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TREATABILITY MANUAL

VOLUME V. Summary

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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INSTRUCTIONS FOR UPDATE OF VOLUME V, TREATABILITY MANUAL
CHANGE 1 AND CHANGE 2 (1/24/83)

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PREFACE

In January, 1979, USEPA's Office of Enforcement and Office of Water and Waste Management requested help from the Office of Research and Development in compiling wastewater treatment performance data into a "Treatability Manual."

A planning group was set up to manage this activity under the chairmanship of William Cawley, Deputy Director, Industrial Environmental Research Laboratory - Cincinnati. The group includes participants from: 1) the Industrial Environmental Research Laboratory - Cincinnati; 2) Effluent Guidelines Division; 3) Office of Water Enforcement and Permits; 4) Municipal Environmental Research Laboratory - Cincinnati; 5) R.S. Kerr, Environmental Research Laboratory - Ada; 6 Industrial Environmental Research Laboratory - Research Triangle Park; 7) WAPORA, Incorporated; and 8) Burke-Hennessy Associates, Incorporated.

The objectives of this program are :

- to provide readily accessible data and information on treatability of industrial waste streams;
- to provide a basis for research planning by identifying gaps in knowledge of the treatability of certain pollutants and waste streams.

The primary output from this program is a five volume Treatability Manual. This was first published in June 1980, with revisions made in September 1981 and August 1982. This publication replaces Volume I in its entirety, and updates Volumes II, III, IV, and V. The individual volumes are named as follows:

Volume I - Treatability Data
Volume II - Industrial Descriptions
Volume III - Technologies
Volume IV - Cost Estimating (In the process of revision for later publication)
Volume V - Summary

ACKNOWLEDGEMENT

The development of this revision to the Treatability Manual has resulted from efforts of a large number of people. It is the collection of contributions from throughout the Environmental Protection Agency, particularly from the Office of Water Enforcement, Office of Water and Waste Management, and the Office of Research and Development. Equally important to its success were the efforts of the employees of WAPORA, Inc., and Burke-Hennessy Associates, Inc., who participated in this operation.

A list of names of contributors would not adequately acknowledge the effort expended in the development of the manual. This document exists because of the major contributions of numerous individuals within EPA and the EPA contractors, including:

Effluent Guidelines Division
Office of Water Regulations and Standards, Office of Water

Permits Division
Office of Water Enforcement and Permits, Office of Water

National Enforcement Investigation Center
Office of Enforcement

Office of Research and Development

Center for Environmental Research Information

Municipal Environmental Research Laboratory

Robert S. Kerr Environmental Research Laboratory

Industrial Environmental Research Laboratory
Research Triangle Park, NC

Industrial Environmental Research Laboratory
Cincinnati, OH

As Committee Chairman, I would like to express my sincere appreciation to the Committee Members and others who contributed to the success of this effort.

William A. Cawley, Deputy Director,
IERL-Ci
Chairman, Treatability Coordination
Committee

Date: 1/24/83

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V.1 INTRODUCTION

The Treatability Manual presents in five volumes* a survey of the effectiveness of various water pollution treatment processes when applied to particular industrial effluents.

V.1.1 OBJECTIVES

The Treatability Manual is designed to be used to:

- Evaluate the potential effectiveness and costs of proposed effluent treatment systems,
- Determine the potential cost and feasibility of compliance with discharge limitations under consideration, and
- Develop the wastewater pollution control and monitoring strategies to be employed at specific sites.

This Manual is <u>not</u> intended to:

- Specify the final effluent concentrations to be required for industrial processes,
- Address "in process" controls,
- Describe wastewater recycling or reuse systems (although their existence is mentioned in Volume II, when such information was provided in the literature),
- Contain an exhaustive study of pollution removal efficiencies or the reliability and applicability of control equipment,
- Define methods or costs for the disposal of by-products of water pollution control, such as solid waste or air pollution, or
- Characterize the suitability of wastewater pollution control equipment and auxiliary processes for meeting air pollution regulations and RCRA regulations.

*Volume IV has been withdrawn for revisions, and will be published when these are completed.

Nevertheless, this Manual does provide background information on some of these issues. This, along with other data, may be useful when calculating "best engineering judgment" limits for second-round permits which reflect Best Available Technology for toxic pollutants.

V.1.2 DATA SOURCES

The bibliography in Section V.6 includes all references used in Volumes I through III of the Manual. (Part D is reserved for references used in the revision to Volume IV). All of these references are available in a central file located at:

> Library, Andrew W. Briedenbach Environmental Research Center
> U.S. Environmental Protection Agency
> 26 West St. Clair Street
> Cincinnati, Ohio 45268

To avoid potentially repetitious literature searches, all other sources examined during this study not containing data considered relevant to this effort are listed in the bibliography.

