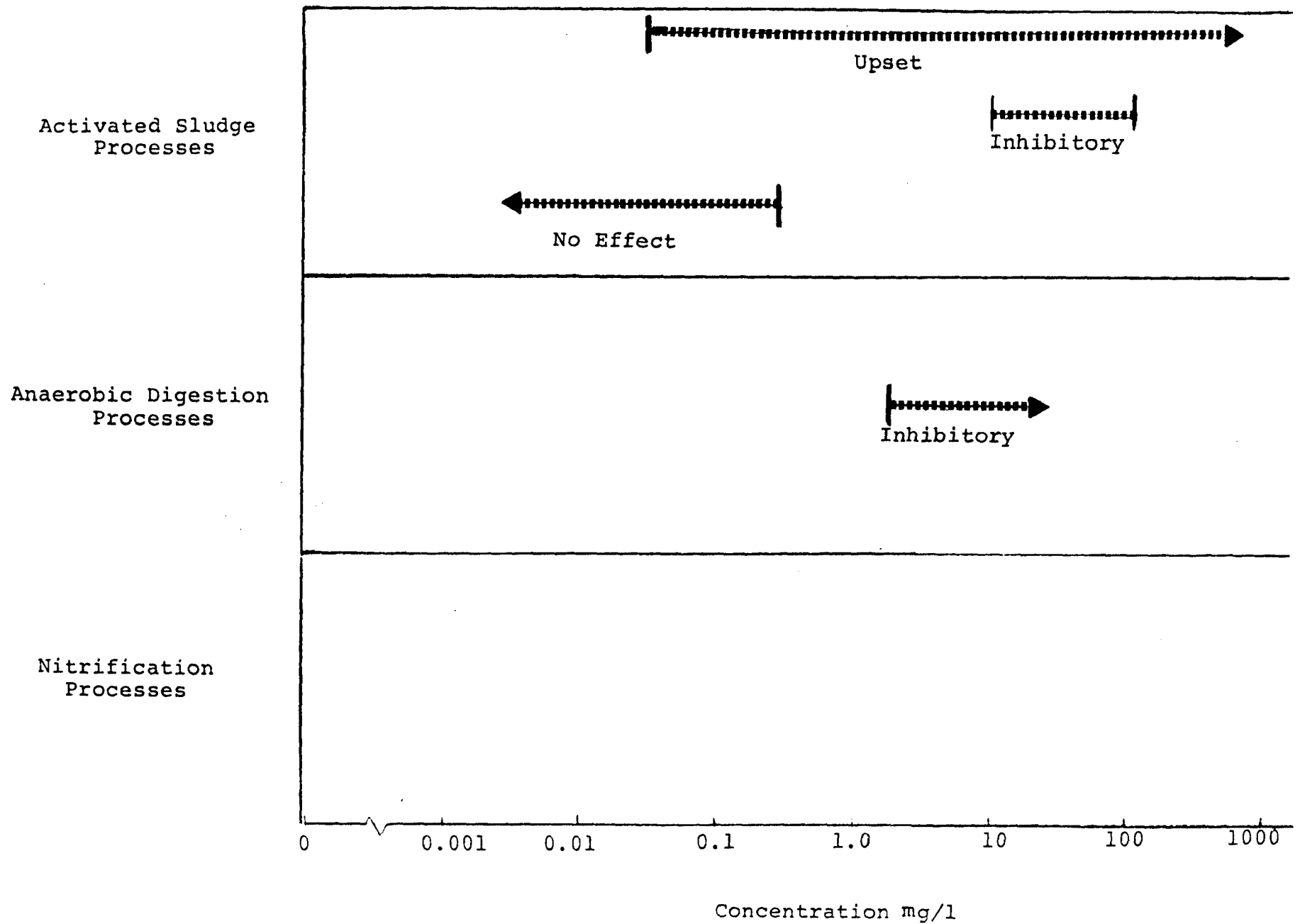


TABLE 5-4

DATA SUMMARY

EFFECT OF CADMIUM
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
0.02		T			E-104
1	T				E-21
10 - 50	I				E-29
60	U				E-29
100	T				E-29

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-4
EFFECT OF CADMIUM
ON BIOLOGICAL TREATMENT PROCESSES

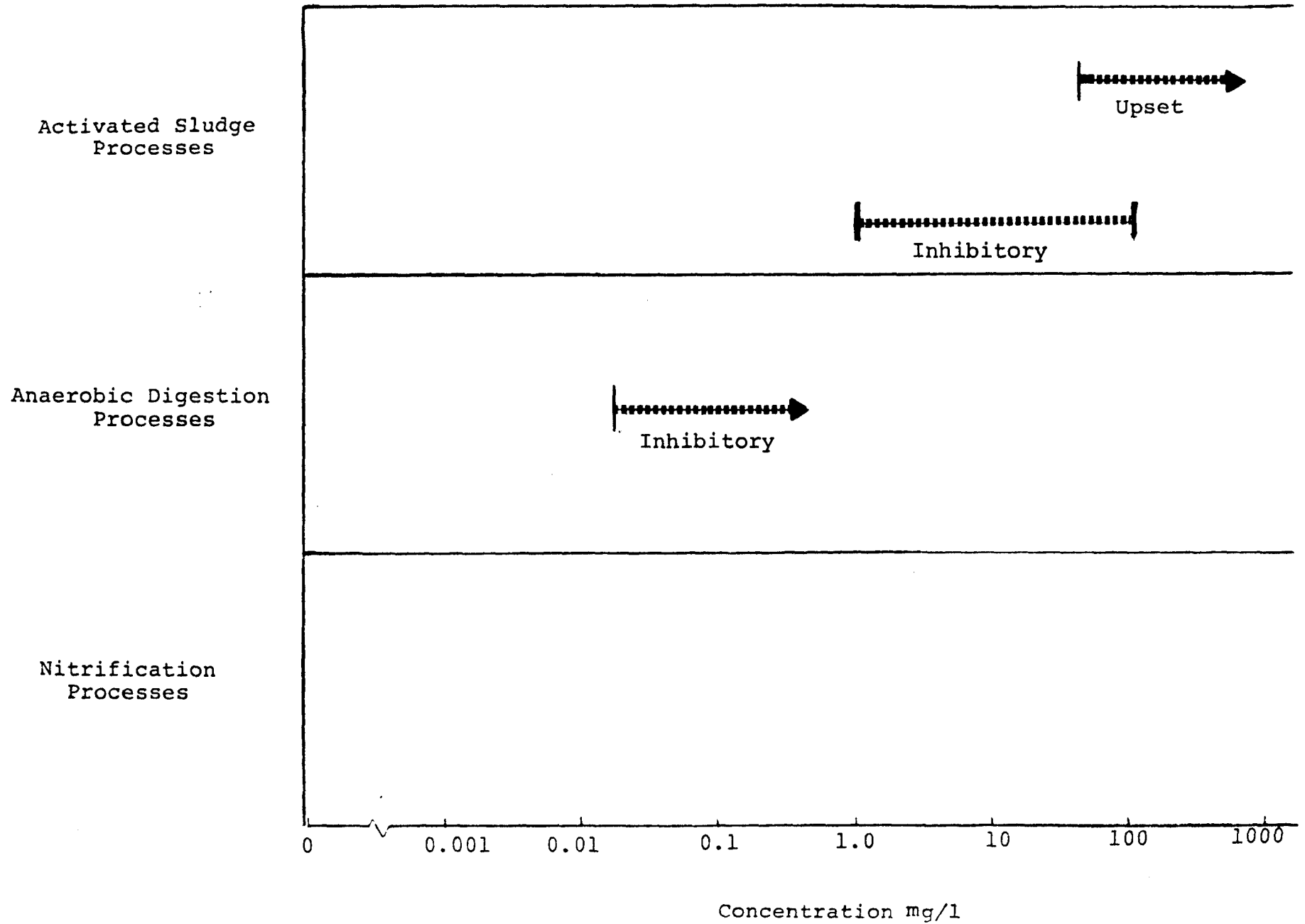


TABLE 5-5
DATA SUMMARY
EFFECT OF CHROMIUM
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
0.005- 0.05	B				E-5
0.25			I		E-119
1	N				E-5
1	I			K ₂ Cr ₂ O ₇	E-5
1	T				A-1
1.5		T			A-1
2.5			U		E-13, E-29, E-117
5			U		A-1
5		T			A-1
7	I			25% Loss in BOD Removal	A-1
8.8	I			25 mg/l K ₂ Cr ₂ O ₇	E-8
5-10	I				E-29, E-78
10	T				E-29, E-78
10	I			29% Loss in BOD Removal	E-28
15			I	Cr III	E-29
4			I		E-17
0-50				Cr III, No Effect on Trickling Filter Operation	E-29

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

TABLE 5-5 (continued)
DATA SUMMARY
 EFFECT OF CHROMIUM
 ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
50	I			3% Loss in BOD Removal	E-118
50	I				E-88
50		N			E-3
50		U			E-118, E-78
100			I	Reduced Nitrifi- cation by 66-78%	E-5
100	I			3% Loss in BOD Removal	E-118
300			I		E-118
300		U			E-118
500		U			E-118
500		U			E-29
430 + 1440			U		E-29

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-5
EFFECT OF CHROMIUM
ON BIOLOGICAL TREATMENT PROCESSES

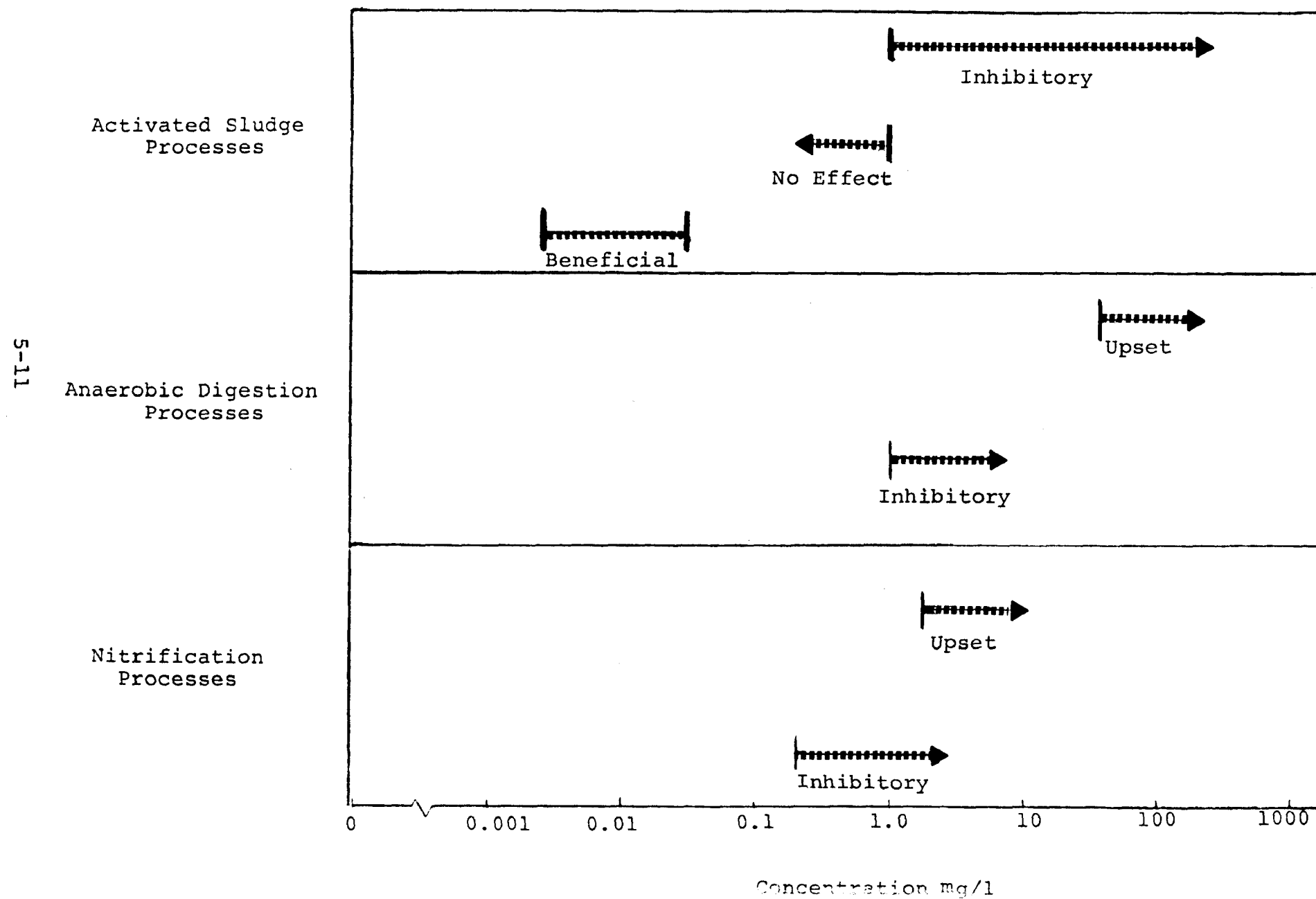


TABLE 5-6

DATA SUMMARY

EFFECT OF COPPER
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
0.005- 0.05	B				E-29
0.05			I		E-100
0.1	T				E-2
0.2	T				E-33
0.2	N			With 5 mg/l Zn	E-5, E-29
0.4	N			With CN	E-118
0.5				Toxic to all Micro Organisms	E-5
0.5			I		E-2
0.5-0.56				Inhibition of Micro Organisms	E-29
0.7	T				E-1
1.0	T				A-1,E-2,E-5,E-24, E-29,E-78,E-109
1.0	N			With CN	E-29
1.0		T			E-5, E-15
1.2	I			2% Loss in BOD Removal	E-118
2.4		U		With 20 mg/l Zn	E-5, E-29
2.5	I			4% Loss in BOD Removal	E-118

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

TABLE 5-6 (continued)

DATA SUMMARYEFFECT OF COPPER
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
3.6	U			With 8.6 mg/l CN	E-16
4	I				E-29
5	I				E-29
5		N			E-118
5	I			6% Loss in BOD Removal	E-118
10	I			3.6% Loss in BOD Removal	E-118
10	I			With CN 7% Loss in BOD Removal	E-118
10	N				E-29
1-10	T				E-29
10		N			E-118
10		T		With CN	E-118
10	I			With 100 mg/l CN	E-29
10	I			With 10 mg/l Ni	E-29
10	I			With 100 mg/l CrO ₄ ⁼	E-29
10	I			With 100 mg/l Fe	E-29
15	I			5.3% Loss in BOD Removal	E-118
15		I			E-118

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

TABLE 5-6 (continued)

DATA SUMMARYEFFECT OF COPPER
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
15	I				E-129
25		I			E-118
25	I			With CN 2.5% Loss in BOD Removal	E-118
30	I				E-29
45	I				E-43
50	I				E-29
50		I			E-29
64	I				E-118
75	I				E-29
100	I				E-2, E-118
210	U				E-118
410	U				E-118
1000		I		Cuprous 14.9% Loss in Gas Production	E-29
1000		I		Cuprous 49.4% Loss in Gas Production	E-29

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-6
EFFECT OF COPPER
ON BIOLOGICAL TREATMENT PROCESSES

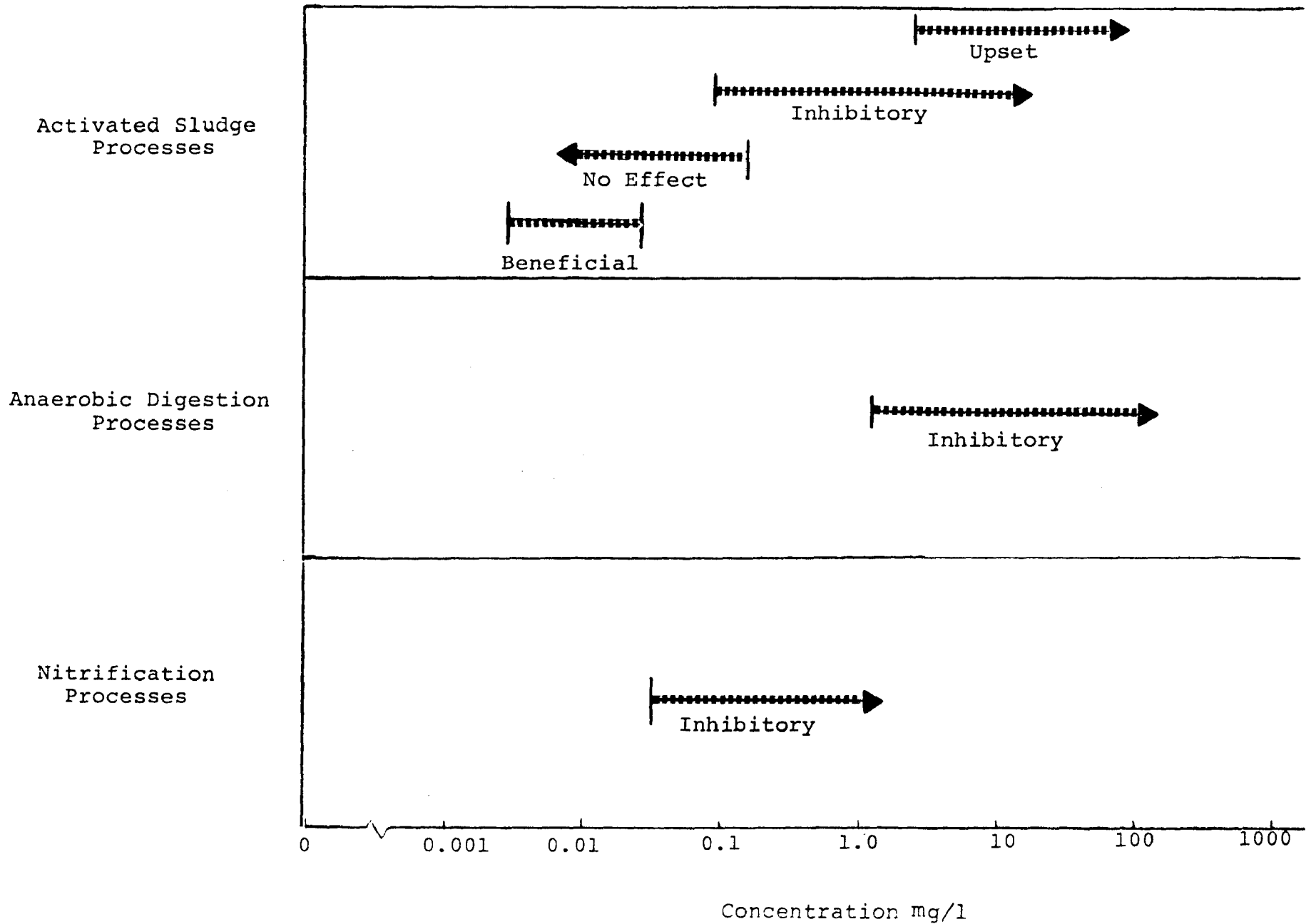


TABLE 5-7
DATA SUMMARY

EFFECT OF CYANIDE
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
0.01- 0.05	N				E-118
0.1		T		In Raw Sewage	A-1, E-5,
0.3- 0.5	I				E-21
0.34			I	0.65 mg/l N_aCN Reduced Nitrifi- cation by 75%	E-5
1		T			A-1
1	T				A-1
1.6		T			A-1
2	T				E-5
2	I			As HCN	E-5
2		T			A-1, E-5
2			I		A-1, E-5
2-3	I				A-1, E-5
3	I			5% Reduction in BOD Removal	A-1, E-5
4	I				A-1, E-5
5	I				E-15
21			U	40 mg/l N_aCN	E-5
30			I		E-5
30				Interfered with Trickling Filter Operation	E-7

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

TABLE 5-7 (continued)

DATA SUMMARYEFFECT OF CYANIDE
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
40	I				E-29
100		U			E-5
100	I			With 10 mg/l cu	E-29
100	I			With 10 mg/l Ni	E-29
480	U			480 mg/l KCN	E-29

NOTES:

B = Beneficial

N = No Effect

I = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-7
EFFECT OF CYANIDE
ON BIOLOGICAL TREATMENT PROCESSES

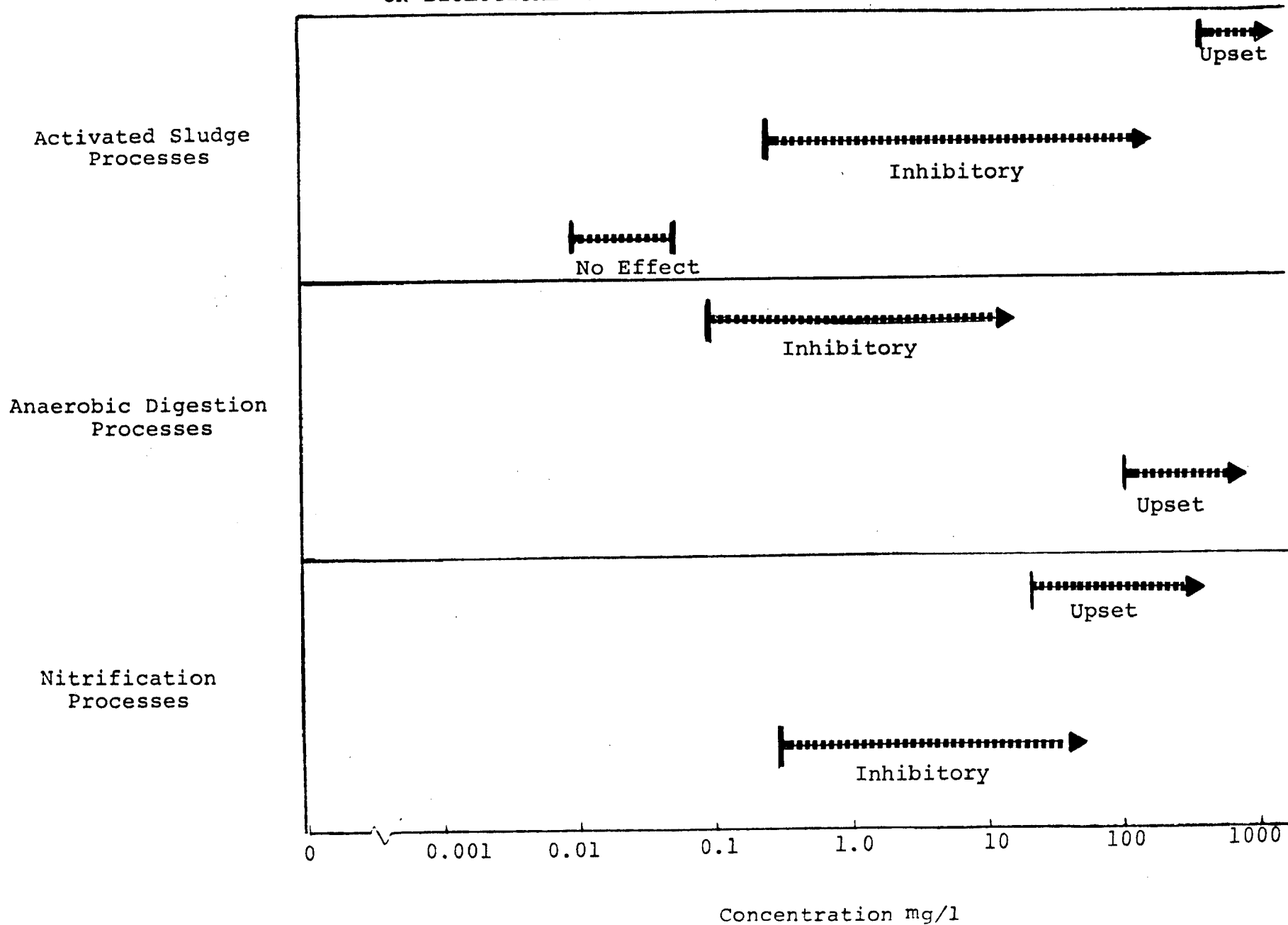


TABLE 5-8
DATA SUMMARY
EFFECT OF IRON
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
0		I		Lack of Iron Inhibits Digestion	E-39, E-112
0	I			Lack of Iron Reduces Metabolism	E-39, E-112
5	T				E-5
5		T			A-1
5-20		I		Due to Acidity	E-5, E-118
100	N				E-21
1000	U				E-29

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-8
EFFECT OF IRON
ON BIOLOGICAL TREATMENT PROCESSES

5-20

Activated Sludge
Processes

Inhibitory

Inhibitory

Upset

Anaerobic Digestion
Processes

Inhibitory

Inhibitory

Nitrification
Processes

0 0.001 0.01 0.1 1.0 10 100 1000

Concentration mg/l

TABLE 5-9

DATA SUMMARYEFFECT OF LEAD
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
0.005-0.05	N				E-5
0.05			N		E-100
0.5			I		E-5
0.1-1.0	I				E-5
50	N				E-21
10-100	I				E-29

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-9
EFFECT OF LEAD
ON BIOLOGICAL TREATMENT PROCESSES

5-22

Activated Sludge
Processes

No Effect

Inhibitory

Anaerobic Digestion
Processes

Nitrification
Processes

No Effect

Inhibitory

0 0.001 0.01 0.1 1.0 10 100 1000

Concentration mg/l

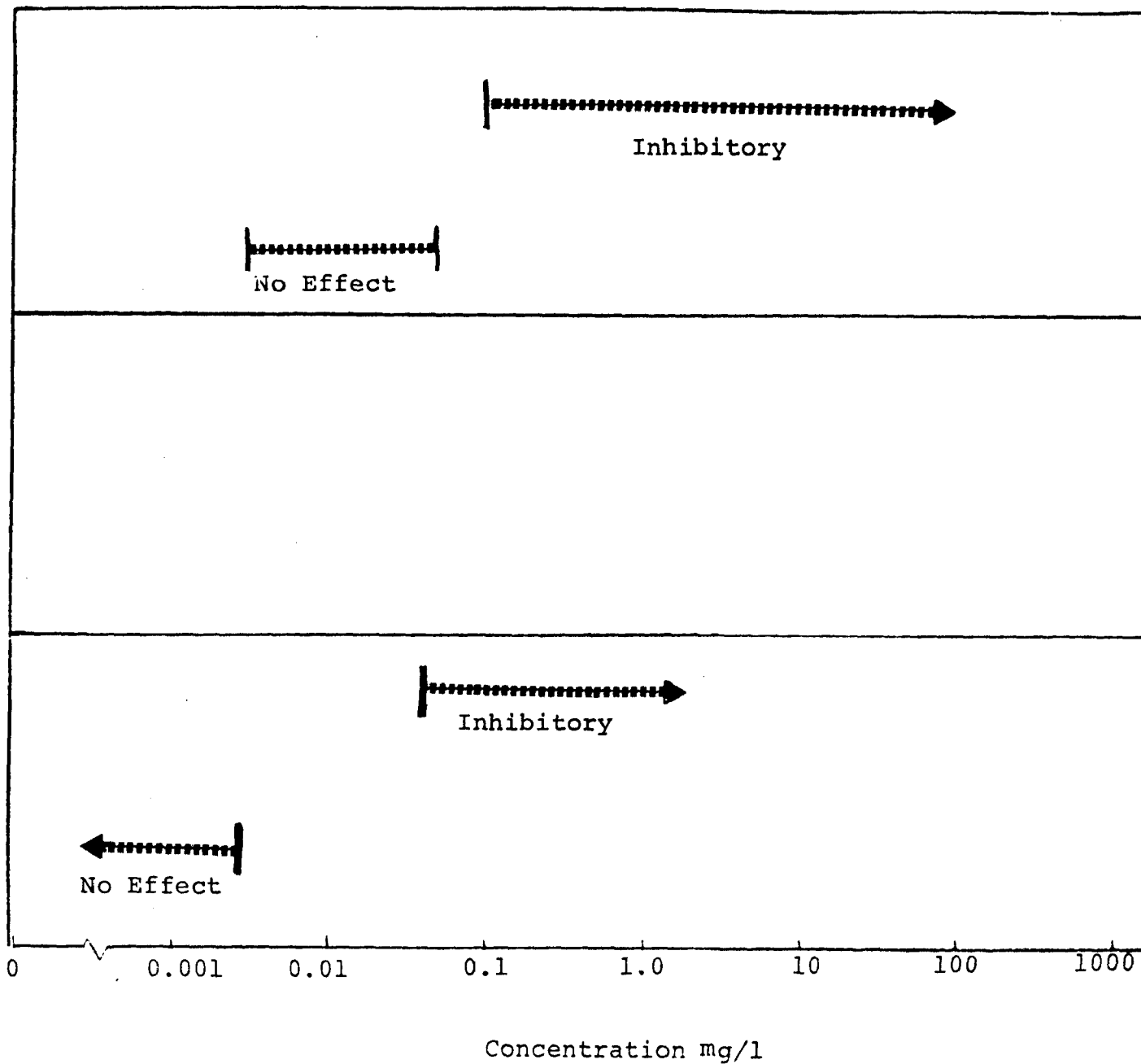


TABLE 5-10

DATA SUMMARYEFFECT OF MANGANESE
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
7	N				E-29
10	I				E-29
50	U				E-21
12.5-50			B		E-29
50-100	I				E-29

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-10
EFFECT OF MANGANESE
ON BIOLOGICAL TREATMENT PROCESSES

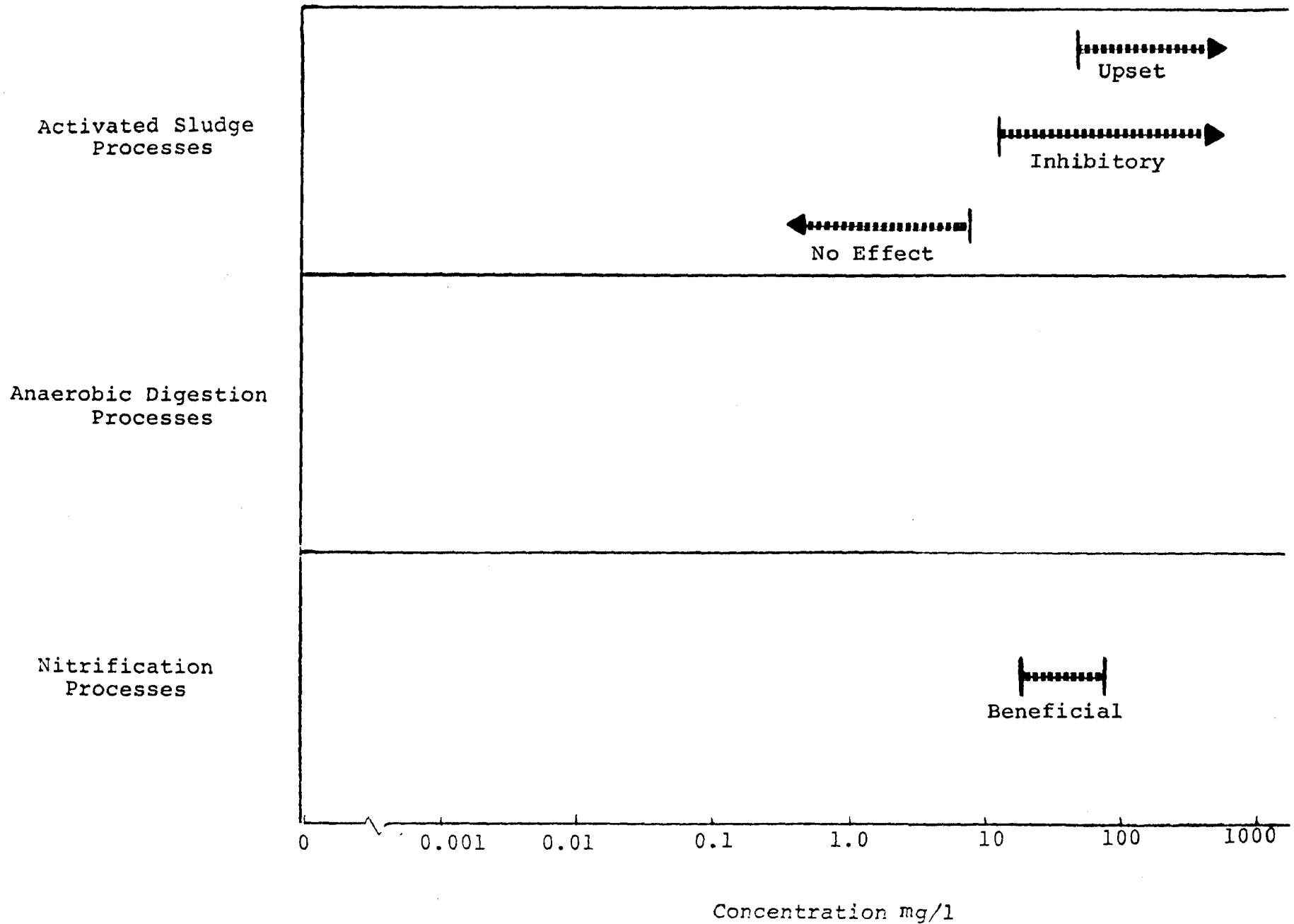


TABLE 5-11
DATA SUMMARY
EFFECT OF MERCURY
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
0.1 - 1.0	I				E-28
1.0	I				E-28
1.0	I				E-29
2.5	T				E-21
2.5	I				E-29, E-122
2.5-5	T				E-29
5	I				E-70
5	I			14% Loss in COD Removal	E-122
5	I			40% Loss in COD Removal	E-29
10	I			59% Loss in COD Removal	E-29
43		N			E-18
50	I				E-29
200	U				E-29
1365		I			E-18

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-11
EFFECT OF MERCURY
ON BIOLOGICAL TREATMENT PROCESSES

5-26

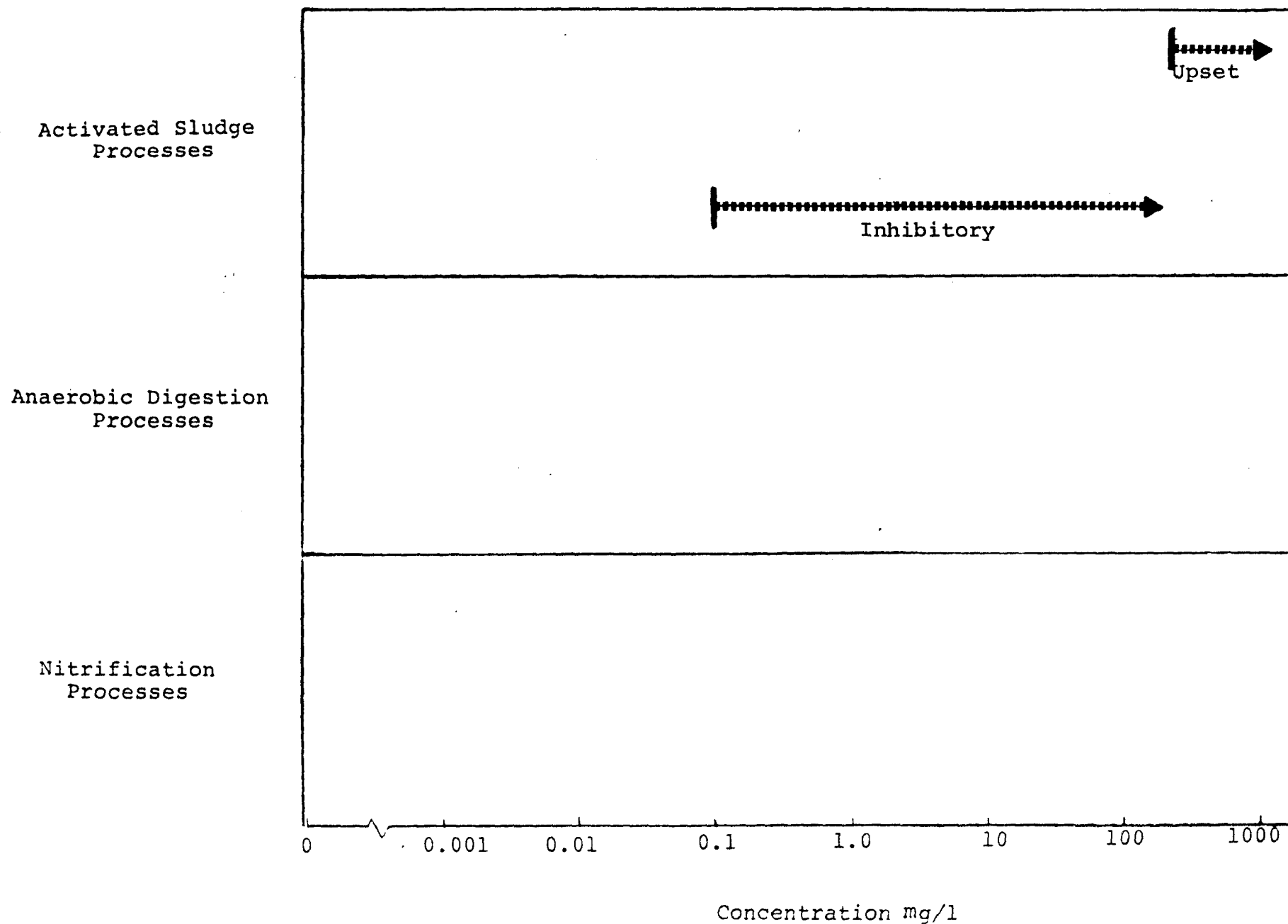


TABLE 5-12
DATA SUMMARY

EFFECT OF NICKEL
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
1	N				E-118
2		T			A-1
1-2.5	T				A-1
2.5	I			2.5% Loss in BOD Removal	E-118
0.5-3			I		E-25, E-118
5	I			5% Loss in BOD Removal	E-118
5	I				E-29
10	I			5% Loss in BOD	E-118
10			I		E-118
10		N			E-118
25	I				E-118
25	U				E-19
40		N			E-29
50	U				E-3
500		I		9.4% Reduction in Gas Production	E-5

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-12
EFFECT OF NICKEL
ON BIOLOGICAL TREATMENT PROCESSES

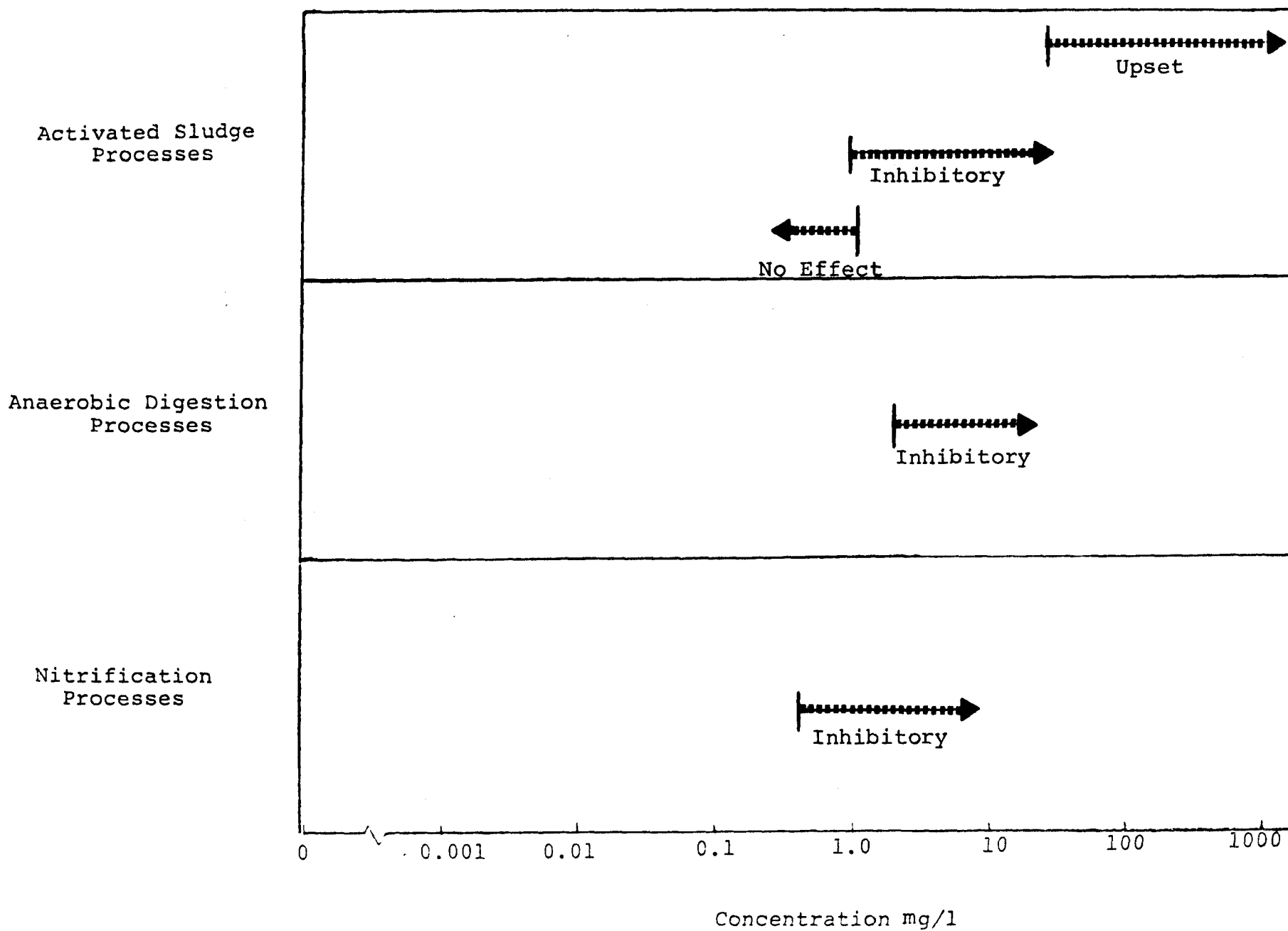


TABLE 5-13
DATA SUMMARY

EFFECT OF SILVER
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
5	I			84% Loss in BOD Removal	E-8, E-9
25	U				E-21
2-250	N			As Thiosulfate	E-8, E-9, E-120, A-1

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-13
EFFECT OF SILVER
ON BIOLOGICAL TREATMENT PROCESSES

5-30

Activated Sludge
Processes

Upset

Inhibitory

Anaerobic Digestion
Processes

Nitrification
Processes

0 0.001 0.01 0.1 1.0 10 100 1000

Concentration mg/l

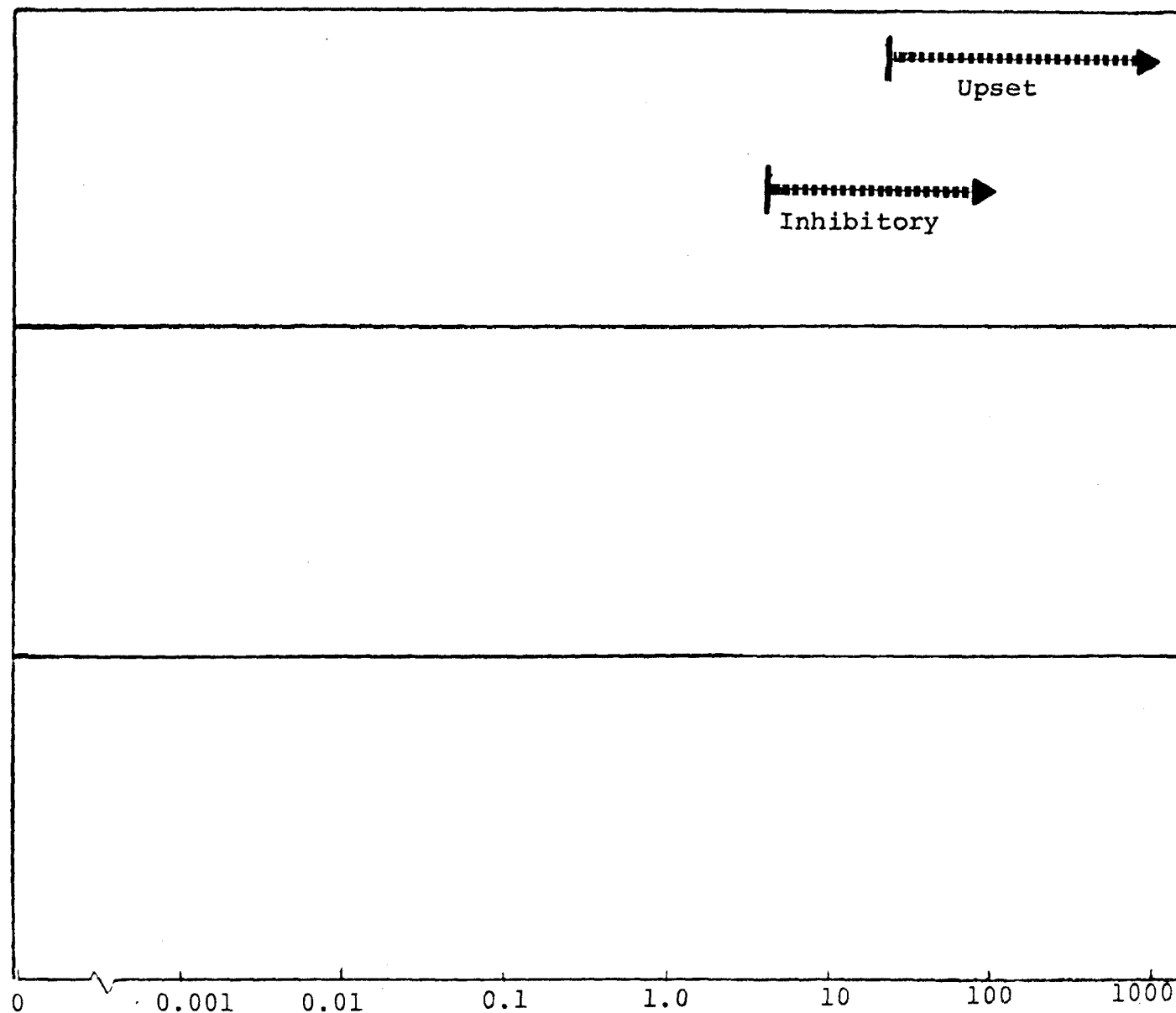


TABLE 5-14

DATA SUMMARYEFFECT OF SULFATE
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
500		I			E-11, E-17
2400		I		12% Reduction in Gas Production	E-19
> 2400		U			E-19

NOTES:

B = Beneficial

N = No Effect

T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-14
EFFECT OF SULFATE
ON BIOLOGICAL TREATMENT PROCESSES

5-32

Activated Sludge
Processes

Anaerobic Digestion
Processes

Nitrification
Processes

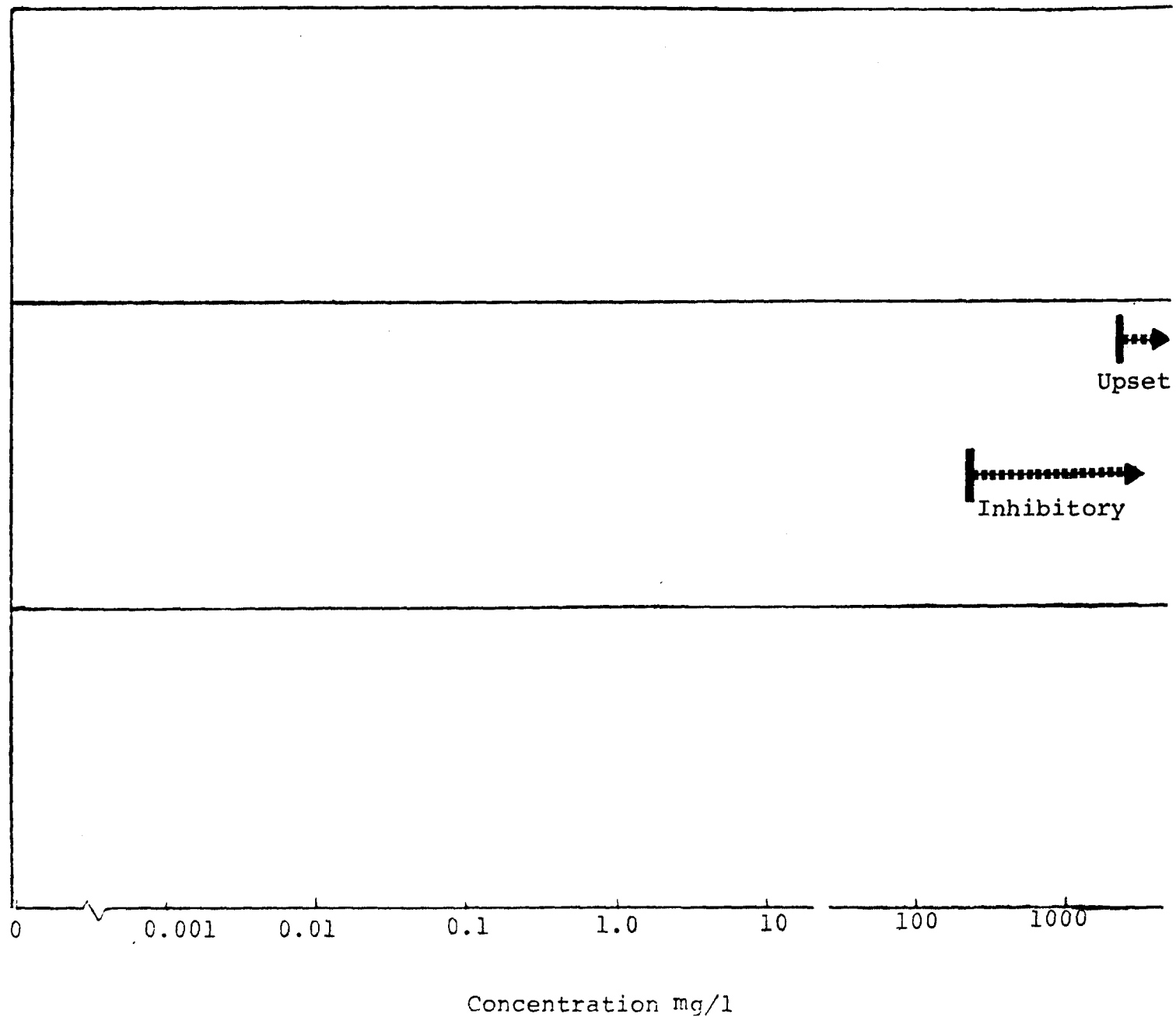


TABLE 5-15

DATA SUMMARYEFFECT OF SULFIDE
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
25-50	I				E-35
50		I			E-20
50-100		N			E-120
100		I		50% Reduction in Gas Production	E-19
100		I		33% Loss in Gas Production	E-20
165		U			E-19
200		U			E-19
200		N		With Acclimation	E-35, E-120
200		I		80% Reduction in Gas Production	E-20
400		N		FeS	E-35
400		I		95% Reduction in Gas Production	E-20

NOTES:

B = Beneficial

N = No Effect

I = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-15
EFFECT OF SULFIDE
ON BIOLOGICAL TREATMENT PROCESSES

5-34

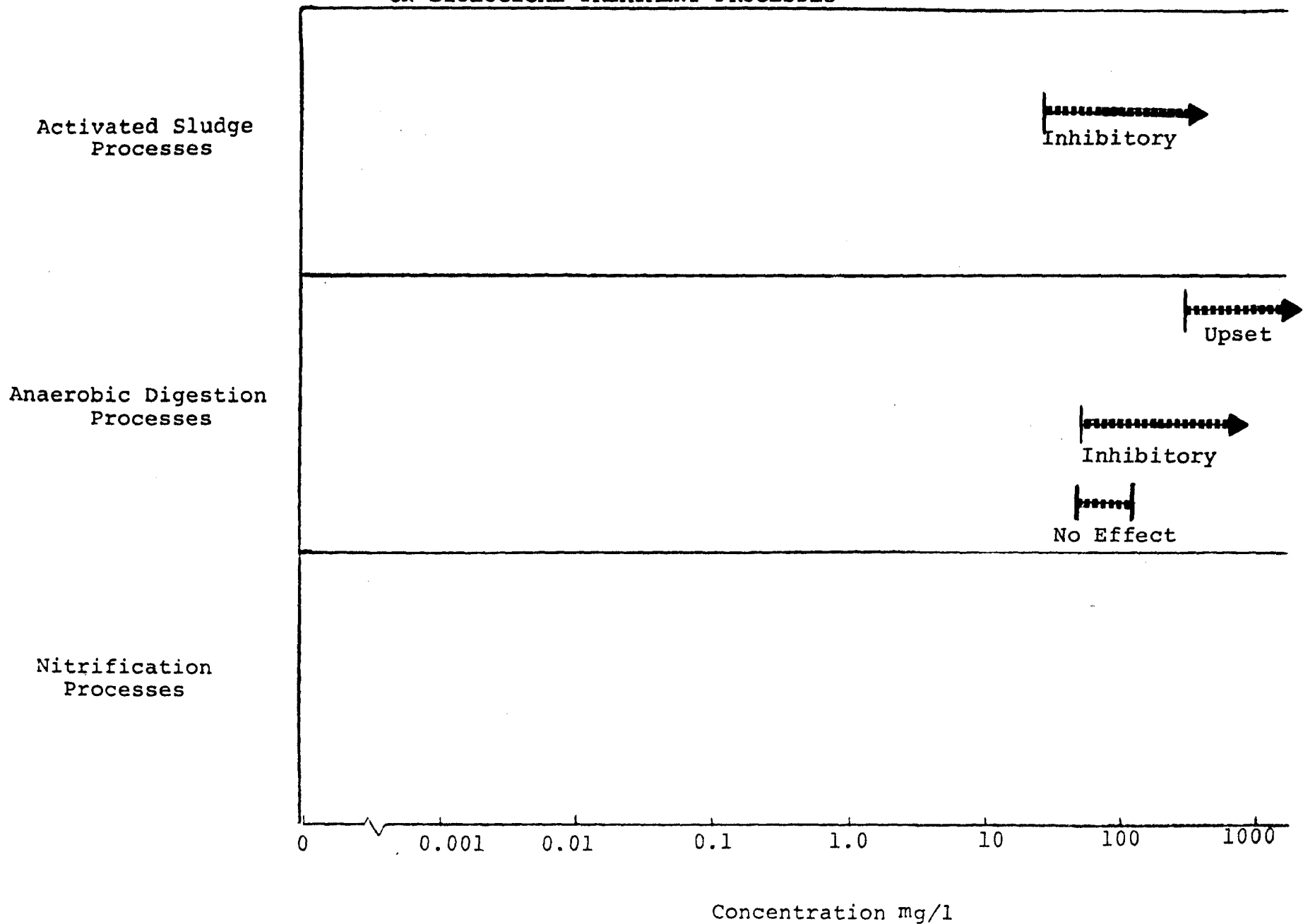


TABLE 5-16

DATA SUMMARYEFFECT OF ZINC
ON BIOLOGICAL TREATMENT PROCESSES

Concentration	Effect On				
mg/l	Activated Sludge Processes	Anaerobic Digestion Processes	Nitrifi- cation Processes	Comments	References
0.005- 0.08	N				E-29
0.3	T				E-33
0.08-0.5	I				E-29
0.08-0.5			I		E-100
1	I			With 10 mg/l Cd	E-29
2.5	N				E-118
5		T			A-1, E-7
5	T				E-29, E-35
2.5-10	T				E-29
10	N			With CN	E-118
5-10	T				E-29
10		N			E-3
10	I			2% Loss in BOD Removal	E-118
10	N				E-22
10-20		T			E-6, E-78
20		U			E-118
20	I			2% Loss in BOD Removal	E-118
20	I				E-67
1000		I			E-5

NOTES:

B = Beneficial

N = No Effect

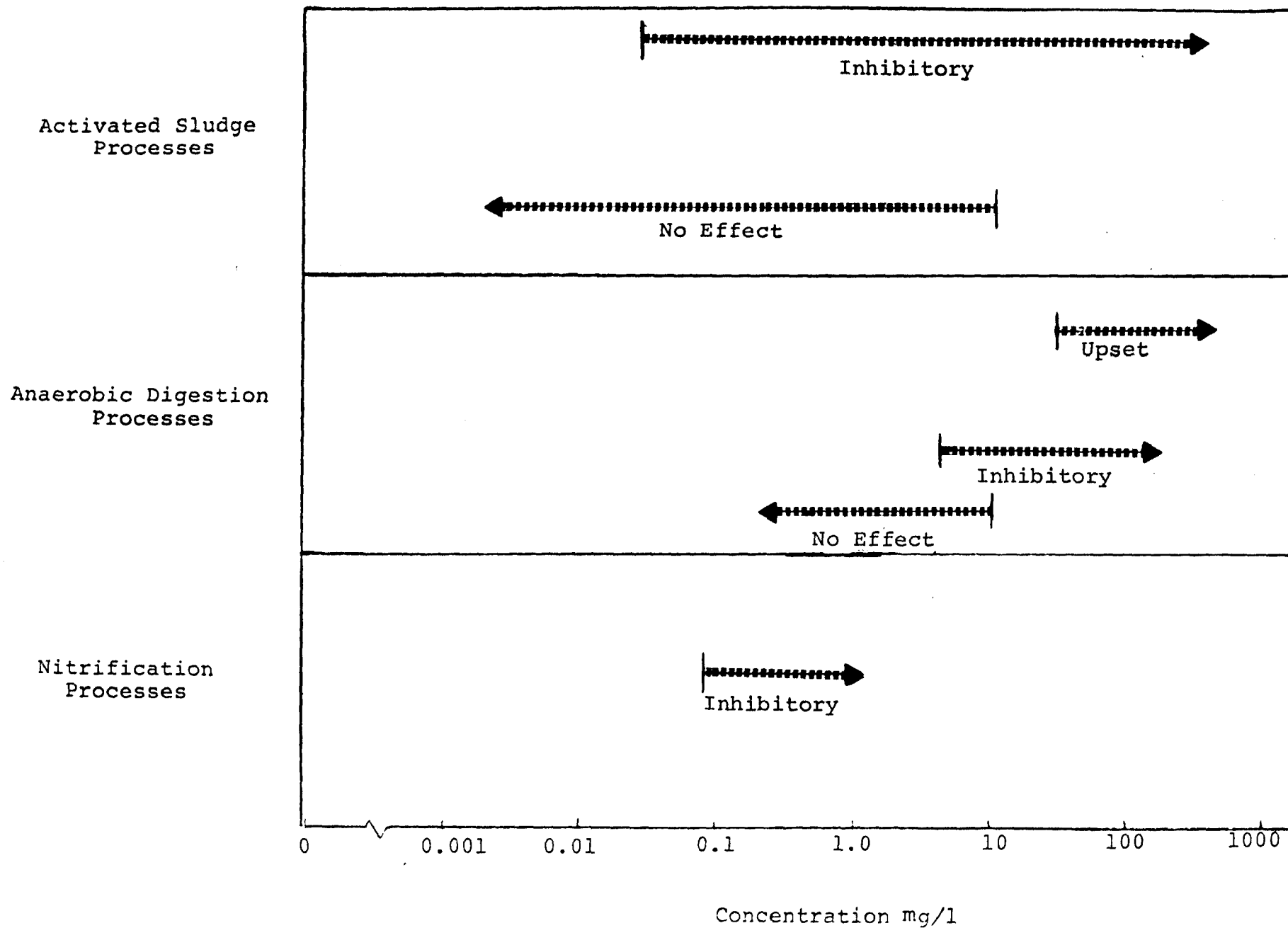
T = Threshold for Inhibitory Effects

I = Inhibitory

U = Upset

Concentrations represent influent to the unit processes.