V.2 EXECUTIVE SUMMARIES OF VOLUMES I THROUGH IV

V.2.1 VOLUME I - TREATABILITY DATA

Volume I is a compendium of treatability data for specific pollutants. Information is provided on the compounds listed in the Consolidated Permit Application Form 2C (NPDES) Section V, Part C (EPA Form 3510-2C). Information also is provided on other hazardous materials. The pollutants covered have been organized into the following chemical categories:

- Metals and inorganics
- Ethers
- Phthalates
- Nitrogen compounds
- Phenols
- Aromatics
- Polynuclear aromatic hydrocarbons
- PCB's and related compounds
- Halogenated hydrocarbons
- Pesticides
- Oxygenated compounds
- Miscellaneous

The following information is provided for each pollutant:

- Alternate names of the chemical;
- Chemical Abstracts Number;
- Physical, chemical, and biological properties, including: molecular weight, melting point, boiling point, vapor pressure, solubility in water at 20°C, log octanol/water partition coefficient (relevant to bioaccumulation), Henry's Law constant (reflecting ease of "stripping"), and biodegradability data;
- Probable fate of the compound in the aqueous environment. Removal processes considered include photolysis, oxidation, hydrolysis, volatilization, sorption and biological processes;
- Data on the effectiveness of activated carbon to control the material, for organics;
- Data on the precipitation and coagulation properties of metals;

- Industrial occurrence of the material. Minimum, maximum, and mean concentrations are reported for both untreated and treated wastewater for each industrial category in which the substance has been detected;

- Removal efficiencies and median effluent concentrations for specific control technologies; and

- Water quality criteria for the pollutant.

V.2.2 VOLUME II - INDUSTRIAL DESCRIPTIONS

Volume II contains a general description of each of the "primary industries" named in the "NRDC Consent Agreement" (Natural Resources Defense Council versus Russell E. Train, 8 ERC 2120 [D.D.C. 1976] amended on March 1979) and their major subcategories. It also includes:

- Subcategory-wide or industry-wide tables covering,

  - the number of dischargers,
  - the types of pollution control systems in use,
  - the range of effluent flow rates and pollutant concentrations in controlled and uncontrolled waste streams, and
  - the efficiency of control systems, when available;

- Summary tables on BPT effluent guidelines and the status of BAT guidelines, New Source Performance Standards, and Pretreatment standards; and

- Tabulated information on individual plants specifying industrial subcategory, control systems (including operating characteristics when available), effluent concentrations, and influent concentrations when available.

If recycling, reuse, or subsurface injection of wastewater is practiced at a plant, this is noted in the plant-specific table; however, no details are included.

V.2.3 VOLUME III - TECHNOLOGIES FOR CONTROL/REMOVAL OF POLLUTANTS

Volume III summarizes information on the nature and effectiveness of various pollution control technologies. The discussions address the following:

- Description of technology;

- Representative types and modifications;

- Technology status;

- Applications;
- Advantages and limitations;
- Reliability;
- Chemicals required;
- Residuals generated;
- Design criteria; and
- Performance.

A summary table for each technology is provided showing effluent pollutant concentrations and pollutant removability data, including minimum, maximum, and median data, and the number of data points used to generate this information. Data sheets summarizing the results of tests at specific installations are also included.

V.2.4 VOLUME IV - COST ESTIMATING

Volume IV is under major revision and will be available at a later date.

V.5 REFERENCES

5-1. U.S. Environmental Protection Agency. Technical support document for auto and other laundries industry. Contract No. 68/03/2550. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. Variously paginated.

5-2. U.S. Environmental Protection Agency. Status report on the treatment and recycle of wastewaters from the car wash industry (draft contractor's report). Contract 68-01-5767. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979.

5-3. Kleper, M.H., R.L. Goldsmith, and A.Z. Gollan. Demonstration of ultrafiltration and carbon adsorption for treatment of industrial laundering wastewater. EPA-600/2-78/177. Prepared for IERL, Office of Research and Development, Washington, D.C.; 1978. 109 pp.

5-4. U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the coal mining point source category. EPA 440/1-81/057b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management; 1981. 429 pp. plus appendices.

5-5. U.S. Environmental Protection Agency. Draft development document for inorganic chemicals manufacturing point source category - BATEA, NSPS, and pretreatment standards. EPA-440/1-79/007. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1979. 934 pp.

5-6. U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source category; general. EPA-440/1-80/024b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 456 pp.

5-7. U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the leather tanning and finishing point source category. EPA-440/1-74/016a. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974. 158 pp.

5-8. U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the leather tanning and finishing point source category. EPA-440/1-79/016. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 381 pp.

5-9. U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the aluminum forming point source category. EPA-440/1-80/073a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 604 pp.

5-10. U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the battery manufacturing point source category. EPA 440/1-80/067a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 823 pp.