FIGURE 5-16
EFFECT OF ZINC
ON BIOLOGICAL TREATMENT PROCESSES



APPENDIX 6
POLLUTANT REMOVAL AND PASS THROUGH DATA

Computer Report No. 1 - Summary of POTW Removal Data by EPA Region.

Computer Report No. 2 - POTW Categorization.

Computer Report No. 3 - POTW Removal Data, Reference Information.

Computer Report No. 4 - POTW Removal Data Analysis, 24 Hr. Composite - 6 Hr. Simultaneous Composite, Comparison of Results.

Computer Report No. 5 - POTW Removal Data Analysis, by Plant Category.

Computer Report No. 6 - Summary of POTW Removal Data.

Computer Report No. 7 - POTW Effluent Data Analysis.

Computer Report No. 8 - Summary of POTW Effluent Data.

Table 6-1 - Cumulative Frequency Distribution of Removal Data.

Table 6-2 - Cumulative Frequency Distribution of Effluent Data.

PLANT TYPE

EPA REGION	A1	OTHER A	B1	OTHER B	C1	OTHER C	D,J,(MISC)	TOTAL
I	15	0	6	0	12	0	0	33
II	33	3	9	9	5	10	0	69
III	0	5	3	9	1	5	1	24
IV	5	2	5	9	3	4	5	33
V	14	0	14	11	23	19	6	87
VI	0	0	1	1	0	0	0	2
VII	4	0	6	1	6	2	0	19
VIII	0	0	0	0	0	0	0	0
IX	0	0	0	0	0	0	0	0
X	1	0	0	0	1	0	0	2
TOT	72	10	44	40	51	40	12	269

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CATEGORY

DESCRIPTION

A PRIMARY SEDIMENTATION TREATMENT PROCESS
 A01 CONVENTIONAL
 A02 FLASH AERATION 4HEAD OF CLARIFICATION
 A03 CHEMICAL FLOCCULATION, CLARIFICATION
 A04 LIME, FERRIC CHLORIDE ADDITION, PRIMARY SEDIMENTATION, CLARIFICATION
 A05 PREAERATION, POLYMER ADDITION, PRIMARY SEDIMENTATION
 B TRICKLING FILTER
 B01 A01. TRICKLING FILTER, CLARIFIER
 B02 A01. TF-HIGH RATE, CLARIFIER
 B03 A04. TRICKLING FILTER, CLARIFIER
 B04 A01. TF-2 IN SERIES, CLARIFIER
 B05 A01. TF-2 HIGH RATE IN SERIES, CLARIFIER
 C ACTIVATED SLUDGE
 C01 A01. ACTIVATED SLUDGE, CLARIFIER
 C02 EXTENDED AERATION, CLARIFIER-NO PRIMARY SETTLING
 C03 A04. ACTIVATED SLUDGE, CLARIFIER
 C04 A01. AS-POLYMER ADDITION, CLARIFIER
 C05 A01. AS-STEP AERATION, CLARIFIER
 C06 A01. AS-HIGH RATE, CLARIFIER
 C07 C01. POLISHING LAGOON
 C08 EXTENDED AERATION, 2 POLISHING LAGOONS IN SERIES-NO PRIMARY SETTLING
 C09 A01. AS-KRAUS PROCESS
 C10 A01. AS-KRAUS PROCESS, 2 FACULTATIVE LAGOONS IN SERIES
 C14 A01. AS-POLYMER ADDITION, POLISHING LAGOON
 C19 ACTIVATED SLUDGE, CLARIFIER-NO PRIMARY SETTLING
 C20 AS-HIGH RATE, CLARIFIER-NO PRIMARY SETTLING
 D FILTRATION
 D01 C01. FILTRATION
 D02 AS-CONVENTIONAL AND HIGH RATE IN PARALLEL, FILTRATION-NO PRIMARY SED
 D03 C19. FILTRATION
 D04 C20. FILTRATION
 D05 EXTENDED AERATION, CLARIFIER, FILTRATION-NO PRIMARY SETTLING
 D06 A01. AS-HIGH RATE, FILTRATION
 D07 R02. FILTRATION
 J MISCELLANEOUS PROCESSES
 J01 AERATED LAGOON
 J02 OXIDATION DITCH, STABILIZATION POND

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CATEGORY	DESCRIPTION	NO. OF PLANTS	PERCENT OF TOTAL
-01	UNDER 0.050 MGD TREATMENT FLOWRATE	6	2
-02	0.051 THRU 0.100 MGD	3	1
-03	0.101 THRU 0.250 MGD	11	4
-04	0.251 THRU 0.500 MGD	20	7
-05	0.501 THRU 1.000 MGD	29	11
-06	1.001 THRU 5.500 MGD	101	38
-07	5.501 THRU 12.500 MGD	39	15
-08	12.501 THRU 31.500 MGD	30	11
-09	31.501 THRU 75.000 MGD	12	5
-10	75.001 THRU 110.000 MGD	7	2
-11	OVER 110.000 MGD	11	4
	TOTAL	269	100

CATEGORY	DESCRIPTION
A	UNDER 20 PERCENT INDUSTRIAL FLOW
B	21 THRU 40 PERCENT
C	41 THRU 50 PERCENT
D	51 THRU 60 PERCENT
E	61 THRU 70 PERCENT
F	OVER 70 PERCENT
G	UNKNOWN
H	NONE

REF. NO.	CATEGORY	SAMPLING PROCEDURE	SAMPLING DATE	REMARKS	MAJOR INDUSTRY	POTW CONTROL
1.00	D07.06G	FC024S	741030	EVERY 30 MIN	POULTRY	00
2.00	C09.06G	FC024S	741107	EVERY 30 MIN		
3.00	C10.06G	FC024S	741107	EVERY 30 MIN		
4.00	C05.06G	FC024S	741113	EVERY 30 MIN		
5.01	C02.04G	FC024S	741113	EVERY 30 MIN		
5.02	J01.06G	FC024S	741113	EVERY 30 MIN		
6.00	A01.06G	FC024S	741113	EVERY 30 MIN		
7.01	A01.10G	FC024S	741114	EVERY 30 MIN		
7.02	D01.06E	FC024S	741114	EVERY 30 MIN		
8.00	B01.04C	FC024S	730905	EVERY 30 MIN		
10.00	A01.06G	FC024S	741126	EVERY 30 MIN		
11.00	A01.06G	FC024S	741017	EVERY 30 MIN		
12.00	J02.03G	FC024S	730830	EVERY 30 MIN		
13.00	B01.03G	FC024S	730829	EVERY 30 MIN		
14.00	B02.04G	FC024S	710630	EVERY 30 MIN	CHEESE PLANT	00 01 01
15.00	A01-08G	G R	7201 THRU 7309	FC DLY,MO COMP AVG		
15.01	C05-10G	G R	7201 THRU 7309	FC DLY,MO COMP AVG		
15.02	C05-11G	G R	7201 THRU 7309	FC DLY,MO COMP AVG		
15.03	C06-08G	G R	7201 THRU 7309	FC DLY,MO COMP AVG		
15.04	C06-08G	G R	7201 THRU 7309	FC DLY,MO COMP AVG		
15.05	C06-09G	G R	7201 THRU 7309	FC DLY,MO COMP AVG		
15.06	C06-09G	G R	7201 THRU 7309	FC DLY,MO COMP AVG		
15.07	C06-10G	G R	7201 THRU 7309	FC DLY,MO COMP AVG		
15.08	C06-10G	G R	7201 THRU 7309	FC DLY,MO COMP AVG		
16.00	A02.08G	FC024S	741023	EVERY 30 MIN		
18.00	B02.05G	FC024S	741010	EVERY 30 MIN		
19.00	C01.06B	FC024S	741003	EVERY 30 MIN		
20.00	B02.06G	FC024S	741023	EVERY 30 MIN		
21.00	C06-04G	C 024S	700311 THRU 701203		TANNERY	
22.00	B02-01G	FC024S	710109 THRU 710119			
23.00	B01-06G	FC024S	710928			
24.00	B02-06G	FC024S	721114			
25.01	B02-06G	FC024S	710223 THRU 700826			
25.02	B02-06G	FC024S	710223 THRU 700826			
25.03	C06-07G	FC024S	710223 THRU 700215			
26.00	B02-03G	C 024S	710114			
28.00	B02-04G	FC024S	711102			
29.00	C06-04G	C 024S	710120			
30.00	B02-06G	C 024S	740305			
31.00	B02-04G	C 024S	710823 THRU 701112			
32.00	C01-11G	C 024S	740101 THRU 741231	INF 1X/WK,EFF DLY		
33.00	D01-04G	C 024S	740101 THRU 741231	INF 1X/WK,EFF DLY		
34.00	C01-11G	C 024S	740101 THRU 741231	INF 1X/WK,EFF DLY		
35.00	D01-06G	C 024S	740101 THRU 741231	INF 1X/WK,EFF DLY		
36.00	C01-11G	C 024S	740101 THRU 741231	INF 1X/WK,EFF DLY		
37.00	C02-05G	C 024S	740101 THRU 741231	INF 1X/WK,EFF DLY		
42.00	A01-06H	FC024S	740930	EVERY 4 HR	NONE COIN LAUNDRY MACHINE SHOP	
43.00	B01-04A	FC008S	741112	EVERY 2 HR		
44.00	B01-04A	C 024S	740723	EVERY 2 HR		
45.00	B04-05D	FC024S	740410	EVERY 2 HR		

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REF. NO.	CATEGORY	SAMPLING PROCEDURE	SAMPLING DATE	REMARKS	MAJOR INDUSTRY	POTW CONTROL
46.00	B04-06H	FC024S	741023	EVERY 3 HR	NONE	
47.00	C01-05A	G	740717		PLATING	
48.00	C01-05H	C 024S	740808		NONE	
49.00	C04-07A	G	741022		PLASTIC, MACH	
50.00	C06-06A	C 024S	740807			
51.00	C19-01H	C 024S	740723	EVERY 4 HR	NONE	
52.00	C19-03H	C 024S	740716		NONE	
53.00	C19-04G	FC024S	740522	EVERY HR		
54.00	C20-04A	C 024S	740813			
55.00	C20-06B	C 024S	741106	EVERY 3 HR	PLASTIC	
56.00	D01-04H	C 024S	740730	EVERY 2 HR	NONE	
57.00	D02-04A	C 024S	740710	EVERY 2 HR		
58.00	C01-01H	C 024S	740501		NONE	
58.01	J01-01H	C 024S	740501		NONE	
59.00	B03-05D	FC024S	740716	EVERY 2 HR		
59.01	C03-04U	FC024S	740716	EVERY 2 HR		
60.00	C14-09A	FC024S	740709			
61.01	B02-08G	FC024R	6310 THRU 6311	HOURLY, 13DAY AVG		
61.02	C01-05G	FC024R	6312	HOURLY, 5DAY AVG		
61.03	C01-07G	FC024R	6307	HOURLY, 14DAY AVG		
61.04	C01-09G	FC024R	6309	HOURLY, 14DAY AVG		
65.01	A01-10G	FC S	730622 THRU 730802	DAILY, WK COMP AVG		
65.02	C01-08G	FC S	730622 THRU 730802	DAILY, WK COMP AVG		
68.00	C01-08G	G	7301 THRU 7312	COMP WEEKLY, YR AVG		
69.00	B01-06G	FC024S	741030	EVERY 30 MIN		
71.00	B01-06G	FC024S	741106	EVERY 30 MIN		
72.00	B02-06G	FC024S	741009	EVERY 30 MIN		
73.00	C01-05G	FC024S	741106	EVERY 30 MIN		
74.00	B02-06G	FC024S	741022	EVERY 30 MIN		
75.00	A01-07G	FC024S	741126			
76.00	A02-06G	FC024S	741022	EVERY 30 MIN		
77.00	B02-05G	FC024S	741121	EVERY 30 MIN		
78.00	B01-09G	G R	7307 THRU 7406	COMP MONTHLY, AVG		
78.01	B05-10G	G R	7307 THRU 7406	COMP MONTHLY, AVG		
81.01	A01-09G	FC S	7201 THRU 7207	DAILY, 2WK COMP AVG		
81.02	A01-08F	FC S	7201 THRU 7207	DAILY, 2WK COMP AVG		
81.03	A01-08G	FC S	7201 THRU 7207	DAILY, 2WK COMP AVG		
81.04	B01-07G	FC S	7201 THRU 7207	DAILY, 2WK COMP AVG		
81.05	C01-06G	FC S	7201 THRU 7207	DAILY, 2WK COMP AVG		
81.06	A01-06G	FC S	7201 THRU 7207	DAILY, 2WK COMP AVG		
92.01	A01-07A	C 006S	6506	EVERY 15 MIN		
92.02	A01-07A	C 006S	6506	EVERY 15 MIN		
92.03	B01-07A	C 006S	6506	EVERY 15 MIN		
92.04	A01-06A	C 006S	6506	EVERY 15 MIN		
92.05	A01-06A	C 006S	6506	EVERY 15 MIN		
92.06	A01-06A	C 006S	6506	EVERY 15 MIN		
92.08	A01-07A	C 006S	6506	EVERY 15 MIN		
92.09	A01-06A	C 006S	6506	EVERY 15 MIN		
92.10	A01-06A	C 006S	6506	EVERY 15 MIN		
92.11	B01-06A	C 006S	6506	EVERY 15 MIN		

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REF.NO.	CATEGORY	SAMPLING PROCEDURE	SAMPLING DATE	REMARKS	MAJOR INDUSTRY	POTW CONTROL
92.12	B01-07A	C 006S	6506	EVERY 15 MIN		
92.13	B01-06A	C 006S	6506	EVERY 15 MIN		
92.14	B01-07A	C 006S	6506	EVERY 15 MIN		
92.17	A01-07A	C 006S	6506	EVERY 15 MIN		
92.18	C01-05A	C 006S	6506	EVERY 15 MIN		
92.19	C01-07A	C 006S	6506	EVERY 15 MIN		
92.20	C01-06A	C 006S	6506	EVERY 15 MIN		
92.21	C01-06A	C 006S	6506	EVERY 15 MIN		
92.22	A01-06B	C 006S	6506	EVERY 15 MIN		
92.23	A01-08B	C 006S	6506	EVERY 15 MIN		
97.01	C01-07B	C 024S	7201 THRU 7205			
97.02	B01-06B	C 024S	7201 THRU 7205			
97.03	C01-07B	C 024S	7201 THRU 7205			
97.05	A01-06E	C 024S	7201 THRU 7205			
97.06	A01-07B	C 024S	7201 THRU 7205			
97.07	B01-07B	C 024S	7201 THRU 7205			
97.08	B01-08B	C 024S	7201 THRU 7205			
97.09	C05-07B	C 024S	7201 THRU 7205			
97.10	C01-06A	C 024S	7201 THRU 7205			
97.11	C01-08B	C 024S	7201 THRU 7205			
97.12	C05-08B	C 024S	7201 THRU 7205			
97.14	B02-07C	C 024S	7201 THRU 7205			
97.17	C01-11C	C 024S	7201 THRU 7205			
97.18	C01-10B	C 024S	7201 THRU 7205			
97.21	A01-07A	C 024S	7201 THRU 7205			
97.23	C01-08C	C 024S	7201 THRU 7205			
97.26	B01-07C	C 024S	7201 THRU 7205			
97.27	A01-07A	C 024S	7201 THRU 7205			
97.28	C01-06A	C 024S	7201 THRU 7205			
97.29	A01-06A	C 024S	7201 THRU 7205			
97.30	C05-06F	C 024S	7201 THRU 7205			
97.31	B04-06A	C 024S	7201 THRU 7205			
97.32	B04-07C	C 024S	7201 THRU 7205			
97.33	A01-06A	C 024S	7201 THRU 7205			
97.35	A01-06B	C 024S	7201 THRU 7205			
150.00	C01-06A	C 024S	740705 740706 740707	EVERY HR, AVG		
153.00	B01-06A	C 024S	740626			
154.00	C07-06G	C 024S	740622 740623	AVG		
155.00	C01-02H	C 024S	740621 740622 740623	AVG	NONE	
156.00	B01-07G	C 024S	740621 740622 740623	AVG		
158.00	C08-02G	C 024S	740618 740619 740620	AVG		
160.00	C01-07A	C 024S	740618			
162.00	C01-08A	C 024S	740617			
163.00	C01-06G	C 024S	740827 THRU 740901	AVG 5 DAILY COMP	DYE	
164.00	B01-06A	C 024S	741028 THRU 741030	AVG 2 DAILY COMP	METAL PLAT	
165.00	B01-06A	C 024S	741028 THRU 741030	AVG 2 DAILY COMP		
166.00	B01-05G	C 024	741028 INF 741029 EFF		PLAT,DAIRY	
167.00	B04-06G	C 024S	741028 THRU 741031	AVG 3 DAILY COMP	PLAT,MEAT PKG	
201.00	A01-08A	C 006S	740604 740304	AVG		
202.00	A01-06F	C 006S	740516 740201	AVG		

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REF. NO.	CATEGORY	SAMPLING PROCEDURE	SAMPLING DATE	REMARKS	MAJOR INDUSTRY	POTW CONTROL
203.00	B02-07H	C 006S	740626			
204.00	A01-07A	C 006S	740618			
205.00	A03-06A	C 006S	740816			
206.00	A01-05A	C 006S	740108 730828	AVG		
207.00	B01-06H	C 006S	740506 740318	AVG	NONE	
208.00	A01-06A	C 006S	740429 740208	AVG		
209.00	A01-05A	C 006S	740118 730731	AVG		
210.00	B01-07A	C 006S	740327 740115	AVG		
211.00	A01-06B	C 006S	740429 740307	AVG		
212.00	A01-09A	C 006S	740812			
213.00	A04-06D	C 006S	740531 740221	AVG		
214.00	B01-06H	C 006S	740207 730907	AVG	NONE	
215.00	A01-06H	C 006S	740701		NONE	
216.00	A01-06H	C 006S	740508 740308	AVG		
217.00	A01-08C	C 006S	740131 730925	AVG		
218.00	A01-09D	C 006S	730927			
219.00	B01-06H	C 006S	740621		NONE	
220.00	C01-09A	C 006S	740702			
221.00	B01-06A	C 006S	740626			
223.00	A01-08A	C 006S	740401 740114	AVG		
224.00	A01-06A	C 006S	740619			
225.00	A01-08A	C 006S	740621			
226.00	A01-05A	C 006S	740114			
227.00	A01-06A	C 006S	740604			
229.00	A01-07A	C 006S	740221			
231.00	B02-06B	C 006S	740228 731220	AVG		
232.00	A01-09A	C 006S	740513 740226	AVG		
233.00	B02-06A	C 006S	740809			
234.00	A01-08A	C 006S	740618			
235.00	A01-08A	C 006S	740506 740315	AVG		
236.00	A01-06A	C 006S	740128 731119	AVG		
237.00	B02-06A	C 006S	740424 740227	AVG		
238.00	A01-06A	C 006S	740627			
239.00	C05-04A	C 006S	740125			
240.00	A01-05A	C 006S	740122 730906	AVG		
241.00	A01-05A	C 006S	740201 730223	AVG		
242.00	A01-01A	C 006S	740617			
243.00	A01-03A	C 006S	740424 740129	AVG		
245.00	A01-01A	C 006S	740618			
246.00	B02-06A	C 006S	740301 731220	AVG		
248.00	B01-05A	C 024	740205 740919	1974 AVG		
250.00	A01-03A	C 024	740328			
251.00	B01-06A	C 024	740124 0709 0808 0919	AND 741008 1212AVG		
252.00	A01-05A	C 024	740220 0820 1010 1212	1974 AVG		
253.00	C01-07A	C 024	740129 0418 0611 0702	0813 0904 1001 AVG		
254.00	B02-05H	C 024	740129 0620 0711 0801	0813 0910 1001 AVG		
255.00	B02-05A	C 024	740326 0815 1010 1210	1974 AVG		
256.00	C01-06B	C 024	740220 0606 0827 1022	1126 1974 AVG		
257.00	C01-06A	C 024	740827 1022 1126	1974 AVG		
258.00	B02-06A	C 024	741017			

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REF. NO.	CATEGORY	SAMPLING PROCEDURE	SAMPLING DATE	REMARKS	MAJOR INDUSTRY	POTW CONTROL
259.00	A02-06C	C 024	740326 740611			
260.00	A01-06A	C 024	740507			
263.00	C01-07A	C 006S	740516 740327	AVG		
264.00	A01-08A	C 006S	740531 740322	AVG		
266.00	B01-07A	C 006S	740313			
267.00	C01-05A	C 006S	740501 740306	AVG		
269.00	C01-05A	C 006S	740530 740320	AVG		
269.00	C01-06A	C 006S	740514 740319	AVG		
270.00	C01-05A	C 006S	740305			
271.00	C01-06A	C 006S	740502 740307	AVG		
272.00	C01-09A	C 006S	740509 740314	AVG		
274.00	A01-08A	C 006S	740506 740311	AVG		
275.00	A01-07A	C 006S	740513 740318	AVG		
276.00	A01-08A	C 006S	740304			
277.00	C01-07B	C 006S	740326			
280.00	B01-04G	FC024S	720823	EVERY 15 MIN		
281.00	B01-04G	FC024R	740708	EVERY 6 MIN		
282.00	A01-05G	FC024S	671003	EVERY 15 MIN	DAIRY	
283.00	B01-05G	FC024S	691215	EVERY 15 MIN		
284.00	C01-06G	FC024S	740826	EVERY 10 MIN	MEAT PACKING	
285.00	C01-06G	C 024S	740430			
286.00	B03-06G	FC024S	700203	EVERY 15 MIN		
287.00	C01-06B	FC024S	740709	EVERY 6 MIN	BREWERY	
288.00	A01-04H	C 024S	740715	EVERY 15 MIN	NONE	
289.00	A01-06G	FC024S	730102 730103	15 MIN, 2 DAY AVG		
291.00	C01-06A	FC024S	740724			
292.00	A01-06G	FC024S	690521	EVERY 15 MIN		
295.00	B01-06A	FC024S	750122	EVERY HR	POTATO CHIP	
296.00	C06-06A	FC024S	750213		PAINT, OIL	
297.00	B02-03A	FC024S	750107	EVERY HR	METAL, PLASTIC	
298.00	C06-06A	FC024S	750206		METAL	
299.00	C06-07G	FC024S	750204			
300.00	A01-03G	FC024S	750116		SLAUGHTER	
301.00	B01-03A	FC024S	750127	EVERY HR	DAIRY PROD	
302.00	B04-06H	FC024S	741023	EVERY 3HR	NONE	
303.01	C01-05G	FC024S	740911		METAL	
303.02	C02-05G	FC024S	740911		METAL	
304.00	C06-06H	FC024S	750115		NONE	
305.00	D06-06H	C 024S	750212	EVERY HR, INF GRAB	NONE	
306.00	B01-03G	FC024S	741203	EVERY HR	METAL	
307.00	B01-03G	FC024S	741217			
308.00	B03-02H	FC024S	750121		NONE	
309.00	C03-08F	FC024S	750121	INF BY POTW EQN	PAPER MILL	
310.00	B01-06G	FC024S	750219	EVERY 2HR	FOOD PROCESS	
311.00	A01-07G	FC024S	750128	EVERY HR	MFG, DAIRY	
312.00	B01-06G	FC024S	730813 THRU 730816	EVERY 1 HR	TEXTILE DYE	
313.01	B05-06G	FC024S	730618 THRU 730622		DAIRY-PLASTIC	
313.02	B02-06H	FC024S	730618 THRU 730620		NONE	
314.01	B02-07G	FC024S	730620 THRU 730624		ROOFING MFG.	
314.02	C01-06G	FC024S	730621 THRU 730623		PAPER-PAINT	

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POTW REMOVAL DATA
REFERENCE INFORMATION

REF. NO.	CATEGORY	SAMPLING PROCEDURE	SAMPLING DATE	REMARKS	MAJOR INDUSTRY	POTW CONTROL
315.00	J01-05H	FC024S	730618 THRU 730620		NONE	
316.00	C01-07G	FC024S	740122 740423	AVG		
317.00	A01-05A	FC024S	740507		FOOD-PHARMA	01
318.00	B02-08G	FC024S	740116 THRU 741030	AVG 8 SAAMPLES	PAINT MFG	
319.00	B01-06A	FC024S	740124 THRU 741003	AVG 3 SAMPLES	FOUNDRY	
320.00	B01-04A	FC024S	740402		PRINTING	01
321.00	C04-06G	FC024S	740326 THRU 741211	AVG 4 SAMPLES	IRON-GLASS	
325.00	C06-11A	G S	740724 741010	AVG	MEAT PKG, PLAT	03
326.00	A02-11A	G S	740724 741010	AVG		03
326.01	A02-11A	G 024S	730924 THRU 731007	EVERY 4HR, 14DAY AV		03
327.00	A02-11A	G S	740724 741010	AVG		03
327.01	A02-11A	G 024S	730930 731007	EVERY 4HR, 8DAY AVG		03
328.00	C05-08A	G S	740103 THRU 741022	AVG 7SAMPLES	MUNITION, DYE	03
329.00	B01-08B	G S	740822			04
331.00	D01-11A	G S	740122		STEEL, POWER	09
332.00	C01-09A	G S	730725 730726	AVG	PAPER MILL	04
333.00	B05-08G	G S	740318 740627	AVG		03
335.00	A05-07A	C 001S	731211		WIRE	06
336.00	B01-06A	G S	741120			03

NOTE: (NEUTRAL REMOVALS FOLLOW)

24 HR COMPOSITE - 6 HR SIMULTANEOUS COMPOSITE, COMPARISON OF RESULTS

5/23/75

PARAMETERS			C1		B1		C1	
			24	6	24	6	24	6
00550 TOT-SXLT	OIL-GREASE MG/L	NO.	5.00	0.0	2.00	0.0	4.00	0.0
		MAX	64.81	0.0	62.00	0.0	48.49	0.0
		MIN	12.50	0.0	22.00	0.0	9.29	0.0
		MEAN	39.03	0.0	42.00	0.0	66.57	0.0
		STD.DEV	23.88	0.0	28.24	0.0	38.26	0.0
00556 SFP-FUNNEL	OIL-GREASE MG/L	NO.	0.0	0.0	1.00	0.0	0.0	0.0
		MAX	0.0	0.0	95.50	0.0	0.0	0.0
		MIN	0.0	0.0	95.50	0.0	0.0	0.0
		MEAN	0.0	0.0	95.50	0.0	0.0	0.0
		STD.DEV	0.0	0.0	0.00	0.0	0.0	0.0
00560 INFRARED	OIL-GREASE MG/L	NO.	0.0	0.0	0.0	0.0	0.0	0.0
		MAX	0.0	0.0	0.0	0.0	0.0	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	0.0	0.0	0.0	0.0	0.0	0.0
		STD.DEV	0.0	0.0	0.0	0.0	0.0	0.0
00500 TOTAL, TS	RESIDUE MG/L	NO.	11.00	10.00	12.00	5.00	16.00	3.00
		MAX	40.96	44.82	31.40	63.33	63.91	51.64
		MIN	1.37	5.15	0.62	14.03	7.44	12.30
		MEAN	11.60	27.65	18.42	37.70	32.85	34.14
		STD.DEV	11.78	13.11	7.96	19.19	16.12	20.03
00530 TOT NFLT. SS	RESIDUE MG/L	NO.	15.00	27.00	23.00	6.00	29.00	9.00
		MAX	67.78	91.89	96.55	96.58	98.54	97.37
		MIN	21.45	16.79	25.86	19.72	33.33	40.32
		MEAN	41.37	57.20	70.39	64.94	78.21	73.54
		STD.DEV	15.41	17.75	19.43	37.34	20.19	21.23
00310 5DAY	BOD MG/L	NO.	11.00	37.00	18.00	9.00	25.00	13.00
		MAX	39.26	88.70	95.20	90.84	97.58	96.84
		MIN	0.0	0.0	41.43	4.76	51.22	64.58
		MEAN	17.60	34.87	76.74	69.10	84.27	86.49
		STD.DEV	13.92	22.60	15.07	31.38	13.18	9.80
00340 HI LEVEL	COD MG/L	NO.	10.00	0.0	15.00	0.0	19.00	0.0
		MAX	51.77	0.0	93.32	0.0	92.86	0.0
		MIN	4.64	0.0	34.38	0.0	23.70	0.0
		MEAN	27.15	0.0	68.64	0.0	71.95	0.0
		STD.DEV	22.12	0.0	17.03	0.0	17.41	0.0
00335 LOW LEVEL	COD MG/L	NO.	1.00	0.0	0.0	0.0	1.00	0.0
		MAX	19.39	0.0	0.0	0.0	91.72	0.0
		MIN	19.39	0.0	0.0	0.0	91.72	0.0
		MEAN	19.39	0.0	0.0	0.0	91.72	0.0
		STD.DEV	0.00	0.0	0.0	0.0	0.00	0.0
00342 SALINE	SEA COND MG/L	NO.	2.00	0.0	3.00	0.0	5.00	0.0
		MAX	19.49	0.0	78.44	0.0	93.35	0.0
		MIN	0.0	0.0	61.65	0.0	52.34	0.0
		MEAN	9.70	0.0	71.15	0.0	75.03	0.0
		STD.DEV	13.71	0.0	8.62	0.0	16.10	0.0

PARAMETERS			A1		B1		C1	
			24	6	24	6	24	6
32730 PHENOLICS 4AAP DISTIL	NO./L	NO.	1.00	0.0	6.00	0.0	8.00	0.0
		MAX	50.00	0.0	79.41	0.0	98.26	0.0
		MIN	50.00	0.0	0.0	0.0	0.0	0.0
		MEAN	50.00	0.0	50.57	0.0	52.90	0.0
		STD.DEV	0.00	0.0	30.26	0.0	37.05	0.0
00945 SULFATE	MG/L	NO.	4.00	9.00	4.00	4.00	5.00	2.00
		MAX	57.89	27.78	79.74	43.75	25.42	38.57
		MIN	0.0	0.0	2.80	17.14	5.71	0.0
		MEAN	15.05	7.12	34.29	28.66	18.40	19.29
		STD.DEV	27.98	10.93	32.44	12.40	7.51	27.27
00665 TOTAL PHOSPHORUS	MG/L	NO.	5.00	0.0	11.00	0.0	20.00	0.0
		MAX	18.25	0.0	52.54	0.0	92.31	0.0
		MIN	0.0	0.0	9.14	0.0	9.72	0.0
		MEAN	9.65	0.0	26.12	0.0	49.96	0.0
		STD.DEV	6.42	0.0	14.25	0.0	26.34	0.0
00610 NITROGEN, AMMONIA	MG/L	NO.	10.00	28.00	15.00	5.00	21.00	10.00
		MAX	61.05	64.29	99.49	37.50	98.00	84.21
		MIN	0.0	0.0	2.78	5.26	3.79	6.69
		MEAN	19.08	20.91	47.81	17.08	45.49	36.23
		STD.DEV	21.08	14.97	29.37	13.71	33.68	23.75
TI-9 00625 NITROGEN, KJELDAHL, TOTAL	MG/L	NO.	6.00	0.0	10.00	1.00	10.00	0.0
		MAX	59.72	0.0	85.31	93.68	91.67	0.0
		MIN	0.0	0.0	7.00	93.68	10.71	0.0
		MEAN	21.32	0.0	40.36	93.68	37.00	0.0
		STD.DEV	21.88	0.0	26.48	0.00	25.89	0.0
01002 TOT ARSENIC AS	UG/L	NO.	1.00	0.0	1.00	0.0	1.00	0.0
		MAX	0.0	0.0	0.0	0.0	60.00	0.0
		MIN	0.0	0.0	0.0	0.0	60.00	0.0
		MEAN	0.0	0.0	0.0	0.0	60.00	0.0
		STD.DEV	0.00	0.0	0.00	0.0	0.00	0.0
01027 TOT CADMIUM CD	UG/L	NO.	13.00	9.00	13.00	2.00	15.00	1.00
		MAX	25.00	0.0	75.00	0.0	80.00	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	5.77	0.0	24.24	0.0	18.36	0.0
		STD.DEV	10.96	*****	28.80	*****	29.97	0.00
01034 TOT CHROMIUM CR	UG/L	NO.	14.00	11.00	17.00	6.00	21.00	1.00
		MAX	80.00	66.67	98.94	50.00	98.33	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	31.49	18.11	47.83	20.00	61.41	0.0
		STD.DEV	32.10	22.99	32.42	24.49	33.02	0.00
01051 TOT LEAD PB	UG/L	NO.	15.00	8.00	15.00	3.00	24.00	1.00
		MAX	83.24	50.00	92.97	90.00	95.00	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	16.66	18.75	30.22	30.00	46.80	0.0
		STD.DEV	29.12	20.77	29.96	51.96	32.43	0.00

PARAMETERS			A1		B1		C1	
			24	6	24	6	24	6
71900 TOT MERCURY HG	UG/L	NO.	8.00	7.00	6.00	2.00	17.00	1.00
		MAX	75.00	75.00	61.54	66.67	99.58	81.25
		MIN	0.0	0.0	0.0	50.00	0.0	81.25
		MEAN	31.70	26.43	30.94	58.33	50.74	81.25
		STD.DEV	34.10	30.51	26.19	11.79	30.20	0.00
01042 TOT COPPER CU	UG/L	NO.	15.00	18.00	19.00	7.00	25.00	5.00
		MAX	77.27	46.88	95.23	85.00	92.31	64.29
		MIN	0.0	0.0	16.67	0.0	14.29	25.00
		MEAN	32.54	13.17	54.49	49.57	63.10	46.52
		STD.DEV	27.12	15.84	23.79	33.46	22.54	16.93
01097 TOT ANTIMONY Sb	UG/L	NO.	0.0	0.0	0.0	0.0	0.0	0.0
		MAX	0.0	0.0	0.0	0.0	0.0	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	0.0	0.0	0.0	0.0	0.0	0.0
		STD.DEV	0.0	0.0	0.0	0.0	0.0	0.0
01067 TOT NICKEL NI	UG/L	NO.	14.00	8.00	11.00	2.00	22.00	1.00
		MAX	92.19	0.0	86.39	0.0	80.00	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	9.84	0.0	19.95	0.0	21.67	0.0
		STD.DEV	25.43	*****	25.61	*****	24.39	0.00
6-12 01147 TOT SELENIUM SE	UG/L	NO.	0.0	0.0	0.0	0.0	1.00	0.0
		MAX	0.0	0.0	0.0	0.0	0.0	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	0.0	0.0	0.0	0.0	0.0	0.0
		STD.DEV	0.0	0.0	0.0	0.0	0.00	0.0
01077 TOT SILVER AG	UG/L	NO.	0.0	0.0	0.0	0.0	0.0	0.0
		MAX	0.0	0.0	0.0	0.0	0.0	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	0.0	0.0	0.0	0.0	0.0	0.0
		STD.DEV	0.0	0.0	0.0	0.0	0.0	0.0
01092 TOT ZINC ZN	UG/L	NO.	12.00	14.00	19.00	5.00	27.00	2.00
		MAX	66.67	68.75	87.89	70.42	99.29	66.67
		MIN	0.0	0.0	0.0	20.00	0.0	52.94
		MEAN	37.33	19.70	47.74	42.05	62.87	59.80
		STD.DEV	21.99	19.27	24.34	18.54	27.13	9.71
01102 TOT TIN SN	UG/L	NO.	0.0	0.0	0.0	0.0	1.00	0.0
		MAX	0.0	0.0	0.0	0.0	0.0	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	0.0	0.0	0.0	0.0	0.0	0.0
		STD.DEV	0.0	0.0	0.0	0.0	0.00	0.0
00680 TOT ORG CARBON TOTAL TOC	MG/L	NO.	6.00	22.00	3.00	5.00	4.00	4.00
		MAX	50.94	56.43	76.76	84.13	87.78	74.07
		MIN	6.82	0.0	60.54	56.32	70.90	41.94
		MEAN	24.06	24.69	70.51	72.35	78.07	64.12
		STD.DEV	16.20	18.88	8.69	11.44	7.04	15.10

PARAMETERS			C1		R1		C1	
			24	--	24	--	24	6
01106 TOT ALUMINUM AL	UG/L	NO.	1.00	0.0	2.00	0.0	2.00	0.0
		MAX	10.87	0.0	41.67	0.0	31.03	0.0
		MIN	10.87	0.0	0.0	0.0	0.0	0.0
		MEAN	10.87	0.0	20.83	0.0	15.52	0.0
		STD.DEV	0.00	0.0	29.45	0.0	21.94	0.0
01045 TOT IRON FE	UG/L	NO.	10.00	11.00	9.00	3.00	15.00	3.00
		MAX	88.89	75.00	79.85	87.50	97.67	97.50
		MIN	13.79	0.0	0.0	46.67	7.70	42.86
		MEAN	37.33	43.25	42.45	63.39	59.73	77.79
		STD.DEV	24.97	19.45	22.19	21.40	29.85	30.34
01055 TOT MANGANESE MN	UG/L	NO.	6.00	7.00	5.00	3.00	4.00	0.0
		MAX	33.33	81.25	64.54	0.0	42.86	0.0
		MIN	2.90	0.0	18.52	0.0	3.33	0.0
		MEAN	12.19	14.94	48.36	0.0	18.83	0.0
		STD.DEV	10.87	29.89	18.09	*****	17.63	0.0
00720 TOTAL	CYANIDE, MG/L	NO.	1.00	0.0	2.00	0.0	4.00	0.0
		MAX	0.0	0.0	0.0	0.0	98.21	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	0.0	0.0	0.0	0.0	54.86	0.0
		STD.DEV	0.00	0.0	*****	0.0	44.78	0.0
6-13 38260	MRAS MG/L	NO.	2.00	0.0	5.00	0.0	6.00	0.0
		MAX	90.86	0.0	78.24	0.0	93.52	0.0
		MIN	10.67	0.0	35.43	0.0	33.76	0.0
		MEAN	50.70	0.0	60.40	0.0	63.70	0.0
		STD.DEV	56.71	0.0	22.05	0.0	24.52	0.0
01032 CHROMIUM, UG/L AS CR	HEXAVALENT	NO.	3.00	0.0	5.00	0.0	4.00	0.0
		MAX	0.0	0.0	60.00	0.0	54.29	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	0.0	0.0	29.45	0.0	13.57	0.0
		STD.DEV	*****	0.0	30.02	0.0	27.14	0.0
00605 ORGANIC	NITROGEN, MG/L	NO.	3.00	7.00	4.00	2.00	9.00	4.00
		MAX	63.64	69.23	66.67	75.00	94.60	85.71
		MIN	1.17	9.09	0.0	66.67	14.49	76.92
		MEAN	30.49	43.66	35.40	70.83	61.30	81.81
		STD.DEV	31.41	21.00	27.47	5.89	27.71	4.09
00666 PHOSPHORUS	DISSOLVED MG/L	NO.	1.00	0.0	1.00	0.0	2.00	0.0
		MAX	0.0	0.0	14.81	0.0	49.15	0.0
		MIN	0.0	0.0	14.81	0.0	43.42	0.0
		MEAN	0.0	0.0	14.81	0.0	46.29	0.0
		STD.DEV	0.00	0.0	0.00	0.0	4.05	0.0
01040 DISSOLVED MG/L AS CR	CO-PEL.	NO.	0.0	23.00	0.0	6.00	0.0	7.00
		MAX	0.0	45.00	0.0	62.50	0.0	87.50
		MIN	0.0	0.0	0.0	0.0	0.0	12.50
		MEAN	0.0	18.74	0.0	37.24	0.0	56.09
		STD.DEV	0.0	17.07	0.0	23.09	0.0	28.97

REPORT NO. 6
NOTE: (NEGATIVE REMOVALS DELETED)

POTW REMOVAL DATA ANALYSIS
24 HR COMPOSITE - 6 HR SIMULTANEOUS COMPOSITE. COMPARISON OF RESULTS

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PARAMETERS		24	H1		24	H1		24	C1	
			--	6		--	6		--	6
01030 CHROMIUM, DISSOLVED MG/L AS CR	NO.	0.0		28.00	0.0		6.00	0.0		9.00
	MAX	0.0		80.65	0.0		50.00	0.0		65.67
	MIN	0.0		0.0	0.0		0.0	0.0		0.0
	MEAN	0.0		15.59	0.0		8.33	0.0		22.61
	STD.DEV	0.0		22.92	0.0		20.41	0.0		28.92
01049 LEAD, DISSOLVED MG/L AS PB	NO.	0.0		31.00	0.0		6.00	0.0		9.00
	MAX	0.0		66.67	0.0		90.00	0.0		0.0
	MIN	0.0		0.0	0.0		0.0	0.0		0.0
	MEAN	0.0		10.22	0.0		33.06	0.0		0.0
	STD.DEV	0.0		21.81	0.0		40.69	0.0		*****
01065 NICKEL, DISSOLVED MG/L AS NI	NO.	0.0		29.00	0.0		6.00	0.0		9.00
	MAX	0.0		50.00	0.0		0.0	0.0		55.56
	MIN	0.0		0.0	0.0		0.0	0.0		0.0
	MEAN	0.0		4.09	0.0		0.0	0.0		12.23
	STD.DEV	0.0		12.58	0.0		*****	0.0		24.28
01025 CADMIUM, DISSOLVED MG/L AS CD	NO.	0.0		31.00	0.0		6.00	0.0		9.00
	MAX	0.0		25.00	0.0		0.0	0.0		57.14
	MIN	0.0		0.0	0.0		0.0	0.0		0.0
	MEAN	0.0		0.81	0.0		0.0	0.0		11.90
	STD.DEV	0.0		4.49	0.0		*****	0.0		23.69
6-14 01056 MANGANESE, DISSOLVED MG/L AS MN	NO.	0.0		18.00	0.0		5.00	0.0		5.00
	MAX	0.0		21.43	0.0		35.71	0.0		92.86
	MIN	0.0		0.0	0.0		0.0	0.0		0.0
	MEAN	0.0		5.65	0.0		12.14	0.0		34.57
	STD.DEV	0.0		7.14	0.0		17.05	0.0		37.57
71890 MERCURY, DISSOLVED MG/L AS HG	NO.	0.0		20.00	0.0		2.00	0.0		7.00
	MAX	0.0		84.21	0.0		50.00	0.0		14.29
	MIN	0.0		0.0	0.0		22.22	0.0		0.0
	MEAN	0.0		21.28	0.0		36.11	0.0		2.04
	STD.DEV	0.0		26.16	0.0		19.64	0.0		5.40
70507 TOT ORTHO- PHOSPHATE MG/L	NO.	1.00		21.00	0.0		4.00	0.0		8.00
	MAX	6.10		82.93	0.0		25.42	0.0		63.64
	MIN	6.10		0.0	0.0		9.09	0.0		2.33
	MEAN	6.10		28.12	0.0		16.15	0.0		38.43
	STD.DEV	0.00		20.66	0.0		6.82	0.0		22.45
00690 TOT CARBON MG/L AS C	NO.	0.0		26.00	0.0		5.00	0.0		4.00
	MAX	0.0		57.01	0.0		83.80	0.0		61.33
	MIN	0.0		0.0	0.0		52.09	0.0		34.02
	MEAN	0.0		22.29	0.0		68.35	0.0		52.29
	STD.DEV	0.0		18.05	0.0		12.71	0.0		12.76

PARAMETERS			24	H1 --	6	24	H1 --	6	24	C1 --	6
00650 TOTAL PHOSPHATE	NO.	MG/L	3.00		9.00	2.00		3.00	4.00		3.00
	MAX		45.55		34.88	11.75		53.57	24.10		63.16
	MIN		1.56		7.64	1.35		41.18	16.98		39.39
	MEAN		18.67		22.47	6.55		45.56	20.83		48.16
	STD.DEV		24.35		9.42	7.35		6.95	3.49		13.05
00671 DISSOLVED ORTHOPHOSPHATE	NO.	MG/L	2.00		0.0	3.00		0.0	2.00		0.0
	MAX		20.00		0.0	50.59		0.0	96.80		0.0
	MIN		7.39		0.0	2.17		0.0	84.21		0.0
	MEAN		13.95		0.0	24.13		0.0	90.51		0.0
	STD.DEV		8.56		0.0	24.52		0.0	8.90		0.0
01037 COBALT,TOT UG/L AS CO	NO.		0.0		0.0	0.0		0.0	0.0		0.0
	MAX		0.0		0.0	0.0		0.0	0.0		0.0
	MIN		0.0		0.0	0.0		0.0	0.0		0.0
	MEAN		0.0		0.0	0.0		0.0	0.0		0.0
	STD.DEV		0.0		0.0	0.0		0.0	0.0		0.0
01007 BARIUM,TOT UG/L AS BA	NO.		1.00		0.0	0.0		0.0	0.0		0.0
	MAX		0.0		0.0	0.0		0.0	0.0		0.0
	MIN		0.0		0.0	0.0		0.0	0.0		0.0
	MEAN		0.0		0.0	0.0		0.0	0.0		0.0
	STD.DEV		0.00		0.0	0.0		0.0	0.0		0.0