5-11. U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the coil coating point source category. EPA-440/1-81/071b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1981. 481 pp.

5-12. U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the electrical and electronic components point source category. EPA-440/1-80/075a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. Variously paginated.

5-13. U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the foundries (metal molding and casting) point source category. EPA-440/1-80/070a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 860 pp.

5-14. U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the metal finishing point source category. EPA-440/1-80/091a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. Variously paginated.

5-15. U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the photographic equipment and supplies segment of the photographic point source category. EPA-440/1-80/077a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. Variously paginated.

5-16. U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the porcelain enameling point source category. EPA-440/1-81/072b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1981. 515 pp.

5-17. U.S. Environmental Protection Agency. Final development document for proposed effluent limitations guidelines, new source performance standards and pretreatment standards for the explosives manufacturing point source category; subcategory E, formulation and packaging of blasting agents, dynamite, and pyrotechnics. Performed by Hydroscience for the Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. Variously paginated.

5-18. U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the explosives manufacturing point source category. EPA-440/1-76/006j. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976. 215 pp.

5-19. U.S. Environmental Protection Agency. Technical review of the best available technology, best demonstrated technology, and pretreatment technology for the gum and wood chemicals point source category. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C; 1978. Variously paginated.

5-20. U.S. Environmental Protection Agency. Contractor engineering report for the development of effluent limitations guidelines and standards for the pharmaceutical manufacturing point source category. EPA-440/1-80/084a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. Variously paginated.

5-21. U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines standards for the nonferrous metals manufacturing point source category. EPA-440/1-79/019-a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 622 pp.

5-22. U.S. Environmental Protection Agency. Development document for BAT effluent limitations guidelines and new source performance standards for ore mining and dressing industry. Contract No. 6332/MI. Prepared for Effluent Guidelines Division, Washington, D.C.; 1979. Variously paginated.

5-23. Coco, J.H., E. Klein, D. Howland, J.H. Mayes, W.A. Myers, E. Patz, C.J. Romero, and F.H. Yocum. Development of treatment and control technology for refractory petrochemical wastes (draft report). EPA-600/2-79/080, Prepared for RSKERL, Office of Research and Development, Ada, OK. 220 pp.

5-24. U.S. Environmental Protection Agency. Extraction of chemical pollutants from industrial wastewaters with volatile solvents. EPA-600/2-76/220. Prepared for RSKERL, Office of Research and Development, Ada, OK; 1976. 510 pp.

5-25. U.S. Environmental Protection Agency. Draft engineering report for development of effluent limitations guidelines for the ink manufacturing industry (BATEA, NSPS, Pretreatment). Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1979. Variously paginated.

5-26. U.S. Environmental Protection Agency. Draft engineering report for development of effluent limitations guidelines for the paint manufacturing industry (BATEA, NSPS, Pretreatment). Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1979. Variously paginated.

5-27. U.S. Environmental Protection Agency. Development document for proposed effluent limitations guidelines, new source performance standards, and pretreatment standards for the petroleum refining point source category. EPA 440/1-79/014b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C., December 1979. 366 pp.

5-28. U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the petroleum refining point

source category. EPA-440/1-74/014a. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C., 1974. 195 pp.

5-29. U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the pulp, paper and paperboard and the builders paper and board mills point source categories. EPA-440/1-80/025b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 632 pp.

5-30. U.S. Environmental Protection Agency. Review of the best available technology for the rubber processing point source category. Contract No. 68-01-4673. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1978. Variously paginated.

5-31. U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the steam electric point source category. EPA-440/1-80/029b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington D.C.; 1980. 597 pp.

5-32. U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the textile mills point source category. EPA-440/1-79/022b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 678 pp.

5-33. U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the timber products processing point source category. EPA-440/1-79/023b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 427 pp.

5-34. U.S. Environmental Protection Agency. Fate of priority pollutants in publicly owned treatment works pilot study. EPA-440/1-79/300. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 33 pp.

5-35. Clement Associates, Inc. Analytical methods development, Section 2.4.2.4, working paper for draft development document for effluent limitations guidelines and standards for the organic chemicals manufacturing and plastic and synthetic materials point source categories. Prepared for Organic Chemical Branch, Effluent Guidelines Division, 1981.

5-36. U.S. Environmental Protection Agency. Sampling and analysis procedures for screening of industrial effluents for priority pollutants. Environmental Monitoring and Support Laboratory, Cincinnati, OH; April, 1977. 69 pp.

5-37. U.S. Environmental Protection Agency. Analytical methods for the verification phase of the BAT review. Effluent Guidelines Division, Washington, D.C.; June 1977.

5-38. American Public Health Association, et al. Standard methods for the examination of water and wastewater. 14th edition; 1975.