REPORT NO. 4
NOTE: NEGATIVE REMOVALS TREATED

POTW REMOVAL DATA ANALYSIS BY PLANT

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PARAMETERS	CATEGORY	FI	OTHER A		OTHER B		OTHER C		MISC (D, J)
			FI	OTHER A	FI	OTHER B	FI	OTHER C	
00550	OIL-GREASE	NO. POTW	5.00	1.00	2.00	3.00	4.00	2.00	0.0
TOT-SXLT	MG/L	MAX	64.81	90.14	62.00	73.84	88.49	92.86	0.0
		MIN	12.50	00.14	22.00	36.59	9.29	51.69	0.0
		MEAN	39.63	90.14	42.00	58.48	66.57	72.27	0.0
		STD. DEV	23.86	0.00	28.28	19.47	38.26	29.11	0.0
00554	OIL-GREASE	NO. POTW	0.0	0.0	1.00	0.0	0.0	3.00	1.00
SEP-FUNNEL	MG/L	MAX	0.0	0.0	95.50	0.0	0.0	90.00	88.89
		MIN	0.0	0.0	95.50	0.0	0.0	84.00	88.89
		MEAN	0.0	0.0	95.50	0.0	0.0	87.17	88.89
		STD. DEV	0.0	0.0	0.00	0.0	0.0	3.01	0.00
00560	OIL-GREASE	NO. POTW	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INFRARED	MG/L	MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		STD. DEV	0.0	0.0	0.0	0.0	0.0	0.0	0.0
00500	RESIDUE	NO. POTW	21.00	5.00	17.00	24.00	20.00	12.00	2.00
TOTAL, TS	MG/L	MAX	44.82	24.08	63.33	61.35	63.91	31.72	46.02
		MIN	1.37	0.0	0.62	7.79	7.44	5.11	21.78
		MEAN	19.25	8.70	24.09	28.97	32.46	16.84	33.90
		STD. DEV	14.63	10.03	14.75	14.23	15.96	9.32	17.14
00530	RESIDUE	NO. POTW	42.00	8.00	32.00	37.00	41.00	29.00	9.00
TOT NFLT, SS	MG/L	MAX	91.89	62.88	96.58	97.42	98.54	98.54	97.94
		MIN	16.79	25.81	19.72	30.61	33.33	8.57	59.66
		MEAN	51.55	49.14	71.94	76.10	77.35	75.15	87.98
		STD. DEV	18.43	11.64	23.10	15.45	19.58	23.21	12.68
00310	BOD	NO. POTW	48.00	6.00	30.00	33.00	41.00	30.00	9.00
SDAY	MG/L	MAX	88.70	42.44	95.20	97.22	97.58	99.22	98.46
		MIN	0.0	1.79	4.76	43.75	51.22	17.86	71.77
		MEAN	30.91	24.27	75.76	78.86	85.20	83.38	91.15
		STD. DEV	22.05	15.65	21.00	15.09	11.73	18.47	9.22
00340	COD	NO. POTW	10.00	6.00	15.00	14.00	20.00	13.00	5.00
HIGH LEVEL	MG/L	MAX	81.77	78.29	93.32	87.20	92.86	93.52	86.88
		MIN	4.64	13.24	34.38	37.33	23.70	74.83	63.70
		MEAN	27.15	33.62	68.64	68.15	71.28	84.77	72.43
		STD. DEV	22.12	23.82	17.03	14.49	17.21	6.08	9.29
00335	COD	NO. POTW	1.00	0.0	0.0	0.0	1.00	2.00	1.00
LOW LEVEL	MG/L	MAX	19.39	0.0	0.0	0.0	91.72	94.81	89.63
		MIN	19.39	0.0	0.0	0.0	91.72	72.13	89.63
		MEAN	19.39	0.0	0.0	0.0	91.72	83.47	89.63
		STD. DEV	0.00	0.0	0.0	0.0	0.00	16.04	0.00
00342	SEA COD	NO. POTW	2.00	0.0	3.00	6.00	6.00	4.00	2.00
SALINE	MG/L	MAX	19.39	0.0	78.48	95.40	93.35	83.89	91.93
		MIN	0.0	0.0	61.65	48.20	52.34	64.58	89.33
		MEAN	9.70	0.0	71.15	79.75	77.62	74.21	90.63
		STD. DEV	13.71	0.0	8.62	17.69	15.74	8.02	1.84

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NOTE: NEGATIVE REMOVALS DELETED

KOTW REMOVAL DATA ANALYSIS BY PLANT

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PARAMETERS	CATEGORY	#1	OTHER A	B1	OTHER B	C1	OTHER C	MISC(D,J)
32730 PHENOLICS	NO.POTW	1.00	1.00	7.00	5.00	8.00	10.00	4.00
4AAP DISTIL	UG/L	50.00	25.00	79.41	85.00	98.26	96.05	89.47
	MIN	0.00	25.00	0.0	7.74	0.0	69.23	0.0
	MEAN	50.00	25.00	52.14	48.18	52.90	84.68	64.69
	STD.DEV	0.00	0.00	27.94	31.35	37.05	9.57	43.22
00945 SULFATE	NO.POTW	13.00	0.0	8.00	3.00	8.00	7.00	1.00
	MG/L	57.84	0.0	79.74	18.18	38.57	64.58	60.69
	MIN	0.0	0.0	2.80	6.38	0.0	0.0	60.69
	MEAN	9.84	0.0	31.48	12.69	17.28	11.52	60.69
	STD.DEV	17.14	0.0	22.93	5.94	12.40	23.63	0.00
00665 TOTAL PHOSPHORUS	NO.POTW	5.00	3.00	14.00	12.00	22.00	19.00	5.00
	MG/L	16.25	52.38	53.57	99.42	92.31	90.60	69.74
	MIN	0.0	20.00	9.14	0.0	9.72	0.0	20.91
	MEAN	9.65	32.23	27.90	30.03	50.44	40.79	42.34
	STD.DEV	6.42	17.59	14.53	32.64	25.20	27.87	20.16
00610 NITROGEN, AMMONIA	NO.POTW	38.00	7.00	23.00	26.00	32.00	22.00	7.00
	MG/L	64.29	26.87	49.49	98.98	98.00	99.70	97.00
	MIN	0.0	1.15	2.78	0.0	3.79	9.76	0.0
	MEAN	20.43	15.37	38.86	45.26	42.58	60.50	70.19
	STD.DEV	16.50	8.65	27.52	33.49	30.24	31.57	37.25
00625 NITROGEN, KJELDAHL, TOTAL	NO.POTW	6.00	1.00	12.00	9.00	10.00	8.00	0.0
	MG/L	59.72	24.39	93.68	88.72	91.67	93.60	0.0
	MIN	0.0	24.39	7.00	16.86	10.71	4.55	0.0
	MEAN	21.32	24.39	46.33	59.02	37.00	53.62	0.0
	STD.DEV	21.88	0.00	28.70	26.89	25.89	33.40	0.0
01002 TOT ARSENIC	NO.POTW	1.00	0.0	1.00	3.00	1.00	6.00	0.0
	UG/L	0.0	0.0	0.0	33.33	60.00	60.00	0.0
	MIN	0.0	0.0	0.0	0.0	60.00	0.0	0.0
	MEAN	0.0	0.0	0.0	22.22	60.00	19.72	0.0
	STD.DEV	0.00	0.0	0.00	19.24	0.00	30.56	0.0
01027 TOT CADMIUM	NO.POTW	28.00	3.00	18.00	18.00	19.00	29.00	5.00
	UG/L	45.45	76.47	75.00	66.67	80.00	87.69	50.00
	MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	6.37	25.49	24.65	13.96	15.08	15.56	16.00
	STD.DEV	12.17	44.15	27.08	21.86	27.32	25.88	23.02
01034 TOT CHROMIUM	NO.POTW	31.00	6.00	27.00	22.00	27.00	33.00	6.00
	UG/L	80.00	69.15	98.94	85.71	98.33	92.31	77.01
	MIN	0.0	7.89	0.0	0.0	0.0	0.0	0.0
	MEAN	25.45	33.47	41.92	33.83	60.15	37.43	37.72
	STD.DEV	26.34	26.12	31.68	28.44	32.23	32.13	36.95
01051 TOT LEAD	NO.POTW	28.00	8.00	21.00	21.00	29.00	28.00	8.00
	UG/L	98.24	77.88	93.42	84.62	95.00	90.65	93.33
	MIN	0.0	0.0	0.0	0.0	0.0	0.0	6.25
	MEAN	20.10	32.08	40.26	31.98	42.96	36.31	43.35
	STD.DEV	25.00	24.53	33.29	29.68	32.83	31.99	32.46

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PARAMETERS	CATEGORY	A1	OTHER A	B1	OTHER B	C1	OTHER C	MISC(D,J)
V	----->							
71900 TOT MERCURY	NO.POTW	19.00	3.00	4.00	12.00	19.00	19.00	4.00
MG	UG/L	75.00	0.0	66.67	50.00	99.58	71.43	50.00
	MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	29.79	0.0	38.77	25.60	50.55	25.02	20.83
	STD.DEV	28.65	*****	24.41	21.60	30.44	27.33	25.00
01042 TOT COPPER	NO.POTW	39.00	5.00	30.00	20.00	35.00	35.00	7.00
CU	UG/L	77.27	73.33	95.23	85.00	95.16	92.86	95.83
	MIN	0.0	12.90	0.0	20.00	14.29	0.0	50.97
	MEAN	23.89	38.71	56.02	51.53	61.23	56.39	77.81
	STD.DEV	23.78	24.16	26.07	20.90	22.64	25.53	15.05
01097 TOT ANTIMONY	NO.POTW	0.0	0.0	0.0	0.0	0.0	1.00	0.0
	UG/L	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	STD.DEV	0.0	0.0	0.0	0.0	0.0	0.00	0.0
01067 TOT NICKEL	NO.POTW	24.00	4.00	16.00	19.00	26.00	28.00	5.00
NI	UG/L	92.19	14.29	86.39	96.67	80.00	76.35	44.83
	MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	6.34	6.07	22.34	27.01	22.06	24.56	23.85
	STD.DEV	19.78	7.23	27.02	30.37	23.41	23.90	22.58
01147 TOT SELENIUM	NO.POTW	0.0	0.0	0.0	1.00	1.00	3.00	0.0
	UG/L	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	STD.DEV	0.0	0.0	0.0	0.00	0.00	*****	0.0
01077 TOT SILVER	NO.POTW	0.0	0.0	0.0	2.00	0.0	1.00	0.0
AG	UG/L	0.0	0.0	0.0	33.33	0.0	0.0	0.0
	MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	0.0	0.0	0.0	16.67	0.0	0.0	0.0
	STD.DEV	0.0	0.0	0.0	23.57	0.0	0.00	0.0
01092 TOT ZINC	NO.POTW	32.00	7.00	28.00	27.00	34.00	32.00	5.00
ZN	UG/L	68.75	88.00	88.57	92.50	99.29	91.67	91.67
	MIN	0.0	5.41	0.0	0.0	0.0	0.0	37.41
	MEAN	24.87	32.80	47.70	48.88	63.93	52.60	74.72
	STD.DEV	21.73	30.30	22.86	23.82	25.38	24.29	21.55
01102 TOT IIV	NO.POTW	0.0	0.0	0.0	1.00	1.00	3.00	0.0
	UG/L	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	STD.DEV	0.0	0.0	0.0	0.00	0.00	*****	0.0
00680 TOT ORG CARBON	NO.POTW	28.00	3.00	8.00	16.00	8.00	8.00	2.00
TOTAL TOC	MG/L	56.43	26.45	84.13	82.84	87.78	89.36	75.12
	MIN	0.0	4.48	56.32	8.08	41.94	60.23	57.50
	MEAN	24.55	17.75	71.66	60.38	71.10	78.70	66.31
	STD.DEV	18.05	11.68	9.87	19.69	13.21	10.17	12.46

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PARAMETERS	CATEGORY	A1	OTHER A	B1	OTHER B	C1	OTHER C	MISC(D,J)
01105 TOT ALUMINUM	NO.POTW	1.00	0.0	3.00	2.00	3.00	7.00	3.00
Al	UG/L	MAX	10.87	0.0	91.09	89.58	31.03	94.22
		MIN	10.87	0.0	0.0	75.00	0.0	0.0
		MEAN	10.87	0.0	44.25	82.29	15.90	46.57
		STD.DEV	0.00	0.0	45.60	10.31	15.53	32.71
01045 TOT IRON	NO.POTW	21.00	7.00	14.00	16.00	20.00	19.00	8.00
FF	UG/L	MAX	88.89	73.64	67.50	89.83	97.67	97.67
		MIN	0.0	0.0	0.0	0.0	7.70	10.00
		MEAN	40.44	35.82	48.80	50.44	63.92	65.82
		STD.DEV	21.44	22.42	24.39	27.70	28.48	24.86
01055 TOT MANGANESE	NO.POTW	13.00	3.00	9.00	13.00	6.00	14.00	6.00
MN	UG/L	MAX	81.25	29.73	64.54	71.95	42.86	93.46
		MIN	0.0	7.38	0.0	6.63	3.33	0.0
		MEAN	13.67	18.82	30.57	30.74	25.45	44.88
		STD.DEV	22.32	11.19	26.70	20.87	17.18	34.30
00720	CYANIDE,	NO.POTW	1.00	1.00	3.00	1.00	5.00	6.00
TOTAL	MG/L	MAX	0.0	66.67	80.00	6.54	98.21	86.57
		MIN	0.0	66.67	0.0	6.54	0.0	0.0
		MEAN	0.0	66.67	26.67	6.54	59.94	18.59
		STD.DEV	0.00	0.00	46.19	0.00	40.41	34.77
38260	MRAS	NO.POTW	2.00	2.00	5.00	2.00	6.00	3.00
	MG/L	MAX	40.86	19.15	78.24	89.27	93.52	83.33
		MIN	10.67	16.67	35.43	71.65	33.76	38.24
		MEAN	50.76	17.91	60.40	80.46	63.70	58.12
		STD.DEV	56.71	1.76	22.05	12.46	24.52	23.02
01032	HEXAVALENT	NO.POTW	3.00	0.0	5.00	1.00	4.00	10.00
CHROMIUM, UG/L AS CR		MAX	0.0	0.0	60.00	0.0	54.29	75.00
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	0.0	0.0	29.45	0.0	13.57	14.42
		STD.DEV	*****	0.0	30.02	0.00	27.14	30.44
00605	NITROGEN,	NO.POTW	10.00	0.0	6.00	3.00	13.00	2.00
ORGANIC	MG/L	MAX	69.23	0.0	75.00	65.93	94.60	72.16
		MIN	1.17	0.0	0.0	11.76	14.49	23.91
		MEAN	39.71	0.0	47.21	36.67	67.61	48.04
		STD.DEV	43.53	0.0	28.19	27.34	24.76	34.12
00666	DISSOLVED	NO.POTW	1.00	0.0	1.00	0.0	2.00	1.00
PHOSPHOPUS	MG/L	MAX	0.0	0.0	14.81	0.0	49.15	0.0
		MIN	0.0	0.0	14.81	0.0	43.42	0.0
		MEAN	0.0	0.0	14.81	0.0	46.29	0.0
		STD.DEV	0.00	0.0	0.00	0.0	4.05	0.00
01040	COPPER,	NO.POTW	23.00	1.00	6.00	4.00	7.00	1.00
DISSOLVED MG/L AS CU		MAX	45.00	30.30	62.50	25.00	87.50	66.67
		MIN	0.0	30.30	0.0	0.0	12.50	66.67
		MEAN	15.74	30.30	37.24	13.04	56.09	66.67
		STD.DEV	17.07	0.00	23.09	11.49	28.97	0.00

PARAMETERS	CATEGORY	A1	OTHER A	M1	OTHER B	C1	OTHER C	MISC(D,J)
01030 CHROMIUM, DISSOLVED MG/L AS CR	NO.POTW MAX MIN MEAN STD.DEV	28.00 40.65 0.0 15.54 22.92	0.0 0.0 0.0 0.0 0.0	6.00 50.00 0.0 8.33 20.41	4.00 88.89 0.0 34.72 43.12	9.00 65.67 0.0 22.61 28.92	1.00 0.0 0.0 0.0 0.00	0.0 0.0 0.0 0.0 0.0
01049 LEAD, DISSOLVED MG/L AS PB	NO.POTW MAX MIN MEAN STD.DEV	31.00 66.67 0.0 10.22 21.81	1.00 0.0 0.0 0.0 0.00	6.00 90.00 0.0 33.06 40.69	4.00 50.00 0.0 12.50 25.00	9.00 0.0 0.0 0.0 *****	1.00 0.0 0.0 0.0 0.00	0.0 0.0 0.0 0.0 0.0
01065 NICKEL, DISSOLVED MG/L AS NI	NO.POTW MAX MIN MEAN STD.DEV	29.00 50.00 0.0 4.04 12.58	1.00 0.0 0.0 0.0 0.00	6.00 0.0 0.0 0.0 *****	4.00 0.0 0.0 0.0 *****	9.00 55.56 0.0 12.23 24.28	1.00 0.0 0.0 0.0 0.00	0.0 0.0 0.0 0.0 0.0
01025 CADMIUM, DISSOLVED MG/L AS CD	NO.POTW MAX MIN MEAN STD.DEV	31.00 25.00 0.0 0.81 4.49	1.00 0.0 0.0 0.0 0.00	6.00 0.0 0.0 0.0 *****	4.00 0.0 0.0 0.0 *****	9.00 57.14 0.0 11.90 23.69	1.00 0.0 0.0 0.0 0.00	0.0 0.0 0.0 0.0 0.0
01056 MANGANESE, DISSOLVED MG/L AS MN	NO.POTW MAX MIN MEAN STD.DEV	18.00 21.43 0.0 5.65 7.14	0.0 0.0 0.0 0.0 0.0	5.00 35.71 0.0 12.14 17.05	4.00 26.67 0.0 12.51 11.13	5.00 92.86 0.0 34.57 37.57	1.00 71.43 71.43 71.43 0.00	0.0 0.0 0.0 0.0 0.0
71890 MERCURY, DISSOLVED MG/L AS HG	NO.POTW MAX MIN MEAN STD.DEV	20.00 94.21 0.0 21.28 26.16	0.0 0.0 0.0 0.0 0.0	2.00 50.00 22.22 36.11 19.64	2.00 50.00 0.0 25.00 35.36	7.00 14.29 0.0 2.04 5.40	1.00 0.0 0.0 0.0 0.00	0.0 0.0 0.0 0.0 0.0
70507 TOT ORTHO- PHOSPHATE MG/L	NO.POTW MAX MIN MEAN STD.DEV	22.00 82.93 0.0 27.12 20.71	0.0 0.0 0.0 0.0 0.0	4.00 25.42 9.09 16.15 6.82	5.00 70.83 12.14 32.61 23.77	8.00 63.64 2.33 38.43 22.45	1.00 99.05 99.05 99.05 0.00	0.0 0.0 0.0 0.0 0.0
00690 TOT CARBON MG/L AS C	NO.POTW MAX MIN MEAN STD.DEV	26.00 57.01 0.0 22.29 18.05	1.00 5.97 5.97 5.97 0.00	5.00 83.80 52.09 68.35 12.71	4.00 64.44 42.22 50.60 9.87	4.00 61.33 34.02 52.29 12.76	1.00 90.16 90.16 90.16 0.00	0.0 0.0 0.0 0.0 0.0

PARAMETERS	CATEGORY	#1	OTHER A	B1	OTHER B	C1	OTHER C	MISC(D,J)
V	----->							
00650 TOTAL	NO.POTW	12.00	1.00	5.00	6.00	7.00	1.00	0.0
PHOSPHATE	MG/L	46.55	26.87	53.57	69.33	63.16	89.52	0.0
	MAX	1.56	26.87	1.35	0.0	16.98	89.52	0.0
	MIN	21.52	26.87	29.96	25.47	32.54	89.52	0.0
	MEAN	13.24	0.00	22.23	25.01	16.62	0.00	0.0
	STD.DEV							
00671 DISSOLVED	NO.POTW	2.00	0.0	3.00	0.0	2.00	0.0	0.0
ORTHOPHOSPHATE	MG/L	20.00	0.0	50.59	0.0	96.80	0.0	0.0
	MAX	7.89	0.0	2.17	0.0	84.21	0.0	0.0
	MIN	13.95	0.0	24.13	0.0	90.51	0.0	0.0
	MEAN	8.56	0.0	24.52	0.0	8.90	0.0	0.0
	STD.DEV							
01037 COBALT,TOT	NO.POTW	0.0	2.00	0.0	0.0	0.0	2.00	0.0
UG/L AS CO	MAX	0.0	60.00	0.0	0.0	0.0	0.0	0.0
	MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	0.0	30.00	0.0	0.0	0.0	0.0	0.0
	STD.DEV	0.0	42.43	0.0	0.0	0.0	*****	0.0
01007 BARIUM,TOT	NO.POTW	1.00	0.0	0.0	1.00	0.0	1.00	0.0
UG/L AS BA	MAX	0.0	0.0	0.0	54.55	0.0	14.71	0.0
	MIN	0.0	0.0	0.0	54.55	0.0	14.71	0.0
	MEAN	0.0	0.0	0.0	54.55	0.0	14.71	0.0
	STD.DEV	0.00	0.0	0.0	0.00	0.0	0.00	0.0

PARAMETERS V		CATEGORY ----->	PRIMARY (A)	TRICKLING FILTER (B)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL PLANTS (A+B+C+OTHER)
00550	OIL-GREASE	NO.POTW	5.0000	5.0000	4.0000	9.0000	0.0	17.0000
TOT-SXLT	MG/L	MAX	90.1376	73.8407	88.4852	88.4852	0.0	92.8571
		MIN	12.5000	22.0000	9.2872	9.2872	0.0	9.2872
		MEAN	48.7490	51.8851	66.5686	58.4111	0.0	56.3845
		STD.DEV	24.6907	21.7001	38.2612	29.0570	0.0	28.4696
0055A	OIL-GREASE	NO.POTW	0.0	1.0000	3.0000	4.0000	1.0000	5.0000
SEP-FUNNEL	MG/L	MAX	0.0	95.5000	90.0000	95.5000	90.0000	95.5000
		MIN	0.0	95.5000	84.0000	84.0000	90.0000	84.0000
		MEAN	0.0	95.5000	87.1667	89.2500	90.0000	89.1777
		STD.DEV	0.0	0.0000	3.0156	4.8379	0.0000	4.1947
00560	OIL-GREASE	NO.POTW	0.0	0.0	0.0	0.0	0.0	0.0
INFHARED	MG/L	MAX	0.0	0.0	0.0	0.0	0.0	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	0.0	0.0	0.0	0.0	0.0	0.0
		STD.DEV	0.0	0.0	0.0	0.0	0.0	0.0
00500	RESIDUE	NO.POTW	25.0000	41.0000	29.0000	70.0000	9.0000	102.0000
TOTAL, TS	MG/L	MAX	44.8193	63.3333	63.9134	63.9134	52.2388	63.9134
		MIN	0.1980	0.6211	5.1095	0.6211	5.4616	0.0
		MEAN	17.9075	26.9446	27.0552	26.9904	24.8250	24.7855
		STD.DEV	14.1806	14.4746	16.4159	15.1925	14.3667	15.5400
00530	RESIDUE	NO.POTW	47.0000	66.0000	62.0000	128.0000	31.0000	200.0000
TOT NFLT, SS	MG/L	MAX	91.4919	97.4212	98.5437	98.5437	98.5437	98.5437
		MIN	16.7883	19.7183	8.5714	8.5714	87.3134	8.5714
		MEAN	51.0116	74.6986	75.1669	74.9249	93.5479	69.8022
		STD.DEV	17.9246	19.1476	21.7615	20.3787	3.2612	22.1670
00310	BOD	NO.POTW	52.0000	60.0000	65.0000	125.0000	31.0000	199.0000
SDAY	MG/L	MAX	88.7006	96.4602	99.2188	99.2188	98.3193	99.2188
		MIN	0.0	4.7619	17.8571	4.7619	85.4430	0.0
		MEAN	30.2367	77.4453	83.8410	80.7705	93.1482	67.7471
		STD.DEV	21.7091	17.7546	15.2908	16.7645	4.1688	29.1271
00340	COU	NO.POTW	15.0000	27.0000	27.0000	54.0000	15.0000	84.0000
HI LEVEL	MG/L	MAX	81.7721	93.3232	92.8571	93.3232	93.0295	93.5206
		MIN	4.6835	34.3750	23.7037	23.7037	23.7037	4.6835
		MEAN	29.4072	68.5252	74.1641	71.3447	79.2360	64.3905
		STD.DEV	22.9731	15.1302	15.7923	15.5823	18.1649	23.8339
00335	COU	NO.POTW	1.0000	0.0	3.0000	3.0000	2.0000	5.0000
LOW LEVEL	MG/L	MAX	19.3925	0.0	94.8148	94.8148	94.8148	94.8148
		MIN	19.3925	0.0	72.1311	72.1311	91.7241	19.3925
		MEAN	19.3925	0.0	86.2233	86.2233	93.2695	73.5384
		STD.DEV	0.0000	0.0	12.3027	12.3028	2.1893	31.5282

NOTES:

- 1) NEGATIVE REMOVALS DELETED
- 2) PRIMARY (A) INCLUDES A01,A02
- 3) TRICKLING FILTER (B) INCLUDES B01,B02,B04,B05
- 4) ACTIVATED SLUDGE (C) INCLUDES C01,C02,C05,C06,C09,C19,C20
- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD-5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 85% REMOVAL FOR BOTH PARAMETERS

/PARAMETERS V		CATEGORY ----->	PRIMARY (A)	TRICKLING FILTER (B)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL PLANTS (A+B+C+OTHER)
00342	SEA COD	NO.POTW	2.0000	9.0000	10.0000	19.0000	3.0000	24.0000
SALINE	MG/L	MAX	19.3925	95.3964	93.3511	95.3964	93.3511	95.3964
		MIN	0.0	48.1967	52.3416	48.1967	87.0886	0.0
		MEAN	9.6963	76.8786	76.2544	76.5501	89.1760	72.4863
		STD.DEV	13.7126	15.2534	12.7352	13.5864	3.6164	23.3288
32730	PHENOLICS	NO.POTW	2.0000	12.0000	16.0000	28.0000	7.0000	37.0000
4AAP DISTIL	UG/L	MAX	50.0000	85.0000	98.2609	98.2609	96.0526	98.2609
		MIN	25.0000	0.0	0.0	0.0	0.0	0.0
		MEAN	37.5000	50.4891	69.1646	61.1608	64.9988	61.3401
		STD.DEV	17.6776	28.0577	31.2366	30.8442	42.4991	30.5589
00945	SULFATE	NO.POTW	13.0000	10.0000	13.0000	23.0000	4.0000	41.0000
	MG/L	MAX	57.8947	79.7422	38.5714	79.7422	25.4237	79.7422
		MIN	0.0	2.8000	0.0	0.0	2.2989	0.0
		MEAN	9.8780	28.3498	11.8723	19.0364	14.7034	17.2660
		STD.DEV	17.1409	21.3001	12.0523	18.2918	10.8557	20.1632
00665	TOTAL	NO.POTW	7.0000	24.0000	36.0000	60.0000	18.0000	81.0000
PHOSPHORUS	MG/L	MAX	24.2991	99.4185	92.3077	99.4185	92.3077	99.4185
		MIN	0.0	0.0	0.0	0.0	6.5367	0.0
		MEAN	13.2186	25.6007	41.9167	35.3903	47.4827	37.8046
		STD.DEV	8.1411	21.9699	24.9894	24.9716	27.1234	26.2613
00610	NITROGEN,	NO.POTW	42.0000	48.0000	47.0000	95.0000	26.0000	157.0000
AMMONIA	MG/L	MAX	64.2857	99.4941	99.7015	99.7015	99.7015	99.7015
		MIN	0.0	0.0	3.7879	0.0	3.7879	0.0
		MEAN	19.7504	41.0735	48.7321	44.8624	65.3043	39.9600
		STD.DEV	16.0708	29.8591	31.3228	30.6713	33.9926	31.1176
00625	NITROGEN,	NO.POTW	7.0000	20.0000	11.0000	31.0000	3.0000	47.0000
KJELDAHL, TOTAL	MG/L	MAX	59.7222	93.6842	91.6667	93.6842	91.6667	93.6842
		MIN	0.0	7.0000	4.5455	4.5455	36.3636	0.0
		MEAN	21.7594	49.9227	34.0453	44.2887	71.1143	44.3923
		STD.DEV	20.0055	27.3765	26.4399	27.7004	30.2623	28.6991

NOTES:

- 1) NEGATIVE REMOVALS DELETED
- 2) PRIMARY (A) INCLUDES A01,A02
- 3) TRICKLING FILTER (B) INCLUDES B01,B02,B04,B05
- 4) ACTIVATED SLUDGE (C) INCLUDES C01,C02,C05,C06,C09,C19,C20
- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD-5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 85% REMOVAL FOR BOTH PARAMETERS

PARAMETERS V	CATEGORY ----->	PRIMARY (A)	TRICKLING FILTER (B)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL PLANTS (A+B+C+OTHER)
01002 TOT ARSENIC AS	NO.POTW UG/L	1.0000 0.0	3.0000 33.3333	5.0000 60.0000	8.0000 60.0000	2.0000 60.0000	12.0000 60.0000
	MAX	0.0	0.0	0.0	0.0	0.0	0.0
	MIN	0.0	11.1111	24.0000	19.1667	30.0000	20.4167
	MEAN	0.0000	19.2450	32.8634	27.7030	42.4264	26.6678
	STD.DEV						
01027 TOT CADMIUM CD	NO.POTW UG/L	31.0000 76.4706	35.0000 75.0000	44.0000 87.6923	79.0000 87.6923	11.0000 53.8461	122.0000 87.6923
	MAX	0.0	0.0	0.0	0.0	0.0	0.0
	MIN	8.2248	19.8551	16.7704	18.1370	9.6497	15.1049
	MEAN	17.2113	24.9946	26.9183	25.9644	21.4719	24.1799
	STD.DEV						
01034 TOT CHROMIUM CR	NO.POTW UG/L	36.0000 80.0000	48.0000 98.9412	54.0000 98.3333	102.0000 98.9412	20.0000 98.3333	154.0000 98.9412
	MAX	0.0	0.0	0.0	0.0	0.0	0.0
	MIN	26.0159	37.6953	46.3708	42.2882	52.4383	38.7910
	MEAN	26.1279	30.2658	33.9051	32.3797	39.3630	31.8146
	STD.DEV						
01051 TOT LEAD PB	NO.POTW UG/L	34.0000 88.2353	41.0000 93.4193	49.0000 95.0000	90.0000 95.0000	19.0000 95.0000	145.0000 95.0000
	MAX	0.0	0.0	0.0	0.0	0.0	0.0
	MIN	24.1034	37.0009	38.5565	37.8478	45.9701	34.2641
	MEAN	26.3064	31.2869	32.2960	31.6716	35.3599	31.0457
	STD.DEV						
71900 TOT MERCURY HG	NO.POTW UG/L	21.0000 75.0000	20.0000 66.6667	34.0000 99.5833	54.0000 99.5833	14.0000 81.2500	86.0000 99.5833
	MAX	0.0	0.0	0.0	0.0	0.0	0.0
	MIN	26.9503	30.3073	38.7528	35.6248	49.2762	32.5740
	MEAN	28.6170	23.4209	32.1854	29.3016	21.4477	28.5871
	STD.DEV						
01042 TOT COPPER CU	NO.POTW UG/L	44.0000 77.2727	49.0000 95.2294	63.0000 95.1613	112.0000 95.2294	22.0000 92.3077	172.0000 95.8333
	MAX	0.0	0.0	0.0	0.0	0.0	0.0
	MIN	25.5771	54.1968	57.1917	55.8810	69.2626	49.5492
	MEAN	24.0147	24.2583	24.2747	24.2045	22.6787	27.8885
	STD.DEV						
01097 TOT ANTIMONY Sb	NO.POTW UG/L	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.0000 0.0
	MAX	0.0	0.0	0.0	0.0	0.0	0.0
	MIN	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	0.0	0.0	0.0	0.0	0.0	0.0
	STD.DEV	0.0	0.0	0.0	0.0	0.0	0.0000
01067 TOT NICKEL NI	NO.POTW UG/L	28.0000 92.1875	32.0000 86.3855	49.0000 80.0000	81.0000 86.3855	16.0000 37.5000	124.0000 96.6667
	MAX	0.0	0.0	0.0	0.0	0.0	0.0
	MIN	6.2990	21.4848	20.4195	20.8404	8.9410	19.6489
	MEAN	18.4166	23.9625	21.3254	22.2630	14.6326	24.7609
	STD.DEV						

NOTES:

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- 4) ACTIVATED SLUDGE (C) INCLUDES C01,C02,C05,C06,C09,C19,C20
- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD-5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 85% REMOVAL FOR BOTH PARAMETERS

PARAMETERS V	CATEGORY ----->	PRIMARY (A)	TRICKLING FILTER (B)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL PLANTS (A+B+C+OTHER)
01147 TOT SELENIUM	NO.POTW	0.0	0.0	2.0000	2.0000	1.0000	5.0000
UG/L	MAX	0.0	0.0	0.0	0.0	0.0	0.0
	MIN	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	0.0	0.0	0.0	0.0	0.0	0.0
	STD.DEV	0.0	0.0	*****	*****	0.0000	*****
01077 TOT SILVER	NO.POTW	0.0	1.0000	0.0	1.0000	0.0	3.0000
AG	UG/L	MAX	33.3333	0.0	33.3333	0.0	33.3333
	MIN	0.0	33.3333	0.0	33.3333	0.0	0.0
	MEAN	0.0	33.3333	0.0	33.3333	0.0	11.1111
	STD.DEV	0.0	0.0000	0.0	0.0000	0.0	19.2450
01042 TOT ZINC	NO.POTW	38.0000	52.0000	58.0000	110.0000	19.0000	167.0000
ZN	UG/L	MAX	88.0000	88.5714	99.2857	99.2857	99.2857
	MIN	0.0	0.0	0.0	0.0	42.1053	0.0
	MEAN	31.0493	46.2715	58.3914	52.6615	71.3264	48.8794
	STD.DEV	22.9848	22.0988	25.1160	24.4006	14.9530	26.4544
01102 TOT TIN	NO.POTW	0.0	0.0	3.0000	3.0000	0.0	5.0000
UG/L	MAX	0.0	0.0	0.0	0.0	0.0	0.0
	MIN	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	0.0	0.0	0.0	0.0	0.0	0.0
	STD.DEV	0.0	0.0	*****	*****	0.0	*****
00680 TOT ORG CARBON	NO.POTW	30.0000	23.0000	13.0000	36.0000	8.0000	75.0000
TOTAL, TOC	MG/L	MAX	55.4270	84.1346	89.3617	89.3617	89.3617
	MIN	0.0	8.0824	41.9355	8.0824	72.0779	0.0
	MEAN	23.9512	63.5019	73.1626	66.9904	79.1304	49.1584
	STD.DEV	17.8074	17.7721	12.2421	16.4939	6.8380	27.4015

NOTES:

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- 4) ACTIVATED SLUDGE (C) INCLUDES C01,C02,C05,C06,C09,C19,C20
- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD-5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 85% REMOVAL FOR BOTH PARAMETERS

PARAMETERS V	CATEGORY ----->	PRIMARY (A)	TRICKLING FILTER (B)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL PLANTS (A+B+C+OTHER)
01105 TOT ALUMINUM AL	NO. POTW UG/L	1.0000	5.0000	9.0000	14.0000	5.0000	20.0000
	MAX	10.8696	91.0853	80.7692	91.0853	80.7692	97.8723
	MIN	10.8696	0.0	0.0	0.0	0.0	0.0
	MEAN	10.8696	59.4670	31.0498	41.1988	36.3607	42.4248
	STD.DEV	0.0000	38.7336	25.7011	32.6770	30.7257	36.2361
01045 TOT IRON FF	NO. POTW UG/L	27.0000	30.0000	35.0000	65.0000	15.0000	107.0000
	MAX	88.8889	89.8327	97.6744	97.6744	97.6744	97.7340
	MIN	0.0	0.0	7.6965	0.0	37.5000	0.0
	MEAN	39.6611	49.6736	63.0609	56.8822	79.3918	54.4198
	STD.DEV	22.0123	25.7745	27.0891	27.1318	17.1486	27.9096
01055 TOT MANGANESE MN	NO. POTW UG/L	16.0000	21.0000	19.0000	40.0000	10.0000	66.0000
	MAX	81.2500	71.9512	93.4641	93.4641	93.4641	93.4641
	MIN	0.0	0.0	0.0	0.0	13.8462	0.0
	MEAN	14.6363	31.1776	38.0421	34.4382	47.1870	31.2223
	STD.DEV	20.4798	23.2465	31.5947	27.3842	30.3930	27.2164
00720 TOTAL	CYANIDE, MG/L	NO. POTW	4.0000	10.0000	14.0000	5.0000	22.0000
	MAX	0.0	80.0000	98.2143	98.2143	98.2143	98.2143
	MIN	0.0	0.0	0.0	0.0	0.0	0.0
	MEAN	0.0	21.6355	32.4716	29.3755	48.8868	30.8839
	STD.DEV	0.0000	39.0317	40.2475	38.7146	41.0122	38.9021
6-26 38260	MRAS MG/L	NO. POTW	4.0000	7.0000	8.0000	15.0000	21.0000
	MAX	90.8602	89.2733	93.5233	93.5233	91.5385	93.5233
	MIN	10.6667	35.4305	33.7553	33.7553	50.0000	10.6667
	MEAN	34.3356	66.1342	59.1519	62.4103	70.7692	59.3179
	STD.DEV	37.8509	21.1108	22.7038	21.4882	29.3719	27.2496

NOTES:

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- 4) ACTIVATED SLUDGE (C) INCLUDES C01,C02,C05,C06,C09,C19,C20
- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD-5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 85% REMOVAL FOR BOTH PARAMETERS

REPORT NO. A		SUMMARY OF POTW REMOVAL DATA						
PARAMETERS V	CATEGORY ----->	PRIMARY (A)	TRICKLING FILTER (B)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL PLANTS (A+B+C+OTHER)	
01032	HEXAVALENT CHROMIUM, UG/L AS CR	NO.POTW 3.0000 MAX 0.0 MIN 0.0 MEAN 0.0 STD.DEV *****	6.0000 60.0000 0.0 24.5454 29.4242	13.0000 75.0000 0.0 15.2705 29.3448	19.0000 75.0000 0.0 18.1994 28.8824	5.0000 0.0 0.0 0.0 *****	27.0000 75.0000 0.0 12.8070 25.4801	
00605	NITROGEN, ORGANIC MG/L	NO.POTW 10.0000 MAX 69.2308 MIN 1.1696 MEAN 39.7083 STD.DEV 23.5323	8.0000 75.0000 0.0 47.6869 25.4775	15.0000 94.6000 14.4928 65.0046 25.6135	23.0000 94.6000 0.0 58.9810 26.3655	5.0000 94.6000 58.9743 80.9077 15.0376	34.0000 94.6000 0.0 51.9238 27.2627	
00666	DISSOLVED PHOSPHORUS MG/L	NO.POTW 1.0000 MAX 0.0 MIN 0.0 MEAN 0.0 STD.DEV 0.0000	1.0000 14.8148 14.8148 14.8148 0.0000	3.0000 49.1525 0.0 30.8578 26.8769	4.0000 49.1525 0.0 26.8471 23.3650	0.0 0.0 0.0 0.0 0.0	5.0000 49.1525 0.0 21.4777 23.5286	
01040	COPPER, DISSOLVED MG/L AS CU	NO.POTW 23.0000 MAX 65.0000 MIN 0.0 MEAN 18.7356 STD.DEV 17.0688	10.0000 62.5000 0.0 27.5574 22.2836	8.0000 87.5000 12.5000 57.4091 27.0812	18.0000 87.5000 0.0 40.8248 28.2462	6.0000 87.5000 25.0000 65.3521 22.0187	42.0000 87.5000 0.0 28.4778 24.6455	
01090	ZINC, DISSOLVED MG/L AS ZN	NO.POTW 21.0000 MAX 71.4286 MIN 0.0 MEAN 25.3454 STD.DEV 18.1713	7.0000 60.0000 0.0 39.9350 20.9625	7.0000 87.5000 14.2857 53.6482 31.8898	14.0000 87.5000 0.0 46.7916 26.8851	4.0000 87.5000 45.4545 69.9053 20.7082	36.0000 87.5000 0.0 33.1986 24.2174	
01030	CHROMIUM, DISSOLVED MG/L AS CR	NO.POTW 28.0000 MAX 80.6452 MIN 0.0 MEAN 15.5886 STD.DEV 22.9236	10.0000 88.8889 0.0 18.8889 32.2030	10.0000 65.6716 0.0 20.3526 28.1859	20.0000 88.8889 0.0 19.6207 29.4636	6.0000 88.8889 0.0 33.4046 38.7118	48.0000 88.8889 0.0 17.2687 25.6291	
01049	LEAD, DISSOLVED MG/L AS PB	NO.POTW 31.0000 MAX 66.6667 MIN 0.0 MEAN 10.2150 STD.DEV 21.8061	10.0000 90.0000 0.0 24.8333 35.2281	10.0000 0.0 0.0 0.0 *****	20.0000 90.0000 0.0 12.4167 27.3886	6.0000 50.0000 0.0 13.8889 22.1527	52.0000 90.0000 0.0 10.8654 23.7211	

NOTES:

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- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD-5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 85% REMOVAL FOR BOTH PARAMETERS

/PARAMETERS V	CATEGORY ----->	PRIMARY (A)	TRICKLING FILTER (H)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL PLANTS (A+B+C+OTHER)
01065 NICKEL, DISSOLVED MG/L AS NI	NO.POTW MAX MIN MEAN STD.DEV	24.0000 50.0000 0.0 4.0887 12.5805	10.0000 0.0 0.0 0.0 *****	10.0000 55.5555 0.0 11.0101 23.2125	20.0000 55.5555 0.0 5.5050 16.9450	6.0000 0.0 0.0 0.0 *****	50.0000 55.5555 0.0 4.5734 14.2371
01025 CADMIUM, DISSOLVED MG/L AS CD	NO.POTW MAX MIN MEAN STD.DEV	31.0000 25.0000 0.0 0.8065 4.4901	10.0000 0.0 0.0 0.0 *****	10.0000 57.1429 0.0 10.7143 22.6503	20.0000 57.1429 0.0 5.3571 16.5296	6.0000 50.0000 0.0 8.3333 20.4124	52.0000 57.1429 0.0 2.5412 10.8957
01056 MANGANESE, DISSOLVED MG/L AS MN	NO.POTW MAX MIN MEAN STD.DEV	18.0000 21.4286 0.0 5.6515 7.1377	9.0000 35.7143 0.0 12.3064 13.8533	6.0000 92.8571 0.0 40.7143 36.8200	15.0000 92.8571 0.0 23.6695 28.3084	4.0000 92.8571 20.0000 47.3810 32.9329	33.0000 92.8571 0.0 13.8415 21.4632
71890 MERCURY, DISSOLVED MG/L AS HG	NO.POTW MAX MIN MEAN STD.DEV	20.0000 84.2105 0.0 21.2799 26.1570	4.0000 50.0000 0.0 30.5555 24.2161	8.0000 14.2857 0.0 1.7857 5.0508	12.0000 50.0000 0.0 11.3757 19.4119	3.0000 0.0 0.0 0.0 *****	32.0000 84.2105 0.0 17.5658 24.0163
6-28 70507 TOT ORTHO- PHOSPHATE MG/L	NO.POTW MAX MIN MEAN STD.DEV	22.0000 82.9268 0.0 27.1162 20.7055	9.0000 70.8333 9.0909 25.2945 19.3681	9.0000 99.0476 2.3256 45.1609 29.1433	18.0000 99.0476 2.3256 35.2277 26.0900	4.0000 58.3333 40.0000 47.2083 8.1347	40.0000 99.0476 0.0 30.7663 23.3294
00690 TOT CARBON MG/L AS C	NO.POTW MAX MIN MEAN STD.DEV	26.0000 57.0111 0.0 22.2897 18.0518	9.0000 83.7956 42.2222 60.4625 14.3129	5.0000 90.1639 34.0206 59.8665 20.2218	14.0000 90.1639 34.0206 60.2496 15.8738	4.0000 64.5833 60.7843 62.7863 2.0065	41.0000 90.1639 0.0 34.8535 25.1943

NOTES:

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PARAMETERS		CATEGORY	PRIMARY	TRICKLING	ACTIVATED	BIOLOGICAL	SECONDARY	TOTAL ALL PLANTS
V		----->	(A)	FILTER	SLUDGE	PLANTS	PLANTS	(A+B+C+OTHER)
				(B)	(C)	(B+C)		
00650	TOTAL	NO. POTW	13.0000	11.0000	8.0000	19.0000	0.0	32.0000
PHOSPHATE	MG/L	MAX	46.5517	69.3333	89.5238	89.5238	0.0	89.5238
		MIN	1.5625	0.0	16.9811	0.0	0.0	0.0
		MEAN	21.9299	27.5111	39.6647	32.6284	0.0	28.2821
		STD. DEV	12.7638	22.7160	25.3521	23.9716	0.0	20.6210
00671	DISSOLVED	NO. POTW	2.0000	3.0000	2.0000	5.0000	2.0000	7.0000
ORTHOPHOSPHATE	MG/L	MAX	20.0000	50.5882	96.8000	96.8000	96.8000	96.8000
		MIN	7.8947	2.1739	84.2105	2.1739	84.2105	2.1739
		MEAN	13.9474	24.1350	90.5053	50.6831	90.5053	40.1871
		STD. DEV	8.5597	24.5178	8.9022	40.5201	8.9027	37.7903
01037	COBALT, TOT	NO. POTW	2.0000	0.0	2.0000	2.0000	0.0	4.0000
	UG/L AS CO	MAX	60.0000	0.0	0.0	0.0	0.0	60.0000
		MIN	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	30.0000	0.0	0.0	0.0	0.0	15.0000
		STD. DEV	42.4264	0.0	*****	*****	0.0	30.0000
01007	BARIUM, TOT	NO. POTW	1.0000	1.0000	1.0000	2.0000	0.0	3.0000
	UG/L AS BA	MAX	0.0	54.5455	14.7059	54.5455	0.0	54.5455
		MIN	0.0	54.5455	14.7059	14.7059	0.0	0.0
		MEAN	0.0	54.5455	14.7059	34.6257	0.0	23.0838
		STD. DEV	0.0000	0.0000	0.0000	28.1708	0.0	28.2213

NOTES:

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PARAMETERS		CATEGORY	A1	OTHER A	B1	OTHER B	C1	OTHER C	MISC(D,J)
V		----->							
00550	OIL-GREASE	NO.POTW	5.0000	1.0000	5.0000	5.0000	7.0000	5.0000	0.0
TOT-SXLT	MG/L	MAX	44.0000	21.5000	72.0000	37.8000	130.0000	58.5000	0.0
		MIN	19.0000	21.5000	4.0000	5.0000	6.0000	1.0000	0.0
		MEAN	29.1000	21.5000	25.8000	17.2000	36.9143	19.5200	0.0
		STD.DEV	9.4387	0.0000	27.0106	13.5422	43.5760	24.7896	0.0
00556	OIL-GREASE	NO.POTW	0.0	0.0	3.0000	0.0	0.0	4.0000	1.0000
SFP-FUNNEL	MG/L	MAX	0.0	0.0	9.0000	0.0	0.0	8.0000	5.0000
		MIN	0.0	0.0	1.0000	0.0	0.0	1.0000	5.0000
		MEAN	0.0	0.0	4.1667	0.0	0.0	4.7500	5.0000
		STD.DEV	0.0	0.0	4.2525	0.0	0.0	2.8723	0.0000
00560	OIL-GREASE	NO.POTW	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INFRARED	MG/L	MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		MIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		MEAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		STD.DEV	0.0	0.0	0.0	0.0	0.0	0.0	0.0
00500	RESIDUE	NO.POTW	25.0000	6.0000	21.0000	25.0000	22.0000	15.0000	3.0000
TOTAL, TS	MG/L	MAX	1842.0000	1269.0000	2034.0000	3030.0000	3440.0000	1980.0000	770.0000
		MIN	346.0000	400.0000	300.0000	40.0000	294.0000	371.0000	630.0000
		MEAN	678.4800	684.0000	697.3809	666.9678	741.3635	716.0000	689.3333
		STD.DEV	372.0469	334.3118	472.4102	572.1072	701.6296	388.2290	72.3948
00530	RESIDUE	NO.POTW	49.0000	8.0000	32.0000	37.0000	42.0000	30.0000	9.0000
TOT NFLT, SS	MG/L	MAX	314.0000	161.0000	228.0000	196.0000	175.0000	185.0000	94.0000
		MIN	15.0000	85.5000	5.0000	6.0000	2.0000	4.0000	3.0000
		MEAN	90.9428	110.5625	47.2813	41.4297	32.4286	37.9767	20.5555
		STD.DEV	64.5526	25.2321	44.1930	38.2320	31.8795	45.9761	33.1176
00310	BOD	NO.POTW	54.0000	6.0000	32.0000	33.0000	41.0000	31.0000	9.0000
5DAY	MG/L	MAX	650.0000	300.0000	245.0000	180.0000	200.0000	230.0000	131.0000
		MIN	20.0000	51.0000	8.0000	2.2000	3.0000	2.0000	2.0000
		MEAN	166.3759	198.6667	51.1875	47.6848	27.7707	25.2516	23.2000
		STD.DEV	111.5490	94.6983	55.4103	43.2595	37.4381	41.5822	41.8200
00340	COD	NO.POTW	11.0000	6.0000	15.0000	15.0000	20.0000	13.0000	5.0000
HI LEVEL	MG/L	MAX	768.0000	555.0000	210.0000	370.0000	275.0000	148.0000	329.0000
		MIN	58.0000	147.0000	26.0000	32.0000	31.7000	14.3000	53.0000
		MEAN	351.7271	292.1665	109.5667	176.3333	109.1250	55.0231	139.8000
		STD.DEV	248.0525	152.9436	56.9887	106.6633	70.1036	32.5391	111.2617
00335	COD	NO.POTW	1.0000	0.0	1.0000	0.0	1.0000	4.0000	1.0000
LOW LEVEL	MG/L	MAX	345.0000	0.0	66.0000	0.0	24.0000	51.0000	28.0000
		MIN	345.0000	0.0	66.0000	0.0	24.0000	14.0000	28.0000
		MEAN	345.0000	0.0	66.0000	0.0	24.0000	28.7500	28.0000
		STD.DEV	0.0000	0.0	0.0000	0.0	0.0000	15.7982	0.0000
00342	SEA COD	NO.POTW	2.0000	0.0	3.0000	6.0000	6.0000	4.0000	2.0000
SALINE	MG/L	MAX	514.0000	0.0	315.0000	158.0000	173.0000	119.0000	32.0000
		MIN	345.0000	0.0	102.0000	18.0000	16.0000	29.0000	28.0000
		MEAN	429.5000	0.0	177.6667	95.3333	84.6667	81.0000	30.0000
		STD.DEV	119.5031	0.0	119.1401	61.9439	71.4554	38.6781	2.8283