5-39. U.S. Environmental Protection Agency. Methods for chemical analysis of water and wastes. EPA-600/4-79/020. Environmental Monitoring and Support Laboratory, Cincinnati, OH; 1979.

5-40. Holtzclaw, P.W., and M.D. Neptune. Approach to quality assurance/quality control in the organic chemicals industry monitoring program. Presented in Journal of Environmental Science and Health, Vol. A15, No. 5. pp 525-543.

5-41. McNulty, K.J., R.L. Goldsmith, A. Gollan, S. Hossain, and D. Grant. Reverse osmosis field test: treatment of copper cyanide rinse waters. EPA-600/2-77/107. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1977. 89 pp.

5-42. Brandon, C.A., and J.J. Porter. Hyperfiltration for renovation of textile finishing plant wastewater. EPA-600/2-76/060. Prepared for IERL, Office of Energy, Minerals and Industry, Research Triangle Park, NC; 1976. 147 pp.

5-43. Olem, H. The rotating biological contactor for biochemical ferrous iron oxidation in the treatment of coal mine drainage. No. W77-05337, Penn State University. Prepared for U.S. Department of Commerce, Office of Water Research and Technology. 1975.

5-44. U.S. Environmental Protection Agency. Development document for effluent limitations guidelines for the pesticide chemicals manufacturing point source category. EPA-440/1-78/060e. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1978. 316 pp.

5-45. Kleper, M.H., R.L. Goldsmith, T.V. Tran, D.H. Steiner, J. Pecevich, and M.A. Sakillaris. Treatment of wastewaters from adhesives and sealants manufacturing by ultrafiltration. EPA-600/2-78/176. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1978. 120 pp.

5-46. U.S. Environmental Protection Agency. Selected biodegradation techniques for treatment and/or ultimate disposal of organic materials. EPA-600/2-79/006. Prepared for IERL, Cincinnati, OH; 1973. 377 pp.

5-47. Schimmel, C., and D.B. Griffin. Treatment and disposal of complex industrial wastes. EPA-600/2-76/123. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1976.

5-48. U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the synthetic resins segment of the plastics and synthetic materials manufacturing point source category. EPA-440/1-74/010a. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974. 238 pp.

5-49. U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and new source performance standards for the mineral mining and processing industry point source category. EPA-440/1-76/059a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976. 432 pp.

5-50. U.S. Environmental Protection Agency. Effects of liquid detergent plant effluent on the rotating biological contactors. EPA-600/2-78/129. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1978. 58 pp.

5-51. U.S. Environmental Protection Agency. Revised technical review of the best available technology, best demonstrated technology, and pretreatment technology for the timber products processing point source category. 68-01-4827. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1978. Variously paginated.

5-52. U.S. Environmental Protection Agency. Physical, chemical, and biological treatment techniques for industrial wastes. Volume I. EPA/SW-148C. U.S. Environmental Protection Agency, Office of Solid Wastes, Washington, D.C.; 1976. Variously paginated.

5-53. U.S. Environmental Protection Agency. Handbook for analytical quality control in water and wastewater laboratories. Analytical Quality Control Laboratory, National Environmental Research Center, Cincinnati, OH; 1972. Variously paginated.

5-54. JRB Associates, Inc. Organic chemicals industry priority pollutant data: data listings, descriptive statistics, and percent reduction. Memorandum, J.Ackermann, JRB, to C. Norwood, JRB, June 8, 1981. Modified by USEPA Effluent Guidelines Division (Plant codes deleted); 1981.

5-55. Wise, Hugh E., and Paul D. Fahrenthold. Occurrence and predictability of priority pollutants in wastewaters of the organic chemicals and plastics/synthetic fibers industrial categories. Presented in part at the 181st American Chemical Society National Meeting, Division of Industrial and Engineering Chemistry, Symposium on Treatability of Industrial Aqueous Effluents, Atlanta, GA; April 1981. 40 pp.

5-56. U.S. Environmental Protection Agency. Project recommendations for the soap and detergent manufacturing industry (SIC 2841) BAT/toxics study. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1976. 26 pp.

5-57. Kloepfer, Robert P. Jerry R. Dias, and Billy J. Fairless. Priority pollutant methodology quality assurance review. Reprinted from Chemistry in Water Reuse, Volume 1, Chapter 9, edited by W.J. Cooper, Ann Arbor Science Publishers, Inc.; 1981. pp 207-227.

5-58. U.S. Environmental Protection Agency. Guidelines established test procedures for the analysis of pollutants; proposed regulations. Federal Register, Vol. 44, No. 233, pp. 69464-69575, as modified by Federal Register, Vol. 44, No. 244, pp. 75028-75052; December, 1979. 135 pp.

5-59. Weishaar, Michael F. 1981. Letter, Michael F. Weishaar, Manager of Environmental Affairs, Monsanto Chemicals Intermediates Co., to Paul Fahrenthold, USEPA, August 5, 1981. 12 pp.

5-60. Walk, Haydel & Associates, Inc. Contractors Engineering Report analysis of organic chemicals and plastics and synthetic resin industries. Conventional and Nonconventional Pollutant Parameters, Volume I and II. Prepared for Effluent Guidelines Division. Office of Water and Waste Management, Washington, D.C.; 1981. Variously Paginated.

5-61. U.S. Environmental Protection Agency. Closed-cycle textile dyeing: full-scale hyperfiltration demonstration (design). EPA-600/2-80/055. Prepared for IERL, Office of Research and Development, Research Triangle Park, NC; 1980. 103 pp.

5-62. U.S. Environmental Protection Agency. Proceedings: First national symposium/workshop on rotating biological contactor technology. EPA-600/9-80/046a. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980. 792 pp.

5-63. Utility Water Act Group. 1982. Utility Water Act Group Comments on the draft revised treatability manual, 14 July 1982. Variously paginated.

Master Bibliography/Document Access Key

The Master Bibliography/Document Access Key is a central file for all references obtained in the development of the Treatability Manual. The list includes over 600 references. Reference cites include, as standard information, a microfiche number and volume reference cites, on the first line. The second line contains further identifiers in the form of EPA document or contract numbers, PB numbers, Library of Congress numbers as well as any other reference specific numbers available. The remainder of the lines are reserved for the reference cite. The individual volume cross-referencing tables are comprised of volume specific reference cites (i.e. 1-2, 3-8) in one column cross-referenced to the appropriate microfiche number from the Master Bibliography.

0001 3-78
EPA-440/1-76/060n
U.S. Environmental Protection Agency. Development document for interim final effluent limitations, guidelines and proposed new source performance standards for the hospital point source category. EPA-440/1-76/060n. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976. 131 pp.

0002 3-76 5-49
EPA-440/1-76/059a
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and new source performance standards for the mineral mining and processing industry point source category. EPA-440/1-76/059a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976. 432 pp.

0003 3-86

U.S. Environmental Protection Agency. Draft technical report for revision of steam electric effluent limitations guidelines. U.S. Environmental Protection Agency, Washington, D.C.; 1978. 607 pp.

0004 3-108 5-24
EPA-600/2-76/220 PB 266-241
U.S. Environmental Protection Agency. Extraction of chemical pollutants from industrial wastewaters with volatile solvents. EPA-600/2-76/220. Prepared for RSKERL, Office of Research and Development, Ada, Oklahoma; 1976. 510 pp.

0005 2-58 3-68
Contract Nos. 68-01-3289 and 68-01-3884
U.S. Environmental Protection Agency. Technical study report BATEA-NSPS-PSES-PSNS: textile mills point source category (draft contractor's report). Contract Nos. 68-01-3289 and 68-01-3884. Prepared for U.S. Environmental Protection Agency, Washington, D.C.; 1978. Variously paginated.

0006 3-71
Contract Nos. 68-01-3273, 68-01-4762, and 68-02-2618
U.S. Environmental Protection Agency. Draft technical assistance in the implementation of the BAT review of coal mining industry point source category (draft contractor's report). Contract Nos. 68-01-3273, 68-01-4762, and 68-02-2618. Prepared for Effluent Guidelines Division, Washington, D.C.; 1979.

0007 3-85
Contract No. 68-01-4492
U.S. Environmental Protection Agency. Draft development document for inorganic chemicals manufacturing point source category -

BATEA, NSPS, and pretreatment standards (draft contractor's report). Contract No. 68-01-4492. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1979.

0008
EPA-400/1-77/087A PB 238-464
U.S. Environmental Protection Agency. Supplement for pretreatment to the development document for the inorganic chemicals manufacturing point source category. EPA-400/1-77/087A. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1977.

0009 1-33 2-14 3-11 5-8
EPA-440/1-79/016
U.S. Environmental Protection Agency. Proposed development document for proposed effluent limitations guidelines, new source performance standards, and pretreatment standards for the leather tanning and finishing point source category. EPA-440/1-79/016. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 381 pp.

0010 2-45 3-70
EPA-440/1-76/083A
U.S. Environmental Protection Agency. Interim final supplement for pretreatment to the development document for the petroleum refining industry existing point source category. EPA-440/1-76/083A. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1977. 115 pp.

0011 2-3 3-117 5-2
Contract No. 68-01-5767
U.S. Environmental Protection Agency. Status report on the treatment and recycle of wastewaters from the car wash industry (draft contractor's report). Contract No. 68-01-5767. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1979.

0012 2-2 3-84 5-1
Contract No. 68-03-2550
U.S. Environmental Protection Agency. Technical support document for auto and other laundries industry (draft contractor's report). Contract No. 68-03-2550. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. Variously paginated.