PARAMETERS	CATEGORY		OTHER A	M1	OTHER B	C1	OTHER C	MISC(D,J)	
V									
32730	PHENOLICS	NO.POTW	4.0000	4.0000	8.0000	7.0000	9.0000	11.0000	5.0000
4AAP DISTIL	UG/L	MAX	53.0000	45.0000	3000.0000	24.0000	2000.0000	353.0000	30000.0000
		MIN	0.1000	0.1500	0.0300	0.0300	0.0200	0.0400	2.0000
		MEAN	13.4750	22.2875	385.6873	6.7671	226.4699	35.6400	6003.1992
		STD.DEV	26.4504	19.1841	1056.4651	9.4492	665.1030	105.2899	13414.5742
00945	SULFATE	NO.POTW	17.0000	2.0000	11.0000	7.0000	14.0000	15.0000	3.0000
	MG/L	MAX	150.0000	150.0000	243.0000	454.0000	223.0000	470.0000	400.0000
		MIN	26.0000	72.0000	38.0000	22.0000	33.0000	17.0000	136.0000
		MEAN	64.1765	111.0000	73.7273	177.4286	88.7857	134.6000	254.6667
		STD.DEV	32.5311	55.1543	57.5257	189.1868	68.8778	102.7121	134.0049
00940	CHLORIDE	NO.POTW	38.0000	6.0000	18.0000	16.0000	22.0000	17.0000	4.0000
CL	MG/L	MAX	2169.0000	290.0000	330.0000	990.0000	1561.0000	610.0000	410.0000
		MIN	43.0000	60.0000	32.0000	36.0000	43.0000	43.8000	148.0000
		MEAN	313.2419	123.5000	112.1667	172.9062	256.4497	210.1647	274.5000
		STD.DEV	433.4438	84.8356	71.1063	251.3995	342.6404	175.1463	109.8527
00665	TOTAL	NO.POTW	8.0000	3.0000	17.0000	13.0000	23.0000	23.0000	6.0000
PHOSPHORUS	MG/L	MAX	77.0000	10.0000	18.3000	20.0000	10.4000	10.3000	8.7800
		MIN	1.3400	4.0000	3.2700	1.6000	1.0000	0.4600	2.7000
		MEAN	15.1775	6.0167	8.7706	9.0685	4.1930	5.4317	5.9600
		STD.DEV	25.1363	3.4498	3.4594	5.5395	2.3527	3.1812	2.4041
00630	NITROGEN,	NO.POTW	2.0000	0.0	11.0000	10.0000	11.0000	17.0000	3.0000
NO2-NO3	MG/L	MAX	10.0000	0.0	16.0000	23.8000	7.8000	19.9000	13.0000
		MIN	0.0300	0.0	0.0260	0.1500	0.0200	0.0300	0.6300
		MEAN	5.0150	0.0	5.1419	7.7250	1.7973	5.2485	8.1100
		STD.DEV	7.0498	0.0	4.9174	7.1650	2.6517	6.2322	6.5791
00610	NITROGEN,	NO.POTW	54.0000	8.0000	33.0000	35.0000	41.0000	31.0000	8.0000
AMMONIA	MG/L	MAX	256.5999	24.5000	115.0000	76.0000	26.0000	27.5000	17.8000
		MIN	2.1000	4.3000	0.0300	0.1300	0.2000	0.0700	0.1200
		MEAN	20.7145	14.8500	18.2281	14.7714	11.4107	9.5529	5.3950
		STD.DEV	35.9821	7.1762	19.9891	14.0357	7.2425	8.0652	6.4845
00625	NITROGEN,	NO.POTW	7.0000	1.0000	13.0000	10.0000	11.0000	8.0000	0.0
KJELDAHL, TOTAL	MG/L	MAX	47.0000	31.0000	39.0000	46.7500	34.0000	26.2500	0.0
		MIN	8.5000	31.0000	1.2000	2.2000	1.5000	1.6000	0.0
		MEAN	23.4286	31.0000	17.3615	14.6340	18.7809	10.2437	0.0
		STD.DEV	12.2421	0.0000	11.4365	12.6386	10.0763	9.3281	0.0
01002 TOT ARSENIC	NO.POTW	1.0000	0.0	1.0000	4.0000	1.0000	7.0000	0.0	0.0
AS	UG/L	MAX	2.0000	0.0	2.0000	20.0000	2.0000	5.0000	0.0
		MIN	2.0000	0.0	2.0000	0.5000	2.0000	2.0000	0.0
		MEAN	2.0000	0.0	2.0000	8.3250	2.0000	3.7143	0.0
		STD.DEV	0.0000	0.0	0.0000	8.3679	0.0000	1.6036	0.0
01027 TOT CADMIUM	NO.POTW	30.0000	7.0000	22.0000	22.0000	23.0000	33.0000	6.0000	6.0000
CD	UG/L	MAX	40.0000	480.0000	66.0000	20.0000	20.0000	1970.0000	35.0000
		MIN	3.0000	4.0000	1.0000	1.0000	2.0000	2.0000	1.0000
		MEAN	13.0000	85.2857	12.6954	9.7273	11.2609	69.4151	10.6667
		STD.DEV	6.2795	174.3504	13.7692	5.1193	6.4893	341.2322	12.2583

PARAMETERS	CATEGORY	A1	OTHER A	B1	OTHER B	C1	OTHER C	MISC(D,J)
V	----->							
01034 TOT CHROMIUM	NO.POTW	36.0000	9.0000	29.0000	28.0000	32.0000	36.0000	7.0000
CR	UG/L	2600.0000	350.0000	3200.0000	1200.0000	2520.0000	400.0000	600.0000
	MAX							
	MIN	6.0000	14.0000	9.0000	3.0000	5.0000	5.0000	10.0000
	MEAN	190.1055	168.6667	327.4206	132.5357	323.7717	57.1583	110.1429
	STD.DEV	442.4038	99.2658	733.4914	262.0610	687.3762	90.6973	216.5660
01051 TOT LEAD	NO.POTW	30.0000	9.0000	23.0000	25.0000	30.0000	30.0000	8.0000
PR	UG/L	1700.0000	386.0000	550.0000	1800.0000	350.0000	200.0000	50.0000
	MAX							
	MIN	10.0000	29.0000	5.0000	9.0000	3.0000	4.0000	12.0000
	MEAN	157.7667	132.2222	94.2174	133.4400	74.2900	51.7767	31.0000
	STD.DEV	297.4857	112.0921	144.7010	355.7373	76.1513	49.1337	10.9021
71900 TOT MERCURY	NO.POTW	21.0000	3.0000	11.0000	14.0000	22.0000	20.0000	5.0000
HG	UG/L	1.6000	5.0000	1.8750	10.0000	200.0000	5.0000	1.7000
	MAX							
	MIN	0.1000	5.0000	0.1000	0.2000	0.1000	0.2000	0.2000
	MEAN	0.6000	5.0000	0.5341	1.2439	9.8091	0.6115	0.5400
	STD.DEV	0.3834	0.0062	0.4497	2.5438	42.4839	1.0692	0.6542
01042 TOT COPPER	NO.POTW	42.0000	7.0000	32.0000	25.0000	40.0000	37.0000	7.0000
CU	UG/L	1700.0000	380.0000	1800.0000	1000.0000	1600.0000	180.0000	152.0000
	MAX							
	MIN	10.0000	40.0000	2.6000	19.0000	10.0000	6.0000	6.0000
	MEAN	199.3333	168.5714	155.4562	99.0400	105.7500	62.6027	32.1429
	STD.DEV	296.0693	110.3505	334.9673	193.3092	254.8947	51.1277	53.0831
01097 TOT ANTIMONY	NO.POTW	0.0	0.0	0.0	0.0	0.0	1.0000	0.0
	UG/L							
	MAX	0.0	0.0	0.0	0.0	0.0	5.0000	0.0
	MIN	0.0	0.0	0.0	0.0	0.0	5.0000	0.0
	MEAN	0.0	0.0	0.0	0.0	0.0	5.0000	0.0
	STD.DEV	0.0	0.0	0.0	0.0	0.0	0.0000	0.0
01067 TOT NICKEL	NO.POTW	27.0000	7.0000	22.0000	21.0000	32.0000	32.0000	6.0000
NI	UG/L	300.0000	1700.0000	1130.0000	1533.0000	1800.0000	4000.0000	240.0000
	MAX							
	MIN	6.0000	18.0000	11.0000	7.0000	3.0000	7.0000	5.0000
	MEAN	69.7407	594.0000	178.1227	197.5238	110.9562	1332.0625	67.3333
	STD.DEV	54.6708	749.7041	292.4619	365.1274	309.5474	7056.5898	86.6525
01147 TOT SFLENTUM	NO.POTW	0.0	0.0	0.0	1.0000	1.0000	3.0000	0.0
	UG/L							
	MAX	0.0	0.0	0.0	5.0000	2.0000	5.0000	0.0
	MIN	0.0	0.0	0.0	5.0000	2.0000	2.0000	0.0
	MEAN	0.0	0.0	0.0	5.0000	2.0000	4.0000	0.0
	STD.DEV	0.0	0.0	0.0	0.0000	0.0000	1.7321	0.0
01077 TOT SILVER	NO.POTW	1.0000	0.0	1.0000	2.0000	0.0	1.0000	0.0
AG	UG/L	13.0000	0.0	445.7000	10.0000	0.0	10.0000	0.0
	MAX							
	MIN	13.0000	0.0	445.7000	2.0000	0.0	10.0000	0.0
	MEAN	13.0000	0.0	445.7000	6.0000	0.0	10.0000	0.0
	STD.DEV	0.0000	0.0	0.0000	5.6568	0.0	0.0000	0.0
01092 TOT ZINC	NO.POTW	42.0000	8.0000	33.0000	30.0000	40.0000	37.0000	6.0000
ZN	UG/L	3600.0000	680.0000	2800.0000	1321.0000	1400.0000	800.0000	338.0000
	MAX							
	MIN	30.0000	132.0000	40.0000	20.0000	10.0000	30.0000	9.0000
	MEAN	542.4045	355.2500	347.0635	254.5667	258.8823	188.1702	123.3333
	STD.DEV	703.7622	152.9484	552.4749	319.8511	301.3843	166.0566	151.6491

PARAMETERS	CATEGORY	A1	OTHER A	B1	OTHER B	C1	OTHER C	MISC(D,J)
01102 TOT TIN	NO.POTW UG/L	0.0	0.0	0.0	1.0000	1.0000	4.0000	0.0
	MAX	0.0	0.0	0.0	400.0000	12600.0000	400.0000	0.0
	MIN	0.0	0.0	0.0	400.0000	12600.0000	400.0000	0.0
	MEAN	0.0	0.0	0.0	400.0000	12600.0000	400.0000	0.0
	STD.DEV	0.0	0.0	0.0	0.0000	0.0000	0.0	0.0
00680 TOT ORG CARBON	NO.POTW	33.0000	4.0000	8.0000	16.0000	9.0000	8.0000	2.0000
TOTAL.TOC	MAX	539.0000	228.0000	96.0000	129.0000	95.0000	35.0000	102.0000
	MIN	52.0000	128.0000	33.0000	15.0000	11.0000	10.0000	34.0000
	MEAN	141.1211	177.0000	54.2500	51.8687	41.8555	22.5000	68.0000
	STD.DEV	86.5486	40.8733	22.9705	29.4061	25.2905	7.2702	48.0831
00410 ALKALINITY	NO.POTW	6.0000	4.0000	10.0000	13.0000	10.0000	15.0000	4.0000
PH 4.5	MAX	300.0000	258.0000	319.0000	344.0000	400.0000	384.0000	317.0000
	MIN	83.0000	18.5000	133.0000	41.0000	117.0000	78.0000	135.0000
	MEAN	186.5000	134.8750	203.3500	162.2308	244.6000	238.2000	264.0000
	STD.DEV	79.1495	99.7165	63.8173	104.3830	107.7918	80.6967	86.4283
00400 PH	NO.POTW	54.0000	8.0000	36.0000	33.0000	36.0000	24.0000	9.0000
	MAX	8.2000	7.9000	7.9000	8.0000	8.0000	8.3000	7.9000
	MIN	5.0000	5.6000	6.6000	4.0000	6.2000	6.3000	7.0000
	MEAN	7.0539	6.9125	7.2822	7.0836	7.1997	7.2937	7.4778
	STD.DEV	0.4973	0.7434	0.3627	0.7608	0.4258	0.4908	0.3031
00095 SPECIFIC CONDUCTANCE MICROMHO	NO.POTW	3.0000	3.0000	10.0000	7.0000	8.0000	18.0000	3.0000
	MAX	970.0000	600.0000	1475.0000	4400.0000	1900.0000	3170.0000	2500.0000
	MIN	615.0000	500.0000	634.0000	669.0000	791.0000	760.0000	1820.0000
	MEAN	828.3333	550.0000	942.5000	1455.5713	1208.0000	1446.9443	2106.6665
	STD.DEV	188.0360	49.9959	314.5103	1328.3367	382.5190	672.5767	352.3655
01105 TOT ALUMINUM	NO.POTW	1.0000	0.0	4.0000	2.0000	3.0000	9.0000	3.0000
AL	MAX	410.0000	0.0	1450.0000	100.0000	200.0000	570.0000	200.0000
	MIN	410.0000	0.0	100.0000	20.0000	100.0000	100.0000	100.0000
	MEAN	410.0000	0.0	735.0000	60.0000	166.6667	211.1111	133.3333
	STD.DEV	0.0000	0.0	553.0823	56.5685	57.7348	148.5298	57.7349
01045 TOT IRON	NO.POTW	23.0000	8.0000	18.0000	17.0000	20.0000	21.0000	8.0000
FE	MAX	3500.0000	5000.0000	10000.0000	65550.0000	6800.0000	1550.0000	1100.0000
	MIN	400.0000	620.0000	100.0000	110.0000	100.0000	100.0000	35.0000
	MEAN	1344.3042	2083.7500	1331.7222	4572.0586	941.0498	482.2856	267.3750
	STD.DEV	847.8044	1287.4473	2225.0439	15725.2813	1527.0234	424.9780	349.1960
01055 TOT MANGANESE	NO.POTW	16.0000	6.0000	12.0000	17.0000	7.0000	18.0000	6.0000
MN	MAX	362.0000	390.0000	329.0000	580.0000	443.0000	940.0000	138.0000
	MIN	30.0000	66.0000	40.0000	20.0000	20.0000	10.0000	12.0000
	MEAN	147.9375	250.3333	120.5833	148.8235	141.2857	147.4444	51.5000
	STD.DEV	102.7452	107.4531	89.0601	150.6980	143.2210	212.7679	46.2504
50060 CHLORINE	NO.POTW	26.0000	2.0000	8.0000	12.0000	10.0000	13.0000	3.0000
TOT PESTICIDE	MAX	10.0000	3.0000	3.0000	3.0000	3.0000	3.0000	1.1000
	MIN	0.2000	0.1000	0.1000	0.1000	0.6000	0.0700	0.2500
	MEAN	1.9558	1.5500	1.8775	2.0558	1.5090	1.1385	0.6500
	STD.DEV	1.4374	2.0506	1.1025	0.8526	0.7272	0.8896	0.4272

PARAMETERS	CATEGORY	A1	OTHER A	B1	OTHER B	C1	OTHER C	MISC(D,J)
01102 TOT TIN	NO.POTW	0.0	0.0	0.0	1.0000	1.0000	4.0000	0.0
	UG/L	0.0	0.0	0.0	400.0000	12600.0000	400.0000	0.0
	MIN	0.0	0.0	0.0	400.0000	12600.0000	400.0000	0.0
	MEAN	0.0	0.0	0.0	400.0000	12600.0000	400.0000	0.0
	STD.DEV	0.0	0.0	0.0	0.0000	0.0000	0.0	0.0
00680 TOT ORG CARBON	NO.POTW	33.0000	4.0000	8.0000	16.0000	9.0000	8.0000	2.0000
TOTAL.TOC	MG/L	539.0000	228.0000	96.0000	129.0000	95.0000	35.0000	102.0000
	MIN	52.0000	128.0000	33.0000	15.0000	11.0000	10.0000	34.0000
	MEAN	141.1211	177.0000	54.2500	51.8687	41.8555	22.5000	68.0000
	STD.DEV	86.5486	40.8733	22.9705	29.4061	25.2905	7.2702	48.0831
00410 ALKALINITY	NO.POTW	6.0000	4.0000	10.0000	13.0000	10.0000	15.0000	4.0000
PH 4.5	MG/L	300.0000	258.0000	319.0000	344.0000	400.0000	384.0000	317.0000
	MIN	83.0000	18.5000	133.0000	41.0000	117.0000	78.0000	135.0000
	MEAN	186.5000	134.8750	203.3500	162.2308	244.6000	238.2000	264.0000
	STD.DEV	79.1495	99.7165	63.8173	104.3830	107.7918	80.6967	86.4283
00400 PH	NO.POTW	54.0000	8.0000	36.0000	33.0000	36.0000	24.0000	9.0000
	SU	8.2000	7.9000	7.9000	8.0000	8.0000	8.3000	7.9000
	MIN	5.0000	5.6000	6.6000	4.0000	6.2000	6.3000	7.0000
	MEAN	7.0539	6.9125	7.2822	7.0836	7.1997	7.2937	7.4778
	STD.DEV	0.4973	0.7434	0.3627	0.7608	0.4258	0.4908	0.3031
00095 SPECIFIC	NO.POTW	3.0000	3.0000	10.0000	7.0000	8.0000	18.0000	3.0000
CONDUCTANCE MICROMHO	MAX	970.0000	600.0000	1475.0000	4400.0000	1900.0000	3170.0000	2500.0000
	MIN	615.0000	500.0000	634.0000	669.0000	791.0000	760.0000	1820.0000
	MEAN	828.3333	550.0000	942.5000	1455.5713	1208.0000	1446.9443	2106.6665
	STD.DEV	188.0360	49.9959	314.5103	1328.3367	382.5190	672.5767	352.3655
01105 TOT ALUMINUM	NO.POTW	1.0000	0.0	4.0000	2.0000	3.0000	9.0000	3.0000
AL	UG/L	410.0000	0.0	1450.0000	100.0000	200.0000	570.0000	200.0000
	MIN	410.0000	0.0	100.0000	20.0000	100.0000	100.0000	100.0000
	MEAN	410.0000	0.0	735.0000	60.0000	166.6667	211.1111	133.3333
	STD.DEV	0.0000	0.0	553.0823	56.5685	57.7348	148.5298	57.7349
01045 TOT IRON	NO.POTW	23.0000	8.0000	18.0000	17.0000	20.0000	21.0000	8.0000
FE	UG/L	3500.0000	5000.0000	10000.0000	65550.0000	6800.0000	1550.0000	1100.0000
	MIN	400.0000	620.0000	100.0000	110.0000	100.0000	100.0000	35.0000
	MEAN	1344.3042	2083.7500	1331.7222	4572.0586	941.0498	482.2856	267.3750
	STD.DEV	847.8044	1287.4473	2225.0439	15725.2813	1527.0234	424.9780	349.1960
01055 TOT MANGANESE	NO.POTW	16.0000	6.0000	12.0000	17.0000	7.0000	18.0000	6.0000
MN	UG/L	362.0000	390.0000	329.0000	580.0000	443.0000	940.0000	138.0000
	MIN	30.0000	66.0000	40.0000	20.0000	20.0000	10.0000	12.0000
	MEAN	147.9375	250.3333	120.5833	148.8235	141.2857	147.4444	51.5000
	STD.DEV	102.7452	107.4531	89.0601	150.6980	143.2210	212.7679	46.2504
50060 CHLORINE	NO.POTW	26.0000	2.0000	8.0000	12.0000	10.0000	13.0000	3.0000
TOT PESTICIDEAL	MG/L	10.0000	3.0000	3.0000	3.0000	3.0000	3.0000	1.1000
	MIN	0.2000	0.1000	0.1000	0.1000	0.6000	0.0700	0.2500
	MEAN	1.9558	1.5500	1.8775	2.0558	1.5090	1.1385	0.6500
	STD.DEV	1.4374	2.0506	1.1025	0.8526	0.7272	0.8896	0.4272

PARAMETERS	CATEGORY	A)	OTHER A	B)	OTHER B	C)	OTHER C	MISC(D,J)
01090 ZINC, DISSOLVED MG/L AS ZN	NO.POTW MAX MIN MEAN STD.DEV	26.0000 3.2500 0.0400 0.3941 0.6701	1.0000 0.5900 0.5900 0.5900 0.0000	4.0000 0.0700 0.0600 0.0650 0.0058	3.0000 0.1000 0.0500 0.0700 0.0265	8.0000 1.1600 0.0100 0.2912 0.4621	1.0000 0.0800 0.0800 0.0800 0.0000	0.0 0.0 0.0 0.0 0.0
01030 CHROMIUM, DISSOLVED MG/L AS CR	NO.POTW MAX MIN MEAN STD.DEV	31.0000 0.5600 0.0100 0.0723 0.1197	1.0000 0.0700 0.0700 0.0700 0.0000	6.0000 0.0100 0.0100 0.0100 0.0000	4.0000 0.0100 0.0100 0.0100 0.0	9.0000 0.7000 0.0100 0.1233 0.2284	1.0000 0.0100 0.0100 0.0100 0.0000	0.0 0.0 0.0 0.0 0.0
01040 LEAD, DISSOLVED MG/L AS PB	NO.POTW MAX MIN MEAN STD.DEV	31.0000 0.2000 0.1000 0.1097 0.0301	1.0000 0.3000 0.3000 0.3000 0.0000	6.0000 0.1000 0.0200 0.0867 0.0327	4.0000 0.1000 0.1000 0.1000 0.0001	9.0000 0.1000 0.1000 0.1000 0.0	1.0000 0.1000 0.1000 0.1000 0.0000	0.0 0.0 0.0 0.0 0.0
01065 NICKEL, DISSOLVED MG/L AS NI	NO.POTW MAX MIN MEAN STD.DEV	31.0000 0.8200 0.1000 0.1313 0.1330	1.0000 0.1000 0.1000 0.1000 0.0000	6.0000 0.1000 0.1000 0.1000 0.0001	4.0000 0.1000 0.1000 0.1000 0.0001	9.0000 0.8000 0.1000 0.1944 0.2324	1.0000 0.1000 0.1000 0.1000 0.0000	0.0 0.0 0.0 0.0 0.0
01025 CADMIUM, DISSOLVED MG/L AS CD	NO.POTW MAX MIN MEAN STD.DEV	31.0000 0.0300 0.0100 0.0124 0.0062	1.0000 0.0200 0.0200 0.0200 0.0000	6.0000 0.0100 0.0100 0.0100 0.0000	4.0000 0.0100 0.0100 0.0100 0.0	9.0000 0.1200 0.0100 0.0222 0.0367	1.0000 0.0100 0.0100 0.0100 0.0000	0.0 0.0 0.0 0.0 0.0
01056 MANGANESE, DISSOLVED MG/L AS MN	NO.POTW MAX MIN MEAN STD.DEV	31.0000 0.3600 0.0005 0.1578 0.0796	1.0000 0.2400 0.2400 0.2400 0.0000	6.0000 0.1100 0.0300 0.0667 0.0301	4.0000 0.1100 0.0600 0.0850 0.0238	9.0000 0.2600 0.0200 0.1244 0.0838	1.0000 0.0200 0.0200 0.0200 0.0000	0.0 0.0 0.0 0.0 0.0
71890 MERCURY, DISSOLVED MG/L AS HG	NO.POTW MAX MIN MEAN STD.DEV	25.0000 0.0017 0.0001 0.0005 0.0004	1.0000 0.0023 0.0023 0.0023 0.0000	4.0000 0.0009 0.0001 0.0006 0.0003	4.0000 0.0018 0.0003 0.0008 0.0007	8.0000 0.0008 0.0001 0.0005 0.0002	1.0000 0.0010 0.0010 0.0010 0.0000	0.0 0.0 0.0 0.0 0.0
70507 TOT ORTHO- PHOSPHATE MG/L	NO.POTW MAX MIN MEAN STD.DEV	33.0000 7.7000 0.7000 3.2524 1.6278	2.0000 8.0000 3.7000 5.8500 3.0405	7.0000 3.6000 0.7000 2.5143 0.9907	13.0000 13.0000 1.7500 6.7808 3.9475	9.0000 28.0000 1.0000 4.6778 8.7695	4.0000 18.0000 0.1000 7.6750 8.0653	0.0 0.0 0.0 0.0 0.0
00690 TOT CARBON MG/L AS C	NO.POTW MAX MIN MEAN STD.DEV	28.0000 580.0000 80.0000 180.6964 90.0194	2.0000 252.0000 225.0000 238.5000 19.0904	5.0000 111.0000 50.0000 76.4000 28.5778	5.0000 160.0000 52.0000 46.2000 43.8315	5.0000 90.0000 40.0000 62.8000 17.9218	1.0000 24.0000 24.0000 24.0000 0.0000	0.0 0.0 0.0 0.0 0.0

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PARAMETERS		CATEGORY	A1	OTHER A	B1	OTHER B	C1	OTHER C	MISC(D,J)
		----->							
00900 TOTAL	HANDNESS MG/L	NO.POTW	13.0000	1.0000	5.0000	1.0000	6.0000	0.0	0.0
		MAX	330.0000	154.0000	110.0000	44.0000	632.0000	0.0	0.0
		MIN	30.0000	154.0000	32.0000	44.0000	60.0000	0.0	0.0
		MEAN	100.0000	154.0000	88.0000	44.0000	191.3333	0.0	0.0
		STD.DEV	77.4759	0.0000	32.1558	0.0000	221.4921	0.0	0.0
00425 -BICARBONATE	ALKALINITY MG/L	NO.POTW	11.0000	0.0	4.0000	0.0	4.0000	0.0	0.0
		MAX	300.0000	0.0	160.0000	0.0	104.0000	0.0	0.0
		MIN	74.0000	0.0	102.0000	0.0	22.0000	0.0	0.0
		MEAN	155.0000	0.0	122.0000	0.0	62.0000	0.0	0.0
		STD.DEV	74.6978	0.0	25.8714	0.0	42.9884	0.0	0.0
00650 PHOSPHATE	TOTAL MG/L	NO.POTW	15.0000	1.0000	9.0000	12.0000	8.0000	4.0000	0.0
		MAX	68.0000	24.5000	36.5000	26.0000	90.0000	28.2500	0.0
		MIN	15.5000	24.5000	11.5000	1.5600	14.0000	1.1000	0.0
		MEAN	31.4533	24.5000	24.5500	11.8117	30.3237	14.3375	0.0
		STD.DEV	13.1506	0.0000	9.5018	7.2740	25.1594	11.6836	0.0
00070	TURBIDITY JTU	NO.POTW	4.0000	4.0000	7.0000	5.0000	6.0000	3.0000	1.0000
		MAX	68.0000	76.5000	40.0000	99.0000	54.0000	29.3000	5.0000
		MIN	25.0000	26.0000	15.0000	21.0000	3.0000	20.0000	5.0000
		MEAN	48.7500	49.8750	27.9000	43.8000	24.0167	25.1000	5.0000
		STD.DEV	17.7645	21.3477	9.6126	31.4436	16.9215	4.7149	0.0000
00671 ORTHOPHOSPHATE	DISSOLVED MG/L	NO.POTW	3.0000	0.0	3.0000	1.0000	3.0000	0.0	0.0
		MAX	40.0000	0.0	6.7500	15.0000	3.0000	0.0	0.0
		MIN	1.4000	0.0	4.2000	15.0000	0.1600	0.0	0.0
		MEAN	14.9667	0.0	5.1500	15.0000	1.4533	0.0	0.0
		STD.DEV	21.7049	0.0	1.3937	0.0000	1.4368	0.0	0.0
01037	COBALT,TOT UG/L AS CO	NO.POTW	0.0	2.0000	0.0	0.0	0.0	2.0000	1.0000
		MAX	0.0	30.0000	0.0	0.0	0.0	20.0000	20.0000
		MIN	0.0	20.0000	0.0	0.0	0.0	20.0000	20.0000
		MEAN	0.0	25.0000	0.0	0.0	0.0	20.0000	20.0000
		STD.DEV	0.0	7.0711	0.0	0.0	0.0	0.0271	0.0000
01007	BARIUM,TOT UG/L AS BA	NO.POTW	1.0000	0.0	0.0	1.0000	0.0	1.0000	0.0
		MAX	160.0000	0.0	0.0	100.0000	0.0	5800.0000	0.0
		MIN	160.0000	0.0	0.0	100.0000	0.0	5800.0000	0.0
		MEAN	160.0000	0.0	0.0	100.0000	0.0	5800.0000	0.0
		STD.DEV	0.0000	0.0	0.0	0.0000	0.0	0.0000	0.0
00074	TURBIDITY FTU	NO.POTW	1.0000	0.0	1.0000	1.0000	0.0	1.0000	0.0
		MAX	57.0000	0.0	10.0000	25.0000	0.0	6.0000	0.0
		MIN	57.0000	0.0	10.0000	25.0000	0.0	6.0000	0.0
		MEAN	57.0000	0.0	10.0000	25.0000	0.0	6.0000	0.0
		STD.DEV	0.0000	0.0	0.0000	0.0000	0.0	0.0000	0.0

PARAMETERS V	CATEGORY ----->	PRIMARY (A)	TRICKLING FILTER (B)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL PLANTS (A+B+C+OTHER)
00550 OIL-GREASE TOT-SXLT	NO.POTW MG/L	6.0000 44.0000 19.0000 27.8333 9.3310	11.0000 72.0000 4.0000 21.1091 20.0922	8.0000 130.0000 5.0000 32.9250 41.8917	19.0000 130.0000 4.0000 26.0842 30.7029	1.0000 9.4000 9.4000 9.4000 0.0000	29.0000 130.0000 1.0000 26.0414 26.4917
00556 OIL-GREASE SEP-FUNNEL	NO.POTW MG/L	0.0 0.0 0.0 0.0 0.0	3.0000 9.0000 1.0000 4.1667 4.2525	3.0000 8.0000 5.0000 6.0000 1.7321	6.0000 9.0000 1.0000 5.0833 3.0727	2.0000 5.0000 1.0000 3.0000 2.8284	8.0000 9.0000 1.0000 4.5625 2.9693
00560 OIL-GREASE INFRARED	NO.POTW MG/L	0.0 0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0 0.0
00500 RESIDUE TOTAL, TS	NO.POTW MG/L	30.0000 1842.0000 346.0000 688.8665 362.0049	45.0000 2034.0000 40.0000 628.6487 389.8845	33.0000 3440.0000 294.0000 712.2119 578.5815	78.0000 3440.0000 40.0000 664.0024 477.1821	9.0000 727.0000 312.0000 548.7776 158.4633	119.0000 3440.0000 40.0000 692.3796 495.3723
00530 RESIDUE TOT NFLT, SS	NO.POTW MG/L	54.0000 314.0000 15.0000 93.2722 62.4438	66.0000 228.0000 5.0000 42.6500 37.0209	64.0000 185.0000 2.0000 37.1250 39.7279	130.0000 228.0000 2.0000 39.9300 38.3284	31.0000 30.0000 2.0000 11.1935 7.1759	210.0000 314.0000 2.0000 53.4518 52.1177
00310 BOD 5DAY	NO.POTW MG/L	58.0000 650.0000 20.0000 166.7810 110.4911	62.0000 245.0000 4.0000 48.5710 47.2754	65.0000 230.0000 2.0000 28.2861 40.7063	127.0000 245.0000 2.0000 38.1889 45.0249	31.0000 28.0000 2.0000 10.5355 7.4303	209.0000 650.0000 2.0000 74.6075 92.2027
00340 COD HI LEVEL	NO.POTW MG/L	10.0000 768.0000 58.0000 334.8125 222.3276	28.0000 361.0000 26.0000 138.8036 80.2413	27.0000 275.0000 31.7000 98.3518 65.3504	55.0000 361.0000 26.0000 118.9454 75.4455	15.0000 231.0000 26.0000 65.7333 52.3604	86.0000 768.0000 14.3000 158.6546 147.1832
00335 COD LOW LEVEL	NO.POTW MG/L	1.0000 345.0000 345.0000 345.0000 0.0000	1.0000 66.0000 66.0000 66.0000 0.0000	5.0000 51.0000 14.0000 27.8000 13.8456	6.0000 66.0000 14.0000 34.1667 19.9139	4.0000 27.0000 14.0000 22.0000 5.5976	9.0000 345.0000 14.0000 74.2222 104.4721

NOTES:

- 1) NEGATIVE REMOVALS DELETED
- 2) PRIMARY (A) INCLUDES A01, A02
- 3) TRICKLING FILTER (B) INCLUDES B01, B02, B04, B05
- 4) ACTIVATED SLUDGE (C) INCLUDES C01, C02, C05, C06, C09, C19, C20
- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD-5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 95% REMOVAL FOR BOTH PARAMETERS

/PARAMETERS V		CATEGORY ----->	PRIMARY (A)	TRICKLING FILTER (B)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL (A+B+C+D)
00342 SALINE	SEA COD MG/L	NO.POTW	2.0000	9.0000	10.0000	19.0000	3.0000	24.0000
		MAX	514.0000	315.0000	173.0000	315.0000	51.0000	514.0000
		MIN	345.0000	18.0000	16.0000	16.0000	25.0000	16.0000
		MEAN	429.5000	122.7778	83.2000	101.9474	42.3333	123.7083
		STD.DEV	119.5015	87.4153	57.7828	74.0122	15.0112	119.1603
32730 4AAP DISTIL	PHENOLICS UG/L	NO.POTW	7.0000	15.0000	18.0000	33.0000	7.0000	49.0000
		MAX	53.0000	3000.0000	2000.0000	3000.0000	10.0000	30000.0000
		MIN	0.1000	0.0300	0.0200	0.0200	2.0000	0.0200
		MEAN	16.2928	208.8579	134.6238	168.3663	4.5971	729.1465
		STD.DEV	23.0982	772.2639	472.7300	617.2905	3.4961	4298.9219
00945	SULFATE MG/L	NO.POTW	19.0000	17.0000	25.0000	42.0000	7.0000	70.0000
		MAX	150.0000	454.0000	223.0000	454.0000	176.0000	470.0000
		MIN	26.0000	22.0000	33.0000	22.0000	44.0000	17.0000
		MEAN	69.1053	94.8823	99.6400	97.7143	110.5714	106.6286
		STD.DEV	36.4370	106.4648	57.9913	79.9841	51.6584	98.8269
00940 CL	CHLORIDE MG/L	NO.POTW	41.0000	33.0000	34.0000	67.0000	14.0000	123.0000
		MAX	2169.0000	488.0000	1561.0000	1561.0000	420.0000	2169.0000
		MIN	43.0000	32.0000	43.0000	32.0000	43.0000	32.0000
		MEAN	296.8584	115.0151	245.9382	181.4536	148.7143	227.6714
		STD.DEV	421.0542	100.3362	288.7170	225.6298	95.2359	309.8406
00665 PHOSPHORUS	TOTAL MG/L	NO.POTW	10.0000	27.0000	40.0000	67.0000	19.0000	95.0000
		MAX	77.0000	18.3000	10.4080	18.3000	10.3000	77.0000
		MIN	1.3400	3.2700	1.0000	1.0000	1.0000	0.4600
		MEAN	12.9470	9.0196	5.2462	6.7668	5.0300	7.0187
		STD.DEV	22.6614	3.8269	2.7136	3.6876	2.9706	8.2370
00630 NO2=NO3	NITROGEN, MG/L	NO.POTW	2.0000	20.0000	21.0000	41.0000	11.0000	56.0000
		MAX	10.0000	16.0000	19.9000	19.9000	19.9000	23.8000
		MIN	0.0300	0.0260	0.0200	0.0200	0.0800	0.0100
		MEAN	5.0150	5.5005	4.3681	4.9205	9.3600	4.9501
		STD.DEV	7.0499	4.7009	5.9565	5.3446	6.0649	5.7187
00610 AMMONIA	NITROGEN, MG/L	NO.POTW	64.0000	66.0000	64.0000	130.0000	29.0000	218.0000
		MAX	256.5999	115.0000	27.5000	115.0000	76.0000	256.5999
		MIN	2.1000	0.0300	0.0700	0.0300	0.0300	0.0300
		MEAN	20.2024	16.6120	11.0571	13.8773	9.0310	15.0710
		STD.DEV	34.6453	17.2708	7.5512	13.6351	14.4904	21.8995
00625 KJELDAHL, TOTAL	NITROGEN, MG/L	NO.POTW	8.0000	22.0000	12.0000	34.0000	3.0000	51.0000
		MAX	47.0000	46.7500	34.0080	46.7500	14.0000	47.0000
		MIN	8.5000	1.2000	1.5000	1.2000	1.5000	1.2000
		MEAN	24.3750	16.8109	18.9658	17.5714	6.7333	16.8844
		STD.DEV	11.6458	11.8657	9.6287	11.0270	6.4933	11.5900

NOTES:

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- 4) ACTIVATED SLUDGE (C) INCLUDES C01,C02,C05,C06,C09,C20
- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD=5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 85% REMOVAL FOR BOTH PARAMETERS

PARAMETERS V	CATEGORY ----->	PRIMARY (A)	TRICKLING FILTER (B)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL PLANTS (A+B+C+OTHER)
01002 TOT ARSENIC AS	NO.POTW UG/L	1.0000 2.0000 2.0000 2.0000 0.0000	4.0000 20.0000 0.5000 6.8250 8.9623	5.0000 5.0000 2.0000 3.2000 1.6432	9.0000 20.0000 0.5000 4.8111 5.9263	2.0000 5.0000 2.0000 3.5000 2.1213	14.0000 20.0000 0.5000 4.6643 4.8573
01027 TOT CADMIUM CD	NO.POTW UG/L	36.0000 40.0000 3.0000 14.0833 8.9805	43.0000 66.0000 1.0000 11.2395 10.4963	50.0000 1970.0000 1.0000 50.1200 277.1191	93.0000 1970.0000 1.0000 32.1430 203.3024	16.0000 1970.0000 2.0000 131.5000 490.2800	145.0000 1970.0000 1.0000 28.2965 167.1832
01034 TOT CHROMIUM CR	NO.POTW UG/L	43.0000 2600.0000 6.0000 188.3488 405.9954	56.0000 3200.0000 3.0000 235.3929 563.0393	61.0000 2520.0000 5.0000 201.9295 515.0706	117.0000 3200.0000 3.0000 217.9461 536.4790	21.0000 200.0000 5.0000 33.5714 46.9430	179.0000 3200.0000 3.0000 197.6112 480.8142
01051 TOT LEAD PB	NO.POTW UG/L	37.0000 1700.0000 10.0000 156.0270 272.0637	47.0000 1800.0000 5.0000 116.0213 276.3105	52.0000 350.0000 3.0000 67.3788 67.6438	99.0000 1800.0000 3.0000 90.4717 197.0117	20.0000 270.0000 10.0000 57.4000 57.2751	157.0000 1800.0000 3.0000 105.7707 221.7903
71900 TOT MERCURY HG	NO.POTW UG/L	23.0000 5.0000 0.1000 0.9826 1.3193	24.0000 10.0000 0.1000 0.9620 1.9679	38.0000 200.0000 0.1000 5.9771 32.3372	62.0000 200.0000 0.1000 4.0358 25.3338	16.0000 200.0000 0.1000 12.9706 49.8766	97.0000 200.0000 0.1000 2.9053 20.2664
01042 TOT COPPER CU	NO.POTW UG/L	48.0000 1700.0000 10.0000 191.0833 278.2058	56.0000 1800.0000 2.6000 132.6892 283.0786	70.0000 1600.0000 8.0000 91.7571 195.1586	126.0000 1800.0000 2.6000 109.9492 238.1161	25.0000 120.0000 8.0000 38.5600 31.3808	192.0000 1800.0000 2.6000 125.6505 242.1976
01097 TOT ANTIMONY UG/L	NO.POTW UG/L	0.0 0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0 0.0	1.0000 5.0000 5.0000 5.0000 0.0000
01067 TOT NICKEL NI	NO.POTW UG/L	33.0000 1700.0000 6.0000 164.5757 387.1809	40.0000 1533.0000 7.0000 198.0425 335.9666	58.0000 40000.0000 3.0000 786.7515 5244.5742	98.0000 40000.0000 3.0000 546.4622 4036.4604	22.0000 370.0000 7.0000 69.8182 74.8423	149.0000 40000.0000 3.0000 410.7668 3278.7412

NOTES:

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- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD-5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 85% REMOVAL FOR BOTH PARAMETERS

/PARAMETERS V	CATEGORY ----->	PRIMARY	TRICKLING FILTER	ACTIVATED SLUDGE	BIOLOGICAL PLANTS	SECONDARY	TOTAL ALL PLANTS
		(A)	(B)	(C)	(B+C)	PLANTS	(A+B+C+OTHER)
01147 TOT SELENIUM	NO.POTW	0.0	0.0	2.0000	2.0000	1.0000	5.0000
UG/L	MAX	0.0	0.0	2.0000	2.0000	2.0000	5.0000
	MIN	0.0	0.0	2.0000	2.0000	2.0000	2.0000
	MEAN	0.0	0.0	2.0000	2.0000	2.0000	3.8000
	STD.DEV	0.0	0.0	0.0	0.0	0.0000	1.6432
01077 TOT SILVER	NO.POTW	1.0000	2.0000	0.0	2.0000	0.0	5.0000
AG	UG/L	MAX	13.0000	445.7000	0.0	445.7000	0.0
	MIN	13.0000	2.0000	0.0	2.0000	0.0	2.0000
	MEAN	13.0000	223.8500	0.0	223.8500	0.0	96.1400
	STD.DEV	0.0000	313.7434	0.0	313.7429	0.0	195.4525
01092 TOT ZINC	NO.POTW	49.0000	60.0000	69.0000	129.0000	22.0000	198.0000
ZN	UG/L	MAX	3600.0000	2800.0000	1400.0000	2800.0000	650.0000
	MIN	30.0000	40.0000	10.0000	10.0000	10.0000	9.0000
	MEAN	550.0610	316.1665	237.6420	274.1650	172.3182	330.4575
	STD.DEV	657.9351	463.5981	257.2742	368.4727	181.4486	463.8679
01102 TOT TIN	NO.POTW	0.0	0.0	3.0000	3.0000	0.0	6.0000
UG/L	MAX	0.0	0.0	12600.0000	12600.0000	0.0	12600.0000
	MIN	0.0	0.0	400.0000	400.0000	0.0	400.0000
	MEAN	0.0	0.0	4466.6641	4466.6641	0.0	2433.3333
	STD.DEV	0.0	0.0	7043.6797	7043.6797	0.0	4980.6016
00680 TOT ORG CARBON	NO.POTW	35.0000	23.0000	14.0000	37.0000	8.0000	82.0000
TOTAL, TOC	MG/L	MAX	539.0000	129.0000	95.0000	129.0000	74.0000
	MIN	52.0000	23.0000	10.0000	10.0000	10.0000	10.0000
	MEAN	141.7999	54.3000	35.3357	47.1243	29.1250	92.0974
	STD.DEV	84.2303	26.2976	22.4007	26.2822	20.9586	78.0483
00410 ALKALINITY	NO.POTW	9.0000	22.0000	22.0000	44.0000	8.0000	64.0000
PH 4.5	MG/L	MAX	300.0000	344.0000	400.0000	400.0000	400.0000
	MIN	18.5000	41.0000	78.0000	41.0000	184.0000	18.5000
	MEAN	167.0555	180.1136	248.0909	214.1023	269.6250	204.7500
	STD.DEV	91.8010	91.7973	93.7499	97.9259	71.1415	94.5882
00400 PH	NO.POTW	59.0000	67.0000	54.0000	121.0000	26.0000	203.0000
SU	MAX	8.2000	8.0000	8.3000	8.3000	8.3000	9.0000
	MIN	5.0000	4.0000	6.2000	4.0000	6.7000	4.0000
	MEAN	7.0764	7.1659	7.2146	7.1876	7.3461	7.1860
	STD.DEV	0.4998	0.5876	0.4604	0.5326	0.3989	0.5534
00095 SPECIFIC	NO.POTW	5.0000	15.0000	20.0000	35.0000	9.0000	53.0000
CONDUCTANCE MICROMHO	MAX	970.0000	1480.0000	2780.0000	2780.0000	2170.0000	4400.0000
	MIN	550.0000	634.0000	760.0000	634.0000	634.0000	500.0000
	MEAN	727.0000	952.2666	1369.3999	1190.6284	1184.1111	1261.0942
	STD.DEV	192.9903	312.1035	518.5095	483.9617	503.4524	716.6147

NOTES:

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- 2) PRIMARY (A) INCLUDES A01,A02
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- 4) ACTIVATED SLUDGE (C) INCLUDES C01,C02,C05,C06,C09,C19,C20
- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD-5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 65% REMOVAL FOR BOTH PARAMETERS

/PARAMETERS V	CATEGORY ----->	PRIMARY (A)	TRICKLING FILTER (B)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL PLANTS (A+B+C+OTHER)
01105 TOT ALUMINUM AL	NO.POTW UG/L	1.0000 410.0000 410.0000 410.0000 0.0000	6.0000 1450.0000 20.0000 510.0000 552.8840	11.0000 570.0000 100.0000 193.6364 135.0016	17.0000 1450.0000 20.0000 305.2939 362.2170	5.0000 200.0000 100.0000 160.0000 54.7717	23.0000 1450.0000 20.0000 281.3042 316.5637
01045 TOT IRON FE	NO.POTW UG/L	30.0000 5000.0000 400.0000 1517.6333 1023.4553	35.0000 65550.0000 100.0000 2905.5999 11024.6836	37.0000 6800.0000 100.0000 746.7837 1171.4160	72.0000 65550.0000 100.0000 1796.2083 7751.0938	17.0000 1000.0000 100.0000 298.8235 223.4851	117.0000 65550.0000 35.0000 1600.8801 6121.0117
01055 TOT MANGANESE MN	NO.POTW UG/L	22.0000 390.0000 30.0000 175.8636 111.6616	28.0000 580.0000 20.0000 136.3214 129.9118	23.0000 940.0000 10.0000 144.2174 200.4855	51.0000 940.0000 10.0000 139.8823 163.7516	11.0000 190.0000 10.0000 82.3636 56.4114	84.0000 940.0000 10.0000 146.5357 145.4156
50060 CHLORINE, TOT RESIDUAL	NO.POTW MG/L	26.0000 10.0000 0.2000 1.9558 1.9374	20.0000 3.0000 0.1000 1.9845 0.9363	22.0000 3.0000 0.2000 1.3555 0.8003	42.0000 3.0000 0.1000 1.6550 0.9140	14.0000 3.0000 0.7200 1.8693 0.8210	74.0000 10.0000 0.0700 1.6957 1.3871
00720 CYANIDE, TOTAL	NO.POTW MG/L	4.0000 0.1700 0.0200 0.0750 0.0656	8.0000 100.0000 0.0030 12.5066 35.3526	20.0000 2.2600 0.0020 0.1380 0.5009	28.0000 100.0000 0.0020 3.6719 18.8833	10.0000 0.1400 0.0020 0.0319 0.0447	41.0000 100.0000 0.0020 2.5179 15.6087
3A260 MPAS	NO.POTW MG/L	6.0000 17.8000 0.4250 5.6725 6.3253	9.0000 3.2800 0.5700 1.7156 0.9443	8.0000 3.2900 0.2000 1.1600 1.1336	17.0000 3.2900 0.2000 1.4541 1.0439	2.0000 0.2200 0.2000 0.2100 0.0141	25.0000 17.8000 0.2000 2.3778 3.5671
00620 NITROGEN, NITRATE	NO.POTW MG/L	40.0000 6.5000 0.0100 1.0554 1.1591	33.0000 11.3800 0.1200 2.1570 2.5661	30.0000 8.0000 0.0200 1.8597 2.2995	63.0000 11.3800 0.0200 2.0154 2.4278	10.0000 6.7400 0.0500 2.0110 2.2987	106.0000 11.3800 0.0100 1.6404 2.0528

NOTES:

- 1) NEGATIVE REMOVALS DELETED
- 2) PRIMARY (A) INCLUDES A01,A02
- 3) TRICKLING FILTER (B) INCLUDES B01,B02,B04,B05
- 4) ACTIVATED SLUDGE (C) INCLUDES C01,C02,C05,C06,C09,C19,C20
- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD-5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 85% REMOVAL FOR BOTH PARAMETERS

PARAMETERS V		CATEGORY ----->	PRIMARY (A)	TRICKLING FILTER (B)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL (A+B+C+)
01032 CHROMIUM, UG/L AS CR	HEXAVALENT	NO.POTW	3.0000	6.0000	14.0000	20.0000	6.0000	29.0000
		MAX	25.0000	20.0000	60.0000	60.0000	60.0000	100.0000
		MIN	5.0000	2.0000	10.0000	2.0000	10.0000	2.0000
		MEAN	16.6667	10.5000	17.2143	15.2000	18.3333	17.1034
		STD.DEV	10.4084	6.6858	15.0189	13.2688	20.4124	19.7634
00615 NITRITE	NITROGEN, MG/L	NO.POTW	40.0000	33.0000	24.0000	57.0000	7.0000	100.0000
		MAX	0.6900	2.0000	8.2450	8.2450	2.0000	8.2450
		MIN	0.0130	0.0040	0.0100	0.0040	0.0600	0.0040
		MEAN	0.1636	0.2643	0.5198	0.3719	0.4421	0.2813
		STD.DEV	0.1236	0.4053	1.6712	1.1212	0.7126	0.8533
00605 ORGANIC	NITROGEN, MG/L	NO.POTW	12.0000	8.0000	16.0000	24.0000	5.0000	37.0000
		MAX	22.0000	11.8000	24.5000	24.5000	6.5000	24.5000
		MIN	4.0000	3.0000	0.4000	0.4000	0.4000	0.4000
		MEAN	10.8833	6.3625	5.4187	5.7333	2.9200	7.6540
		STD.DEV	6.5013	3.3406	6.2788	5.4142	2.2665	6.2512
00666 PHOSPHORUS	DISSOLVED MG/L	NO.POTW	2.0000	4.0000	8.0000	12.0000	2.0000	14.0000
		MAX	5.4000	8.4000	8.0000	8.4000	8.0000	8.4000
		MIN	4.3000	2.3000	1.8000	1.8000	4.0000	1.8000
		MEAN	4.8500	4.4750	4.1125	4.2333	6.0000	4.3214
		STD.DEV	0.7778	2.7072	1.8310	2.0406	2.8284	1.9027
01040 DISSOLVED	COPPER, MG/L AS CU	NO.POTW	32.0000	10.0000	10.0000	20.0000	6.0000	53.0000
		MAX	11.7000	0.1300	1.4000	1.4000	0.1300	11.7000
		MIN	0.0600	0.0300	0.0100	0.0100	0.0100	0.0100
		MEAN	0.5005	0.0730	0.2380	0.1515	0.0483	0.3724
		STD.DEV	2.0460	0.0422	0.4466	0.3191	0.0431	1.6011
01090 DISSOLVED	ZINC, MG/L AS ZN	NO.POTW	26.0000	7.0000	9.0000	16.0000	4.0000	43.0000
		MAX	3.2500	0.1000	1.1600	1.1600	0.0600	3.2500
		MIN	0.0400	0.0500	0.0100	0.0100	0.0100	0.0100
		MEAN	0.3941	0.0671	0.2678	0.1800	0.0425	0.3190
		STD.DEV	0.6701	0.0160	0.4380	0.3361	0.0236	0.5659
01030 DISSOLVED	CHROMIUM, MG/L AS CR	NO.POTW	31.0000	10.0000	10.0000	20.0000	6.0000	52.0000
		MAX	0.5600	0.0100	0.7000	0.7000	0.1000	0.7000
		MIN	0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
		MEAN	0.0723	0.0100	0.1120	0.0610	0.0250	0.0679
		STD.DEV	0.1197	0.0000	0.2183	0.1591	0.0367	0.1338
01049 DISSOLVED	LEAD, MG/L AS PB	NO.POTW	31.0000	10.0000	10.0000	20.0000	6.0000	52.0000
		MAX	0.2000	0.1000	0.1000	0.1000	0.1000	0.3000
		MIN	0.1000	0.0200	0.1000	0.0200	0.1000	0.0200
		MEAN	0.1097	0.0920	0.1000	0.0960	0.1000	0.1081
		STD.DEV	0.0301	0.0253	0.0	0.0179	0.0001	0.0378

NOTES:

- 1) NEGATIVE REMOVALS DELETED
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- 3) TRICKLING FILTER (B) INCLUDES B01,B02,B04,B05
- 4) ACTIVATED SLUDGE (C) INCLUDES C01,C02,C05,C06,C09,C19,C20
- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD-5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 85% REMOVAL FOR BOTH PARAMETERS

PARAMETERS V	CATEGORY ----->	PRIMARY (A)	THICKLING FILTER (B)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL PLANTS (A+B+C+OTHER)
01065 NICKEL, DISSOLVED MG/L AS NI	NO.POTW MAX MIN MEAN STD.DEV	31.0000 0.8200 0.1000 0.1313 0.1330	10.0000 0.1000 0.1000 0.1000 0.0	10.0000 0.8000 0.1000 0.1850 0.2212	20.0000 0.8000 0.1000 0.1425 0.1583	6.0000 0.1000 0.1000 0.1000 0.0001	52.0000 0.8200 0.1000 0.1350 0.1407
01025 CADMIUM, DISSOLVED MG/L AS CD	NO.POTW MAX MIN MEAN STD.DEV	31.0000 0.0300 0.0100 0.0124 0.0062	10.0000 0.0100 0.0100 0.0100 0.0000	10.0000 0.1200 0.0100 0.0210 0.0348	20.0000 0.1200 0.0100 0.0155 0.0246	6.0000 0.0100 0.0100 0.0100 0.0000	52.0000 0.1200 0.0100 0.0137 0.0158
01056 MANGANESE, DISSOLVED MG/L AS MN	NO.POTW MAX MIN MEAN STD.DEV	31.0000 0.3600 0.0005 0.1578 0.0796	10.0000 0.1100 0.0300 0.0740 0.0280	10.0000 0.2600 0.0200 0.1140 0.0857	20.0000 0.2600 0.0200 0.0940 0.0653	6.0000 0.1100 0.0200 0.0750 0.0339	52.0000 0.3600 0.0005 0.1348 0.0807
71890 MERCURY, DISSOLVED MG/L AS HG	NO.POTW MAX MIN MEAN STD.DEV	25.0000 0.0017 0.0001 0.0005 0.0004	8.0000 0.0018 0.0001 0.0007 0.0005	9.0000 0.0010 0.0001 0.0006 0.0003	17.0000 0.0018 0.0001 0.0006 0.0004	4.0000 0.0007 0.0001 0.0005 0.0003	43.0000 0.0023 0.0001 0.0006 0.0005
70507 TOT ORTHO- PHOSPHATE MG/L	NO.POTW MAX MIN MEAN STD.DEV	33.0000 7.7000 0.7000 3.2524 1.6278	20.0000 13.0000 0.7000 5.2875 3.8093	13.0000 28.0000 0.1000 5.6000 8.3430	33.0000 28.0000 0.1000 5.4106 5.8942	6.0000 6.6000 1.0000 2.7167 2.0331	68.0000 28.0000 0.1000 4.3762 4.3830
00690 TOT CARRON MG/L AS C	NO.POTW MAX MIN MEAN STD.DEV	28.0000 580.0000 88.0000 180.6964 95.0200	10.0000 160.0000 50.0000 81.5000 35.2334	6.0000 90.0000 24.0000 56.3333 22.5359	16.0000 160.0000 24.0000 72.0625 32.7481	4.0000 160.0000 40.0000 81.5000 53.6002	46.0000 580.0000 24.0000 145.4239 94.1036
00900 HARDNESS, TOTAL MG/L	NO.POTW MAX MIN MEAN STD.DEV	14.0000 330.0000 30.0000 103.8571 76.2000	6.0000 110.0000 32.0000 80.6667 33.9097	6.0000 632.0000 60.0000 191.3333 221.4921	12.0000 632.0000 32.0000 136.0000 161.7472	0.0 0.0 0.0 0.0 0.0	26.0000 632.0000 30.0000 118.6923 121.6461
00425 ALKALINITY -BICARBONATE MG/L	NO.POTW MAX MIN MEAN STD.DEV	11.0000 300.0000 74.0000 155.0000 74.6980	4.0000 160.0000 102.0000 122.0000 25.8716	4.0000 104.0000 22.0000 62.0000 42.9884	8.0000 160.0000 22.0000 92.0000 45.9065	0.0 0.0 0.0 0.0 0.0	19.0000 300.0000 22.0000 128.4737 70.2899

NOTES:

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- 4) ACTIVATED SLUDGE (C) INCLUDES C01,C02,C05,C06,C09,C19,C20
- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD-5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 85% REMOVAL FOR BOTH PARAMETERS

/PARAMETERS V		CATEGORY ----->	PRIMARY (A)	TRICKLING FILTER (B)	ACTIVATED SLUDGE (C)	BIOLOGICAL PLANTS (B+C)	SECONDARY PLANTS	TOTAL ALL PLANTS (A+B+C+OTHER)
00650	TOTAL	NO.POTW	16.0000	21.0000	11.0000	32.0000	0.0	49.0000
PHOSPHATE	MG/L	MAX	68.0000	36.5000	90.0000	90.0000	0.0	90.0000
		MIN	15.5000	1.5600	1.1000	1.1000	0.0	1.1000
		MEAN	31.0187	17.2709	24.6991	19.8243	0.0	23.6516
		STD.DEV	12.8231	10.3413	23.4743	16.1120	0.0	15.7270
00070	TURBIDITY	NO.POTW	7.0000	12.0000	8.0000	20.0000	0.0	30.0000
	JTU	MAX	76.5000	99.0000	54.0000	99.0000	0.0	99.0000
		MIN	25.0000	15.0000	3.0000	3.0000	0.0	3.0000
		MEAN	48.5000	34.5250	23.7625	30.2200	0.0	34.4400
		STD.DEV	19.4915	21.8395	14.3987	19.5392	0.0	20.8352
00671	DISSOLVED	NO.POTW	3.0000	3.0000	3.0000	6.0000	2.0000	10.0000
ORTHOPHOSPHATE	MG/L	MAX	40.0000	6.7500	3.0000	6.7500	1.2000	40.0000
		MIN	1.4000	4.2000	0.1600	0.1600	0.1600	0.1600
		MEAN	14.9667	5.1500	1.4533	3.3017	0.6800	7.9710
		STD.DEV	21.7049	1.3937	1.4368	2.3880	0.7354	12.0081
01037	COBALT,TOT	NO.POTW	2.0000	0.0	2.0000	2.0000	0.0	5.0000
	UG/L AS CO	MAX	30.0000	0.0	20.0000	20.0000	0.0	30.0000
		MIN	20.0000	0.0	20.0000	20.0000	0.0	20.0000
		MEAN	25.0000	0.0	20.0000	20.0000	0.0	22.0000
		STD.DEV	7.0711	0.0	0.0271	0.0271	0.0	4.4721
01007	BARIIUM,TOT	NO.POTW	1.0000	1.0000	1.0000	2.0000	0.0	3.0000
	UG/L AS BA	MAX	160.0000	100.0000	5800.0000	5800.0000	0.0	5800.0000
		MIN	160.0000	100.0000	5800.0000	100.0000	0.0	100.0000
		MEAN	160.0000	100.0000	5800.0000	2950.0000	0.0	2020.0000
		STD.DEV	0.0000	0.0000	0.0000	4030.5212	0.0	3273.6921
00076	TURBIDITY	NO.POTW	1.0000	2.0000	1.0000	3.0000	1.0000	4.0000
	FTU	MAX	57.0000	25.0000	6.0000	25.0000	6.0000	57.0000
		MIN	57.0000	10.0000	6.0000	6.0000	6.0000	6.0000
		MEAN	57.0000	17.5000	6.0000	13.6667	6.0000	24.5000
		STD.DEV	0.0000	10.6066	0.0000	10.0167	0.0000	23.1588

NOTES:

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- 2) PRIMARY (A) INCLUDES A01,A02
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- 4) ACTIVATED SLUDGE (C) INCLUDES C01,C02,C05,C06,C09,C19,C20
- 5) SECONDARY PLANTS ARE THOSE BIOLOGICAL PLANTS WITH EFFLUENT BOD-5 AND SS LESS THAN OR EQUAL TO 30MG/L AND GREATER THAN OR EQUAL TO 85% REMOVAL FOR BOTH PARAMETERS

TABLE 6-1

CUMULATIVE FREQUENCY DISTRIBUTION
OF REMOVAL DATA
(PERCENT OF PLANTS)

PERCENT REMOVAL	≥	0	10	20	30	40	50	60	70	80	90	100	N
CADMIUM	- PP	100	26	19	6	6	3	3	3	0			31
	- TFP	100	43	43	37	26	9	3	0				35
	- ASP	100	34	30	27	20	16	11	7	2	0		44
	- BP	100	38	35	32	23	13	10	5	1	0		79
CHROMIUM	- PP	100	61	44	36	25	19	19	6	0			36
	- TFP	100	71	67	60	48	31	21	17	8		0	48
	- ASP	100	74	74	67	56	43	41	39	20	10	0	54
	- BP	100	73	71	64	52	37	31	28	15	6	0	102
LEAD	- PP	100	56	50	41	24	15	9	9	3	0		34
	- TFP	100	71	59	54	51	34	27	15	10	5	0	41
	- ASP	100	67	59	57	53	43	31	20	8	2	0	49
	- BP	100	69	59	56	52	39	29	18	9	3	0	90
MERCURY	- PP	100	62	52	33	33	29	19	14	0			21
	- TFP	100	70	60	55	50	10	10	0				20
	- ASP	100	71	65	62	44	29	18	12	6	0		34
	- BP	100	70	63	59	46	26	22	11	7	4	0	54
COPPER	- PP	100	70	47	34	27	18	11	9	0			44
	- TFP	100	98	92	76	71	51	39	31	22	8	0	49
	- ASP	100	97	94	78	75	63	51	37	19	3	0	63
	- BP	100	97	93	77	73	58	46	34	21	5	0	112
NICKEL	- PP	100	18	7	7	4	4	4	4	4	4	0	28
	- TFP	100	56	50	34	16	13	6	6	3	0		32
	- ASP	100	59	43	30	16	8	4	4	0			49
	- BP	100	58	46	32	16	10	5	5	1	0	0	81
ZINC	- PP	100	82	61	39	32	26	13	3	3	0		38
	- TFP	100	92	87	79	62	40	29	15	6	0		52
	- ASP	100	95	91	84	81	64	52	40	22	9	0	58
	- BP	100	94	89	82	72	53	41	28	15	5	0	110
IRON	- PP	100	93	81	67	41	26	15	11	4	0		27
	- TFP	100	93	90	77	60	40	30	23	20	0		30
	- ASP	100	97	91	85	74	71	63	49	31	23		35
	- BP	100	95	91	82	68	57	48	37	26	12	0	65
MANGANESE	- PP	100	37	18	12	6	6	6	6	6	0		16
	- TFP	100	76	66	47	33	28	9	4	0			21
	- ASP	100	73	68	47	42	31	21	21	15	15	0	19
	- BP	100	75	68	47	38	30	15	13	8	8	0	40
PHOSPHORUS													
TOTAL	- PP	INSUFFICIENT DATA											
	- TFP	100	75	50	33	20	12	4	4	4	4	0	24
	- ASP	100	88	77	69	50	33	25	13	8	2	0	36
	- BP	100	83	67	55	38	25	17	10	7	3	0	60
TOTAL "KJELDHAL"													
NITROGEN	- PP	INSUFFICIENT DATA											
	- TFP	100	90	80	70	60	50	40	35	15	5	0	20
	- ASP	100	90	63	45	27	18	18	18	9	9	0	11
	- BP	100	90	74	61	48	39	32	29	13	6	0	31
AMMONIA	- PP	100	71	38	23	9	7	4	0				42
	- TFP	100	79	77	56	41	31	27	20	16	8	0	48
	- ASP	100	93	78	63	55	44	34	29	25	17	0	47
	- BP	100	86	78	60	48	32	30	25	21	13	0	95
PHENOLICS													
TOTAL	- PP	INSUFFICIENT DATA											
	- TFP	100	83	83	67	67	58	50	25	8	0		12
	- ASP	100	94	88	81	81	75	69	63	50	31	0	16
	- BP	100	89	86	75	75	68	61	46	32	18	0	28
TOTAL ORGANIC CARBON													
TOTAL	- PP	100	70	50	33	27	17	0					30
	- TFP	100	96	96	96	91	87	70	39	17	0		23
	- ASP	100				100	92	92	77	23	0		13
	- BP	100	97	97	97	94	89	78	53	19	0	0	36
CHEMICAL OXYGEN DEMAND													
TOTAL	- PP	100	83	44	33	11	11	11	11	6	0		18
	- TFP				100	94	86	81	56	31	11	0	36
	- ASP			100	98	98	95	83	73	48	15	0	40
	- BP	100	100	100	99	96	91	82	64	39	13	0	76
SUSPENDED SOLIDS													
TOTAL	- PP		100	96	85	74	53	34	11	4	2	0	47
	- TFP		100	98	95	92	86	85	73	45	24	0	66
	- ASP	100	98	98	95	94	87	76	66	56	34	0	62
	- BP	100	99	98	95	93	87	80	70	51	29	0	128

TABLE 6-1 (Continued)
CUMULATIVE FREQUENCY DISTRIBUTION
OF REMOVAL DATA
(PERCENT OF PLANTS)

PERCENT REMOVAL	0	10	20	30	40	50	60	70	80	90	100	N
BIOCHEMICAL OXYGEN DEMAND												
- PP	100	83	65	42	29	17	12	6	2	0		52
- TFP	100	98	98	97	97	92	88	77	63	20	0	60
- ASP		100	98	98	98	97	92	83	72	46	0	65
- BP	100	99	98	98	98	94	90	80	68	34	0	125

- NOTES: 1) PP - Primary Plants (A01, A02)
2) TFP - Trickling Filter Plants (B01, B02, B04, B05)
3) ASP - Activated Sludge Plants (C01, C02, C05, C06, C09, C19, C20)
4) BP - Biological Plants (TFP + ASP)
5) N - Number of Plants

TABLE 6-2
CUMULATIVE FREQUENCY DISTRIBUTION
OF EFFLUENT DATA
(PERCENT OF PLANTS)

EFFLUENT CONCENTRATION (ug/l) \geq	0	4	8	12	16	20	24	28	32	36	40	N
CADMIUM - PP	100	89	80	40	37	34	11	9	0			35
- TFP	100	83	68	22	17	15	5	5	2	2	2	41
- ASP	100	92	75	31	27	19	4	4	2	2	2	48
- BP	100	88	72	27	22	17	4	4	2	2	2	89
EFFLUENT CONCENTRATION (ug/l) \geq	0	50	100	150	200	250	300	350	400	450	500	
CHROMIUM- PP	100	73	45	28	25	18	15	13	10	10	8	40
- TFP	100	48	35	25	23	21	21	17	17	12	12	52
- ASP	100	42	25	17	15	12	12	12	12	8	8	60
- BP	100	45	29	21	19	16	16	14	14	10	10	112
EFFLUENT CONCENTRATION (ug/l) \geq	0	50	100	150	200	250	300	350	400	450	500	
LEAD - PP	100	81	54	30	24	5	5	5	3	3	3	37
- TFP	100	58	24	13	9	9	9	9	9	7	7	45
- ASP	100	57	14	10	8	2	0					51
- BP	100	57	19	11	8	5	4	4	4	3	3	96
EFFLUENT CONCENTRATION (ug/l) \geq	0	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0	
MERCURY - PP	100	70	30	17	9	9	9	9	9	9	9	23
- TFP	100	77	27	14	14	5	5	5	5	5	5	22
- ASP	100	62	32	16	14	11	5	5	5	5	5	37
- BP	100	68	31	15	14	8	5	5	5	5	5	59
EFFLUENT CONCENTRATION (ug/l) \geq	0	50	100	150	200	250	300	350	400	450	500	
COPPER - PP	100	88	54	33	25	19	19	13	13	10	8	48
- TFP	100	52	30	13	13	9	9	9	9	9	6	54
- ASP	100	51	31	13	9	4	4	3	1	1	1	68
- BP	100	52	30	13	11	7	7	6	5	5	3	122
EFFLUENT CONCENTRATION (ug/l) \geq	0	50	100	150	200	250	300	350	400	450	500	
NICKEL - PP	100	64	39	12	9	9	9	6	6	6	6	33
- TFP	100	66	47	29	26	16	16	16	16	13	11	38
- ASP	100	57	23	11	11	7	5	5	4	4	4	56
- BP	100	61	33	18	17	11	10	10	9	7	6	94
EFFLUENT CONCENTRATION (ug/l) \geq	0	100	200	300	400	500	600	700	800	900	1000	
ZINC - PP	100	92	71	51	31	31	27	24	22	20	16	49
- TFP	100	79	39	26	19	16	11	9	9	9	7	57
- ASP	100	65	39	18	14	12	9	8	8	3	3	66
- BP	100	72	39	22	16	14	10	8	8	6	5	123
EFFLUENT CONCENTRATION (ug/l) \geq	0	600	1200	1800	2400	3000	3600	4200	4800	5400	6000	
IRON - PP	100	90	53	30	20	10	3	3	3	0		30
- TFP	100	65	24	12	9	6	6	6	6	6	6	34
- ASP	100	30	16	8	3	3	3	3	3	3	3	37
- BP	100	46	20	10	6	4	4	4	4	4	4	71
EFFLUENT CONCENTRATION (ug/l) \geq	0	60	120	180	240	300	360	420	480	540	600	
MANGANESE - PP	100	82	64	41	36	18	9	0				22
- TFP	100	68	39	21	14	14	11	4	4	4	0	28
- ASP	100	78	26	17	13	13	9	9	4	4	4	23
- BP	100	73	33	20	14	14	10	6	4	4	2	51
EFFLUENT CONCENTRATION (mg/l) \geq	0	2	4	6	8	10	12	14	16	18	20	
PHOSPHORUS- PP	100	90	80	60	50	10	10	10	10	10	10	10
TOTAL - TFP	100	100	89	70	63	41	26	7	7	4	0	27
- ASP	100	93	58	38	20	5	0					40
- BP	100	96	70	51	37	19	10	3	3	1	0	67
EFFLUENT CONCENTRATION (mg/l) \geq	0	5	10	15	20	25	30	35	40	45	50	
TOTAL - PP				INSUFFICIENT DATA								
KJELDAHL - TFP	100	86	67	48	29	10	10	10	5	5	0	21
NITROGEN - ASP	100	83	83	67	58	25	8	0				12
- BP	100	85	73	55	39	15	9	6	3	3	0	33
EFFLUENT CONCENTRATION (mg/l) \geq	0	4	8	12	16	20	24	28	32	36	40	
AMMONIA - PP	100	97	84	57	40	24	17	11	5	3	3	63
- TFP	100	86	69	57	36	26	14	11	8	6	5	65
- ASP	100	79	59	43	25	13	5	0				63
- BP	100	83	64	50	31	20	9	5	4	3	2	128

TABLE 6-2 (Continued)

CUMULATIVE FREQUENCY DISTRIBUTION
OF EFFLUENT DATA
(PERCENT OF PLANTS)

EFFLUENT CONCENTRATION (mg/l) \geq	0	1	2	3	4	5	6	7	8	9	10	
PHENOLICS - PP			INSUFFICIENT DATA									
- TFP	100	38	38	38	38	38	38	38	38	38	31	13
- ASP	100	75	75	50	38	31	31	31	31	13	6	16
- BP	100	59	59	45	38	34	34	34	34	24	17	29
EFFLUENT CONCENTRATION (mg/l) \geq	0	30	60	90	120	150	180	210	240	270	300	
TOTAL - PP	100	100	97	77	54	31	17	9	9	3	3	35
ORGANIC - TFP	100	96	30	13	4	0						23
CARBON - ASP	100	50	14	7	0							14
- BP	100	78	24	11	3	0						37
EFFLUENT CONCENTRATION (mg/l) \geq	0	40	80	120	160	200	240	280	320	360	400	
CHEMICAL - PP	100	100	89	89	79	68	63	63	58	42	37	19
OXYGEN - TFP	100	94	72	47	22	14	8	8	3	3	0	36
DEMAND - ASP	100	78	43	20	15	8	3	0				40
- BP	100	86	57	33	18	11	5	4	1	1	0	76
EFFLUENT CONCENTRATION (mg/l) \geq	0	20	40	60	80	100	120	140	160	180	200	
SUSPENDED - PP	100	98	93	78	48	24	20	13	11	9	9	54
SOLIDS - TFP	100	73	42	17	9	6	5	3	2	2	2	66
- ASP	100	58	31	20	11	8	6	6	3	2	0	64
- BP	100	65	37	18	10	7	5	5	2	2	1	130
EFFLUENT CONCENTRATION (mg/l) \geq	0	20	40	60	80	100	120	140	160	180	200	
BIOCHEMICAL- PP	100	100	97	93	86	74	59	52	45	36	28	58
OXYGEN - TFP	100	82	41	20	15	13	8	7	5	5	3	61
DEMAND - ASP	100	40	20	8	5	5	5	5	3	3	2	65
- BP	100	60	30	13	10	9	6	6	4	4	2	126

- NOTES: 1) PP - Primary Plants (AO1, AO2)
 2) TFP - Trickling Filter Plants (BO1, BO2, BO4, BO5)
 3) ASP - Activated Sludge Plants (CO1, CO2, CO5, CO6, CO9, C19, C20)
 4) BP - Biological Plants (TFP + ASP)
 5) N - Number of Plants

APPENDIX 7
ANNOTATED BIBLIOGRAPHY

SECTION A - Introduction

SECTION B - Management of a Control Program

SECTION C - Legal Aspects of a Control Program

SECTION D - Monitoring

SECTION E - Pollutants which Interfere with
Publicly Owned Treatment Works

SECTION F - Removal of Pollutants in Publicly
Owned Treatment Works

SECTION A - INTRODUCTION

Reference: Volume I - Section A & Appendices 1 & 2

- A-1 Theories and Practices of Industrial Waste Treatment, Nemerow, Nelson Leonard, Addison-Wesley Publishing Company, Inc., Reading, Massachusetts, (1963).

This book is divided into four sections:

1. The effects of industrial wastes on a receiving stream and how to treat wastes to protect the stream.
2. Theories of waste treatment including solids removal, neutralization, equalization and proportioning, and removal of dissolved organics and inorganics.
3. Engineering practice and actual case studies which consider economics, public opinion, personality differences, local laws or customs, and previous community experience to help the reader put theories into practice.
4. A condensed evaluation of the nature of major industrial wastes - their origin, characteristics and treatments.

- A-2 Projects in the Industrial Pollution Control Division - December, 1974, Environmental Protection Technology Series, EPA 600/2-75-001 (March, 1975).

This book is a compilation of information sheets from all projects initiated since fiscal year 1967 (through fiscal year 1974). Each sheet contains the objectives, statistical information, and a brief description of one project.

- A-3 "Combined Tannery and Municipal Waste Treatment - Gloversville - Johnstown, New York," Nemerow, N. and R. Armstrong, Proceedings of the 21st Industrial Waste Conference, Purdue University, (1966), p. 447.

This article describes the stream survey used on the Cayadutta Creek to determine the waste treatment required for a combined tannery-municipal waste discharge flow. The sampling procedure used is indicated and the results are discussed. Laboratory scale treatment tests were conducted on the waste stream, and the results and conclusions are presented.

- A-4 "Synthetic Organic Pesticides - An Evaluation of Their Persistence in Natural Water," Okey, Robert W. and Richard H. Bogan, Proceedings of the 11th Pacific Northwest Industrial Waste Conference, Corvallis, Oregon, Cir. No. 29, p. 222 (1963).

Metabolism studies were carried out with the Warburg microrespirometer, and the conventional 5-day 20°C biochemical oxygen demand test to determine the persistence (biodegradeability) of insecticides. The work was carried out in two principal phases. The first employed unacclimated activated sludge, and the second used acclimated activated sludge. A discussion of the results is included.

- A-5 "Toxicity of Chemicals in Paper Factory Effluents," Norup, Bjarne, Water Research, Vol. 6, p. 1585 (1972)

This article presents the results of a study to demonstrate that PCP is as toxic to fish as the dangerous, previously used slimeicides containing mercury. A discussion of the experimental results is given.

- A-6 "Treatment Studies of Combined Textile and Domestic Wastes," Lauria, Donald T. and Charles A. Willis, Proceedings of the 19th Industrial Waste Conference, Purdue University, (1964), p. 45.

Pilot plant studies were conducted to evaluate a completely mixed biological process to treat combined domestic and industrial wastes, produced in the town of Valdese, North Carolina. The results of the pilot plant tests and conclusions are presented in this paper.

- A-7 "Biomonitoring of Industrial Effluents," Jackson, Herbert W., and William A. Brungs, Jr., Proceedings of the 21st Industrial Waste Conference, Purdue University, (1966), p. 117.

This paper describes a method to determine the toxicity of wastewater by using tanks containing aquatic life. The death of fish signal a deleterious change of the wastewater. A schematic flow scheme of the system and operating procedures are given.

- A-8 "Isolation and Identification of Anaerobic and Facultative Bacteria Present in the Digestion Process," Burbank, N. C., Jr., et.al., Proceedings of the 19th Industrial Waste Conference, Purdue University, (1964), p. 552.

The purpose of this study was fivefold:

1. To improve the equipment devised to cultivate anaerobic bacteria.
2. To improve the techniques for identifying anaerobic bacteria.
3. To isolate and identify the anaerobic bacteria and facultative bacteria present in sewage sludge.
4. To correlate the population of the bacteria to the operation of digesters.
5. To isolate and identify anaerobic and facultative bacteria present in the digestion process of meat packing wastes.

Results and conclusions are presented in this study.

- A-9 "Industrial Wastewater Reclamation," Rambow, Carl A., Proceedings of the 23rd Industrial Waste Conference, Purdue University, (1968), p. 1.

The environmental and economic advantages of wastewater reclamation are presented in this paper. Specific case histories are presented where wastewater reclamation has demonstrated distinct advantages over other methods of treatment.

- A-10 "Decision Factors - Separate Industry or Joint Municipal Waste Treatment," Sanders, Francis A., Proceedings of the 23rd Industrial Waste Conference, Purdue University, (1968), p. 1021.

This article discusses the advantages and disadvantages to both industry and communities of joint treatment. The factors which affect the decision of joint treatment, and the advantages of using a consulting engineer are also presented.

- A-11 "Combined Waste Treatment at Grand Island, Nebraska," Gibbs, W.R., and Henry Benjes, Jr., Proceedings of the 22nd Industrial Waste Conference, Purdue University, (1967), p. 800.

This paper discusses the development of the conceptual design of the new sewage collection and treatment system at Grand Island, Nebraska. The detailed design and the operation of the treatment system are also presented.

- A-12 Comparative Effects of Chemical Pretreatment on Carbon Adsorption, Westrick, James J., et al., presented at the Water Pollution Control Federation 47th Annual Conference, October 8-13, 1972.

Three physical-chemical pilot plants were operated, utilizing three different chemical clarification schemes preceding filtration and carbon adsorption. The purpose of the study was to compare effluent qualities from each plant. A method of data analysis was developed to permit simplistic comparison of carbon dosages and costs.

- A-13 "Phys/Chem or Biological: Which Will You Choose?", Barth, E.E., and Jesse M. Cohen, Water & Wastes Engineering, (Nov., 1974).

The relative advantages and disadvantages of physical-chemical and biological wastewater treatment methods are discussed. Examples are given where combinations of both methods can satisfy a particular wastewater requirement.

- A-14 "The Treatment of Industrial Wastewater for Reuse - Chrysler Indianapolis Foundry," Balden, A.R., and Paul R. Erickson, Proceedings of the 25th Industrial Waste Conference, Purdue University, (1970), p. 62.

This paper discusses the waste treatment plant designed for the Chrysler Indianapolis Foundry. The waste treatment plant handles the waste stream produced by the gas scrubbers, which contain iron particles, evaporated oils and phenols.

- A-15 "Wastewater Load Evaluated at a Multi-Product Organic Chemical Plant," Morrissey, A. J. and S. A. LaRocca, Water and Sewage Works, Vol. 117, No. 5, p. 173, (May, 1970).

The wastewaters generated from a chemical plant are characterized and their effects on receiving waters are assessed. The sampling and analysis program is also discussed.

- A-16 "Experience in the Treatment and Re-use of Industrial Waste Waters," Renn, Charles E., Proceedings of the 24th Industrial Waste Conference, Purdue University, (1969), p. 962.

The re-use of industrial waste waters at the Black and Decker Manufacturing Company's Hampstead, Maryland plant were discussed. A detailed description of the collection pond is given, and a discussion of the operating problems faced is also contained.

- A-17 "Water Conservation and Reuse by Industry," Irvine, Robert L., Jr. and William B. Davis, Proceedings of the 24th Industrial Waste Conference, Purdue University (1969), p. 450.

The reasons why industry has not implemented in-plant water management programs for water conservation and reuse are discussed in this paper. The first part of the paper disputes these reasons; the second part discusses how the concepts of conservation and reuse aid in overall plant performance. The third part indicates how the efficiency of biological waste treatment facilities can be increased.

- A-18 "Rough Days Ahead for Industry, but New Methods Gain," Heckroth, Charles W., Water and Wastes Engineering, (January, 1972), p. A2.

This article briefly discusses:

1. The W.P.C.F. meeting held in San Francisco in 1971, including EPA viewpoints regarding latest treatment technology.
2. Studies presented at the WPCF meeting on how five towns are handling both municipal and industrial wastewaters.
3. Advances in pulp and paper, food, plating, plastic, and mining waste treatment systems.

- A-19 "Detection of Industrial Wastes in Municipal Systems," Delaney, Ladin, Journal of the Water Pollution Control Federation, Vol. 42, No. 4, p. 645, (April, 1970).

This article briefly discusses some basic procedures for detecting illegal discharges to sewerage systems. Specific case histories are presented to illustrate each of the author's suggestions.

- A-20 "Acceptable Methods for the Utilization or Disposal of Sludges," U.S. E.P.A., 430/9-75, a preliminary draft of a technical bulletin, Supplement to Federal Guidelines: Design, Operation and Maintenance of Wastewater Treatment Facilities, 26 pp.

This bulletin discusses the factors important to the environmental acceptability of a particular sludge management system. The environmental assessment procedure to determine the acceptability of sludge disposal at a specific site is also discussed. Information on the constraints of various sludge disposal methods is presented.

- A-21 "Wastewater Treatment for Small Communities," Part I, Tchobanoglous, George, Public Works, Vol. 105, No. 7, p. 58, (July, 1974).

This article defines some of the general problems associated with small waste treatment plants. Alternate treatment processes and design considerations for small plants are discussed. Economic comparisons between treatment processes are also given.

- A-22 "Wastewater Treatment for Small Communities," Part 2, Tchobanoglous, George, Public Works, Vol. 105, No. 8, p. 58, (August, 1974).

Design considerations for small activated sludge systems are discussed. An economic evaluation of alternative processes is considered and illustrated. Capital and operating costs for various systems are shown.

- A-23 Industrial Wastes, Rudolfs, W., Reinhold Publishing Corporation, New York, N. Y. (1953), 497 pp.

Brief descriptions of industrial waste-producing processes, sources of wastes, recovery and remedial measures, quantities and characteristics of the wastes, methods of treatment and the effects of the wastes on domestic sewage treatment processes are presented. Various contributors presented waste treatment fundamentals from the physical, chemical, biochemical and engineering viewpoints.

- A-24 "Measuring Open Channel Wastewater Flows," Blois, R.S., Pollution Engr., Vol. 19, No. 6, P. 20, (Nov.-Dec., 1973).

The use of weirs to measure flow rates is discussed. Some basic designs are given, and simple flow recording methods are presented.

- A-25 "Analytical Parameters of Petrochemical and Refinery Wastewaters," Ford, D.L., et. al., Journal of the Water Pollution Control Federation, Vol. 43, No. 8, p. 1712, (August, 1971).

This paper discusses the tests for BOD, COD, TOD, and TOC, and shows how these tests can be used to determine wastewater characterization and wastewater treatability.

- A-26 "Unique System Solves Plastic Problem," Water and Wastes Engineering, Vol. 10, No. 5, p. C-20, (May, 1973).

This article briefly discusses the method used by the Marbon Chemical Division of Borg-Warner Corporation to determine whether a waste stream was biodegradeable. The analysis also produced the design parameters for the full scale plant.

- A-27 "A Method for the Measurement of the Radioactive Content of Wastewater," Haughey, Francis J. and Raymond M. Manganelli, Journal of the Water Pollution Control Federation, Vol. 36, No. 1, p. 88, (January, 1964).

A method to measure the radioactive content of wastewater is presented in this article. The method accounts for the relationship between radioactivity and the various sewage solids fractions.

- A-28 "Municipal Wastewater Treatment Plant Instrumentation," Babcock, Russel H., Water and Wastes Engineering, Vol. 5, No. 8, p. 47, (August, 1968).

This article briefly discusses instruments and controls that can be used in a sewage plant.

- A-29 "Surveillance in Water Quality Management," Ward, Robert C., et al. Journal of the Water Pollution Control Federation, Vol. 45, No. 10, p. 2081, (October, 1973).

This paper reviews the strategy developments in water quality surveillance that have occurred in this country. The paper also discusses the importance of data to successful implementation of these strategies and notes failures in the utilization of the data. Remedies for these situations are also proposed.

- A-30 Manual on Disposal of Refinery Wastes, Volume on Liquid Wastes, American Petroleum Institute, 1801 K Street, N.W., Washington, D.C. (1969).

This document is a comprehensive manual on the disposal and treatment of petroleum refinery wastes. Included is information on the removal and reduction of pollutants, collection and treatment of wastewaters, monitoring, and solubility and toxicity data.

- A-31 Principles of Industrial Waste Treatment, Gurnham, C. Fred, John Wiley & Sons, Inc., New York, New York, (1955), 399 pp.

This book examines the problem of industrial wastes from the unit operations viewpoint. Operations and processes used to treat wastes before discharge include physical, chemical and biological pretreatment. Sources of wastes, their pollutional effects and a review of major industry problems are covered.

- A-32 Industrial Waste Treatment Practice, Eldridge, E. F., McGraw-Hill Book Company, Inc., New York, New York, (1942), 401 pp.

Information and data pertaining to the design and operation of treatment works for industrial wastewaters are given. Wastewaters from important industries are characterized.

- A-33 Choosing the Optimum Financial Strategy, Upgrading Meat Packing Facilities to Reduce Pollution, U.S. EPA Technology Transfer Seminar Publication, October, 1973, 38 pp.

This booklet presents various strategies for financing pollution control equipment. The areas covered include depreciation, State and other financing, tax incentives, and comparisons between on-site and municipal treatment. Three hypothetical meat packing facilities are considered as examples, and their method of optimizing costs are detailed.

- A-34 In Process Modifications and Pretreatment, Upgrading Meat Packing Facilities to Reduce Pollution, U.S. EPA, October, 1973, 90 pp.

Methods of reducing pollution from meat packing plants are described in this report. Both in-plant modifications and pretreatment of wastes are discussed. Two case histories are presented, with operating results. A discussion of odor problems and control is also included.

- A-35 Waste Treatment, Upgrading Meat Packing Facilities to Reduce Pollution, U.S. EPA, October, 1973, 64 pp.

This booklet describes the use of biological wastewater treatment methods to treat waste from meat packing plants. The various biological systems are indicated, and procedures for planning, designing and constructing such facilities are recommended. Proper operation and maintenance procedures are presented, and case histories of several plants utilizing biological treatment are detailed.

- A-36 In-Plant Control of Pollution, Upgrading Textile Operations to Reduce Pollution, U.S. EPA Technology Transfer Seminar Publication, October, 1974, 118 pp.

This study surveys the wastes produced by textile operations and indicates various treatment methods to reduce and eliminate pollution. Examples of flow reduction, water reuse and waste segregation are presented. Different pretreatment techniques are also discussed.

- A-37 Wastewater Treatment Systems, Upgrading Textile Operations to Reduce Pollution, U.S. EPA, October, 1974, 45 pp.

Experience with using biological treatment systems and activated carbon to treat textile wastes is described in this bulletin. The sources and strengths of wastewaters from various textile manufacturing processes are described, and case histories from several plants are indicated.

- A-38 In-Process Pollution Abatement, Upgrading Metal Finishing Facilities to Reduce Pollution, U.S. EPA, July, 1973, 69 pp.

This booklet describes generally the metal finishing industry and techniques that can be used to control pollution. One chapter deals specifically with water pollution, and discusses both conservation and treatment.

- A-39 Waste Treatment, Upgrading Metal Finishing Facilities to Reduce Pollution, U.S. EPA, July, 1973, 47 pp.

Methods of treating metal-finishing wastes are discussed in this document. Methods of process solution regeneration and recovery are indicated and commonly used waste treatment systems are also described. A chapter on solid-liquid separation, solids concentration and sludge disposal is included. The economic considerations of waste treatment are outlined.

- A-40 Upgrading Poultry Processing Facilities to Reduce Pollution, Volume 1 - In-Process Pollution Abatement, Volume 2 - Pre-treatment of Poultry Processing Wastes, Volume 3 - Waste Treatment, U.S. EPA Technology Transfer Seminar Publication, June, 1973.

This three volume set of booklets describes methods of reducing and treating the wastes from poultry processing operations. The first volume describes the industry and its wastes, and presents a case study of process and equipment modifications which were successful in reducing wastewater. The second booklet discusses unit operations which may be used as pretreatment of poultry wastes. The relationship of municipal ordinances and these wastes is also indicated. The third volume discusses complete waste treatment, including planning, selection and operating suggestions. A case history of a waste treatment plant for poultry wastes is included.

- A-41 Technical Aspects of Joint Waste Treatment, Municipal/Industrial, Litsky, W., et.al. editor, Proceedings of an Institute Held at Framingham, Massachusetts, March 5, 1969, Technical Guidance Center for Industrial Water Pollution Control (University of Massachusetts) and Associated Industries of Massachusetts.

This document is a collection of papers dealing with the organizational, managerial and technical aspects of joint industry/municipal sewage treatment. Some of the subjects included are economic studies of joint treatment and case histories of combined treatment. 15 technical papers are included.

For additional information pertaining to this section, please refer to the following articles:

E-31
E-66
E-73
D-112

SECTION B - MANAGEMENT OF A
CONTROL PROGRAM

Reference: Volume I - Section 3

- B-1 "Delaware System Moves Ahead," Webber, Paul J. and Robert C. Kausch, Water and Wastes Engineering, p. 44, January, 1972.

This article describes how the Delaware River Basin Commission set up a regional waste treatment system in cooperation with the local municipalities and industries. The article describes the history, starting from the original agreement, through the pilot plant to the beginning of the final plans.

- B-2 "Classifying Industrial Wastewater Emissions," Williams, Rodney T., Water and Sewage Works, Vol. 121, No. 7, p. 86, (July, 1974).

This article describes the classification methodology of the East Bay Municipal Utility District, Oakland, California to categorize the industrial users of their system. The article describes the classification program, the rate structure, the regulations and permits used.

- B-3 "Pollution Abatement Thru Government-Corporate Cooperation," Reed, Paul E., Water and Sewage Works, Vol. 121, No. 9, p. 104, (September, 1974).

This article describes the managerial, fiscal, and political aspects of the Joint Treatment Facility between the Borough of Naugatuck, Connecticut and Uniroyal, Inc. The Naugatuck Treatment Company, which is owned by Uniroyal, Inc. will run the plant. The financial considerations of this arrangement are described.

- B-4 "Chicago Industrial Waste Surcharge Ordinance," Anderson, Norval E. and Ben Sosewitz, Journal of the Water Pollution Control Federation, Vol. 43, No. 8, p. 1591, (August, 1971).

This article first describes in detail the surcharge program, and then includes a copy of the ordinance used by the Metropolitan Sanitary District of Greater Chicago.

- B-5 "The Joint Municipal and Industrial Wastewater Treatment Approach - A Case History," Hickman, Paul T., Presented at the Water Pollution Control Federation Meeting, Denver, Colorado, October 9, 1974.

This paper presents a case history of the Joint Municipal and Industrial approach to water pollution control, practiced in the City of Springfield, Missouri. The article describes the collection system, treatment plants, and the history of the surcharge system.

- B-6 "All Parties Can Benefit from Joint Municipal-Industry Treatment," Byrd, J. Floyd, Water and Sewage Works, Volume 116, No. 11, p. IW 14, November, 1969.

This article lists the advantages of joint treatment as opposed to separate industrial treatment. A number of specific cases are presented to support these claims. Factors affecting the development of a good ordinance are also listed.

- B-7 "Methods of Charging for the Reception, Treatment and Disposal of Toxic Wastes," Harkness, N., Water Pollution Control, Vol. 69, (1970).

This article presents methods of calculating the costs of (and the charges for) treating toxic wastes mixed with sewage. Different methods are presented for different types of wastes to be treated.

- B-8 "Technical Bases for Assessing the Strength, Charges for Treatment and Treatability of Trade Wastes," Simpson, James R., Water Pollution Control, Vol. 66, No. 2, p. 165, (1967).

This article presents a detailed methodology, with formulas, for determining the strength, and charges for treatment of industrial wastes in publicly owned treatment works.

- B-9 "Rx for Industry: Regionalism," Traquair, William C., Water and Wastes Engineering, May, 1973.

This article states the reasons for choosing joint treatment in Concord, N.H., and describes the treatment system used.

- B-10 "Cooperation Helps Erie," Waytenick, Robert J., Water and Wastes Engineering, September, 1973, p. 76.

This article describes the agreement between Erie, Pennsylvania and the Hammermill Paper Company for a joint waste treatment system. A description of the treatment plant is also presented.

- B-11 "Estimating Industrial Water Pollution in Small Regions," Greenberg, Michael R. and Rae Zimmerman, Journal of the Water Pollution Control Federation, Vol. 45, No. 3, p. 462, (March, 1973).

This article describes the methodology used to develop a model for estimating the volume and quality of industrial effluents. The model was developed for the New York Metropolitan region, consisting of 21 counties.

- B-12 Enforcement Management System Users Guide, U.S. E.P.A., NTIS No. PB 210 716, 210 pp., September, 1972.

The Enforcement Management System (EMS) was developed to aid our pollution control agencies handle data arising from most agency enforcement activities. The system emphasizes management control of enforcement functions and establishes standardized methods of handling data.

- B-13 "Industrial Waste Charges," Seagraves, James A., Journal of the Environmental Engineering Division, ASCE Vol. 99, No. EE 6, p. 873, (December, 1973).

The controversial issues involved in establishing equitable industrial charges for wastewater discharges are discussed. Included are several examples of existing surcharge methods.

- B-14 "Combined Treatment," Byrd, J. F., Proceedings of the 16th Industrial Waste Conference, Purdue University, (1961), p. 92.

The advantages and limitations of combined municipal-industrial sewage treatment are discussed. Several methods of recovering costs are also reviewed.

- B-15 "Potential of Large Metropolitan Sewers for Disposal of Industrial Wastes," Gibbs, Charles V. and Ray H. Bothel, Journal of the Water Pollution Control Federation, Vol 37, No. 10, p. 1417, (October, 1965).

The advantages to industry of locating in a large metropolitan area to benefit from joint treatment of industrial wastes are discussed. The discussion includes the relative financial, personnel, technical and treatability aspects of sewage treatment.

- B-16 "Development of an Industrial Waste Study for a Municipality," Meers, J. E., et al, Journal of the Water Pollution Control Federation, Vol. 36, No. 12, p. 1501, (December, 1964).

A survey was conducted to develop a comprehensive sewerage plan for the Bloom Township Sanitary District, Chicago Heights, Illinois. The objectives of the study were to identify wastewater constituents that interfere with treatment works, to determine the extent that the present facilities could be utilized, and to evaluate the present sewer use ordinance.

- B-17 "An Industry Approach to Pollution Abatement," Rocheleau, R.F., and E. F. Taylor, Journal of the Water Pollution Control Federation, Vol. 36, No. 10, p. 1185, (October, 1964).

The factors necessary to implement an effective industrial waste management program are discussed. Control methods and techniques are also described and economic considerations are stressed.

- B-18 "New Concepts in Industrial Sewage Collection," Munson, Edward D., Journal of the Water Pollution Control Federation, Vol. 36, No. 9, p. 1146, (September, 1964).

This article discusses the segregation of industrial wastes and their conveyance through open channels as a means of wastewater collection and treatment. The Bayport, Texas industrial sewerage plan is also described.

- B-19 "Combined Treatment - A Coast to Coast Coverage,"
Byrd, J. Floyd, Journal of the Water Pollution Control
Federation, Vol. 39, No. 4, p. 601, (April, 1967).

This article discusses factors that can contribute to the failure or success of combined industrial and municipal wastewater treatment systems. The advantages of performance and cost of joint treatment are examined. Precautions necessary to assure success are also outlined.

- B-20 "Combined Treatment at Kalamazoo - Cooperation in Action,"
Swets, Donald H., et al, Journal of the Water Pollution
Control Federation, Vol. 39, No. 2, p. 204, (February, 1967).

This article describes the steps which led to the establishment of a government and industry joint wastewater treatment system. Some of the philosophies that shaped the venture, and how the program evolved and was implemented are discussed. Points of view are presented by representatives of each of the affected institutions: public works director, industry, city and state.

- B-21 "Evaluation Factors for Joint Waste Treatment," Reiter, W.M.,
Pollution Engineering, Vol. 6, No. 12, p. 38, (December, 1974).

This article contains a general discussion on the factors that need to be considered in a joint municipal-industrial waste treatment program. Factors include waste treatability; federal, state and municipal regulations; pretreatment requirements; and cost and extent of monitoring and surveillance.

- B-22 "Planning and Execution of Industrial Waste Treatability
Studies," Westfield, James D., et al, Proceedings of the
26th Industrial Waste Conference, Purdue University, (1971),
p. 832.

This paper presents an approach to planning a treatability study. The approach defines a framework which can be used to plan and conduct any industrial waste treatability evaluation. Treatment processes can then be selected to satisfy required removals.

- B-23 "The Foundation of Successful Industrial Waste Disposal to Municipal Sewage Works," Wisely, W.H., Proceedings of the 5th Industrial Waste Conference, Purdue University, (1949), p. 360.

Factors leading to successful joint (municipal and industrial) sewage treatment relationships are discussed. Some of the common causes for breakdown in these arrangements are outlined.

- B-24 "Management of Industrial Effluent Disposal in Britain," Jackson, C. J., Journal of the Water Pollution Control Federation, Vol. 41, No. 12, p. 2020, (December, 1969).

This article discusses the wastewater treatment and disposal factors to be considered in making industrial planning decisions. Factors discussed include treatment and disposal methods, pretreatment requirements, and costs.

- B-25 "Planning Industrial Waste Treatment," Black, H. H., Journal of the Water Pollution Control Federation, Vol. 41, No. 7, p. 1277, (July, 1969).

This article presents those concepts that may serve as guidelines for those engaged in the planning of industrial waste treatment. Factors that must be considered for effective planning are discussed, including evaluation of waste load and receiving waters, treatment requirements, development of design criteria, and monitoring.

- B-26 "Treatment of Mixed Industrial Wastes at Bayport's Industrial Complex", Meriwether, George B., Journal of the Water Pollution Control Federation, Vol. 41, No. 3, p. 440, (March, 1969).

The central wastewater collection and treatment system for the Bayport industrial complex is described. Pretreatment requirements, management of the program and the system of user charges are also discussed.

- B-27 "How to Manage Industrial Inflow," Williams, R. T. and R. J. Dolan, Water and Sewage Works, Vol. 121, No. 12, p. 46, (December, 1974).

The development of a wastewater management plan for the East Bay Municipal Utility District, Oakland, California is reported. The discussion includes ordinance development, sampling program, service charges, and permit programs.

- B-28 "The Advantages of Industrial-Municipal Wastewater Treatment," Watson, K. S., Journal of the Water Pollution Control Federation, Vol. 42, No. 2, p. 209, (February, 1970).

This article discusses the advantages of joint treatment, and indicates the different approaches that a sanitary district can take. Case histories are discussed, such as the Los Angeles County Sanitation Districts, Allegheny County, and the Metropolitan Sewer District of Greater Chicago. An equitable finance formula is also discussed.

- B-29 "Industrial Effluents: Problems of Recovering Costs," Lewin, V. H., Discharge of Industrial Effluents to Municipal Sewerage Systems, p. 77, Proceedings of Symposium of the Institute of Water Pollution Control, London. November 29-30, 1971.

This paper discusses several systems now in use in England and Wales to recover the costs of industrial sewage treatment. Some of the problems involved are also discussed. The experiences of the City of Oxford, which has been using a Mogden-type formula for cost recovery, are reported.

- B-30 "Methods of Charging for the Treatment and Disposal of Industrial Effluents in Municipal Sewerage Systems," Simpson, J. R. and G. A. Truesdale, Discharge of Industrial Effluents to Municipal Sewerage Systems, p. 65, Proceedings of Symposium of the Institute of Water Pollution Control, London. November 29-30, 1971.

A method to calculate user charges for industrial effluents is presented. A charge for both the capital and operating costs is recommended. Calculations for capital costs are based upon sewerage system design; operating costs are based upon quantity and character of flow. Formulae to make these calculations, and several examples of their implementation are also included.

- B-31 "Present Industrial Effluent Legislation and Its Short-Comings," Fisher, N. S., Discharge of Industrial Effluents to Municipal Sewerage Systems, p. 14, Proceedings of Symposium of the Institute of Water Pollution Control, London, November 29-30, 1971.

This paper reviews British law pertaining to the discharge of trade effluents and comments on some of the shortcomings of its provisions. Several views are presented on where the responsibility for water quality control should be.

- B-32 "Effects of the 1972 Water Pollution Control Act Amendments on Industrial Waste Monitoring in Anondaga County," Ott, Randy, et al, presented at the New York Water Pollution Control Association, January, 1974.

An extensive analysis program was conducted to estimate industry's proportionate cost of wastewater treatment. A discussion of cost of such a program, data collection, and results of the program are presented in this paper.

For additional information pertaining to this section, please refer to the following articles:

D-3	E-15
D-12	E-16
D-29	E-28
D-34	
D-42	
D-76	
D-114	

SECTION C - LEGAL ASPECTS
OF A CONTROL PROGRAM

Reference: Volume I - Section C & Appendix 3

- C-1 "Wastes May Not Be a Treat for Pretreatment," Chemical Week, October 9, 1974.

This article discusses the disadvantages of pretreatment for organic chemical manufacturing plants. The disadvantages discussed include economic, technical and political considerations.

- C-2 "The Sewer Ordinance Basics," Calver, Robert and Trevor Saxon, Water and Sewage Works, Vol. 121, No. 8, p. 54, (August, 1974).

The fundamentals of wastewater control are discussed, including the need for an industrial sewer ordinance. Recommendation for planning and designing the ordinance are also included and user charge formulas are presented.

- C-3 "Regulations and Service Charges for the Treatment of Industrial Wastewater in Federally Assisted Public Facilities," Gutierrez, A. F., Paper presented to the Southeast Section Convention of the American Waterworks Association, San Antonio, Texas, October 11, 1971.

The importance of adopting a community ordinance to control and regulate the use of public wastewater facilities, to protect these facilities and to provide an equitable system of cost recovery is discussed. Included is a cost recovery formula and several examples which illustrate its use.

- C-4 "Energetic Enforcement of Industrial Waste Ordinances," Lavin, Allen, Proceedings of the 23rd Industrial Waste Conference, Purdue University, p. 550, 1968.

This paper discusses why industrial waste ordinances have been failing, and how the Metropolitan Sanitary District of Greater Chicago is enforcing theirs. The author also presents arguments for strict enforcement of industrial waste ordinances.

- C-5 "Municipal Waste Ordinances - The Views of Industry," Byrd, J. F., Journal of the Water Pollution Control Federation, Vol. 37, No. 12, p. 1635, (December, 1965).

The views of industry are presented on what constitutes a good municipal waste ordinance. The discussion centers on those aspects of the model ordinance, presented in Water Pollution Control Federation's Manual of Practice #3, "Regulation of Sewer Use," which are of interest to industry.

- C-6 Development of a State Effluent Charge System, U.S. E.P.A., NTIS No. PB 210 711, 215 pp., February, 1972.

The Vermont permit and fee system that has been developed and implemented is described in this book. Various methods of fee calculations are discussed and the reasons for selection of one are set forth. The following issues are discussed: incentive effect on dischargers, the relation of dischargers to instream economic damages, equity, constitutionality, economic efficiency, technical and administrative feasibility and income potential.