0013 2-33 3-87

U.S. Environmental Protection Agency. Effluent limitations guidelines and standards for the pharmaceutical manufacturing point source category (draft contractor's report). Prepared for Effluent Guidelines Division, Washington, D.C.; 1979.

0014

U.S. Environmental Protection Agency. Supplement to the draft contractor's engineering report for the development of effluent limitations guidelines for the pharmaceutical point source category (BATEA, NSPS, BCT, BMP, Pretreatment). Prepared for Effluent Guidelines Division, Washington, D.C.; 1979.

0015 2-38 5-22
Contract No. 68-01-4845
U.S. Environmental Protection Agency. Preliminary draft development document for BAT effluent limitations guidelines and new source performance standards for the ore mining and dressing industry, (draft contractor's report). Contract No. 68-01-4845. Prepared for Effluent Guidelines Division, Washington, D.C.; 1979.

0016 1-46 2-38 3-66 5-22
Contract No. 68-01-4845
U.S. Environmental Protection Agency. Draft development document for BAT effluent limitations guidelines and new source performance standards for the ore mining and dressing industry (draft contractor's report). Contract No. 68-01-4845. Prepared for Effluent Guidelines Division, Washington, D.C.; 1979. Variously paginated.

0017 3-83
Contract No. 68-01-4379
U.S. Environmental Protection Agency. Foundry industry (draft contractor's report). Contract No. 68-01-4379. U.S. Environmental Protection Agency, Washington, D.C.; 1979.

0018 1-51 2-50 3-28 5-30
Contract No. 68-01-4673
U.S. Environmental Protection Agency. Review of best available technology for the rubber processing point source category (draft contractor's report). Contract No. 68-01-4673. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1978. Variously paginated.

0019 3-75 5-44
EPA-440/1-78/060e PB 285 480
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and standards for the pesticide chemicals manufacturing point source category. EPA-440/1-78/060e. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1978. 316 pp.

0021 3-69
EPA 440/1-76/060b
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the gum and wood chemicals

manufacturing. EPA 440/1-76/060b. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976.

0022
EPA-440/1-78/061d PB 286 520
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the ore mining and dressing point source category, Volume I. EPA-440/1-78/061d. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1978.

0023 1-64 2-37 3-25
EPA-440/1-78/061e PB 286 521
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the ore mining and dressing point source category, Volume II. EPA-440/1-78/061e. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1978.

0024 3-82
Contract No. 68-01-4624
U.S. Environmental Protection Agency. Preliminary data base for review of BATEA effluent limitations guidelines, NSPS, and pretreatment standards for the pulp, paper, and paperboard point source category. Contract No. 68-01-4624. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979.

0025 1-43 2-30 3-15 5-19

U.S. Environmental Protection Agency. Technical review of the best available technology, best demonstrated technology, and pretreatment technology for the gum and wood chemicals point source category (draft contractor's report). Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1978.

0026
EPA-440/1-75/057
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and new source performance standards for the coal mining point source category. EPA 440/1-75/057. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0030 2-1

NRDC Consent Decree Industry Summary, 1979.
- Auto and Other Laundries
- Coal Mining

- Coil Coating Industry
- Electroplating
- Explosive Manufacturing
- Foundries
- Gum and Wood Chemicals
- Inorganic Chemicals
- Iron and Steel Industry
- Leather Tanning and Finishing Industry
- Rubber Processing
- Nonferrous Metals Manufacturing Industry
- Ore Mining and Dressing
- Paint and Ink Formulation
- Petroleum Refining
- Porcelain Enameling
- Pulp, Paper, and Paperboard Industry
- Steam Electric Power
- Textile Mills
- Timber Products
- POTW

0031 3-103
EPA-600/2-76/197 PB 265 363
Petersen, R.J., and K.E. Cobian. New membranes for treating metal finishing effluents by reverse osmosis. EPA-600/2-76/197. Prepared for IERL, Cincinnati, Ohio; 1976. 59 pp.

0032 3-93
EPA-600/2-77/104 PB 271 015
Bollyky, L.J. Ozone treatment of cyanide bearing plating waste. EPA-600/ 2-77/104. Prepared for IERL, Cincinnati, Ohio; 1977. 43 pp.

0033 3-109
EPA-600/2-73/024 PB 234 447
Treatment and recovery of fluoride industrial wastes. EPA-600/ 2-73/024. Grumman Aerospace Corporation, Bethpage, N.Y.; 1974.

0034 3-36, 46 5-52
EPA/SW-148C PB 275 287
U.S. Environmental Protection Agency. Physical, chemical, and biological treatment techniques for industrial wastes. EPA/SW-148C. U.S. Environmental Protection Agency, Office of Solid Waste, Washington, D.C.; 1976.

0035 2-26
EPA-440/1-79/072a
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the porcelain enameling point source category. EPA-400/1-79/072a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 588 pp.