- C-7 "Effluent Guidelines - Industry's Point of View," Elkin, Harold F, et al, Pollution Engineering, Vol. 20, No. 6, p. 18, (November-December, 1974).

This article examines industry's view toward the development and use of effluent guidelines for industrial discharges to navigable waters. It presents a case history of the development of petroleum refining discharge guidelines.

- C-8 "Chicago vs. Industry Polluters," Lue-Hing, Cecil, and Earl W. Knight, Water and Wastes Engineering, p. 71, September, 1973.

This article briefly discusses the water pollution problem caused by industries discharging to the Metropolitan Sanitary District (MSD) of Greater Chicago and the actions taken by the MSD to correct these problems.

- C-9 "Some Experiences in the Pretreatment of Industrial Waste Going to the Municipal Sewer System of Philadelphia," Reich, J. S., Proceedings of the 10th Industrial Waste Conference, Purdue University, (1955), p. 244.

The pretreatment and disposal practices of several types of industries discharging to the Philadelphia treatment system are discussed. The city has established a set of criteria upon which pretreatment requirements are based.

- C-10 "Control of Industrial Wastes Entering Municipal Sewers," Carpenter, Carl B., Proceedings of the 11th Industrial Waste Conference, Purdue University, (1956), p. 1.

This article presents the experiences of the Hammond Sanitary District's monitoring and ordinance program. The article describes its monitoring system to catch illegal dischargers. Case histories dealing with problem wastes from industry are also presented. These case histories deal with such items as waste streams containing spent pickle liquors, oil spills, and sulfuric acid plant wastes.

- C-11 "Establishing Industrial Waste Ordinances," Taylor, Dean M., Proceedings of the 10th Industrial Waste Conference, Purdue University, (1955), p. 255.

This paper discusses the basic requirements which should be recognized in preparation of an industrial wastewater ordinance. Factors to be considered include a clear definition of terms, conditions for usage of the public sewers, prohibitions of specific substances, monitoring requirements, penalties and charges.

- C-12 "Experience with Waste Ordinance and Surcharges at Greensboro, North Carolina," Shaw, Ray E., Jr., Journal of the Water Pollution Control Federation, Vol. 42, No. 1, p. 44, (January, 1970.)

This article is a case history of how an ordinance system was developed in the City of Greensboro, North Carolina. The article includes discussions on the ordinance structure, the method of establishing the surcharge, the sampling procedures, and presents several case histories.

- C-13 "Factors in the Development of an Industrial Waste Ordinance," Hamlin, W.G., Proceedings of the 9th Industrial Waste Conference, Purdue University, (1954), p. 14.

This article discusses some of the many factors which must be considered before drafting an adequate industrial waste ordinance. Factors to be considered include: statement of purpose and policy, definition of terms, definition of public sewer usage, prohibition of specific substances, conditions of industrial waste discharge, industrial waste charges, refunds, penalties and validation.

- C-14 "Pretreatment Requirements for Industrial Waste Discharged to Municipal Treatment Systems," Escher, Dennis E. and Andrew J. Kicinski, presented at the ASCE-EED Specialty Conference on Environmental Engineering Research, Development and Design, Pennsylvania State University. July, 1974.

This paper considers the subject of developing criteria for the pretreatment of industrial wastes prior to their discharge into municipal sewage treatment systems. The article presents a detailed discussion of the 1972 amendments to the Federal Water Pollution Control Act, including requirements and interpretations. The paper also discusses some recommended effluent limitations for pretreatment.

- C-15 "Consents and Agreements," Finch, John, Discharge of Industrial Effluents to Municipal Sewerage Systems, Proceedings of Symposium of The Institute of Water Pollution Control, London, p. 23, November 29-30, 1971.

Legal aspects of implementing the Acts of Parliament pertaining to wastewater treatment are discussed. Included are several model agreements, which contain regulations establishing effluent limitations, financial arrangements and management control programs.

- C-16 "MOP No. 3 Regulation of Sewer Use", Journal of the Water Pollution Control Federation.

Part I - Vol. 45, No. 9, p. 1985 (September, 1973)

Part II- Vol. 45, No. 10, p. 2216 (October, 1973)

This manual of practice has been prepared to assist municipalities regulate and control wastewater facilities. The importance of controlling usage is emphasized. The fundamental requirements of the regulations that are essential to proper control are indicated. The effects of inadequate control, and considerations in developing a code and ordinance, are also discussed. The second part of this manual presents and discusses a model ordinance for wastewater control. Charges for wastewater service are indicated and recommendations to implement the ordinance are made.

- C-17 "Heavy Metals in Digesters: Failure and Cure," Regan, Terry M. and Mercer Peters, Journal of the Water Pollution Control Federation, Vol. 42, No. 10, p. 1832 (October, 1970), also reported in Proceedings of the 25th Industrial Waste Conference, Purdue University, (1970), p. 645.

This article reports the action taken after primary digester failure at the Lexington, Kentucky treatment plant. The failure was caused by excessive metal concentrations. The costs incurred from this failure are also presented. The waste sampling system that was subsequently instituted is described.

- C-18 Metropolitan Sewerage System, Seattle, Washington. Resolution No. 2158. Regarding the Control and Disposal of Industrial Waste into the Metropolitan Sewerage System, July, 1974.

- C-19 City of Atlanta, Georgia
- a. Sewer Service Charges and Industrial Waste Surcharges, 1971.
 - b. Standards of Acceptability of Industrial or Trade Wastes for Admission into Sewers of the City of Atlanta, Georgia, 1971.
- C-20 Metropolitan Sewer Board, St. Paul, Minnesota, Sewage and Waste Control Rules and Regulations for the Metropolitan Disposal System, December 1, 1971.
- C-21 The Sanitary District of Rockford, Illinois, Ordinance No. 309, Pollutant Discharge Control Ordinance of the Sanitary District of Rockford, 1974.
- C-22 City of New York, New York
- a. Rules and Regulations Relating to the Use of the Public Sewer System for the Discharge of Sewage, Industrial Waste and Other Wastes, Including Surcharges and Penalties.
 - b. Amendment to the Administrative Code, Section 687-1.0 Industrial Waste; Sewer Surcharges.
- C-23 City of Houston, Texas, Disposal of Industrial Waste Through City Sewer System, 1974.
- C-24 Metropolitan Sewer District of Greater Cincinnati, Cincinnati, Ohio, Rules and Regulations, December 4, 1968.

- c-25 Commission of Jefferson County, Jefferson County, Alabama
 - a. Rules and Regulations for Discharge of Waste Into Sanitary Sewerage System, April, 1970.
 - b. Resolution for Industrial Waste Surcharge, September, 1972.
- c-26 The Metropolitan St. Louis Sewer District, St. Louis, Missouri
 - a. Ordinance No. 2289, May, 1972
 - b. Ordinance No. 2412, March, 1973
 - c. Ordinance No. 2444, June, 1973
- c-27 City of Akron, Ohio, Ordinance No. 499, Industrial Wastes; Regulations for Non-acceptable, 1963.
- c-28 City of Dallas, Texas, Industrial Waste Ordinance, 1969.
- c-29 City of Topeka, Kansas, Ordinance No. 13664, 1975.
- c-30 City of Fitchburg, Massachusetts, The Discharge of Waters and Wastes Into the Public Sewer System.
- c-31 Westchester County Environmental Facilities, Westchester County, New York, Sewer Ordinance No. 1, Rules, Regulations and Ordinances Governing the Discharge of Sewage, Industrial' Wastes or Other Wastes.
- c-32 City of Olean, New York, Sewer Use Ordinance, September, 1968.
- c-33 Township of Towamencin, Pennsylvania, Rates, Rules and Regulations, April, 1967.
- c-34 City of Muncie, Indiana, Muncie Code of Ordinances; Laws Pertaining to This Division, 1954-1967.

- C-35 Sewer Utility of the City of Boulder, Boulder, Colorado, Ordinance No. 3836.
- C-36 Environmental Improvement Agency of New Mexico, Santa Fe, New Mexico, Industrial Waste Ordinance, a model ordinance.
- C-37 County of Onondaga, Syracuse, New York, Rules and Regulations Relating to the Use of the Public Sewer System, 1972.
- C-38 The Metropolitan Sanitary District of Greater Chicago, Chicago, Illinois
 - a. Sewage and Waste Control Ordinance as Amended, 1972.
 - b. Sewer Permit Ordinance, 1969, Amended, 1972.
 - c. Industrial Waste Division Procedural Manual.
- C-39 Texas Water Quality Board, Austin, Texas, A Suggested Industrial Waste Ordinance.
- C-40 City of Wichita, Kansas
 - a. Title 16, Sewers, Sewage Disposal and Drains, 1964
 - b. An Ordinance Amending Sections of the Code
- C-41 State of Vermont, Suggested Model Sewer Use Ordinance, January, 1975.
- C-42 California Water Pollution Control Association, Berkeley, California
 - a. Model Wastewater Discharge Permit Application Questionnaire, October, 1974.
 - b. Model Wastewater Discharge Ordinance, April, 1974.
- C-43 State of Massachusetts, Suggested Rules and Regulations Regarding the Use of Common Sewers, 1974.
- C-44 City of Wilmington, Delaware, Exclusion of Materials Detrimental to the Sewerage System

- C-45 Buffalo Sewer Authority, Buffalo, New York, Sewer Regulations of the Buffalo Sewer Authority.
- C-46 East Bay Municipal Utility District, Oakland, California
 - a. Ordinance No. 27, Waste Water Control Ordinance, 1972
 - b. Wastewater Discharge Permit Parts A-G
- C-47 Sanitation Districts of Los Angeles County, Los Angeles, California
 - a. An Ordinance Regulating Sewer Construction, Sewer Use and Industrial Wastewater Discharges, April, 1972.
 - b. Instructions for Obtaining a Permit for Industrial Wastewater Discharge
 - c. Instructions for Filing an Industrial Wastewater Treatment Surcharge Statement
 - d. Industrial Wastewater Charge Rates, 1971
 - e. Technical Report - Waste Discharge to the Ocean
- C-48 "Pretreatment Requirements for Industrial Wastes Discharged to Municipal Treatment Systems," Escher, E.D., and Kicinski, A.J., ASCE-EED Specialty Conference on Environmental Engineering Research, Development and Design, Penn State University.

Results of a study of the ordinances of 100 geographically distributed municipalities are presented. Ordinance status is covered along with ranges of limitations on certain pollutants as established by the ordinances in force.

For additional information pertaining to this section, please refer to the following articles:

B-4	D-112	F-16
B-10		F-41
B-20		
B-21		
B-23		
B-27		
B-31		

SECTION D - MONITORING

Reference: Volume I Section D & Appendix 4

- D-1 "The Need for, and Methods of, Monitoring and Control of Industrial Discharges to Sewers," Wrigley, K. J. and F. Ashworth, Discharge of Industrial Effluents to Municipal Sewerage Systems, p. 91, Proceedings of the Symposium of the Institute of Water Pollution Control, London, (Nov. 29-30, 1971).

Several aspects of monitoring trade wastes are discussed including regulatory control, instrumental methods of analysis, and qualifications of personnel. The monitoring system used in Manchester for the past ten years is discussed.

- D-2 "Self-Contained Sampling and Measurement System Features Respirometer," Robert Shaw Controls, Water and Sewage Works, Vol. 121, No. 2, p. 53 (February, 1974).

This article discusses a self-contained sampling and measurement system which measures oxygen utilized to determine BOD. The sampler aerates the effluent sample and measures the DO before and after. Response time is 2 minutes.

- D-3 "Make Water Pollution Control a Meaningful Local Responsibility," Craddock, John M., The American City, May, 1974, p. 63.

This article discusses the procedure used by the Division of Water Quality of the Muncie, Indiana Sanitary District to monitor industrial and commercial wastewaters within their jurisdiction. Automatic samplers are placed on discharges to the sanitary sewer system, which permit monitoring for metals, BOD₅, COD and suspended solids.

- D-4 "Instrumentation for Measurement of Wastewater Flow," Nedved, Thomas K. et al, Journal of the Water Pollution Control Federation, Vol. 44, No. 5, p. 820 (May, 1972).

A new instrument has been developed, which measures both stream flow and its characteristics. The device is portable, self-contained, and independent of outside power sources. The system takes a stream sample after a preset flow volume has passed. The instrument is identified and described in this article.

- D-5 "Polarographic Method for Nitrate and Dissolved Oxygen Analysis," Hwang, C. P. and C. R. Forsberg, Water and Sewage Works, Vol. 120, No. 4, p. 71, (April, 1973).

This article discusses the disadvantages of the common methods for measuring nitrates and dissolved oxygen. The article then describes a test utilizing a polarographic apparatus with a rapid dropping electrode. The test results are presented.

- D-6 "A Rapid Biochemical Oxygen Demand Test Suitable for Operational Control," Mullis, Michael K. and Edward D. Schroeder, Journal of the Water Pollution Control Federation, Vol. 43, No. 2, p. 209 (February, 1971).

A method to determine the total biological oxygen demand of soluble wastes using the chemical oxygen demand test and a mass culture of cells is presented in this article. Experimental and operational data are both presented. A method to shorten the time required to determine BOD is discussed.

- D-7 "The Use of Collaborative Studies to Evaluate Water Analysis Instruments," McFarren, Earl F. and Raymond J. Lishka, Journal of the Water Pollution Federation, Vol. 43, p. 67 (January, 1971).

A collaborative study has been indicated as a method to obtain objective evaluation of measurement instruments in laboratories. Studies of fluorides, pesticides, metals and nutrients in water were conducted by the Analytical Reference Service. These collaborative studies are analyzed, and the reliability of various instruments is presented.

- D-8 "Total Phosphorus Analysis: Persulfate on Ashing?" Gupta, Kailash B. and Alphonse E. Zaroni, Water and Sewage Works, Vol. 121, No. 7, p. 74 (July, 1974).

This article describes two methods for total phosphorus analysis, the persulfate oxidation and the dry ashing method. The article presents analytical procedures for both methods, and examples of tests on natural water samples are included. Comparisons of the two tests are presented and discussed.

- D-9 "Metals in Sewage Measured Simply but Accurately,"
The American City, August, 1972, p. 40

This article describes how the laboratory at the Irwin Creek Wastewater Treatment Plant in Charlotte, North Carolina uses an atomic absorption spectrophotometer to monitor metal elements.

- D-10 "Laboratory Tests for Plant Operation Control and Stream Quality Measurement," Banerji, Shankha K., Journal of the Water Pollution Control Federation, Vol. 43, No. 3, p. 399 (March 1971).

A number of water quality tests, including those for BOD, COD, TOC, total oxygen demand, suspended solids, sludge volume index and oxidation - reduction potential are discussed in this article. The advantages and disadvantages of each test are also discussed.

- D-11 "Gauging and Sampling Industrial Wastewater (Open Channel)," Klein, Larry A. and Albert Montague, Journal of the Water Pollution Control Federation, Vol. 42, No. 8, p. 1468 (August, 1970).

The gauging and sampling system developed by New York City to measure industrial discharge to the sewer system is presented in this article. The methods utilized are applicable to open channels. The methods described include: an inflatable gas bag and portable ejector system for in-plant gauging; and a combination V-notch weir or flume with a head measuring device and a propeller meter for out-of-plant measurements.

- D-12 "Routine Surveillance Alternatives for Water Quality Management," Ward, Robert C., Journal of the Water Pollution Control Federation, Vol. 46, No. 12, p. 2645 (December, 1974).

Grab sampling, automatic monitoring, and remote sensing are reviewed in this paper. Their individual and collective roles in the overall design of a routine water quality surveillance program are discussed.

- D-13 "Portable Device to Measure Industrial Wastewater Flow," Forester, R. and D. Overland, Journal of the Water Pollution Control Federation, Vol. 46, No. 4, p. 777 (April, 1974).

This paper describes a method of monitoring the wastewater pumps in a sewage treatment plant to record the pump's operating time. The paper indicates how this defines both the total flow and the flow during any period of time. This data can compliment automatic samplers in obtaining accurate wastewater measurements.

- D-14 "Carbon Measurements in Water Quality Monitoring," Maier, Walter J. and Hugh L. McConnell, Journal of the Water Pollution Control Federation, Vol. 46, No. 4, p. 623 (April, 1974).

This article discusses the use of a carbon analyzer to test natural waters in Minnesota. The results of an extensive test program are presented. The program tested the organic and inorganic carbon content of the waterways, various equipment, and the correlations between BOD/TOC and COD/TOC ratios.

- D-15 "Comparison of Wastewater Sampling Techniques," Tarazi, D. S. et. al., Journal of the Water Pollution Control Federation, Vol. 42, No. 5, p. 708, (May, 1970).

The results of a study comparing two sampling techniques is presented. One technique uses grab samples and the other composite samples. The tests were run on two separate outfalls and results of the tests are indicated.

- D-16 "Evaluation of an Automatic Chemical Analysis Monitor for Water Quality Parameters," O'Brien, James E. and Rolf A. Olsen, Journal of the Water Pollution Control Federation, Vol. 42, No. 3, p. 380, (March, 1970).

This article evaluates an automatic water monitoring unit with 12 channels to measure: Nitrate, Nitrite, Alkalinity-pH 8.3, Alkalinity-pH 4.6, Phenol, Free Ammonia, Sulfate, Phosphate, Iron (Fe), COD, Methylene Blue Active Substance, and Fluoride. The test site was on the Hudson River, 3 miles south of Albany, New York. Operational problems of the unit are discussed. Modifications to the unit in attempts to overcome some problems are discussed, and factors which must be taken into consideration in the design of an automatic system are reported.

- D-17 "The Detection of Organic Pollution by Automated COD," Molof, A. H. and N. S. Zaleiko, Proceeding of the 19th Industrial Waste Conference, Purdue University (1964), p.540.

This paper presents the results of experimental work to convert the manual COD test as outlined in Standard Methods to an automated chemical test. The test consists of using a colorimeter to measure the Hexavalent Chromium present after the oxidation steps. Laboratory and field test results are both given.

- D-18 "An automated BOD Respirometer," Arthur, Robert M., Proceedings of the 19th Industrial Waste Conference, Purdue University, (1964), p. 628.

This paper describes an automatic instrument which measures BOD utilizing the partial pressure of oxygen over a sample with the use of a manometer.

- D-19 "A Colorimetric Method for Determining Chemical Oxygen Demand," Gaudy, A. F. and M. Ramanathan, Proceedings of the 19th Industrial Waste Conference, Purdue University (1964), p. 915

The purpose of the experiments reported in this article was to determine whether COD values obtained by the standard titrimetric procedure were equivalent to those obtained colorimetrically when identical samples were subjected to identical reflux conditions. Tests were conducted on municipal, industrial, and joint wastes. Laboratory tests on a standard compound were also included.

- D-20 "The Determination of Total Organic Carbon in Water," Larson, T. E. et. al., Proceedings of the 19th Industrial Waste Conference, Purdue University (1964), p. 762.

This paper discusses one method for measuring the carbon dioxide process by the TOC test, which uses Van Slyke reagent. Laboratory test results are presented and discussed.

- D-21 "Characterization of Industrial Wastes by Instrumental Analysis," Clark, H. A. Proceedings of the 23rd Industrial Waste Conference, Purdue University (1967) p. 26.

This paper presents a general discussion of a large laboratory in Toronto, and discusses the work functions and equipment available in the laboratory. The use of the instruments (including polarography, atomic adsorption spectrophotometry, and chromatographic methods), and the application of these techniques to industrial wastes is also indicated.

- D-22 "A Fluorometric Method for the Determination of Lignin Sulfonates in Natural Waters," Thruston, Alfred D., Jr., Journal of the Water Pollution Control Federation, Vol. 42, No. 8, p. 1551 (August, 1970).

The use of a simple fluorometer for the detection of low concentrations of lignin sulfonate solutions is described in this article. An optical bridge fluorometer was used in experiments which are also described. The limits of fluorescent assay are presented and details of a continuous monitoring system are also indicated.

- D-23 "Remote Sensing of Water Pollution," Hom, Leonard W., Journal of the Water Pollution Control Federation, Vol. 40, No. 10, p. 1728 (October, 1968).

The concept and theory of remote sensing are discussed in this article. A discussion of the various factors which govern the remote sensing of water pollution is also included. Different types of remote sensing are discussed and the advantages and limitations of many are presented.

- D-24 "Application of the Total Carbon Analyzer for Industrial Wastewater Evaluation," Ford, Davis L., Proceedings of the 23rd Industrial Waste Conference, Purdue University (1968), p. 989.

This article presents information on the correlation of BOD and COD to TOC for various chemicals and for various industrial waste streams (e.g. chemical and petrochemical). Literature was used as the source for the raw data.

- D-25 "Identification of Petroleum Products in Water," Lively, L., et al, Proceedings of the 20th Industrial Waste Conference, Purdue University (1965), p. 657.

This paper presents an analytical method to determine petroleum products in water. Specific industrial problems are then used to illustrate the application of these analytical methods.

- D-26 "Value of Instrumentation in Wastewater Treatment," Salvatorelli, Joseph, Journal of the Water Pollution Control Federation, Vol. 40, No. 1, p. 101 (January, 1968).

Instrumentation and its application to waste treatment plants is discussed in this article. The types of instrumentation available, the value of instrumentation, the applications of instruments and examples of their use are all discussed.

- D-27 "Monitoring and Treatment of Cyanide - Bearing Plating Wastes," Vought, John H., Journal of the Water Pollution Control Federation, Vol. 39, No. 12, p. 1971 (Dec., 1967).

Treatment plant controls, and monitoring equipment at a Motorola plant are described. Their automatic monitoring includes pH and cyanide measurement.

- D-28 "Determination of Organics in Water," Andelman, Julian B. et. al., Proceedings of the 20th Industrial Waste Conference, Purdue University (1965) p. 220.

This paper assesses the extent of recoverability of organics when activated carbon is used to remove organics from wastewater. The organics are then extracted from the carbon and measured. Municipal tap water was used as the sample for the experiments.

- D-29 "Water Quality Monitoring must be Action-Oriented," Stack, Vernon T., Jr., Water and Waste Engineering, Vol. 8, No. 3, p. 310 (March, 1971).

This article discusses monitoring systems in detail. Problems in their administration (with potential solutions) are indicated, particularly in regard to obtaining representative samples. A review of automatic samplers on the market is also included.

- D-30 "Waste Monitoring by Gas Chromatography," Cochran, L. G. and F. D. Bess, Journal of the Water Pollution Control Federation, Vol. 38, No. 12, p. 2002 (Dec., 1966).

The development of gas chromatography and its use at the Institute, West Virginia Plant of Union Carbide Corporation is presented in this article. Gas chromatographs help control organic loadings on the treatment plant, trace abnormal losses of chemicals common to several departments, and evaluate the effectiveness of treatment.

- D-31 "A Rapid Wastewater Sensitivity Test," Brown, James A., Jr., Industrial Waste, May/June, 1972, p. 28.

The application of a modified paper disc technique for rapid screening of wastewater is described. Materials that exert a deleterious effect on the physiological function of the microorganisms in activated sludge may be detected by this technique. The test is qualitative, and the details of the technique are presented.

- D-32 "Cold Vapor" Method for Determining Mercury," Kopp, John F. et. al., Journal of the American Water Works Association, Vol. 64, p. 20 (Jan., 1972).

This article presents an analytical method for measuring mercury in water. The method was developed in the author's laboratory. An atomic absorption spectrophotometer with auxiliary equipment is required.

- D-33 "Mercury Analysis and Toxicity: A Review," Baker, Robert A. and Ming-Dean Luh, Water and Sewage Works, Vol. 118, No. 5, p. IW-21, (May, 1971). (Also included in Industrial Wastes, May/June, 1971)

This article reviews various methods used to measure mercury, both qualitatively and quantitatively. The advantages and disadvantages of each procedure are discussed. The toxicological effects of mercury are also indicated in this article.

- D-34 "Monitoring Wastewater? Try these Methods," Churchill, R. J. and T. A. Helbig, Industrial Wastes, September/October 1974, p. 26.

A basic approach to a self-monitoring system is presented in this article. The needs for and methods to obtain representative samples are indicated, and the Federal Guidelines and various analytical methods are reported.

- D-35 "A New Technique for Industrial Waste Sampling," Beach, Martha I. and John S. Beach, Jr., Industrial Wastes, January/February, 1973, p. 28.

This article describes a sampling technique called the sequential composite, and compares it to grab samples, simple composites and flow proportioned composites.

- D-36 "Atomic Absorption Spectrophotometry Simplifies Heavy-Metals Analysis," Willey, Benjamin F., et. al., Journal of the American Water Works Association, Vol. 64, p. 303, (May, 1972)

This article presents the basic operating principles and procedures for adjusting the instrument settings of an atomic absorption spectrophotometer and precautions concerning its operation. Its application for the analysis of heavy metals is discussed in detail. The article also compares atomic absorption with wet chemical analysis.

- D-37 "Rapid Phosphate Determination by Fluorimetry," Guyon, John C. and Wolbur D. Shults, Journal of the American Water Works Association, Vol. 63, p. 403 (August, 1969).

Two similar procedures for determining phosphate concentrations are discussed. One method is suitable for lower concentrations and the second for higher levels. The elimination of interferences of cations and anions is also discussed. The apparatus, reagents and procedures to be used and the effects of certain variables are presented.

- D-38 "Detection and Monitoring of Phenolic Wastewater,"
McRae, A. D. et. al., Proceedings of the 14th
Industrial Waste Conference, Purdue University, (1959).

This paper describes the modifications made to an instrument which used a nitrous acid-mercuric nitrate reagent (millions Reagent) to monitor phenols. Modifications included a water softener, buffering agent and indolac reagent. The modifications were made on an instrument which monitored the effluent from the Imperial Oil Limited Oil Refinery in Sarnia, Ontario, Canada.

- D-39 "Polarographic Scanning of Industrial Waste Samples,"
Porter, J. D. and W. W. Sanderson, Proceedings of the
9th Industrial Waste Conference, Purdue University
(1954).

A method of screening water samples to determine which metals are present is reported. The advantage of this screening is to eliminate analyzing for metals which are not present. A detailed description of the equipment and the procedure of the tests is given.

- D-40 "New, Simplified Methods for Metal Analysis," McFarren,
Earl F., Journal of the American Water Works Association,
Vol. 64, p. 28 (January, 1972).

This article summarizes the theory and operation of atomic absorption spectrophotometry. Different procedures applicable to determine various metals is discussed. The metals include zinc, copper, iron, magnesium, manganese, silver, cobalt, nickel, cadmium, chromium, aluminum, beryllium, barium, vanadium, arsenic and mercury.

- D-41 "Cadmium, Chromium, Lead, Mercury: A Plenary Account for
Water Pollution, Part I - Occurrence, Toxicity and Detection,"
Cheremisinoff, Paul, N. and Yousuf H. Habib, Water and
Sewage Works, Vol. 119, No. 7, p. 73 (July, 1972).

A description of the nature, sources and uses of the metals listed in the title are presented. The toxicity (level of concentration at which it becomes toxic) and toxic effects of each metal are also given. Analytic methods for detection of these elements are indicated.

- D-42 "Monitoring New York's Water Automatically," Maylath, Ronald E., Journal of the American Water Works Association, Vol. 63, p. 517 (August, 1971).

This article describes the automatic monitoring system used throughout New York State. The surveillance network provides information to consulting engineers, industrial firms, and local, state and federal agencies. The system consists of different "Building Blocks," including major monitoring stations, remote terminals, and computer stations.

- D-43 "TLC Finds Hexane Solubles," Atanus, Herbert, Water and Wastes Engineering, Vol. 11, No. 10, p. 26 (October, 1974).

A thin-layer chromatography (TLC) technique is used to help separate and identify hexane solubles at the Metropolitan Sanitary District of Chicago. A description of the technique and its advantages are given.

- D-44 "Modern Monitoring of a Treated Industrial Effluent," Ostendorf, R. G. and J. F. Byrd, Journal of the Water Pollution Control Federation, Vol. 41, No. 1 p. 89 (January, 1969).

This article describes the monitoring system used by the Charmin Paper Products Company to monitor their waste treatment plant on the Susquehanna River. Parameters monitored automatically are total carbon, suspended solids, and pH. A detailed description of the system and its interlocks to the treatment plant are given.

- D-45 "Rapid Instrumental Measurement of the Organic Load in Wastewaters," Lysyj, I. et. al., Journal of the Water Pollution Control Federation, Vol. 41, No. 5, p. 831, (May, 1969).

A pyrographic approach to determine the total organic carbon is presented in this article. The results of experiments are then compared and correlated to BOD values. These tests were run in Los Angeles.

- D-46 "Comparison Studies of Winkler vs. Oxygen Sensor," Reynolds, Jeremiah F., Journal of the Water Pollution Control Federation, Vol. 41, No. 12, p. 2002 (December, 1969).

This article discusses two techniques to accelerate and simplify dissolved oxygen determinations compared to the Winkler test method. Both methods use oxygen sensors.

- D-47 "Evaluation of Instrumentation and Control," Babcock, Russell H., Journal of the Water Pollution Control Federation, Vol. 44, No. 7, p. 1416 (July, 1972).

Methods to evaluate what automatic controls are practical in sewage treatment plants are discussed. The parameters discussed include control variables, the need for records, the caliber of personnel available, and the need for detection of alarm conditions. The advantages and disadvantages of electrical and pneumatic instrumentation are presented and compared.

- D-48 "Analytical Determination of Metals Affecting Sewage Treatment," Riehl, M. L. and E. G. Will, Proceedings of the 4th Industrial Waste Conference, Purdue University (1948).

This paper describes the early work conducted to develop analytic methods for the determination of metals, such as copper, zinc, iron, chromium, nickel, cadmium, and cyanide. The methods include colorimetric, volumetric and gravimetric techniques.

- D-49 "Monitoring Industrial Pollutants by Pyrolysis - Methane Detection Method," Lysyj, I. et. al., Journal of the Water Pollution Control Federation, Vol. 40, No. 5, Part 2, p. R181, (May, 1968).

This article discusses the monitoring of methyl-containing organic compounds, which occur in industrial wastes, but not in natural pollutants. Natural organic pollutants contain hydroxyl and amino groups. Therefore, the procedure discussed in this paper (the use of pyrolysis-methane detection methods) can determine whether an industry has discharged to a particular stream or treatment plant. The instruments include a gas chromatograph, a hydrogen flame ionization detector, a microcombustion furnace, and a recorder.

- D-50 "Instrumentation for Water Pollution Control," Jones, Robert H., Pollution Engineering, Vol. 3, No. 6, p. 22 (November/December, 1971).

A brief summary of where controls and instrumentation can be used in a sewage treatment plant is indicated in this article. Their specific use in a plating waste treatment plant is also reported.

- D-51 "A Rapid Method for the Estimation of Trace Amounts of Kerosene in Effluents," Lee, E. G. H. and C. C. Walden, Water Research, Vol. 4, No. 9, p. 641 (1970).

This article discusses a method to determine the concentration of hydrocarbons in water, in the range of 10-100 mg/l. The method involves separating and concentrating the hydrocarbons by adsorption on activated carbon, followed by removing the hydrocarbons with acetone and measuring the turbidity of the acetone.

- D-52 "Analysis of Water for Molecular Hydrogen Cyanide", Nelson, K. H. and I. Lysyj, Journal of the Water Pollution Control Federation, Vol. 43, No. 5, p. 799 (May, 1971).

The toxicity of cyanide and its relationship to the presence of HCN and total cyanide is reported in this article. The method presented for the measurement of hydrogen cyanide combines vapor phase equilibration (Gas chromatographic methods) with amperometric techniques. The technique consists of sparging a small portion of the undissociated HCN from the sample, trapping the HCN in dilute base, and then measuring the sparged HCN with a rotating gold anode.

- D-53 "The Role of Automatic Sampling in Industrial Waste Control," Beach, Martha I, and C. Fred Gurnham, Mid Atlantic Industrial Waste Conference, No. 5 p. 225 (1971).

This paper reviews the advantages of industrial self-monitoring and presents a handbook type approach to the selection of the right type of sampling equipment.

- D-54 "Atomic Absorption Spectrophotometer Facilitates Water Analysis," Water and Sewage Works, Vol. 121, No. 1, p. 27 (January, 1974).

This article describes how spectrophotometric techniques are used at the Ben Nesin Laboratory in New York State.

- D-55 "Determination of Heavy Metals in Municipal Sewage Plant Sludges by Neutron Activation Analysis," Water, Air and Soil Pollution, Vol. 3, No. 3, p. 327 (September, 1974).

A discussion of the use of Neutron Activation Analysis (NAA) to scan sewage sludges for trace metal content is presented. The meanings of the variations in metal concentrations are discussed and the precision and potential of NAA is reported.

- D-56 "The Determination of Heavy Metals in Domestic Sewage Treatment Plant Wastes," Van Loon, J. C. et. al., Water, Air and Soil Pollution, Vol. 2, No. 4, p. 473 (December, 1973).

Atomic absorption spectroscopy procedures are outlined for the determination of some heavy metals in solids and liquids. Problems associated with sample preparation and sample solution interferences are described. Sewage treatment plant products (both liquid and solid) are analyzed and the results are given for samples representative of a wide range of sewage input patterns.

- D-57 "Rapid Determination of Total Organic Carbon (TOC) in Sewage," Blackmore, R. H. and Doris Voshel, Water and Sewage Works, Vol. 114, No.10, p. 398 (October, 1967).

This article presents TOC data gathered at the Grand Rapids, Michigan sewage treatment plant by the use of the Leco Carbon analyzer connected to a Leco Combustion Furnace. This data is compared to data for BOD and COD on the same wastes.

- D-58 "Statistical Evaluation of BOD verses ODI," Reynolds, Jeremiah F. and Karl A. Goellner, Water and Sewage Works, Vol. 121, No. 1, p. 31 (January, 1974).

This article describes the test procedure for the determination of the oxygen demand index (ODI).

- D-59 "Gas-Liquid Chromatographic Techniques for Petrochemical Wastewater Analysis," Sugar, William J. and Richard A. Conway, Journal of the Water Pollution Control Federation, Vol. 40, No. 9, p. 1622 (September, 1968).

Laboratory techniques for efficiently selecting gas-liquid chromatographic (GLC) operating parameters based on different problems are described. Measurements can be made down to one mg/l. Emphasis was placed on the selection of column liquid phases for separation of a wide span of organic types, definition of the utility of temperature programming, and improvement of precision by use of an internal standard.

- D-60 "Analysis of Municipal and Chemical Wastewaters by an Instrumental Method for COD Determination," Stenger, V. A. and C. E. Van Hall, Journal of the Water Pollution Control Federation, Vol. 40, No. 10, p. 1755 (October, 1968).

This article reports the experience gained from a new method of COD determination. This method uses a vapor phase oxidation-reduction system and takes two minutes to complete. Tests were run on the wastewater at the sewage treatment plant at Midland, Michigan, and at the Dow Chemical Co. in the same city. The test results are reported.

- D-61 "Differentiation of LAS and ABS in Water," Maeller, Claude Z. et. al., Journal of the Water Pollution Control Federation, Vol. 39, No. 10, Part 2, p. R92 (October, 1967).

A method of differentiating between ABS based detergents (Low Biodegradability) and LAS based detergents (High Biodegradability) can be achieved. This method combines and modifies those developed by Fairing and Short; and Frazee and Crisler. The method is described in this article.

- D-62 "An Automated Method for the Determination of Formaldehyde in Sewage and Sewage Effluents," Musselwhite, C. C. and K. W. Petts, Water Pollution Control, Vol. 73, No. 4, p. 443 (1974).

This article presents a method to automatically measure the concentration of formaldehyde. The method utilizes a chemical reaction to produce a color which can be measured colorimetrically. An automatic analyzer is used as a necessary piece of equipment.

- D-63 "A Safe Solvent for Oil and Grease Analyses," Chanin, G. et. al., Journal of the Water Pollution Control Federation, Vol. 39, No. 11, p. 1892 (November, 1967).

Procedures for determining oil and grease are presented, consisting of using either Trichlorotrifluoroethane or using the soxhlet extraction method for sludge, instead of hexane which is called for in "standard methods," but which can be dangerous in the laboratory.

- D-64 "Comparative Studies of Dissolved Oxygen Analysis Methods," McKeown, J. J. et. al., Journal of the Water Pollution Control Federation, Vol. 39, No. 8, p. 1323 (August, 1967).

This paper compares the Winkler Method to the membrane electrode method of measuring dissolved oxygen. The interferences present in the sample are also discussed.

- D-65 "Detection of Trace Metals in Water," Kerber, Jack, D., Industrial Water Engineering, Vol. 10, No. 5, (September/October, 1973).

A basic discussion on atomic absorption is presented. It's operation and application to the measurement of metals in water are discussed. Costs for equipment are also given.

- D-66 "The Determination of Stable Organic Compounds in Waste Effluents at Microgram per Liter Levels by Automatic High-Resolution Ion Exchange Chromatography," Katz, Sidney et. al., Water Research, Vol. 6, No. 9, p. 1029 (September, 1972).

This article presents the results of a study using high-resolution ion exchange chromatography to measure pollutants in sewage. A description of the equipment, the field experiments, the results and conclusions are presented.

- D-67 "Automated Fluorometric Method for Determination of Boron in Waters, Detergents and Sewage Effluents," Afghan, Badar K., et. al., Water Research, Vol. 6, No. 12, p. 1475 (1972).

This method of automatically measuring boron is based on the reaction of 4 chloro-2-hydroxy-4methoxybenzophenone (CHMB) with boron to produce fluorescent species in a 90% sulfuric acid medium. Measurements are in the 5-100 microgram per liter range. The equipment, procedures, and results of experiments are presented.

- D-68 "Industry's Idea Clinic," various authors, Journal of the Water Pollution Control Federation, Vol. 37, No. 4, p. 508 (April, 1965).

A discussion was held on industrial waste automatic sampling among individuals at the Federation's 37th Annual Conference. Members of industry presented their experiences with different monitoring schemes including operational problems and solutions.

- D-69 "An Industrial Waste Sampling Program," Woodruff, Paul H., Journal of the Water Pollution Control Federation, Vol. 37, No. 9, p. 1223 (September, 1965).

This article discusses the waste sampling program used by the Midland Division of the Dow Chemical Company. The mechanics of setting up a sampling program, and the sampling systems installed are both reported.

- D-70 A Study of Methods used in Measurement and Analysis of Sediment Loads in Streams-Report T, Progress Report, Laboratory Investigation of Pumping-Sampler Intakes, Federal Inter-Agency Sedimentation Project, Minneapolis, Minnesota (April, 1966).

This document describes the development of a pumping sampler intake structure that is dependable and draws an accurate sample.

- D-71 A Study of Methods used in Measurement and Analysis of Sediment Loads in Streams, Report U, An Investigation of a Device for Measuring the Bulk Density of Water-Sediment Mixtures, Beverage, J. P. and J. V. Skinner, Federal Inter-Agency Sedimentation Project, Minneapolis, Minnesota (August, 1974).

This booklet describes a device which was developed to test whether sediment concentration can be determined by measuring the bulk density of the liquid. The device is a special neutrally buoyant container. The displacement of an indicator rod is measured after equilibrium is reached. Results of the experiment are given and discussed.

- D-72 A Study of Methods used in Measurement and Analysis of Sediment Loads in Streams, Catalog of Instruments and Reports for Fluvial Sediment Investigations, Federal Inter-Agency Sedimentation Project, Minneapolis, Minnesota, (June, 1974).

Suspended sediment samplers, bed material samplers, pumping type bottling samplers, a hand size analyzer, and a laboratory splitter, all developed by the Federal Inter-Agency Sedimentation Project, are described, with pictures and drawings.

- D-73 "Orthophosphate Determinations Using Premeasured Reagents," Baskett, Russell C., Water and Sewage Works, January, 1973, p. 47.

A simple, fast orthophosphate measurement can be made by mixing 5 ml of sample with a premeasured polyethylene powder pillow, and measuring the color 1 minute later on a spectrophotometer (710 mμ). The chemical is PhosVer III (Hach Co.).

- D-74 "Total Mercury Analysis: Review and Critique," Reimers, Robert S. et. al., Journal of the Water Pollution Control Federation, Vol. 45, No. 5, p. 815 (May, 1973).

This article presents a detailed discussion on the analysis for total mercury. Headings include techniques for wet oxidation and complete combustion of mercury samples; preconcentration of mercury, and analytical techniques including gravimetric methods, volumetric methods, polarography, amperometric analysis, catalytic analysis, colorimetric analysis, and atomic absorption.

- D-75 "Industrial Waste Treatment Plant Instrumentation," Babcock, R.H., Water and Waste Engineering, Vol. 5, No. 9, p. 3 (Sept. 1968).

This paper briefly discusses how controls and instrumentation can be used for pumping, cyanide destruction, chrome reduction, neutralization, and batch treatment.

- D-76 Permit Program Guidance for Self-Monitoring and Reporting Requirements, United States Environmental Protection Agency, Office of Water Enforcement (October 1, 1973).

This document provides guidance to those interested in setting up a self-monitoring program. It is directed towards both industrial and municipal interests. The report includes guidance on data management, report schedules and many other areas.

- D-77 "Automatic Samplers for Sewage and Effluents," Levin, V. H. and A. Latten, Process Biochemistry, June, 1973, p. 15.

This paper reviews various samplers, by manufacturer, and describes each one. The advantages and disadvantages of each machine are presented.

- D-78 "Automatic Samplers," Wood, L. B., and H. H. Stanbridge, Water Pollution Control, Vol. 67, p. 495 (1968).

This article presents the results of a survey of automatic samplers available in England. The survey was conducted to help decide which samplers to use in the Department of Public Health Engineering of the Greater London Council. The article discusses general features to examine in samplers, and describes various samplers by manufacturer.

- D-79 "Instrumentation in Water Pollution Control Analysis," Williamson, T. and A. S. Millar, Water Pollution Control, Vol. 70, (1971).

The use of instrumentation to replace classical "wet" methods to determine chemical analysis can be used to reduce analysis time and increase reliability and precision. This article discusses the auto analyzer, atomic-absorption spectrophotometer, and gas-liquid chromatography in reference to the above factors.

- D-80 "In-Process Monitoring," Zabban, Walter, presented at the EPA Technology Transfer Seminar on Monitoring Industrial Wastewater, Arlington, Va., January 9, 1975.

This article presents the advantages of in process monitoring of wastes by industry. The article also discusses how process monitoring can be used to prevent treatment plant upsets, features to look for in monitoring equipment, and the use of monitoring to measure various parameters.

- D-81 Literature Survey of Instrumental Measurements of Biochemical Oxygen Demand for Control Application, 1960-1973, Environmental Monitoring Series, National Environmental Research Center, Office of Research and Development, U. S. EPA, Cincinnati, Ohio 45268, EPA-670/4-74-001 (February, 1974).

This report determines the state-of-the-art of instrumental biochemical oxygen demand methods. A survey of related literature published between 1960 and 1973 is used. An alternative solution is suggested for monitoring secondary treatment plants, using differential test values of a sample (e.g. Δ TOC, Δ TOD, or Δ COD).

- D-82 Performance of the Union Carbide Dissolved Oxygen Analyzer, Environmental Monitoring Series, Office of Research and Development, U. S. EPA, Cincinnati, Ohio 45268, EPA 670/4-73-018 (July, 1973).

Union Carbide dissolved oxygen analyzer, model 1101, was evaluated to determine the effectiveness of the thallium electrode in the measurement of dissolved oxygen (DO). Tests included stability, transient response, linearity, and temperature compensation.

- D-83 "The Work of the Dalmarnock Laboratory, Glasgow," Cunningham, M. F. et. al., Water Pollution Control, Vol. 72, No. 4, p. 392 (1973).

The monitoring and analysis activities of a sewage works laboratory are described. Activities include the use of gas liquid chromatography to identify oils, lithium salt injection to determine flow measurements, infra-red spectrophotometry to determine organic carbon content, atomic absorption spectrophotometry to determine mercury, and gas and thin layer chromatography to determine chlorinated organics.

- D-84 "The Determination of Phenolic Materials in Industrial Wastes," Ettinger, M. B. and R. C. Kroner, Proceedings of the 5th Industrial Waste Conference, Purdue University p. 345 (1949).

This article reviews some methods and procedures that can be used to determine phenolic materials in industrial wastes. A detailed description is given of procedures to screen out interfering materials. The use of bromine demand and Gibbs techniques to determine phenol is also presented.

- D-85 "Solvents in Sewage and Industrial Waste Waters: Identification and Determination," Ellison, W. K. and T. E. Wallbank, Water Pollution Control, Vol. 73, No. 6 p. 656, (1974).

The use of infra-red and ultra-violet spectroscopy in conjunction with gas chromatography is assessed as a detection and identification technique. Its application to identifying traces of immiscible solvent residues in samples of industrial waste waters, sewages and sludges is presented.

- D-86 "Cobalt Interference in the Non-Steady State Clean Water Test," Kalinske, A. A. et. al., Water and Sewage Works, Vol. 120, No. 7, p. 54, (July, 1973).

Laboratory tests evaluated the oxygenation capacity of aeration equipment using the "non-steady state clean water techniques." Deoxygenation of the aerator test basin was accomplished by adding sodium sulfite and a cobalt salt catalyst. Cobalt interference in the determination of dissolved oxygen by the Winkler Method was also investigated.

- D-87 "1975 Annual Review of the New Developments in Water Quality Instrumentation," Cheremisinoff, Paul N. and Richard Young, Pollution Engineering, March, 1975, p. 28.

This review reports the significant developments made by instrument manufacturers during 1975, and mentions some new products that may be useful to pollution engineers. Included is a list of instrument manufacturers.

- D-88 "Thin Layer Chromatography as a Sorting Test for Metals in Trade Effluent," Bailey, A. R., Water Pollution Control, Vol. 68, No. 4, p. 449, (1969).

Detailed information is presented on procedures to identify and determine metal components in trade effluents. Thin layer chromatography is the recommended method. Results from the Purdy and Truter equation for determining metal concentrations are compared to those obtained from atomic absorption.

- D-89 "Thin Layer and Gas Chromatographic Analysis of Parathion and Methyl Parathion in the Presence of Chlorinated Hydrocarbons," Kawahara, F. K. et. al., Journal of the Water Pollution Control Federation, Vol. 39, No. 3, p. 446, (March, 1967).

Methods to identify and measure chlorinated hydrocarbons and thiophosphate pesticides in water are described. The procedure used was employed to follow the course of accidental contamination in a river by pesticides. A discussion of sampling, extraction, analysis by thin layer and gas chromatography, and infra-red spectrophotometry are also included.

- D-90 "Chloride Interference in Nitrate Nitrogen Determination," Malhotra, S. K., and A. E. Zanoni, Journal of the American Water Works Association, Vol. 62, No. 9, p. 568, (September, 1970).

This paper presents graphs to quantitatively determine the interference of chlorides in the Standard Methods test for Nitrate Nitrogen.

- D-91 "Automatic Sampling and Measurement of Small Liquid Flows," Evans, M. R. and R. Edgar, Water Pollution Control, Vol. 70, (1971).

This article describes a sampling machine which was developed without using a peristaltic pump or a timing clock. The article also describes the construction of a low-cost flow recorder, which uses an overflow weir and a float-operated pen.

- D-92 "Determination of Proteins in Waste Water," Woods, Calvin, Process Industrial Waste Control, Vol. 49, No. 4, p. 501 (July, 1965).

Different techniques for measuring proteins in wastewater are presented. The advantages and disadvantages of each technique are indicated. Some of the methods described include kjeldahl organic nitrogen, colorimetric determinations, the Folin reaction, and the Biuret reaction.

- D-93 "Toxic Inorganic Materials and their Emergency Detection by the Polarographic Method," Offner, Harry G. and Edward F. Witucki, Journal of the American Water Works Association, Vol. 60, No. 8, p. 947, (August, 1968).

The use of polarography utilizing the dropping mercury electrode for rapid and easy antimony, arsenic, cadmium, lead, mercury, selenium, tellurium and thallium analysis is discussed. Discussions on these chemicals' physiological and toxic properties are also given.

- D-94 "Monitoring with Carbon Analyzers," Arin, M. Louis, Environmental Science and Technology, Vol. 8, No. 10, p. 898 (October, 1974).

A comparison of different instruments available for TOC determinations is presented. A brief discussion of the correlation between TOC, BOD and COD is also contained.

- D-95 A Quick Biochemical Oxygen Demand Test, U. S. EPA, Water Pollution Control Research Series, EPA No. 16050 EMF (06171), 48 pp.

A study was conducted to develop a satisfactory, short term biological oxygen demand test suitable for operational control of waste treatment processes. The test is a modification of the total biological oxygen demand (T_{bOD}) test. Laboratory experiments were conducted to examine the test, and experimental results are presented.

- D-96 "Mercury in Public Sewer Systems," Evans, Ralph L., et al, Water and Sewage Works, February, 1973, p. 74.

This article presents the results of a study of five municipalities in central Illinois, which were found to contain from 0.1 to 7.9 ppb of mercury in their sewage. Analytical procedures and results are also presented.

- D-97 "Ion-Selective Electrodes for Quality Measurement and Control," Babcock, R. H. Journal of the American Water Works Association, January, 1975, p. 26.

The theory and practice of ion-selective electrodes and their application to water quality measurement is discussed. The limitations of their use in the field is also considered.

- D-98 "Detecting Pollutants with Chemical-Sensing Electrodes," Frant, Martin. S., Environmental Science and Technology, Vol. 8, No. 3, p. 224, (March, 1974).

The advantages and disadvantages of chemical-sensing electrodes for identifying toxic materials in wastewaters are considered. Several applicable analytical methods, detection limits, interferences and limitations are discussed. A list of commercially available electrodes and their area of application is provided.

- D-99 "Variables to be Measured in Wastewater Treatment Plant Monitoring and Control," Roesler, Joseph F. and Robert H. Wise, Journal of the Water Pollution Control Federation, Vol. 46, No. 7, p. 1769, (July, 1974).

This article reviews methods of measuring those variables which would optimize wastewater treatment plant operation and control and minimize costs. The discussion centers on four different groups: Substrate variables, physical and chemical variables, suspended solids variables, and biological activity variables.

- D-100 "When you go into a Manhole or a Sewer, you should Understand Sewer Gases," Nichols, Preston, R., Deeds, & Data, p. 2 (January, 1975).

The sources and characteristics of typical sewer gases are discussed. Eight different instances are considered where gas generation may occur in sewerage systems. Safety precautions for each instance is recommended.

- D-101 "Monitoring and Treatment of Cyanide-Bearing Plating Wastes," Vought, John H., Journal of the Water Pollution Control Federation, Vol. 39, No. 12, p. 1971 (December, 1967).

The treatment and control of cyanide-bearing plating wastes are aided by an instrument performing continuous analysis and monitoring. The sampling and operation of this analyzer is described in detail and operating experiences are presented.

- D-102 "Instrument for Monitoring Trace Organic Compounds In Water," H. C. Bramer et. al., Water & Sewage Works, Vol. 113, No. 8, p. 275 (August, 1966).

An ultra-violet spectrophotometer was developed to measure trace organic compounds in water. It has been demonstrated in qualitative and quantitative work on water bodies and waste effluents. These demonstrations are described in this article.

- D-103 "How to Measure Industrial Wastewater Flow," Thorsen, Thor and Rolf Oen, Chemical Engineering, Vol. 82, No. 4, p. 95 (February 17, 1975).

Techniques for qualitative and quantitative wastewater analysis are discussed. Included is a table of methods for effluent analysis, their costs and reliabilities. Flow calculations and operating principals of weirs and flumes are also discussed.

- D-104 "Determination of Cyanide in Industrial Effluents," Hewitt, P. J. and H. B. Austin, Water Pollution Control, Vol. 71, No. 4, p. 381 (1972).

This article reports on the development of a method to separate "free cyanide" from various complex cyanides. The effect of interfering substances on the rate of recovery of free cyanide is also assessed.

- D-105 "Automated Analysis: The Determination of Ammoniacal, Nitrous and Nitric Nitrogen in River Waters, Sewage Effluents and Trade Effluents," Chapman, B. et. al., Water Pollution Control, Vol. 66, No. 2, p. 185 (1967).

The Technicon auto analyzer is evaluated for ammoniacal, nitrous and nitric nitrogen determinations in river and waste waters. The results are compared with standard analytical methods and presented in tabular form.

- D-106 "Sampling and Monitoring Feature," Water and Waste Treatment, Vol. 16, No. 10, p. 11 (October, 1973).

This report includes a review of current water and wastewater sampling and monitoring equipment. The applications, limitations, manufacturer and description of each instrument is presented.

- D-107 "Comparison of Air and Water Pollution Instrumentation," Rittmiller, Lawrence A. et. al., Pollution Engineering, Vol. 3, No. 6, p. 26 (November-December, 1971).

Sampling and analysis equipment for measuring air and water pollutants are discussed. Tables are included which provide information on instrument characteristics.

- D-108 Simultaneous and Automated Determination of Total Phosphorus and Total Kjeldahl Nitrogen, Gales, Morris E., Jr., and Robert Booth, U.S. EPA, NTIS No. PB 232 710, p.19, (May, 1974).

This study evaluates automated methods for the determination of total phosphorus and total kjeldahl nitrogen. Laboratory studies were conducted to evaluate the detection limits, precision and accuracy of three detection methods (Single Reagent Method for total phosphorus, Selenium Method for nitrogen, and Vanadium Method for nitrogen and phosphorus) in surface waters and wastewaters.

- D-109 Instrumentation for Water Quality Determination, Mentink, ASCE, Water Resources Engineering Conference, March 8-12, 1965, 43 pp.

This pamphlet reviews the operation and theory of instrumentation that is used to measure basic water quality parameters. Several integrated water quality instrumentation systems are discussed. Included are illustrations of instrumentation and their circuits.

- D-110 Automated Water Monitoring Instrument for Phosphorus Contents, Prager, Manfred, U. S. EPA, NTIS No. PB 222 772, June, 1973, 26 pp.

The development of a prototype automated water monitor for trace quantities of phosphorus compounds is reported. The method uses hydrogen flame emission spectroscopy. Operating parameters described include fuel and air flow rates, burner configuration, operating temperature and methods of sample aerosolization.

- D-111 NPDES Permits and Water Analysis, Pojasek, Robert B. Environmental Science and Technology, Vol. 9, No. 4, p. 320, (April, 1975).

This paper reviews the National Pollutant Discharge Elimination System (NPDES) procedure that is required for all individuals who discharge pollutants into a waterway from a point source. To receive a permit, the applicant must summarize his wastewater characteristics according to federally approved methods of sampling and analysis. Included is a table that compares analytical methods for determining water pollutants under the permit program.

- D-112 "Complying with Discharge Regulations," Schafer, Carl J. and N. Lailas, Environmental Science and Technology, Vol. 8, No. 10, p. 903, (October, 1974).

Spokesmen of the federal Environmental Protection Agency report how industries and municipalities must monitor their wastewaters, and what help is available to meet the task of achieving compliance.

- D-113 Wastewater Sampling Methodologies and Flow Measurement Techniques, Harris, Daniel J. and W. J. Keffer U. S. EPA No. 907/9-74-005, June, 1974, 117 pp.

This report consolidates and summarizes the activities, experience, sampling methods, and field measurement techniques of the Field Investigations Section of the EPA. Sources of error and data variability are also included.

- D-114 Quantitative Methods for Preliminary Design of Water Quality Surveillance Systems, U. S. EPA, NTIS No. PB 219/010, November, 1972, 226 pp.

Quantitative methods for the preliminary design of water quality surveillance systems are developed and demonstrated in this report. The quantitative methods are organized into a User Handbook. The methods were illustrated on the Wabash River Basin and the results were satisfactory.

- D-115 Estimation of Polychlorinated Biphenyls in the Presence of DDT-Type Compounds, U. S. EPA, NTIS No. PB 233 599, June, 1974, 90 pp.

Research to develop a simple, rapid method for determining PCB, and DDT in water is reported. The emphasis in the experiments is on the sensitivity and specificity of luminescence. Studies include the determination of recoveries and detection sensitivities for compounds of interest. An analysis of several environmental waters is also reported.

- D-116 Analysis for Mercury in Water, A Preliminary Study of Methods, U. S. EPA No. R4-72-003, September, 1972, 58 pp.

A study to develop analytical methods to determine mercury (organic and inorganic) in water is reported. A comparison of various methods in both distilled and surface waters was made.

- D-117 Test Procedure and Standards - ABS and LAS Biodegradability, The Soap and Detergent Association Scientific and Technical Report No. 3, January, 1966, 16 pp.

A procedure to determine the biodegradability of ABS and LAS surfactants is described. Results of two biodegradability test methods, the shake flask and the semicontinuous activated sludge, are presented.

- D-118 Field Tests of LAS Biodegradability, The Soap and Detergent Association, Scientific and Technical Report No. 2, September, 1965, 36 pp.

Field studies were undertaken to evaluate the biodegradability of LAS in extended aeration activated sludge plants under normal operating conditions. The results of four different field tests are presented.

- D-119 "A New Automatic Sampler for Industrial Outfall, Streams and Sewers," Brailsford, H. D., Water and Sewage Works, September, 1968.

The operation of a timer-controlled intermittent pump type sampler is described in this article. A schematic diagram of its circuit is also presented.

- D-120 Fluorescent Probes in the Detection of Insecticides in Water, U. S. EPA, NTIS No. PB 221 336, April, 1973, 41 pp.

Laboratory research has been conducted to synthesize one or more fluorescent probe molecules which would be useful in the analytical methodology for insecticide determinations in water. Development of experimental parameters for design and synthesis of optimum probe molecules is reported in this booklet.

- D-121 Environmental Applications of Advanced Instrumental Analyses: Assistance Projects, FY 69-71, U. S. EPA, May, 1973, 82 pp.

A multitude of analyses involving the identification and measurements of organic pollutants in water are discussed under eleven project categories involving a pollution incident. In most cases these analyses have helped to solve, or at least understand more clearly the related pollution incident. In some cases the analyses provided evidence for enforcement of regulatory legislation.

- D-122 Current Practice in GC-MS Analysis of Organics in Water, U. S. EPA, NTIS No. PB 224 947, August, 1973, 91 pp.

Experiences during five years of evaluating the application of gas chromatography mass spectrometry to wastewater analysis is reported. Procedures are described to analyze for organic water pollutants, including sample collection, handling, preparation, analysis, interpretation of the results, and confirmatory techniques. Case histories illustrating the techniques are also included.

- D-123 "Instrumentation in Pollution Control," Snowden, F.C., Industrial Water Engineering, Vol. 7, No. 6, p.22, (June, 1970).

Sensors and analyzers for various water quality determinations are discussed, including pH, conductivity, dissolved oxygen, and temperature meters. Techniques for measuring process wastes are also discussed. Considered are: plating wastes, acid-base neutralization, activated sludge and flocculation control. Instrumentation for measuring air pollutants is also considered.

- D-124 Sampling of Wastewater, Shelly, Philip E., U. S. EPA, Technology Transfer, Washington, D. C. 20460, June, 1974, 115 pp.

This handbook summarizes wastewater sampling techniques and equipment. It includes a list of sampler manufacturers, and detailed descriptions of some commercially available equipment.

- D-125 Industrial Wastewater Discharges, Compiled and edited by Bureau of Water and Wastewater Utilities Management, Division of Pure Waters, June, 1969, Albany, N. Y. available from the Health Education Service, P. O. Box 7283, Albany, N. Y. 12224, 56 pp.

This guide is a compilation of policy, procedural and technical suggestions for measuring and reporting industrial wastewater characteristics. Part 1 describes the design of a testing and measurement program and Part 2 describes administrative aspects.

- D-126 Organic Pollutant Identification Utilizing Mass Spectrometry, U. S. EPA, NTIS No. PB 224 544, July, 1973.

A system for the rapid identification of volatile organic water pollutants has been developed. It involves gas chromatography/mass spectrometry with computerized matching of mass spectra. Examples are presented to illustrate the use of GC/MS for specific identifications.

- D-127 Pyrographic Gross Characterization of Water Contaminants, U. S. EPA, No. EPA R2-73-227, May, 1973, 94 pp.

A method has been developed for direct analysis of organic materials in aqueous solutions. The method is based on thermal fragmentation followed by gas chromatographic separation and detection of the resulting derivative composition. The results of a field study are reported, and include: a definition of area of potential application of this technique, development of reliable analytical procedures, and development of an efficient data handling system.

For additional information pertaining to this section, please refer to the following articles:

A-7	E-38
A-15	
A-19	
A-24	
A-25	
A-27	
A-28	

SECTION E - POLLUTANTS WHICH INTERFERE WITH
PUBLICLY OWNED TREATMENT WORKS

Reference: Volume I, Section E & Appendix 5

- E-1 "Copper and Anaerobic Sludge Digestion", McDermott, G.N., et.al., Journal of the Water Pollution Control Federation, Vol. 35, No. 5, p. 655 (May, 1963).

The digestion of sludges obtained from sewage to which copper in known concentrations was fed continuously was observed in pilot plant studies. Digester performance was measured by gas production. Studies of the effect of slug doses were also made.

- E-2 "Effects of Copper and Lead Bearing Wastes on the Purification of Sewage", Water and Sewage Works, Vol. 93, No. 1, p. 30 (January, 1946).

A procedure to examine the effects of small concentrations of metal ions on the metabolism of sewage is reported. The metal ion effects on nitrification are also discussed.

- E-3 "Toxicity, Synergism, and Antagonism in Anaerobic Waste Treatment Processes", Kugelman, I.J. and K. K. Chin, Advanced Chemistry, Series 105, Vol. 55, p. 55 (1971)

This report reviews the literature on toxicity, synergism and antagonism in anaerobic digesters. Experimental inadequacies on much published data are pointed out, and methods of minimizing toxic effects of metals and certain organics are indicated. The paper also attempts to categorize quantitatively toxicity and stimulation, on an absolute basis.

- E-4 "Summary Report on the Effects of Heavy Metals on the Biological Treatment Processes", Barth, E. F., et.al., Journal of the Water Pollution Control Federation, Vol. 37, No. 1, p. 86 (January, 1965).

The effects of copper, chromium, nickel and zinc, individually and in combination on biological treatment processes were studied in pilot plant tests. No-effect doses were determined for the aeration and anaerobic digestion phases. Distribution of metals through the activated sludge process and the concentration in the final effluent were also indicated.

- E-5 "Review of Literature on Toxic Materials Affecting Sewage Treatment Processes, Streams, and BOD Determinations", Rudolfs W., et. al., Sewage and Industrial Wastes, Vol. 22, No. 9, p. 1157 (September, 1950).

The review of the literature is divided into three parts. The first part comprises the effect of toxic materials (both organic and inorganic) on sewage treatment processes (both aerobic and anaerobic). It includes a review of the effects of various industrial wastes. The second part reviews the literature that pertains to the physical, chemical, and biological effects of pollutants on streams. The third part reviews the literature on the use of the BOD test as a tool for the detection of inhibitory substances on the oxidation of sewage. Also included is a table listing concentrations of wastes and compounds which inhibit or retard various treatment processes, and flora and fauna.

- E-6 "Zinc in Relation to Activated Sludge and Anaerobic Digestion Processes", McDermott, Gerald N., et.al., Proceedings of the 17th Industrial Waste Conference, Purdue University, p. 461 (1962).

The efficiency of treatment of sewage containing zinc was studied by operation of pilot activated sludge plants. The objectives of the research were to determine the level of zinc that can be tolerated without reducing treatment plant efficiency, and to determine the efficiency of the process in removing zinc.

- E-7 "The Effects of Industrial Wastes on Sewage Treatment", Masselli, Joseph W., et.al., Report prepared by New England Interstate Water Pollution Control Commission, June, 1965.

The effect of industrial wastes on sewage treatment has been reviewed, and methods which may alleviate their effect have been described. Analytical data on metallic content of Connecticut sewages have been recorded and rehabilitation of metal-sick digesters by use of sulfide and sulfate is described.

- E-8 Environmental Effect of Photoprocessing Chemicals, Vol. 1, Report by the National Association of Photographic Manufacturers, Inc., 600 Mamaroneck Ave., Harrison, N.Y. 10528 (1974)

The effects of photographic chemicals on conventional treatment systems and on aquatic organisms are examined. Included are results and discussion of wastewater analysis and the development of a model to predict downstream response to photoprocessing effluent.

- E-9 Environmental Effect of Photoprocessing Chemicals, Vol. II, Report by the National Association of Photographic Manufacturers, Inc., 600 Mamaroneck Avenue, Harrison, N.Y. 10528, 1974, 324 pp.

This volume contains a detailed compilation of all the experimental procedures, results, and data analysis, and provides data to support the statements and conclusions of Vol. I (See Reference E-8).

- E-10 Fate of Benzidine in the Aquatic Environment: A Scoping Study, U. S. EPA Contract # 68-01-2226, January, 1974.

To determine the fate of benzidine in the aquatic environment, the stability of the aqueous phase of benzidine in biologically active systems was studied in the laboratory. Long term BOD and respirometer studies were used to measure the removal or continued presence of aqueous benzidine.

- E-11 "Anaerobic Processes - Literature Review", Ghosh, S., Journal of the Water Pollution Control Federation, Vol. 44, No. 6, p. 948 (June 1972).

Review of the 1971 literature revealed that a greater emphasis was placed by researchers on evaluating the effects of various inhibitory chemicals on the performance of anaerobic digesters. Also, considerable effort was directed toward evaluating the fate of precipitated, insoluble phosphates added to digesters, along with primary and/or secondary sludge.

- E-12 "Effects of Chromium On the Activated Sludge Process", Moore, W. Allan, et. al., Journal of the Water Pollution Control Federation, Vol. 33, No. 1, p. 54 (January 1961). Also published in the Proceedings of the 15th Industrial Waste Conference (1960), Purdue University, p. 158.

Pilot plant studies were conducted to determine the extent to which sewage processes can tolerate chromium wastes. Removal efficiencies (BOD and chromium) and the distribution and concentrations of chromium in various treatment units were examined. Digester effects and sludge settleability were also studied.

- E-13 "Pilot Plant Experiments on the Effects of Some Constituents of Industrial Waste Waters on Sewage Treatment", Wheatland, A.B., et.al., Water Pollution Control, Vol. 70, p. 626 (1971).

Pilot studies to assess the effects of copper, nickel, zinc and chromium on activated sludge performance are outlined with a view towards developing a realistic assessment of user costs based on treatability.

- E-14 "Nickel in Relation to Activated Sludge and Anaerobic Digestion Processes", McDermott, G.N., et.al., Journal of the Water Pollution Control Federation, Vol. 37, No. 2, p. 163 (February 1965).

Pilot plant studies were conducted to determine the level of nickel in waste waters that can be tolerated by aerobic and anaerobic biological treatment processes. The studies included the determination of the efficiency of the processes in removing nickel.

- E-15 "Limits for Toxic Wastes in Sewage Treatment", Coburn, Stuart, Sewage Works Journal, Vol. 21, No. 3, p. 522 (1949).

This paper reviews some of the deleterious effects of industrial wastes on municipal treatment systems. The question of pretreatment standards is also discussed.

- E-16 Controlling the Effects of Industrial Wastes on Sewage Treatment, Masselli, et.al., Technical Report prepared for the New England Interstate Water Pollution Control Commission by Wesleyan University, June 1970, 62 pp.

Factors involved in the joint treatment of industrial and domestic wastewaters are discussed. A discussion on the composition of domestic and industrial wastes, the functions of a treatment plant, the effects and control of industrial wastes, and a monitoring and analysis program are included. Major industrial processes are reviewed and their wastewaters described. Recommendations are made for a control program which maximizes treatment and minimizes deleterious effects on treatment systems.

- E-17 "Anaerobic Processes", Pohland, F.G. and S. J. Kang, Journal of the Water Pollution Control Federation, Vol. 43, No. 6, p. 1129 (June 1971).

This article reviews the 1970 literature on the microbiology and mechanisms involved in anaerobic processes, and on the factors inhibiting these processes.

- E-18 "Mercury in Anaerobic Sludge Digestion", Lingle, James W. and Edward R. Hermann, Journal of the Water Pollution Control Federation, Vol. 47, No. 3, p. 466 (March 1975).

Laboratory studies were conducted to determine whether mercuric chloride in various concentrations are converted into methyl mercury in the anaerobic sludge digestion process. The distribution of mercury within the digester was also determined.

- E-19 "White Water Treatment", Rudolfs, William and H. R. Amberg, Sewage and Industrial Wastes, Vol. 24, No. 10, p. 1278 (October 1952).

Laboratory studies determined the effect of various concentrations of soluble sulfide upon the anaerobic digestion process. White water and sodium acetate were used as substrate in these studies.

- E-20 "Digestion Fundamentals Applied to Digester Recovery - Two Case Studies", Dague, Richard R., et. al., Journal of the Water Pollution Control Federation, Vol. 42, No. 9, p. 1666 (September 1970).

The authors attempted to interpret the theory of anaerobic digestion as applied to digester operation. They report the experiences encountered in solving the problems of two anaerobic digester upsets.

- E-21 "The Effects of Heavy Metals and Toxic Organics on Activated Sludge", Goss, Thomas A., Masters Thesis, University of Pittsburgh (1969).

Manometric techniques were used to determine the relative respiration rates of nonacclimated activated sludge to various heavy metals and organics. Threshold limits of sludge to these components were determined.

- E-22 "Effect of High Sodium Chloride Concentration on Trickling Filter Slimes", Lawton, Gerald W. and Clarence Eggert, Sewage and Industrial Wastes, Vol. 29, No. 11, p. 1228 (November 1957).

Pilot plant studies were conducted to determine whether trickling filter slimes can satisfactorily stabilize organic matter in saline wastes. The effect of these wastes on growths already developed was investigated. Both acclimated and non-acclimated slimes were examined.

- E-23 Aqueous Wastes from Petroleum and Petrochemical Plants, Beychok, M.R., John Wiley & Sons, N. Y., 1967.

Pollutants found in petroleum and petrochemical waste-waters and their environmental effects are discussed. Effluent quality standards from several governmental authorities are included.

- E-24 "Effects of Copper on Aerobic Biological Sewage Treatment", McDermott, Gerald N., et.al., Journal of the Water Pollution Control Federation, Vol. 35, No. 2, p. 227 (February 1963).

Pilot plant studies were conducted to determine the effects of copper on biological treatment systems. BOD removal efficiencies were determined under steady feed and slug doses of copper feed. No-effect concentrations are given.

- E-25 "Field Survey of Four Municipal Wastewater Treatment Plants Receiving Metallic Wastes", Barth, E.F., et.al., Journal of the Water Pollution Control Federation, Vol. 37, No. 8, p. 1101 (August 1965).

Four municipal wastewater treatment plants that receive metallic wastes were sampled for treatment efficiency. Metal distribution among the individual treatment units was determined. Concentration levels that cause no reduction in treatment plant efficiency are also given.

- E-26 Treatability of Oil and Grease Discharged to Publicly Owned Treatment Works, U. S. Environmental Protection Agency, EPA No. 440/575/066, Pretreatment Requirements for Oil and Grease, April, 1975.

This document discusses the available methods for the removal of oil and grease from waste streams. Other items discussed include the method of analysis and currently acceptable concentrations for oil and grease.

- E-27 Toxic Materials Analysis of Street Surface Contaminants, Office of Research and Development, U. S. EPA Report #R2-73-233, August 1973.

Metal loading from road surface runoff is tabulated and compared to normal sanitary sewage flow. The relationship between metals in runoff and metals in sewage treatment plant effluent is made, to evaluate the effect on receiving waters. The effect that collecting runoff in a combined system will have on biological systems is explored. A table summarizes metal concentrations necessary to cause reduction in biological treatment systems.

- E-28 "Annual Report - Control of Toxic and Hazardous Material Spills in Municipalities", Brinsko, G.A., Allegheny County Sanitary Authority., November 4, 1974.

This demonstration project, partially funded by the EPA, involves developing a comprehensive program for the management and control of hazardous materials in the Allegheny County Sanitary Authority municipal wastewater treatment and collection system. The program will include the development of an early warning system with appropriate monitoring and surveillance equipment to permit the plant to respond operationally to shock loadings of contaminants. The demonstration grant is composed of seven specific tasks which include:

1. Literature and Source Review
2. Inventory
3. Pilot Plant Evaluation
4. Monitoring and Surveillance Systems
5. Contingency Plan
6. Operational Modifications to the ALCOSAN Plant
7. Surcharge, Financing and Legislation

This summary deals with work accomplished during the first year of this two-year project.

- E-29 A Handbook on the Effects of Toxic and Hazardous Materials On Secondary Biological Treatment Processes, A Literature Review, Environmental Quality Systems, Inc., Rockville, Maryland, prepared for the Allegheny County Sanitary Authority and the EPA, Sept. 1973, unpublished.

A major goal of this work was to provide background information relating to the effects of toxic and hazardous materials on the performance of biological treatment processes. In addition, background information was collected on the effects of biological processes on toxic materials. The information is presented in four sections: an introduction, the matrix of toxic and hazardous material information, the list of references used to generate the tabular matrix, and a supplementary list of chemicals.

- E-30 "Effects of Alum Addition on Activated Sludge Biota", Anderson, Douglas T. and Mark J. Hammer, Water and Sewage Works, Vol. 120, No. 1, p. 63 (Jan. 1973)

Laboratory studies were conducted to determine the effect of aluminum sulfate (alum) addition to the activated sludge process. The influence of alum on higher life forms and on BOD removals were examined. A comparison was made between effects on domestic and synthetic (glucose-glutamic acid substrate) wastewater.

- E-31 "Literature Review", Journal of the Water Pollution Control Federation, Vol. 46, No. 6, p. 1034 (June, 1974).

A review of the preceding year's literature is presented, including:

1. Treatment technology for major industrial effluents including paper, dairy, chemicals, petroleum, plating, meat, fish, poultry, and fermentation (pharmaceuticals, corn, sugar) industries.
2. Sampling and analysis techniques for continuous monitoring, organic and inorganic chemicals.
3. Physical-chemical waste treatment methods.
4. Microbiology and mechanisms of anerobic processes.
5. Sources, fate, effects of metals and other trace elements.
6. The identification, interactions, inhibitions of waste treatment microbiota.

- E-32 "Activated Sludge Studies with Phenol Bacteria", Radhakrishnan, I., and A. K. Sinha Ray, Journal of the Water Pollution Control Federation, Vol. 46, No. 10, p. 2393 (Oct. 1974).

A series of laboratory studies were conducted to determine the concentrations of phenol that can be metabolized by Bacillus cereus bacteria. Also studied were nitrogen-deficient conditions, temperature variations, and the results of contaminating the culture with wastewater.

- E-33 "Biological Treatability of Trinitrotoluene Manufacturing Wastewater", Nay, Marshall W. Jr., et.al., Journal of the Water Pollution Control Federation, Vol. 46, No. 3, p. 485 (March, 1971)

Laboratory studies were conducted to define the amenability of neutralized wastewater from the counter-current, continuous flow trinitrotoluene (TNT) manufacturing process to biodegradation. The feasibility of using biological processes for treatment of the wastewater was also evaluated.

- E-34 "Toxicity of Copper to Activated Sludge," Ayers, K. C. et. al., Proceedings of the 20th Industrial Waste Conference (1965) Purdue University.

This article summarizes studies carried out at Ohio State University in which attempts were made to investigate the actual mechanism causing partial failure of the activated sludge process due to shock loadings of copper. A description of the pilot plant and the results of the experiments are presented. The work of previous investigations is also discussed.

- E-35 "The Effects of Sulfides on Anaerobic Treatment", Lawrence, Alonzo W., et.al., Proceedings of 19th Industrial Waste Conference, Purdue University (1964), p. 343.

The effects of soluble and insoluble sulfides on anaerobic treatment were investigated by the operation of a series of laboratory digesters receiving daily sulfide additions. Experimental results were discussed with respect to toxic concentrations of soluble sulfides. Possible methods for controlling and eliminating sulfide toxicity were also indicated.

- E-36 "Slug of Chromic Acid Passes Through a Municipal Treatment Plant", English, J. N., et.al., Proceedings of 19th Industrial Waste Conference (1964), Purdue University, p. 493.

A field study was undertaken to determine the effects of passage of a chromic acid slug on the efficiency of a municipal sewage treatment plant. In addition to the levels of chromium in the plant processes attributable to the chromic acid slug, background data on the concentrations of chromium, copper, zinc and nickel are also presented.

- E-37 "Cation Toxicity and Stimulation in Anaerobic Waste Treatment II. Daily Feed Studies", Kugelman, Irwin J. and P. L. McCarty, Proceedings of 19th Industrial Waste Conference (1964), Purdue University, p. 667. Also presented in the Journal of the Water Pollution Control Federation, Vol. 37, p. 97 (1965).

Laboratory studies to investigate cation effects under daily feed conditions on anaerobic waste treatment systems are reported. These studies provide the sanitary engineer with data which can be used to design waste treatment systems. Cation concentrations are examined singly and in combination to determine synergistic and antagonistic effects.

- E-38 "Determination of Biodegradability Using Warburg Respirometric Techniques", Hunter, J. V. and H. Heukelekian, Proceedings of the 19th Industrial Waste Conference (1964), Purdue University, p. 616.

Laboratory studies are reported which examine the Warburg Respirometer as a biodegradability technique. Its applications, procedures for use, interpretations, and the advantages and disadvantages inherent in its use are also presented.

- E-39 "The Role of Iron in Anaerobic Digestion", Pfeffer, John T, and James E. White, Proceedings of the 19th Industrial Waste Conference, (1964) Purdue University, p. 887.

Laboratory studies are reported examining the relationship between iron loading and digester efficiency. The role of iron in reducing soluble phosphate concentrations by precipitation is studied, and the relationship between soluble phosphate concentration and digester efficiency is examined.

- E-40 "Substrate Interaction during Shock Loadings to Biological Treatment Processes", Komolrit, K. and A. F. Gaudy, Jr., Proceedings of the 19th Industrial Waste Conference, (1964) Purdue University, p. 796. Also presented in the Journal of the Water Pollution Control Federation, Vol. 38, No. 8, p. 1259 (August, 1966).

Laboratory studies were conducted under severe shock loading conditions to examine substrate dependence of sequential substrate removal phenomena. A metabolic flow chart for various carbohydrates and related sugar alcohols shows the metabolic pathways.

- E-41 "Effect of High Concentrations of Individual Volatile Acids on Anaerobic Treatment, McCarty, Perry L. and Marc Brosseau, Proceedings of the 18th Industrial Waste Conference (1963), Purdue University, p. 283.

Laboratory studies were conducted to investigate the effects of high concentrations of volatile acids individually and in combination on the digestion of sewage sludge. The purpose was to determine whether volatile acid buildup is the cause or effect of digester upset.

- E-42 "A Procedure for Continuous Nitrification Corrections During Warburg Respirometer Studies", Symons, James, and Roger LaBonte, Proceedings of the 18th Industrial Waste Conference (1963), Purdue University, p. 498.

Background and a discussion of oxygen uptake due to nitrification during Warburg Respirometer biodegradation studies is reported in this article. The paper includes a discussion on possible solutions, theoretical considerations and correction possibilities in order to deal with the nitrification problem.

- E-43 "The Physical and Biological Effects of Copper on Aerobic Biological Waste Treatment Processes", Moulton, Edward Q., and Kenesaw S. Shumate, Proceedings of the 18th Industrial Waste Conference (1963), Purdue University, p. 602.

Laboratory studies were conducted to explain the effects of copper toxicity on aerobic biological treatment systems. The effects of copper dosage on BOD and COD are examined. An explanation of the path and fate of copper ions is proposed.

- E-44 "Effect of Boron on Aerobic Biological Waste Treatment", Banerji, Shankha K., et.al., Proceedings of the 23rd Industrial Waste Conference (1968), Purdue University, p. 956.

Laboratory studies are reported on the effects of boron on an activated sludge system. The effects of different concentrations of boric acid on the growth and on the substrate removal rate of acclimated activated sludge is indicated. Settling characteristics of the sludge are examined and a literature review of the effects of boron on treatment processes and on aquatic life is included.

- E-45 "Development of Biological Treatment Data for Chemical Wastes", Ford, Davis L., et.al., Proceedings of the 22nd Industrial Waste Conference (1967), Purdue University, p. 292.

Laboratory experiments were conducted to develop design criteria for chemical wastes. The feasibility of treating industrial wastewaters on a laboratory scale is examined.

- E-46 "Carbon as a Parameter in Bacterial Systems Growth Limitation and Substrate Utilization Studies", Rickard, M.D. and W. H. Riley, Proceedings of the 20th Industrial Waste Conference (1965), Purdue University, p. 98.

The utility of carbon analysis to trace the metabolism of organic compounds is surveyed. The relationships obtained among cellular carbon, exogenous soluble carbon and viable count during bacterial growth are examined with the rates of synthesis of cellular material.

- E-47 "Effect of Acrylonitrile on Anaerobic Digestion of Domestic Sludge", Lank, John C. Jr., and Alfred T. Wallace, Proceedings of the 25th Industrial Waste Conference (1970), Purdue University, p. 518.

Laboratory studies were conducted to examine the effects of acrylonitrile on anaerobic digestion. Included is a literature survey on the effects of acrylonitrile on aquatic life and aerobic biological treatment.

- E-48 "Trace Metals and Filamentous Microorganism Growth", Pfeffer, John T., et.al., Proceedings of the 20th Industrial Waste Conference (1965), Purdue University, p. 608.

Laboratory experiments were conducted to determine the trace metal requirements that are necessary for bacterial and fungal growth.

- E-49 "Some Effects of High Salt Concentrations on Activated Sludge", Kincannon, D.F. and A. F. Gaudy, Jr., Proceedings of the 20th Industrial Waste Conference (1965), Purdue University, p. 316. Also presented in the Journal of the Water Pollution Control Federation, Vol. 38, No. 7, p. 1148 (July 1966).

Laboratory experiments were conducted to determine the effects of shock loadings of high salt concentrations on sludges developed in waters with low salt content. Conversely, the effects of fresh water on sludges developed in a salt water medium were also examined. Settling characteristics, removal efficiencies and cellular components were indicated.

- E-50 "The Effect of Surface Active Agents on Substrate Utilization in an Experimental Activated Sludge System", McClelland, Nina I. and K. H. Mancy, Proceedings of the 24th Industrial Waste Conference (1969) p. 1361.

Laboratory studies to determine the effect of ABS (alkylbenzene sulfonate) and LAS (linear alkylate sulfonate) on the performance of an activated sludge system are reported. The mechanism of interference with activated sludge systems of compounds with surface active characteristics is also presented.

- E-51 "Combined Treatment of Chemical Wastes and Domestic Sewage in Germany", Bischofsberger, Wolfgang, Proceedings of the 24th Industrial Waste Conference (1969), Purdue University, p. 920.

Pilot plant studies were conducted to determine whether chemical wastes needed to be treated separately or could be combined with domestic sewage. Basic criteria for plant design were developed for a combined activated sludge system.

- E-52 "Factors Responsible for Non-Biodegradability of Industrial Wastes," Irvine, Robert L. Jr. and A. Busch, Proceedings of the 24th Industrial Waste Conference (1969), Purdue University, p. 903.

This paper discusses some basic concepts in biochemistry that can be used to understand the true meaning of biodegradability. The article indicates how these concepts may be used to develop new treatment practices. It points out that some materials that are termed "non-biodegradable" may be degradable under a different set of conditions.

- E-53 "Composition Studies of Activated Sludges," Burkhead, Carl E. and Samuel Waddell, Proceedings of the 24th Industrial Waste Conference (1969), Purdue University, p. 576.

Laboratory studies were conducted to determine the change in chemical composition of activated sludges grown in batch fed units with various pure organic substrates. Energy-synthesis data were also collected to more completely define the chemical changes taking place throughout all phases of the growth cycle.

- E-54 "Sludge Activity Parameters and Their Application to Toxicity Measurements and Activated Sludge," Patterson, James W. et al., Proceedings of the 24th Industrial Waste Conference (1969), Purdue University, p. 127.

This paper reviews the advantages and disadvantages of standard treatment unit monitoring methods. Other specific biochemical parameters and their applicability to activated sludge systems under toxic stress are discussed. A procedure for ATP(adenosine triphosphate) analysis for use as a quantitative measurement of microbial biomass and activity is also included.

- E-55 "Chlorinated Hydrocarbons: Emerging Implications in Regional Planning," Shea, Timothy and Williams Gates, Proceedings of the 24th Industrial Waste Conference (1969), Purdue University, P. 1448.

A study was conducted to develop estimates of chlorinated hydrocarbon emissions in municipal and industrial wastewaters and in water and sediments in the San Francisco Bay-Delta region. A mass balance of pesticide transport into and from the Bay System was also discussed.

- E-56 "Dissolved - Copper Effect on Iron Pipe," Cruse, Henry, Journal of the American Water Works Association, Feb., 1971, p. 79.

Several case studies are presented to show the corrosion effects of galvanized iron pipe as a result of copper concentrations as low as .01 mg/l. Copper sources include water supply, copper addition for algae control and copper pipe upstream of the iron pipe.

- E-57 "Identification and Testing of Compatible Industrial Wastes," Hastings, P. C. and M. W. Davis, Jr., Proceedings of the 27th Industrial Waste Conference (1972), Purdue University, p. 515

Laboratory studies are reported which examine two wastes (Kraft mill bleachery waste of the caustic stage and aluminum containing waste) which mixed together cause a physiochemical reaction resulting in precipitation of organic and inorganic materials. Location of plants with a view towards joint treatment of compatible wastes is suggested.

- E-58 "Effect of Chrome Plating Wastes on the Warsaw, Indiana Treatment Plant," Erganian, George K., Proceedings of the 14th Industrial Waste Conference (1959) Purdue University, p. 127.

An evaluation of the effect of chrome plating wastes on the operation of an activated sludge plant is reported. Relationships between chrome concentration and treatment efficiency, sludge index, and return sludge concentration are presented. Consideration is given to the need for ferrous sulfate as a pretreatment device for chrome bearing wastes. Chrome removals as a result of treatment are also examined.

- E-59 "Significance of a Highly Alkaline Industrial Waste In a Municipal Waste Water Treatment Plant," Leary, R. D., et. al., Proceedings of the 26th Industrial Waste Conference, (1971), Purdue University, p. 566.

The effect of a high alkaline - high chromium content glue and gelatin plant waste on a primary treatment plant is reported. Laboratory study results are also presented on the effects of these wastes on anaerobic digestion. Data is provided on treatment plant performance before and after discharge of the trade waste.

- E-60 "Some Effects of Copper on the Activated Sludge Process," Directo, Leon S. and Edward Moulton, Proceedings of the 17th Industrial Waste Conference (1962), Purdue University, P. 95

The results of pilot plant studies to evaluate the response of activated sludge to various situations are presented in this article. Responses to shock loadings of copper under varying organic loadings and to various suspended solids concentrations are both reported.

- E-61 "The Effect of ABS Shock Loadings on the Activated Sludge Process," Bennett, E. R. and D. W. Ryckman, Proceedings of the 16th Industrial Waste Conference (1961), Purdue University, p. 52.

Laboratory studies were conducted to investigate the effect of shock loadings of ABS on the activated sludge system and to gain an insight into the mechanism involved in the interaction of ABS and the activated sludge microorganisms. The results of these tests are presented in this paper.

- E-62 "The Effect of Whey Upon the Operation of an Activated Sludge Plant," Backmeyer, D. P., Proceedings of the 3rd Industrial Waste Conference (1947), Purdue University, p. 310.

This paper discusses the experiences encountered by an activated sludge treatment plant as a result of batch and continuous doses of whey.

- E-63 "Effects of Synthetic Detergents on Activated Sludge," Manganelli, R. M., Proceedings of the 4th Industrial Waste Conference, (1948), Purdue University, p. 611.

Laboratory studies were conducted to determine the effects of anionic, cationic and nonionic detergents at various pH levels on activated sludge organisms. The results of these studies are reported in this paper.

- E-64 "Some Revised Concepts Concerning Biological Treatment," Sawyer, Clair N. et al., Proceedings of the 9th Industrial Waste Conference (1954), Purdue University, p. 217.

Laboratory studies were conducted to determine the effect on biological treatment of: fluctuating temperature, fluctuating pH levels and starvation periods. The study results are presented in this paper.

- E-65 "University of Toronto Studies Reveal Toxic Metals in Sludges Used for Soils," Water and Sewage Works, Vol. 120, No. 7, p. 50 (July, 1973).

Metal concentrations were measured by atomic absorption from three different dried sludge sources: heavily populated and industrialized, residential and a large town with industries-one of which uses chrome. Concentrations for cadmium, chromium, lead, nickel, zinc, iron, manganese and copper from each of the sludges is reported. In recognition of this toxic metals threat, Ontario established guidelines for sludge disposal.

- E-66 "Inhibition of Aeration Process: A Quantitative Assessment of Some Toxic Materials," Burrows, M. G., Water Pollution Control, Vol. 68, No. 4, p. 457. (1969)

A method is described by which, it is contended, the cost of treating trade effluents containing inhibitory substances can be developed by the use of laboratory-scale activated sludge units.

- E-67 "Some Effects of Zinc on the Performance of Laboratory Scale Activated Sludge Units," Brown, P. and P. R. Andrew, Water Pollution Control, Vol. 71, No. 5, pp. 549-554 (1972).

A laboratory investigation was carried out to determine the effects of zinc on batch type activated sludge units. The test results are presented in this article.

- E-68 "Lead-Cadmium and Endotoxin Interactions," Luzio, Nicholas R., Paper presented to the Senate Commerce Committee, Subcommittee on Environment, February 26, 1973.

Laboratory studies were used to determine the effect of lead and cadmium intake in animals on their ability to fight off bacteria. Different animals were used, and lead or cadmium was administered to the animals along with endotoxins, and the results were reported.

- E-69 "Temperature Acclimation in Aerobic Bio-oxidation Systems," Benedict, Arthur H. and D. A. Carlson, Journal of the Water Pollution Control Federation, Vol. 45, No. 1, P. 10 (Jan. 1973).

Laboratory studies were conducted to determine the effects of high and low temperatures on micro-organisms and on performance efficiency of biological treatment systems. Acclimation of mixed cultures at low and at high temperatures were examined.

- E-70 "Toxic Effects of Mercury on the Activated Sludge Process," Ghosh, Mriganka, and Paul Zugger, Journal of the Water Pollution Control Federation, Vol. 45, No. 3, p. 424 (March, 1973).

Laboratory studies were conducted to determine the concentrations of mercury that exhibit toxic effects on the activated sludge process. The results of the study are reported in this article.

- E-71 "Response of Completely Mixed Systems to Hydraulic Shock Loads," George, Thazhethil, K. and Anthony F. Gaudy, Jr., Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 99, Number EE5, p. 593 (October 1973).

Laboratory tests were used to determine the effects of hydraulic shock loads on activated sludge processes. Two types of shock loads were studied. The first was a constant feed concentration. The second involved a compensating change in feed substrate concentration, so that the daily organic loading remained constant, called "constant daily organic loading." Results of the experiments are given.

- E-72 "Response of Activated Sludge to Organic Transient Loadings," Adams, Carl E. and W. Eckenfelder, Jr., Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 96, p. 333 (April 1970).

Laboratory studies were undertaken to evaluate the effects of organic loadings under steady state and transient conditions upon the activated sludge system. Substrate removal and oxygen uptake kinetic models were examined to determine if these equations could be utilized to predict system responses under transient loadings.

- E-73 Biological Waste Treatment, Genetelli, E. J., Department of Environmental Sciences, College of Agriculture and Environmental Science, Rutgers University, New Brunswick, New Jersey, 35 pp.

The available methods of biological waste treatment, with their different process modifications are presented. In addition, a discussion on shock loadings (both quantitative and toxic) and their affect on biological systems is included.

- E-74 "Toxicity Measurements in Activated Sludge," Hartmann, Ludwig and Gerhard Laubenberger, Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 94, No. 2, p. 247 (April, 1968).

This paper discusses different methods of handling toxicity data, and the problems and difficulties that can arise in toxicity measurements. The Michaels and Menten, Warburg, and Lineweaver and Burk Methods are discussed, with laboratory experiments used to demonstrate their application.

- E-75 "Toxicity Measurements in Activated Sludge," Closure, Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 96, No. S.A. 2 (April, 1970)

This closure discusses several points from article E-74 concerning the Michaels and Menten equations.

- E-76 "Settling Characteristics of Sludge Sedimented from an Industrial Effluent Containing Lead Compounds," Christian, J. R. and D Dollimore, Water Research, Vol. 5, No. 5, p. 177 (1971).

The effect of the presence of oil on the settleability of sludge containing some lead is examined. Laboratory studies examine settling rate, and solids concentration before and after oil removal.

- E-77 "Measurement of Toxicity of Industrial Wastes," Banerji, S. K. et. al., Proceedings of the 3rd Mid-Atlantic Waste Conference, p. 305 (1969).

This paper discusses a method for quantitatively assessing the toxicity of wastewater ingredients which affect biological wastewater treatment. The authors use boron as an example to compare the theoretical calculations to the actual laboratory data.

- E-78 "Effects of Metallic Ions on Biological Waste Treatment Processes," Reid, George W. et al., Water and Sewage Works, Vol. 115, No. 7, p. 320, (July 1968).

Laboratory studies were conducted to observe the effects of metallic ions on slime and on digester efficiency. The study included various concentrations of chromium, cadmium and copper. Pilot plant studies were carried out to determine the effect of metallic ions on trickling filter BOD removal efficiencies, and on metallic uptake by attached slimes.

- E-79 "Effects of Pesticides on Raw Wastewater," Canter, L. W. et. al., Water and Sewage Works, Vol. 116, No. 6, p. 230, (June, 1969).

Laboratory studies are reported which examine the toxic effects of dieldrin, endrin and the organic solvents utilized in commercial pesticide products. Their effects on domestic sewage and on *Escherichia coli* are also examined.

- E-80 "Effects of Heavy Metals on Microorganisms. Application to Process Design," Heck II, Robert P. et. al., Proceedings of the 27th Industrial Waste Conference, (1972), Purdue University.

This paper discusses the use of laboratory monitoring techniques to determine the effects of heavy metals on microorganisms used in biological waste treatment. A discussion of how this data can be applied to process design is also included. Laboratory tests were conducted with copper as the "toxic" material to demonstrate the methods discussed, and the results of the tests are presented.

- E-81 "Sulfide Saturation for Better Digester Performance," Masselli, Joseph W. et. al., Journal of the Water Pollution Control Federation, Vol. 39, No. 8, p. 1369 (August, 1967).

Laboratory experiments were conducted to examine the effects of sulfide saturation of digester sludge on gasification. The precipitation of metals to their insoluble sulfides can eliminate metallic shock to anaerobic digestion.

- E-82 "Elemental Analysis of Wastewater Sludges from 33 Wastewater Treatment Plants in the United States," Salotto, B. Vincent et. al., from the draft report Proceedings of the Research Symposium on Pretreatment and Ultimate Disposal of Wastewater Solids, Rutgers University, New Brunswick, N. J. (May 21-22, 1974).

Analyses of raw and digested sludges for their metal content are reported in this paper. Statistical distribution, general tendencies, and deviations of the data for 21 metals are included. Comparison of the data with sources outside the United States is made. An analysis of sludge samples for nitrogen, phosphorus, sulfur, and heat of combustion was also made.

- E-83 "Effect of Industrial Wastes on Oxidation Pond Performance," Moshe, Meir et. al., Water Research, Vol. 6, No. 10, p. 1165 (Oct. 1972).

Laboratory experiments were conducted to establish the toxicity criteria of different metal ions on oxidation pond operation. Metal ion concentration and pH levels are examined in relation to algal numbers and dissolved oxygen content.

- E-84 "Toxic Effects of Cupric, Chromate and Chromic Ions on Biological Oxidation," Lamb A., and E. L. Tollefson, Water Research, Vol. 7, No. 4, p. 599 (April, 1973).

The toxic effects of cupric, chromate and chromic ions under conditions of shock loading on a laboratory activated sludge system are presented. The relationship between toxic effect and suspended solids concentration is also examined.

- E-85 "Effect of Temperature on the Removal of NTA (Nitrilotriacetic Acid) during Sewage Treatment," Eden, G. E., et. al., Water Research, Vol. 6, No. 8, p. 877 (August, 1972).

Experiments to determine NTA biodegradation by activated sludge processes are reported. The effects of temperature are also examined to predict the impact of winter conditions on NTA removals.

- E-86 "The Role of Sulfide in Preventing Heavy Metal Toxicity in Anaerobic Treatment," Lawrence, Alonzo Wm., and Perry L. McCarty, Journal of the Water Pollution Control Federation, Vol. 37, No. 3, p. 392 (March 1965)

Laboratory studies were performed to determine the effects of copper, zinc, nickel and iron concentrations individually and in combination on anaerobic digestion. The role of sulfide in preventing heavy metal toxicity was also evaluated. The investigation examined sulfide addition as a control procedure to relieve metal toxicity.

- E-87 "Resistance of Carcinogenic Organic Compounds to Oxidation by Activated Sludge," Malaney, G. W. et. al., Journal of the Water Pollution Control Federation, Vol. 39, No. 12, p. 2020, (Dec. 1967)

Laboratory studies were conducted to investigate the ability of activated sludge treatment plants to remove carcinogenic compounds from wastewater. The ability of three activated sludges to oxidize selected compounds was tested and the results are presented in this article.

- E-88 "The Influence of Trivalent Chromium on the Biological Treatment of Domestic Sewage," Bailey, D. A. et. al., Water Pollution Control, Vol. 69, No. 2, p. 100 (1970)

Pilot plant studies were undertaken to determine concentration levels of trivalent chromium that are acceptable to biological treatment processes. The effects of chromium on digestion, trickling filtration and activated sludge performance were studied and are reported in this article.

- E-89 "Biochemical Response of Continuous Flow Activated Sludge Processes to Qualitative Shock Loadings," Komolrit, K. and A. F. Gaudy, Jr., Journal of the Water Pollution Control Federation, Vol. 38, No. 1, p. 85 (January, 1966)

Laboratory studies were conducted to determine the mechanism of substrate interaction in a continuous flow activated sludge system. Variables considered included the combinations and ratios of different substrates, concentration levels and modes of introducing substrates. The shock load responses at various ratios of BOD and Nitrogen were also investigated.

- E-90 "The Effect of Kraft Pulp Mill Effluents on the Growth of Zalerion Maritimum," Churchland, L. M. and M. McClaren, Canadian Journal of Botany, Vol. 50, p. 1269 (1972).

Laboratory studies are reported which measured the growth of marine fungus in Kraft pulp mill effluents. A determination of Z.maritimum as an effective decomposer of caustic effluent is also conducted.

- E-91 "Tolerance of High Salinities by Conventional Wastewater Treatment Processes," Ludzack, F. J. and D. K. Noran, Journal of the Water Pollution Control Federation, Vol. 37, No. 10, p. 1404 (October, 1965)

This article reports the results of laboratory tests to determine the effects of varying concentrations of chlorides upon activated sludge and anaerobic digestion units during sustained operation. The performance of treatment units were evaluated under slug doses, starvation periods and varied feed rates.

- E-92 "The Effects of Surface Active Agents on Aeration," Mancy, K. H. and D. A. Okun, Journal of the Water Pollution Control Federation, Vol. 37, No. 2, p. 212 (February, 1965)

This study analyzed theoretically and experimentally the effect of surface active agents on oxygen transfer kinetics. The article explained how surface active agents interfere with aeration efficiency in waste treatment processes.

- E-93 "Effects of EDTA on Wastewater Treatment," Potos, Chris, Journal of the Water Pollution Control Federation, Vol. 37, No. 9, p. 1247 (Sept. 1965)

This paper reports on the research program initiated to determine the effect of EDTA on several components of sewage treatment. Included are the effects of EDTA on secondary sedimentation, coliform numbers, oxygen utilization, wastewater oxidation and chemical coagulation.

- E-94 "The Response of Activated Sludge to Nitrogen Deficient Conditions," RamaRao, C. V. et. al., Journal of the Water Pollution Control Federation, Vol. 37, No. 10, p. 1422 (October 1965).

Pilot plant studies were conducted to evaluate modifications of the activated sludge process that would effectively treat nitrogen deficient wastewaters. The purpose of the study was to investigate nitrogen economy in the treatment of certain trade wastes, and the study results are presented in this paper.

- E-95 Identification and Control of Petrochemical Pollutants Inhibitory to Anaerobic Processes, J. C. Hovious et. al., EPA Bulletin No. PB-222-287, 111 pp. April, 1973.

Laboratory studies were conducted to identify materials that are potentially inhibitory to anaerobic processes using an unacclimated biomass. A number of petrochemical pollutants and their inhibitory concentrations are given.

- E-96 "The Effect of Temperature on the Removal of Non-Ionic Surfactants during Small Scale Activated Sludge Sewage Treatment - I," Stiff, M. J. et. al., Water Research, Vol. 7, p. 1003 (1973).

Laboratory studies indicated the differences in biodegradation of three non-ionic surface active materials at 15°C, 11°C and 8°C. Comparisons are made with operating results from a small sewage treatment plant.

- E-97 "The Effect of Temperature on the Removal of Non-Ionic Surfactants during Small-Scale Activated Sludge Sewage Treatment - II Comparison of a Linear Alkyl Phenol Ethoxylate with Branched-Chain Alkyl Phenol Ethoxylates," Stiff, M. J. and R. C. Rootham, Water Research, Vol. 7, p. 1407 (1973).

Laboratory studies were conducted to investigate the differences between the biodegradation of a linear alkyl phenol ethoxylate surfactant and two branched-chain alkyl phenol ethoxylates during sewage treatment. Linear alkyl benzene sulphonate (LAS) was also tested to study its removal under varying conditions of temperature.

- E-98 "A Mathematical Model for the Continuous Culture of Microorganisms Utilizing Inhibitory Substrates," Andrews, John F., Biotechnology and Bioengineering, Vol. 10, p. 707 (1968).

A mathematical model is presented for both batch and continuous cultures of microorganisms utilizing inhibitory substrates. The model uses an inhibition function to relate substrate concentration and specific growth rate.

- E-99 "Effects of Pesticides on Nitrite Oxidation by Nitrobacteria agilis," Winely, C. L. and C. L. Clemente, Applied Microbiology, Vol. 19, No. 2, p. 214 (Feb. 1970).

The influence of pesticides on the growth of N. agilis in aerated cultures and on the respiration of N. agilis cell suspensions and cell-free extracts are presented in this article. The effects of eight pesticides on growth and on nitrite oxidation are also reported.

- E-100 "The Influence of Metal Ion Concentrations and pH value on the Growth of a Nitrosomonas Strain Isolated from Activated Sludge," Loveless, J. E. and H. A. Painter, Journal of General Microbiology, Vol. 52, (1968).

Laboratory studies were conducted to determine the effects of metal concentrations on the growth of pure cultures, and the consequences of deficiencies of these metals. The effects of pH and temperature are considered. The article includes a literature survey on factors affecting the growth of Nitrosomonas.

- E-101 "Effect of Chemical Structure on the Biodegradability of Aliphatic Acids and Alcohols," Dias, F. F. and M. Alexander, Applied Microbiology, Vol. 22, No. 6, p. 1114 (December, 1971).

Laboratory studies were undertaken to determine the rate of decomposition of substituted acids by sewage microorganisms. The type, number, and position of the substituents were factors that were considered to determine the susceptibility of a compound to attack.

- E-102 "The Effect of Phenols and Heterocyclic Bases on Nitrification in Activated Sludges," Stafford, D. A., Journal of Applied Bacteriology, Vol. 37, p. 75 (1974).

Laboratory studies were conducted to determine the rates of ammonia and nitrite oxidation when various concentrations of phenols or cresols were added to activated sludge. Concentrations at which nitrification is affected are reported in this article.

- E-103 "Accumulation of Methanogenic Substrates in CCl_4 Inhibited Anaerobic Sewage Sludge Digester Cultures," Sykes, Robert and E. J. Kirsch, Water Research, Vol. 6, p. 41, (1972).