0036 3-92
Contract No. DADA 17-73-C-3025
Chian, E.S.K., M.N. Aschauer, and H.H.P. Fang. Evaluation of new reverse osmosis membranes for the separation of toxic compounds from wastewater. Contract No. DADA 17-73-C-3025. U.S. Army Medical Research and Development Command, Washington, D.C.; 1975. 309 pp.

0037 3-89
Contract No. 68-02-1874
Klieve, J.R., and G.D. Rawlings. Source assessment: textile plant wastewater toxics study phase II. Contract No. 68-02-1874. U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1979. 127 pp.

0038 3-107
Contract No. 68-02-1874
Rawlings, G.D. Evaluation of hyperfiltration treated textile wastewaters. Contract 68-02-1874. U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1978.

0039 3-106 5-46
EPA-600/2-79/006
U.S. Environmental Protection Agency. Selected biodegradation techniques for treatment and/or ultimate disposal of organic materials. EPA-600/2-79/006. Prepared for IERL, Cincinnati, Ohio; 1979. 377 pp.

0040
EPA-440/1-77/084
U.S. Environmental Protection Agency. Supplement for pretreatment to the development document for the steam electric power generating point source category. EPA-440/1-77/084. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1977. 244 pp.

0041
EPA-440/1-74/029a PB 240 853
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the steam electric generating point source category. EPA-440/1-74/029-a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1974.

0042 2-61* 5-34
EPA-440/1-79/300
U.S. Environmental Protection Agency. Fate of priority pollutants in publicly owned treatment works-pilot study. EPA-440/1-79/300. Prepared for Effluent Guidelines Division, Office Water and Waste Management, Washington, D.C.; 1979. 33 pp.

0043
EPA-440/1-79/024a
U.S. Environmental Protection Agency. Draft development document for proposed effluent limitation guidelines and standards for the iron and steel manufacturing point source category, Volume III. EPA-440/1-79/024a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 308 pp.

0044 3-51
EPA-430/9-78/009
U.S. Environmental Protection Agency. Innovative and alternative technology assessment manual. EPA-430/9-78/009 (draft). Prepared for MERL, Cincinnati, Ohio; 1978. 252 pp.

0045 3-110
Contract No. 68-03-2579
U.S. Environmental Protection Agency. Priority pollutant treatability review, industrial sampling and assessment. Contract 68-03-2579. U.S. Environmental Protection Agency, Cincinnati, Ohio; 1978. 47 pp.

0046 3-90
EPA-600/2-78/004h PB 280 959
Rawlings, G.D. Source assessment: textile plant wastewater toxics study phase I. EPA-600/2-78/004h. Prepared for Office of Energy, Minerals, and Industry, IERL, Research Triangle Park, North Carolina; 1979. 153 pp.

0047 3-112 5-43
No. W77-05337 PB 264 534
Olem, H. The rotating biological contactor for biochemical ferrous iron oxidation in the treatment of coal mine drainage. No. W77-05337. Penn State University, Prepared for U.S. Department of Commerce, Office of Water Research and Technology, Washington, D.C.; 1975.

0051

Rosene, Michael R. Application of a polyani-based adsorption model to the competitive adsorption of solids from water solution onto activated carbon. Presented to K. Dostal from Calgon Corp.; 1979.

0052 3-115
EPA-600/2-78/192 PB 288 402
Kleper, M.H., A.Z. Gollan, R.L. Goldsmith, and K.J. McNulty. Assessment of best available technology economically achievable for synthetic rubber manufacturing wastewater. EPA-600/2-78/192. Prepared for IERL, Office of Research and Development, Cincinnati, Ohio; 1978. 182 pp.

0053
EPA-560/6-76/006 PB 251 433
U.S. Environmental Protection Agency. Assessment of wastewater management, treatment technology, and associated costs for abatement of PCB's concentrations in industrial effluents. EPA-560/6-76/006. Office of Toxic Substances, Washington, D.C.; 1976.

0054
EPA-440/1-74/030A PB 241 916
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the fabricated and reclaimed rubber segment of the rubber processing point source category. EPA-440/1-74/030A. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1974.

0055
EPA-440/1-74/004-a PB 238 651
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards-feedlots point source category. EPA-440/1-74/004-a. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974.

0056 2-19
EPA 440/1-79/071a
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the coil coating point source category. EPA 440/1-79/071a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1979.

0057
EPA-440/1-74/007a PB 238 611
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and NSPS for the major inorganic products point source category. EPA-440/1-74/007a. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974.

0058 2-46 3-21

U.S. Environmental Protection Agency. Draft development document including the data base for the review of effluent limitations guidelines (BATEA), new source performance standards, and pretreatment standards for the petroleum refining point source category. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1978.