Laboratory experiments were conducted to determine the effect of carbon tetrachloride (CCl_4) on methane production in sludge digestors. Mechanisms for hydrogen production as a result of methane disruption are also reported.

- E-104 "The Toxicity of Cadmium to Anaerobic Digestion: Its Modification by Inorganic Anions," Mosey, F. E. Water Pollution Control, Vol. 70, p. 584 (1971).

A laboratory study was undertaken to investigate the role of the sulphide and carbonate ions in preventing cadmium toxicity in anaerobic digestion. The study investigated steady additions, shock doses, and pH variations to determine their effect on cadmium toxicity. The study results are reported in this article.

- E-105 "Factors Affecting the Availability of Heavy Metals to Inhibit Anaerobic Digestion," Mosey, J. D., et. al., Water Pollution Control, Vol. 70, p. 668 (1971).

Laboratory experiments were undertaken to examine the effect of metals on anaerobic digestion. The purpose of the experiments was to explain reported variations in toxic concentrations and the study results are reported. This paper includes a discussion on techniques for measuring metal ions in solution. Procedures are suggested for the prevention and correction of inhibition by metals.

- E-106 "Effect of Copper and Hexavalent Chromium On the Specific Growth Rate of Ciliata Isolated from Activated Sludge," Sudo, Ryuichi and Shuichi Aiba, Water Research, Vol. 7, p. 1301 (1973).

The metal concentrations necessary to reduce the growth rate of three species of Ciliata were investigated. Growth rates were determined for both acclimated and non-acclimated cultures.

- E-107 "Inhibition of Anaerobic Digestion of Sewage Sludge by Chlorinated Hydrocarbons," Swanwick, J. D. and Margaret Foulkes, Water Pollution Control, Vol. 70, p. 58, (1971).

The toxicity of chlorinated hydrocarbons to anaerobic digestion is investigated. Solids content, proportion of undigested solids, level of bacterial activity and presence of other toxicants have been identified as important variables influencing inhibitory effects.

- E-108 The Impact of Oily Materials on Activated Sludge Systems, Environmental Protection Agency, NTIS #PB 212-422, EPA # 12050 DSH (March, 1971)

Small scale continuous activated sludge systems were exposed to a variety of oily compounds at various loading rates to observe the removal performance of the systems. Batch studies were used to determine oil biodegradability, and the effects of emulsification and temperature on biodegradability were also observed.

- E-109 "Effect of Toxic Wastes on Treatment Processes and Watercourses," Jackson, S. and V. M. Brown, Water Pollution Control, Vol. 69, p. 292 (1970).

This paper reviews the effects of toxic wastes on aerobic and anaerobic microorganisms and on fish. It identifies the level at which the toxic effects of some substances are likely to be most important. Concentrations are given for materials that are toxic to aerobic, anaerobic and nitrification processes as well as to fish.

- E-110 "The Effect of Chloroform in Sewage on the Production of Gas from Laboratory Digesters," Stickley, D. P, Water Pollution Control, Vol. 69, p. 585 (1970).

The toxicity of chloroform contaminated sludge was investigated in laboratory experiments. Continuous and slug doses of chloroform were administered to determine the effect of various concentrations on gas production. The results of the experiments are reported in this article.

- E-111 "An Investigation into the Effects of Chlorinated Solvents on Sludge Digestion," Barrett, K. A., Water Pollution Control, Vol. 71, p. 389 (1972).

Gas yields from laboratory digesters that were fed with chlorinated solvents were determined. The effects of steady and shock doses and varying conditions of aeration, temperature, gas recirculation were also examined.

- E-112 "Effects of Iron on Activated Sludge Treatment," Carter, John L. and Ross McKinney, Journal of the Environmental Engineering Division, ASCE, Vol. 99, No. EE2, p. 135 (April, 1973).

Laboratory experiments were conducted to relate the iron ion concentration with the rate of biological metabolism. Iron's effect on sludge bulking conditions in waste treatment plants was also examined.

- E-113 "Temperature-Toxicity Model for Oil Refinery Waste," Reynolds, James H. et. al., Journal of the Environmental Engineering Division, ASCE, Vol. 100, No. EE3, p. 557 (June, 1974).

Equations have been developed utilizing continuous flow stirred tank reactor kinetics and enzyme inhibition kinetics to describe the effects of temperature on toxicity to microorganisms. These equations were tested by semi-continuous and continuous flow experiments with phenol and the alga Selenastrum Capricornutum.

- E-114 "Metal Toxicity to Sewage Organisms," Poon, Calvin P. C. and Kiran Bhayani, Journal of the Sanitary Engineering Division, ASCE, Vol. 97, No. SA 2, p. 161 (April, 1971).

Laboratory experiments were conducted to evaluate the role of metal toxicity in the overgrowth of fungus in the activated sludge process. Pure cultures of Geotrichum candidum and sewage bacteria culture were used to obtain an understanding of the toxic behavior through the use of an enzyme inhibition model.

- E-115 "Environmental Effects of Photoprocessing Chemicals," Proceedings of the National Association of Photographic Manufacturers Seminars on Photoprocessing and the Environment, (June, 1974).

A series of papers are contained in these proceedings which cover a broad range of topics pertaining to photoprocessing discharges including: recycling and reuse of chemicals, treatability, properties of photoprocessing wastes, and biological and chemical treatment of photoprocessing effluents.

- E-116 "Nitrogen Transformation in Activated Sludge Treatment," Ganczarczyk, Jerzy, Journal of the Sanitary Engineering Division, ASCE, Vol. 97, No. SA 3 (June, 1971).

This article presents the experimental results of full-scale activated sludge treatment of an unbleached kraft pulp mill nutrient-deficient effluent. The experiment was performed to determine the effect of nitrogen deficiency and nitrogen excess on treatment parameters.

- E-117 "Industrial Wastes-Chemical Structures Resistant to Aerobic Biochemical Stabilization," Ludzack, F. J. and M. B. Ettinger, Journal of the Water Pollution Control Federation, Vol. 32, No. 11, p. 1173 (November, 1960).

This review presents treatability data of various compounds to facilitate comparisons and clarify relations between chemical structure and microbiological assimilation. Biodegradability of hydrocarbons, alcohols, phenols, aldehydes, acids, salts, esters, ethers, ketones, surfactants, amino acids, nitrogen compounds, vinyl and oxy compounds are tabulated and discussed.

- E-118 Interaction of Heavy Metals and Biological Sewage Treatment Processes, U. S. Department of Health Education and Welfare, Environmental Health Series, Water Supply and Pollution Control, Pub. No. 999-WP-22, 201 pp. (May, 1965).

This publication is a collection of 10 research papers originating at the Robert A. Taft Sanitary Engineering Center. The articles describe the effects of chromium, copper, nickel, and zinc on sewage treatment processes. Results of pilot plant studies and full scale municipal plants are given.

- E-119 Correlation of Advanced Wastewater Treatment and Groundwater Recharge, Beckman, Wallace J. and Raymond J. Avendt, U. S. Environmental Protection Agency, Project R-801478, Program Element 1BB043, Roap/Task 21 ASB-30.

With regard to a proposed 5 MGD demonstration facility on Long Island, New York, Advanced Wastewater Treatment (AWT) schemes required for reclamation and ground water recharge were evaluated. A review of the theory and practice of AWT and ground water recharge methods is included.

- E-120 "Anaerobic Waste Treatment Fundamentals; Part III, Toxic Materials and Their Control," McCarty, P. L., Journal of Public Works, November, 1964.

Four methods of controlling materials toxic to anaerobic waste treatment are proposed. Concentrations of materials that are inhibitory to anaerobic digestion are also presented.

- E-121 Water Quality Criteria, Second Edition, McKee, Jack Edwards and Harold W. Wolf, The Resources Agency of California, State Water Resources Control Board, Publication No. 3-A, 548 pp. (1963).

This book is the result of an investigation of technical and scientific literature pertaining to the criteria of water quality for various beneficial uses of water. Included is a condensation and critical evaluation of the literature, and an extensive list of references. A summary of the legal literature is also included.

Discussions on specific pollutants, including radioactivity, pesticides and surface active agents are presented.

- E-122 "The Effect of Mercury on the Activated Sludge Process," Zugger, Paul D. and Mringanka M. Ghosh, Proceedings of the 27th Industrial Waste Conference (1972), Purdue University, p. 792.

Laboratory scale aerobic batch cultures of micro-organisms, similar to those found in the activated sludge treatment process, were used to determine the effects of slug doses of mercury on activated sludge systems. A table which includes the 96 hour median tolerance limit in fish for certain metals is also indicated. A description of the laboratory equipment, procedures, and results is presented.

- E-123 "A Discussion on Inhibition of Anaerobic Digestion of Sewage Sludge by Chlorinated Hydrocarbons," Swanwick, J. D. and Margaret Foulkes, Water Pollution Control, Vol. 70, p. 573, (1971).

This paper is a discussion of article E-107.

- E-124 "Organic Load and the Toxicity of Copper to the Activated Sludge Process," Salotto, B. V. et. al., Proceedings of the 19th Industrial Waste Conference (1964), Purdue University, p. 1034

Activated sludge pilot plant studies investigated the effect of organic loading on the toxicity and distribution of copper in the various treatment processes. The effects of two copper concentrations (one and five mg/l) were studied at each organic loading condition. Determinations of COD, suspended solids, BOD, turbidity and copper at various outlets were used to measure these effects. The ultimate fate of copper is examined.

- E-125 "Anaerobic Processes," Ghosh, S. and F. G. Pohland, Journal of the Water Pollution Control Federation, Vol. 42, No. 6, p. 920 (June 1970).

This article reviews the 1969 literature on anaerobic processes as they pertain to wastewater treatment. Included are reviews of microbiology and mechanisms of the process, process developments and kinetics, analytical methods and control, and process applications.

- E-126 "Toxic Effects of Ammonia Nitrogen in High-Rate Digestion," Melbinger, N. R. and J. Donnellon, Journal of the Water Pollution Control Federation, Vol. 43, No. 8, p. 1658 (August, 1971).

Case studies are reported on two digesters that were upset from the rate of nitrogen ammonia formation. Methods of digester recovery and nitrogen ammonia control are discussed. A discussion by H. Zablatzky follows this article and includes a review of nitrogen ammonia effects on biological treatment.

- E-127 "Anaerobic Processes," Ghosh, S., Journal of the Water Pollution Control Federation, Vol. 45, No. 6, p. 1063 (June, 1973).

This article reviews the 1972 literature on anaerobic processes as they pertain to wastewater treatment. Included are reviews of microbiology and mechanisms of the process, toxicity and inhibition, process developments and control, and process applications.

- E-128 "Effect of Boron on Anaerobic Digestion," Banerji, S. K. and P. R. Parikh, Proceedings of the 4th Mid-Atlantic Industrial Waste Conference (1970).

Laboratory scale tests were used to determine the effect of boron on anaerobic digestion. Doses from 1-3 mg/l boron fed as boric acid was tested on a glucose and acetate fed batch digester. The analytical techniques and the results of the experiments are discussed.

- E-129 Correlation of Advanced Wastewater Treatment and Ground Water Recharge, Beckman, W. J., and R. J. Avendt, prepared for U. S. Environmental Protection Agency, Office of Water Program Operations.

This document reviews advanced wastewater treatment processes and their applicability to renovation of wastewater for ground water recharge. Included is a detailed discussion of the nitrification processes, and the effects of certain inhibitory substances.

- E-130 Hexane Extractable Materials and Problems at Municipal Treatment Plants, Metropolitan Sanitary District of Greater Chicago, Department of Research and Development, Report No. 75-9, May, 1975.

Data on the treatability and fate of Hexane Extractable Materials (oil and grease) as observed at MSD treatment facilities are presented. Accounts of operational problems and secondary effects on sludge disposal are also reported.

- E-131 Treatability of Oil and Grease Discharged to Publicly Owned Treatment Works, USEPA, #440/1-75/066, April, 1975.

The general nature of oil and grease in wastewater is presented in this document. The effects of oil and grease on the removal capabilities of various wastewater treatment processes is also described.

- E-132 "U. S. Environmental Protection Agency Policy on Municipal Sludges," Whittington, W. A., and B. L. Seabrook, prepared for U.S./U.S.S.R. Seminar, Handling, Treatment and Disposal of Sludges, Moscow, U.S.S.R.

This summarizes EPA's Technical Bulletin, Acceptable Methods for the Utilization of Disposal of Sludges. This paper also describes the important factors to consider for planning sludge management programs.

- E-133 Proceedings of the Joint Conference on Recycling Municipal Sludges and Effluents on Land, Champaign, Ill., July 9-13, 1973.

This document contains reprints of more than two dozen papers concerned with recycling of sludge and effluents by land application. A broad range of topics pertinent to this subject are discussed in detail.

- E-134 Proceedings of the National Conference on Municipal Sludge Management, Pittsburgh, Pa., June 11-13, 1974.

More than two dozen papers are presented on all aspects of municipal sludge management, including specific information on substances present in trace amounts in sewage sludges.

- E-135 Wastewater Treatment and Reuse by Land Application, Volume I - Summary, Volume II, Report, U. S. EPA, #660/2-73-006, August, 1973.

These booklets present the results of a nationwide study on current practices of land application of municipal treatment plant effluents and industrial wastes. Land application techniques, such as irrigation, over-land flow and infiltration-percolation are described, and the results from operational systems are indicated. Climate, health, and economic considerations are also addressed by the study.

- E-136 Review of Landspreading of Liquid Municipal Sewage Sludge U.S. EPA, #670/2-75-049 GPO Stock No. 055-001-01024, 96 pp.

This study reviews the state-of-the-art of land-spreading of liquid municipal sewage sludge. The information was obtained from a questionnaire sent to 1900 sewage treatment plants and from available literature. The subjects discussed in the booklet include sludge characteristics, sludge handling, economics of land-spreading, sludge-soil-plant interactions, public health considerations and land acquisition.

- E-137 Renovation of Secondary Effluent for Reuse as a Water Resource, U. S. EPA, # 660/2-74-016, February, 1974, 495 pp.

Land application of secondary treated, chlorinated wastewater is described in this study. 500,000 gpd of water was applied to cropland and forestland by means of sprinkler irrigation. The effect of the water on crop yields and crop composition was studied and is reported. Other factors that were considered included the quantity and quality of recharge to the ground water and the costs of spray irrigation systems.

- E-138 Evaluation of Land Application Systems, U.S. EPA, # 430/9-75-001, March, 1975, 181 pp.

This document offers guidance on how land application of sewage treatment effluent should be incorporated into regional planning studies. A checklist of factors to consider is presented with background

E-138 (continued)

information to aid in their evaluation. The document is divided into sections on wastewater management plans, design plans and specifications, and operation and maintenance manuals.

For additional information pertaining to this section, please refer to the following articles.

A-1	F-5
A-2	F-7
A-23	F-14
A-31	F-17
A-32	F-29
C-17	F-32
D-33	F-66
D-41	F-85
	F-90

SECTION F - REMOVAL OF POLLUTANTS IN PUBLICLY OWNED
TREATMENT WORKS

Reference: Volume I, Section F & Appendix 6

- F-1 "Acclimation of Microorganisms for the Oxidation of Pure Organic Chemicals", Mills, E.J., Jr. and Vernon T. Stack, Jr., Proceedings of the 9th Industrial Waste Conference, (1954) Purdue University, p. 449.

This paper presents the results of tests to determine the acclimation of microorganisms to selected organic compounds. The microorganisms were taken from the Kanawha River in West Virginia, and the organic compounds considered consisted of amines, butyl carbitol acetate, acetanilide, acrylonitrile and glycols.

- F-2 "Activated Sludge Treatment of Cyanide, Cyanate and Thiocyanate", Ludzack, F.J. and R. B. Schaffer, Proceedings of the 15th Industrial Waste Conference, (1960) Purdue University, p. 439.

Laboratory tests were performed on test feeds composed of cyanides, cyanates and thiocyanates to determine the biological treatability of each. The nature of degradation mechanism was examined, and the responses to several variables were studied. Acclimation of the activated sludge, loading rates and efficiencies were also indicated for each compound.

- F-3 "Metabolism of Organic Sulfonates by Activated Sludge", Symons, James M. and L. A. Del Valle-Rivera, Proceedings of the 16th Industrial Waste Conference, (1961) Purdue University, p. 555.

This article presents the results of laboratory tests to determine the mechanism of biological degradation of aromatic sulfonates (synthetic detergents) by activated sludge. The relationship between the structure of a compound and its biodegradability for various sulfonates is studied.

- F-4 "Biological Oxidation of Phenols in a Trickling Filter", Graves, B.S., Proceedings of the 14th Industrial Waste Conference, (1959), Purdue University, p.1.

This paper indicates the results of adding phenols to a domestic waste stream, and how the phenols are removed by a conventional secondary (trickling filter) treatment plant.

- F-5 "Experimental Treatment of Organic Cyanides by Conventional Sewage Disposal Processes", Ludzack, F.J., et.al Proceedings of the 14th Industrial Waste Conference, (1959) Purdue University, p. 547.

A bench scale activated sludge unit was used to test the treatability of nitriles and their effect on the activated sludge. The effect of nitriles on anaerobic digestion was also presented. Results of acclimation tests with various nitriles and alternate methods of removing nitriles were also discussed.

- F-6 "Evaluating Treatability of Selected Industrial Wastes", Jorden, William L. et. al, Proceedings of the 26th Industrial Waste Conference, (1971), Purdue University, p. 514.

This paper presents a procedure for evaluating treatability of industrial wastes using a continuous flow, bench scale completely mixed, slurry reactor. The theory of mixed systems and the equipment and procedure recommended is outlined, as are the results of treatability tests. The purpose of these tests is to utilize the results as a design basis for treatment plants.

- F-7 "Treatability of Wastewater from Soluble Coffee Manufacturing", Hammer, Mark J., et. al, Proceedings of the 26th Industrial Waste Conference, (1971), Purdue University, p. 348.

This article examines the treatability of soluble coffee manufacturing wastes, separately and jointly with domestic waste. The waste characteristics are presented for the coffee wastes, and the bulking effect on activated sludge that the coffee causes is examined.

- F-8 "Performance of Regionally Related Wastewater Treatment Plants", Adams, B.J. and R. S. Gemmel, Journal of the Water Pollution Control Federation, Volume 45 No. 10, p. 2088 (October, 1973)

The variation of plant performance data for activated sludge plants in the Chicago area is contained in this article. A statistical analysis of the BOD, SS, and DO in the discharge of the plants is also presented.

- F-9 "Treatment of Combined Aircraft Overhaul and Domestic Wastes", Rhodes, G. H., et. al., Journal of the Water Pollution Control Federation, Volume 45, No. 12, p. 2549 (December, 1973)

The Jacksonville Naval Air Station had been treating industrial wastes and domestic wastes separately, and neither discharge had met local standards. A study was undertaken to consider joint treatment of these wastes. The procedure used in the study is presented in this article. The characteristics of both waste streams and operating results from the combined treatment plant are contained.

- F-10 "Stability and Removal of Commercial Dyes from Process Wastewater", Porter, John J., Pollution Engineering, Vol. 5, No. 10, p. 27, (October, 1973).

This article presents a description of commercial dye characteristics and their rate of degradation in water. The effect of various waste treatment systems (biological, reverse osmosis, carbon adsorption, coagulation, radiation-oxidation and lime precipitation) on dyes is explored.

- F-11 "Industrial Wastes Treated by Activated Sludge", Clinton, M.O., Proceedings of the 11th Industrial Waste Conference, (1956), Purdue University, p. 88.

A general discussion of how two Wisconsin municipal sewage treatment plants upgraded themselves through activated sludge to meet the increased discharges from local food processing plants is presented.

- F-12 "Removal of Low-Level Radioisotopes from Wastewater by Aerobic Treatment", Lawrence, C. H. and F. W. Gilcress, Journal of the Water Pollution Control Federation, Vol. 37, No. 9, p. 1289 (September, 1965)

Pilot plant removal studies of low-level radionuclides from wastewater are presented. The removal of various radioactive chemicals by primary sedimentation, trickling filtration, secondary sedimentation and lagooning was measured. The mechanism of removal was explored and the effect of radioactive materials on treatment plant efficiency was examined.

- F-13 "How to Treat Polystyrene Wastewater", Mason, Wallace and Gerald S. Allen, Industrial Wastes, September/October 1974 p. 31.

A process description of two pretreatment plants treating polystyrene wastewater is presented. Influent and effluent data, sludge disposal data and general cost information is included.

- F-14 "Biodegradation of Oleates", Williams, J. and E. O. Bennett, Journal of the Water Pollution Control Federation, Vol. 45, No. 8, p. 1671 (August, 1973).

A laboratory study investigating the biodegradability of commercially available oleates and hydroxyoleates is presented. Degradation was determined by the growth of P. aeruginosa. Factors influencing biodegradation, such as oleate concentration, metal interference and purity of the substrate are investigated for a variety of oleates.

- F-15 Evaluation of Processes Available for Removal of Phosphorus from Wastewater, Cecil, Lawrence K., U. S. EPA Contract #14-12-581, EPA No. 17010 DRF, July, 1972.

The most important phosphate removal processes (biological, lime, aluminum and iron) are evaluated for a variety of criteria. The points of application of phosphate removal processes in existing and new facilities are discussed with the alternative sludge disposal methods. A partial list of treatment plants where phosphorus removal capability exists, or is planned, is presented, including capacity, type of removal and P level in the effluents. A short capital and operating cost section is included.

- F-16 "The Factor of Treatability as Applied to Industrial Effluents", Finch, John, Water Pollution Control, Volume 66, Number 2, p. 141 (1967).

This article reviews some of the literature on the interrelationships between industrial discharges and municipal plants. Some guidelines for dealing with administrative problems are also included.

- F-17 "Biological Degradation of Wastes Containing Certain Toxic Chemical Compounds", Howe, Robert H.L., Proceedings of the 16th Industrial Waste Conference, (1961) Purdue University, p. 262.

The biological degradation of several pharmaceutical wastes is discussed in this paper. The results of some laboratory scale and some actual plant removals of antibiotics, phenol-mercury compounds, hormones and organics containing formaldehyde and methyl alcohol are presented. The toxicity and inhibitory effects of some of these compounds are also indicated.

- F-18 "Pretreatment of Toxic Wastes", Chalmers, R. K., Water Pollution Control, Volume 69, p. 281 (1970)

This general article discusses the problems of toxic wastes and what pretreatment alternatives are available to reduce or eliminate toxic discharges.

- F-19 "Constraints to Spreading Sewage Sludge on Cropland", U. S. EPA, News of Environmental Research in Cincinnati, May 31, 1973.

This article discusses the parameters that limit the use of sewage sludge on cropland. Factors which are considered include nitrogen, metals, pathogens, odors, etc. The areas where research and guidance are needed are outlined.

- F-20 "The Biochemical Oxidation of Synthetic Detergents", Bogan, R.H. and C. N. Sawyer, Proceedings of the 10th Industrial Waste Conference, (1955), Purdue University, p. 231

A laboratory study utilizing the Warburg apparatus and the standard 5-day BOD test was conducted to determine the biochemical oxidation of a selected group of anionic and nonionic detergents. Acclimation of various activated sludge seeds was also discussed.

- F-21 "The Aerobic Metabolism of Potassium Cyanide", Nesbitt, John B, et.al., Proceedings of the 14th Industrial Waste Conference, (1959), Purdue University, p. 518.

A laboratory scale experiment was conducted to determine the feasibility of biological treatment of cyanide wastes. The cyanide waste stream was treated by activated sludge in the absence of sewage, and removal data was presented.

- F-22 "Fate and Effects of Trace Elements in Sewage Sludge When Applied to Agricultural Lands", U.S. EPA Bulletin, EPA 670/2-74-005 (January, 1974).

The first part of this bulletin compiles and reports the results of published material dealing with the subject title. The second part explores the potential impact of sludge applications to land, including a review of the effect of various trace metals on crops and soils.

- F-23 "The Treatment of Effluents from a Chrome Side Leather Tannery on a Conventional Biological Filter", Bailey, D. A., et.al., Water Pollution Control, Vol. 71, No. 2, p. 202 (1972).

Bench scale and pilot plant experiments indicated that biological treatment can reduce the BOD of mixed effluents from a chrome side leather tannery to values acceptable to authorities in England. Various pretreatment techniques were presented, and parameters discussed included chromium, sulfide and sludge produced. The data generated can be used to compare pretreatment with the cost of discharging to a municipal plant.

- F-24 "New England Examples of Joint Treatment of Municipal and Industrial Wastewaters", Parker, William H., III, Presented at the 47th Annual Conference of the WPCF, Denver, Colorado, (October, 1974)

This paper lists the advantages and disadvantages of joint treatment and discusses sewer ordinances. Case histories of engineering studies for Fitchburg, Mass., Springfield, Mass., Concord, N. H., Lewiston-Auburn, Maine, and Adams, Mass. are presented and conclusions of joint studies are also presented.

- F-25 "A Guide to the Selection of Cost-Effective Wastewater Treatment Systems", Van Note, R. H., et.al., U.S. EPA Contract No. 68-01-0973, (May, 1973).

Flow sheets describing various unit processes associated with wastewater treatment and sludge handling are presented. Curves depicting total cost in cents per thousand gallons of influent wastewater are shown for plant capacities ranging from 1-100 MGD.

- F-26 "Removal of Metals by Physical and Chemical Treatment Processes", Maruyama, T., et. al., presented at the 45th Annual Conference of the Water Pollution Control Federation, Atlanta, Georgia, October, 1972.

Pilot scale tests of coagulation, sedimentation, filtration and carbon adsorption are evaluated to determine their removal capability on metals and toxic substances. A discussion of metals removal in conventional treatment processes is also contained.

- F-27 "Sources of Metals in New York City Wastewater", Klein, L.A., et.al., Journal of the Water Pollution Control Federation, Vol. 46, p. 2653 (December, 1974).

Removal information from 12 New York City POTW's is presented. Copper, chromium, nickel, zinc and cadmium removal data were based on daily flow proportioned samples combined into monthly composites. The results from 21 monthly averages are presented.

- F-28 "Regulating Latex Paint Wastes", Williams, Rodney, T.,
Part 1 - Industrial Wastes, July/August 1974, p. 34.
Part 2 - Industrial Wastes, Sept./Oct., 1974, p. 36.

The treatability of latex paint wastes in East Bay Municipal Sewer District, Oakland, California, was determined by jar test methods, with the general conclusion that this waste is treatable by activated sludge and chemical coagulation, either at the source or at the POTW. A user charge system example is detailed.

- F-29 "Heavy Metals Removal at Conventional Secondary Treatment Plants", Altschuler, M. and G. Otakie, EPA, internal correspondence, December 20, 1974.

Operating data from POTW's in Byron, Ohio; Grand Rapids, Michigan; Richmond, Indiana, and Rockford, Illinois are presented. These data were extracted from an HEW Report entitled, "Interaction of Heavy Metals and Biological Sewage Treatment Processes", (1965). Data from Alcosan and Muncie, Indiana POTW's are presented and were extracted from "Introduction of Heavy Metals to Wastewater in Three Urban Areas", by J. A. Davis, et.al (1974). The information is correlated and a discussion of inhibitory effects is presented.

- F-30 "Removal of Heavy Metals by Wastewater Treatment Plants", Esmond, S.E., and A. C. Petrasek, Jr., Paper presented at Water and Wastewater Equipment Manufacturers Association, Industrial Water and Pollution Conference and Exposition, Chicago, Illinois, March 14-16, 1973.

Dallas Demonstration Plant (1 MGD) removal data for 12 metals is presented for two treatment processes: an activated sludge process fed by primary effluent, followed by multimedia filtration, and the same activated sludge process, followed by high-lime treatment, multimedia filtration and granular activated carbon adsorption. Four month average data is presented.

- F-31 "Treatment Plant Designed for Anticipated Standards," Schwinn, Donald E., Public Works, Vol. 104, No. 1, p. 54 (January, 1973).

This article reports on the design and construction of a wastewater treatment plant for the District of Columbia. In addition to primary and secondary treatment facilities, plans include provisions for nitrogen and phosphorus removal.

- F-32 "Degradation of a Cationic Surfactant in Activated Sludge Pilot Plants," Fenger, Bert H. et. al., Water Research, Vol. 7, p. 1195 (1973).

Pilot plant activated sludge studies were used to describe and demonstrate the degradation of cationic surfactants. Tetradecyltrimethylammonium chloride (TDBA) was chosen as a representative surfactant. The removal of TDBA was studied, and the conditions which affect removal, such as protein presence, volumetric loading and temperature were noted. The inhibition of non-acclimated activated sludge and the effect of shock loadings of TDBA were also investigated.

- F-33 "Trace Elements in Sewage Sludges," Berrow M. L. and J. Webber, Journal of the Science of Food and Agriculture Vol. 23, p. 93, (June, 1972).

The article presents an analysis of dried sewage sludges from 42 rural and industrial towns in England and Wales. The levels of various metals in the sludges and in the soil are compared, and related to toxicity of vegetation.

- F-34 "Biological Treatment of Cyanides, With and without Sewage," Pettet, A. E. J. and E. V. Mills, Journal of Applied Chemistry, August 4, 1954.

This article discusses the results of a laboratory test used to determine the effect of cyanides on treatment of sewage with percolating filters.

- F-35 Development of a Chemical Denitrification Process,
Gunderloy, Frank C. et. al., EPA, NTIS No. PB 203 597
72 pp., October, 1970.

Laboratory studies of the denitrification process based on the copper catalyzed ferrous ion reduction of nitrate ion in basic media were conducted. The purpose was to determine the effects of process variables on the extent of reduction, and on product distribution. Study results are presented in this article.

- F-36 Biological Treatment of Chlorophenolic Wastes. The Demonstration of a Facility for the Biological Treatment of a Complex Chlorophenolic Waste. Jacksonville, Ark.
NTIS No. PB 206 813, 187 pp., June, 1971.

Pilot plant studies were conducted to determine the biodegradability of chlorophenolic wastes under actual field conditions. Herbicide wastes were treated jointly with municipal wastes in an aerated lagoon located between a conventional sewage treatment plant and a stabilization lagoon. The purpose of this project was to finalize the design, construction and operation for joint treatment of an industrial waste and a municipal waste. The study included biological, chemical, hydraulic and overall considerations.

- F-37 "Treatment of a Combined Wastewater by the Low-Lime Process," Tofflemire, T. J. and Leo J. Hetling,
Journal of the Water Pollution Control Federation,
Vol. 45, No. 2, p. 210, (February, 1973).

This article presents the results of a study to investigate the treatability of a 50:50 mixture of domestic waste and paper mill waste. The studies were conducted on an actual waste flow in Waterford, N. Y. Conclusions and recommendations are both presented.

- F-38 "Characteristics of Municipal Effluents," Pound, Charles, and Ronald W. Crites, Conference on Recycling Municipal Sludges and Effluent, Champaign, Ill.,
July 9-13, 1973.

Physical, chemical, and biological characteristics of municipal wastewaters are presented and discussed. Constituents of raw wastewater and plant effluent are presented for four types of waste treatment plants. The wastes are compared to acceptable irrigation waters.

- F-39 A Characterization of Heavy Metals in Sewage and in the Background Environment, Clough, Kerrigan, G., U. S. EPA, NERC - Cincinnati, June 15, 1972.

This report is a summary of the current knowledge regarding environmental contamination by metals. Major emphasis is given to metal concentrations in sewage effluents.

- F-40 "Physical-Chemical Wastewater Treatment at Niagara Falls, N. Y. and Fitchburg, Mass.," Woodward, Richard L., AICHE Symposium Series, Vol. II, Municipal Waste Treatment (1974).

This paper discusses the reasons for selection of physical-chemical treatment and the design criteria used at the two sites. The Niagara Falls plant is 48 mgd, and the Fitchburg plant is 15 mgd.

- F-41 "Status Report on Niagara Falls AWT Facilities," Siriani, Josef, and Robert C. Marini, presented at the New York Water Pollution Control Association, Winter Meeting, January 22, 1974.

This paper presents the background history of the Niagara Falls Project. A description of the original pilot plant, design and construction of the full scale plant and industry's involvement and responsibility to the plant are all discussed.

- F-42 Wastewater Treatment Technology, Patterson, J. W. et. al., State of Illinois Institute for Environmental Quality, 300 pp., August, 1971.

This report covers twenty-two chemical substances, and discusses their sources and treatment techniques. A general summary for each chemical, with references is also included.

- F-43 "Rate of Phosphorus Uptake by Activated Sludge," Wells, W. N., Water and Sewage Works (January, 1975).

This article describes an experiment to measure the phosphorus uptake by the activated sludge process. Experimental results are presented.

- F-44 "Polychlorinated Biphenyls in Treatment Plant Effluents," Dube, Douglas J. et. al., Journal of the Water Pollution Control Federation, Vol. 46, No. 5, p. 966 (May, 1974).

A survey of polychlorinated biphenyls (PCB) in southeastern Wisconsin municipal wastewater treatment plants was conducted. Gas chromatogram patterns were matched to those for Aroclor 1254. Concentrations were given for influent and effluent from several treatment plants.

- F-45 "Treatment of Oily and Metal Containing Wastewater," Lin Y. H. and J. R. Lawson, Pollution Engineering, Vol. 5, No. 11, p. 45 (November, 1973).

This article presents a series of tables which detail the sources, characteristics and treatment alternatives for oily wastes, often containing toxic metals. Removal efficiencies and effluent concentrations of BOD, oil and suspended solids for characteristic waste streams are indicated for several treatment processes.

- F-46 "Joint Treatment vs. Pretreatment of Food Processing Wastes," Watson K. S. et. al., Journal of the Water Pollution Control Federation, Vol. 46, No. 8, p. 1927 (August, 1974).

The compatibility of dairy and food processing wastes with municipal sewage is discussed in this article. The operational and economical advantages of joint treatment over separate treatment are indicated. A successful example of joint treatment at a cheese manufacturing plant in Lowville, N. Y. is also presented.

- F-47 "New Lake at South Lake Tahoe, California," Wakeman, R., Water and Sewage Works, Vol. 115, No. 8, p. 348 (August, 1968).

Removal efficiencies for BOD, COD, suspended solids, turbidity, phosphates, ABS and coliform are presented for the secondary and advanced portions of the South Lake Tahoe sewage treatment plant.

- F-48 "Wastewater Treatment Lures Industry," Larson R. L., The American City, November, 1971, p. 74.

A wastewater treatment facility has been built in Plant City, Florida to handle domestic sewage and waste from food processors and other industries. The key to the treatment program is an industrial waste ordinance, requiring industries to provide facilities for sampling, measuring flow, determining pH and temperature, and providing pre-treatment in the form of bar screens and pH adjustment.

- F-49 "City - Industry Teamwork Solves Critical Wastewater Problems," Forestell, William L., The American City, July , 1973, p. 57.

The South Charleston Waste Treatment Works receives petrochemical wastes from a large chemical plant and domestic sewage from South Charleston. Separate primary treatment is provided for each waste, and the wastes are combined for secondary treatment. The details of the plant operation and the BOD removals are reported in this article.

- F-50 "Regional Plant Solves Small-Town Wastewater Problem," Cuttica H. C. and R. A. Armstrong, The American City, July , 1974, p. 31.

Two New York cities joined forces to form the Gloversville - Johnstown Sewer Board and build a treatment plant to handle domestic sewage and wastes from more than two dozen industries, including 20 tanneries, 3 textile dyeing plants, and a large glue factory. The 13 mgd plant uses two-stage biological treatment. The first stage is a high-rate trickling filter and the second stage is activated sludge. Removal of BOD and suspended solids has exceeded 90 percent.

- F-51 "Trace Metals in Wastewater Effluents," Chen K. Y. et. al., Journal of the Water Pollution Control Federation, Vol. 46, No. 12, p. 2663 (December, 1974).

An intensive study was conducted at the Hyperion Treatment Plant in Los Angeles to characterize trace metals in the effluents of various treatment processes. The partition of the metals into dissolved and particulate phases, and the size distribution of the particulate borne fractions in wastewater effluents and digested sludge were studied.

- F-52 "Carbon Treatment of a Municipal Wastewater,"
Burns, D. E. and G. L. Shell, Journal of the Water
Pollution Control Federation, Vol. 46, No. 1, p. 148
(January, 1974).

A pilot plant study was conducted in Salt Lake City to evaluate the use of activated carbon to remove soluble organic matter from municipal wastewaters. Carbon treatment in conjunction with chemical treatment was also studied.

- F-53 "Effects of Equalizing Wastewater Flows," La Grega M. D.
and John D. Keenan, Journal of the Water Pollution
Control Federation, Vol. 46, No. 1, p. 123 (January, 1974).

A study was conducted in Newark, N. Y. to determine the effects of maintaining a constant flow of wastewater on treatment plant operation. An equalization tank was used, and the effluent characteristics from constant flow and variable flow conditions were compared.

- F-54 "Stability and Control of Anaerobic Digestion," Graef
S. P. and Andreurs J. F., Journal of the Water Pollution
Control Federation, Vol. 46, No. 4, p. 666
(April, 1974).

A computer was used to simulate the response of an anaerobic digester to organic, toxic and hydraulic overloading. The factors that influence process stability and the indicators of impending digester failure were also studied.

- F-55 "Adsorption of MBAS from Wastewaters and Secondary
Effluents," Rickert, D. A. and J. V. Hunter, Journal of
the Water Pollution Control Federation, Vol. 46, No. 5,
p. 911 (May, 1974).

Methylene blue active substances (MBAS) can be divided into three groups on the basis of adsorption characteristics. The behavior of each group and their interaction with organics present in wastewater are presented in this article.

- F-56 "Biodegradability and Treatability of Combined Nylon and Municipal Waste," Poon C. P. C., Journal of the Water Pollution Control Federation, Vol. 42, No. 1, p. 100 (January, 1970).

A laboratory study was conducted to determine the feasibility of treating combined nylon and municipal wastewaters. Nylon wastes contain high organic levels, solvents and low pH. The most efficient operating parameters and the potential of solvent recovery are reported.

- F-57 "Anionic Detergents in Wastewater Received by Municipal Treatment Plants," Barth E. F. and M. B. Ettinger, Journal of the Water Pollution Control Federation, Vol. 39, No. 5, p. 815 (May, 1967).

An 18 month study of 5 treatment plants to determine the removal of methylene blue active substances (MBAS) is presented in this article. The correlation of MBAS removals and COD removals is also indicated.

- F-58 "Heavy Metal Uptake by Activated Sludge," Cheng, M. H. et. al., Journal of the Water Pollution Control Federation, Vol. 47, No. 2, p. 362 (February, 1975).

This article discusses the mechanism by which activated sludges remove metals from wastewaters. The factors which influence removal and the variation among different metals are also presented.

- F-59 "Heavy Metal Removal by Acclimated Activated Sludge," Neufeld Ronald D. and Edward R. Hermann, Journal of the Water Pollution Control Federation, Vol. 47, No. 2, P. 310 (February, 1975).

This article discusses the removal efficiencies of activated sludges that have been acclimated to levels of mercury, cadmium and zinc up to levels of 1000 mg/l. Biomass production, respiration parameters and kinetic parameters are also indicated as a function of metal-sludge ratio.

- F-60 "Efficiency of Heavy Metals Removal in Municipal Sewage Plants," Brown H. G. et. al., Environmental Letters, Vol. 5, No. 2, p. 103 (1973).

During the first half of 1972 six municipal sewage treatment plants were routinely monitored to determine the efficiency of metals removal. The plants chosen encompassed primary, trickling filter and activated sludge treatment in various size municipalities. The metals that were measured in the influent and effluent were cadmium, chromium, copper, zinc and lead. The removal efficiency for each metal and the relationship between metals removal and suspended solids removal are discussed in this article.

- F-61 "The Fate of Chromium during the Treatment of Sewage," Stones, T., Journal of the Institute of Sewage Purification, 1955, p. 345

This article discusses the concentration changes that chromium undergoes during various unit operations of sewage treatment. Operations discussed include sedimentation, chemical precipitation, biological filtration and activated sludge treatment.

- F-62 "The Fate of Copper During the Treatment of Sewage," Stones, T., Journal of the Institute of Sewage Purification, 1958, p. 82.

The effects of sedimentation, chemical precipitation, biological filtration and activated sludge treatment on copper concentration changes are described in this article.

- F-63 "The Fate of Nickel during the Treatment of Sewage," Stones, T., Journal of the Institute of Sewage Purification, 1959, p. 252.

This article indicates how nickel concentration is affected by sedimentation, chemical precipitation, biological filtration and activated sludge treatment.

- F-64 "The Fate of Zinc during the Treatment of Sewage",
Stones, T. Journal of the Institute of Sewage Purifica-
tion, 1959, p. 254.

Zinc concentration changes have been studied during sedimentation, biological filtration, chemical precipitation and activated sludge treatment. The study results are reported in this article.

- F-65 "The Fate of Lead during the Treatment of Sewage,"
Stones, T., Journal of the Institute of Sewage
Purification, 1960, p. 221.

This article discusses the concentration changes that lead undergoes during treatment by sedimentation, biological filtration, chemical precipitation and activated sludge.

- F-66 "Fate of Heavy Metals in Physical-Chemical Treatment
Processes," Argaman, Y. and C. C. Weddle, AICHE
Symposium Series - Water, 1973.

Results are presented from a series of pilot plant studies on the removal of heavy metals using physical-chemical wastewater treatment processes. The processes investigated were lime precipitation, ferric chloride precipitation, dual media filtration, and activated carbon adsorption. The effect of nitrilotriacetic acid (NTA) on heavy metal removal efficiencies was also investigated.

- F-67 Feasibility of Joint Municipal and Industrial Wastewater
Treatment in the Onondaga Lake Watershed, Onondaga County,
New York, Roy F. Weston, Inc., Final Report FWPCA Grant
No. WPRD 66-01-68, September, 1970.

Bench scale activated sludge studies were conducted at the Metropolitan Sewage Plant to determine heavy metals removal. The results of these studies are presented in this report.

- F-68 "Treatment of Coke Plant Phenolic Wastes in a Municipal Activated Sludge Plant," Mathews W. W., Proceedings of the 13th Industrial Waste Conference (1968), Purdue University.

The Gary, Indiana Sanitary District conducted an experiment to determine the effectiveness of phenol reduction by the activated sludge process. The results of this experiment are presented in this paper, including all of the monthly operating data from the plant.

- F-69 "Nutrient Removals by Conventional Treatment Processes," Johnson W. K., Proceedings of the 13th Industrial Waste Conference (1958), Purdue University.

This paper presents a literature survey and operating data on the nitrogen content of raw sewage, and nutrient removals in primary, chemical and biological treatment plants.

- F-70 "Design and Early Operating Experience of Activated Sludge Plant for Combined Treatment of Pulp, Paper and Domestic Waste," Coughlan F. P. Jr. and A. E. Sparr, Proceedings of the 16th Industrial Waste Conference, (1961) Purdue University, p. 375.

A secondary sewage treatment plant at Westernport, Maryland treats both kraft pulping wastes and domestic sewage. Some of the early operating experiences of this plant, including some removal characteristics, are presented in this article.

- F-71 "Designing a Combined Treatment Works for Municipal Sewage and Packinghouse Wastes at Austin, Minnesota," Hill, Kenneth V., Proceedings of the 13th Industrial Waste Conference (1958), Purdue University, p.260

This article describes the design of a sewage treatment plant for municipal and packinghouse wastes. Operating data and its comparison to design data for a similar plant is also presented.

- F-72 "Treatability of Industrial Wastes in Combination with Domestic Sewage," Sawyer C. N. and P. A. Kahn, Proceedings of the 13th Industrial Waste Conference (1958), Purdue University, p. 341.

This article is a general discussion of factors which affect treatability of combined wastes. Factors discussed include inert solids, fibrous materials, oils and greases, floating materials, flow variations, thermal variations, density variations, pH, toxic materials, BOD load variations, nutritional requirements, ferrous compounds, and odor-producing ingredients.

- F-73 "BOD of Synthetic Organic Chemicals," Lamb C. B. et. al. Proceedings of the 11th Industrial Waste Conference (1956), Purdue University, p. 326.

This article presents the BOD values of a wide range of synthetic organic chemicals. The variations between the BOD value of wastewater effluents and the BOD values in streams is also discussed.

- F-74 "Cyanide Destruction on Trickling Filters," Gurnham C. F., Proceedings of the 10th Industrial Waste Conference (1955) Purdue University, p. 186.

Laboratory scale trickling filter experiments were conducted to determine the treatability of cyanide-bearing sewage. The results of these experiments are discussed in this article. A general discussion on simple and complex cyanide forms is also presented.

- F-75 "A Biodegradability Test for Organic Compounds," Bunch R. L. and C. W. Chambers, Journal of the Water Pollution Control Federation, Vol. 39, No. 2, p. 181 (February, 1967).

A specific laboratory procedure to determine biodegradability is described in this article. The application of the test and the time required for its adaptation is also indicated.

- F-76 "A Procedure and Standards for the Determination of the Biodegradability of Alkyl Benzene Sulfonate and Linear Alkylate Sulfonate," The Subcommittee on Biodegradation Test Methods of the Soap and Detergent Association, Journal of the American Oil Chemists Society, Vol. 42, No. 11, p. 986 (November, 1965).

This article presents a procedure to measure the biodegradability of the compounds mentioned in the title. A semi-continuous activated sludge process to simulate sewage treatment and act as a confirming test is also described.

- F-77 Treatment of Mixed Domestic Sewage and Industrial Waste in Germany, Organization for Economic Co-operation and Development, December, 1966.

This extensive document covers all aspects of sewage treatment in Germany, including the pollution effects of sewage, pretreatment, design criteria and the industry charge systems in use.

- F-78 "Solids Retention in Anaerobic Waste Treatment Systems," Daque R. et. al., Journal of the Water Pollution Control Federation, Vol. 42, No. 2, Part 2, p. R29 (February, 1970).

This article presents the results of a laboratory study to determine biological solids retention times in anaerobic waste treatment systems. Factors which affect retention times and methods for their control are also discussed.

- F-79 "Techniques for Removing Metals from Process Wastewaters," Cadman, T. W. and R. W. Dillinger, Chemical Engineering, April 15, 1974, p. 79.

This general article presents the state-of-the-art of most major methods of metals removal. Strontium and manganese are discussed individually, and a summary of the effects of many ion exchange resins on metals is also presented.

- F-80 "Compact Activated Sludge Treatment of Combined Pretrochemical-Municipal Waste," Kumke G. W. et. al. Water and Wastes Engineering, Vol. 6, No. 5, p. C1, (May, 1969).

A four year evaluation of the activated sludge process performance of the South Charleston, West Virginia Waste Treatment Works was conducted. Performance data on BOD, COD and suspended solids is presented in this article.

- F-81 "Nitrogen Removal by Modified Activated Sludge Process," Balakrishnan B. and W.Eckenfelder, Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 96, No. SA2 p. 7236 (April, 1970).

Nitrification research studies with respect to the activated sludge and trickling filtration processes are reported in this article. The effects of organic loading and hydraulic loading on nitrogen removal are also discussed.

- F-82 "Removal of Sugars by Activated Sludge," Painter, H. A. et. al., Water Research, Vol. 2, No. 6, p. 427, (1968).

This article presents the results of laboratory experiments on the removal of sugars by activated sludge. The efficiency of sugar removal, the relationship between glucose loading and sludge activity and the relationship between BOD loading and sugar removal are all discussed.

- F-83 "Grease Management in Wastewater Treatment," Cibulka J. J. et. al., Proceedings of the 3rd Mid-Atlantic Waste Conference (1969).

The grease removal efficiencies at a treatment plant with a grease removal chamber in Blacksburg, Virginia are reported in this article. The results of a laboratory study are also presented. Factors which affect grease removal are indicated and include pre-chlorination, primary sedimentation, pH, and retention time.

- F-84 "Treatability Studies of Industrial Wastes Effected through Process Simulation," Baker R. W. and F. Guillaume, Water and Sewage Works, Vol. 116, No. 9 p. IW32 (September, 1969)

This article indicates how laboratory treatability studies can simulate treatment plant operations. The laboratory studies can identify problems in advance of design and aid in their correction.

- F-85 "Starch Removal with Non-Acclimated Activated Sludges," Banerji S. K. et. al., Water and Sewage Works, Vol. 114, No. 4, p. 134 (April, 1967).

A laboratory study was conducted to determine the mechanism and efficiency of starch removal by activated sludge. The factors which affect starch removal and the effect of shock loadings were also considered. The study results are presented in this article.

- F-86 "Variability of Waste Treatment Plant Performance," Thomann R. V., Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 96, No. SA3, p. 816 (June, 1970).

Statistical techniques were applied to the time variations of waste treatment processes of municipal plants. Data were obtained from eight plants, and BOD was the major parameter considered.

- F-87 "Removal of Metals by Chemical Treatment of Municipal Waste Water," Nilsson, Rolf, Water Research, Vol. 5, No. 2, p. 51 (1971).

The reduction of the metal content of wastewaters by chemical precipitation with aluminum sulfate and calcium sulfate is reported in this article. The reductions of chromium, lead, copper, mercury, cadmium, arsenic, nickel and copper are related to pH and precipitant levels.

- F-88 "Heavy Metals in Wastewater Treatment Plant Effluents," Mytelka A. I., Journal of the Water Pollution Control Federation, Vol. 45, No. 9, p. 1859, (September, 1973).

The Interstate Sanitation Commission routinely analyzes the metals removal capability of municipal wastewater treatment plants within its jurisdiction. This article presents the results from some of these analyses.

- F-89 "Treatment of Mixed Sewage and Textile Finishing Wastes on Trickling Filters and Activated Sludge," Gibson F. M. and J. H. Wiedman, Proceedings of the 17th Industrial Waste Conference (1962), Purdue University.

Pilot studies were conducted at the Greater Greenville Sewer District, South Carolina, to determine the treatability of combined textile wastes and domestic sewage. The economy of treatment and the relationships between removals and pH and alkalinity were also studied.

- F-90 "Treatability of Oily Wastewater from Food Processing and Soap Manufacture," McCarty P. L. et. al., Proceedings of the 27th Industrial Waste Conference (1972), Purdue University, p. 867.

Laboratory investigations were conducted to determine the treatability of pure fatty substances and selected industrial wastes from a Proctor and Gamble complex in Cincinnati, Ohio. The removal efficiency of the treatment plant and the effect of the wastes on the activated sludge and anaerobic digestion processes are reported in this article.

- F-91 "Amenability of a Mixture of Sewage, Cereal and Board Mill Wastes to Biological Treatment," Quirk, Thomas P., Proceedings of the 13th Industrial Waste Conference (1958), Purdue University, p. 523.

This article presents the results of a laboratory scale study to investigate the feasibility of treating a mixture of industrial wastes and domestic sewage by activated sludge. The oxygen transfer rates observed, the process loading removal characteristics, the oxygen demand rates, the required detention times and the sludge handling characteristics are also discussed.

- F-92 "Combined Treatment of Tannery and Municipal Wastes,"
Nemerow N. L. and R. Armstrong, Water and Wastes
Engineering, Vol. 6, No. 7, p. D-6 (July, 1969).

The results of laboratory experiments are presented, which indicate that activated sludge, or a modification of the process, can be utilized to treat combined tannery and domestic wastes.

- F-93 Removal of Heavy Metals by Conventional Treatment,
Logsdon G. S. and J. M. Symons, reprinted from
U. S. EPA Region II Report #902/9-74-001 (Traces of
Heavy Metals in Water, Removal and Monitoring).

This paper summarizes the research that has been conducted at the NERC laboratory in Cincinnati on removal of trace inorganic substances by water treatment processes. Among the chemicals discussed are methyl mercury, inorganic mercury, barium, selenates, selenites, arsenites and arsenates.

For additional information pertaining to this section, please refer to the following articles:

A-1	E-4	E-58
A-2	E-6	E-69
A-3	E-11	E-73
A-4	E-12	E-82
A-6	E-14	E-85
A-12	E-17	E-97
A-23	E-24	E-121
A-31	E-25	E-125
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