0059 2-44 5-28
EPA-440/1-74/014a PB 238 612
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the petroleum refining point source category. EPA-440/1-74/014a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1974. 195 pp.

0060 3-72
EPA-400/1-75/060
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the pharmaceutical manufacturing point source category. EPA-400/1-75/060. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976. 331 pp.

0061
Contract No. 68-03-2610
U.S. Environmental Protection Agency. Study of effectiveness of activated carbon technology for the removal of specific materials from organic chemical processes. EPA Contract No. 68-03-2610. Final report on Pilot Operations at USS Chemical, Nevella. 1979.

0062
EPA-440/1-74/028A PB 238 316
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the grain processing segment of the grain mills point source category. EPA-440/1-74/028A. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974.

0063
EPA-440/1-75/042A PB 240 863
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the formulated fertilizer segment of the fertilizer manufacturing point source category. EPA-440/1-75/042A. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0064
EPA-440/1-74/001c PB 238 907
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the flat glass segment of the glass manufacturing point source category. EPA-440/1-74/001c. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974.

0065
EPA-440/1-75/041a PB 256 840
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the fish meal, salmon, bottom fish, clam, oyster, sardine, scallop, herring, and abalone segment of the canned and preserved fish and seafood processing industry point source category. EPA-440/1-75/041a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975. 485 pp.

0066
EPA-440/1-74/001b PB 238 078
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the insulation fiberglass manufacturing segment of the glass manufacturing point source category. EPA-440/1-74/001b. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974.

0067
Contract No. 68-01-1507
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and new source performance standards for the iron and steel foundry industry. Contract No. 68-01-1507. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0068 3-74 5-7
EPA-440/1-74/016a PB 238 648
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the leather tanning and finishing point source category. EPA-440/1-74/016a. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974. 157 pp.

0069
Contract No. 68-01-2914
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and new source performance standards for the machinery and mechanical products manufacturing point source category, Vol. I. Contract No. 68-01-2914. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0070
Contract No. 68-01-2914
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and new source performance standards for the machinery and mechanical products manufacturing

point source category, Vol. II. Contract No. 68-01-2914. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0071
Contract No. 68-01-2914
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and new source performance standards for the machinery and mechanical products manufacturing point source category, Vol. III. Contract No. 68-01-2914. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0072
Contract No. 68-01-2914
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and new source performance standards for the machinery and mechanical products manufacturing point source category, Vol. IV. Contract No. 68-01-2914. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0073
EPA-440/1-74/009A PB 241 905
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the major organic products segment of the organic chemicals manufacturing point source category. EPA-440/1-74/009A. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1974.

0074

U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and new source performance standards for the miscellaneous foods and beverages point source category. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0075
EPA-440/1-74/006a PB 241 018
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the phosphoric derived chemicals segment of the phosphate manufacturing point source category. EPA-440/1-74/006a. Prepared for Effluent Guidelines Division Office of Water and Hazardous Materials, Washington, D.C.; 1974.

0076 3-80
EPA-440/1-74/023a PB 240 811
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the plywood, hardboard, and wood preserving segment of the timber products processing point source category. EPA-440/1-74/023a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1974.

0077
EPA-440/1-75/034a PB 256-854
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the pressed and blown glass segment of the glass manufacturing point source category. EPA-440/1-75/034a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0078
EPA-440/1-74/019d PB 240 859
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the primary aluminum smelting subcategory of the aluminum segment of the nonferrous metals manufacturing point source category. EPA-440/1-74/019d. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974.

0079
EPA-440/1-74/012a PB 238 836
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the red meat processing segments of the meat products and rendering processing point source category. EPA-440/1-74/012a. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974.

0080
EPA-440/1-74/019c PB 238 464
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the secondary aluminum smelting subcategory of the aluminum segment of the nonferrous metals manufacturing point source category. EPA-440/1-74/019c. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974.

0081
EPA-440/1-74/008a PB 238 650
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the smelting and slag processing segments of the ferro-

alloy manufacturing point source category. EPA-440/1-74/008a. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974.

0082
EPA-440/1-74/024a PB 238 837
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the steel making segment of the iron and steel manufacturing point source category. EPA-440/1-74/024a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1974.

0083
EPA-440/1-75/036b PB 240 862
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the synthetic polymer segment of the plastics and synthetic materials manufacturing point source category. EPA-440/1-75/036b. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0084 3-79 5-48
EPA-440/1-74/010a PB 239 241
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the synthetic resins segment of the plastics and synthetic materials manufacturing point source category. EPA-440/1-74/010a. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974. 238 pp.

0085
EPA-440/1-74/022a PB 238 832
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the textile mills point source category. EPA-440/1-74/022a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1974.

0086 1-54 2-57 3-24 5-32
EPA-440/1-79/022b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the textile mills point source category. EPA-440/1-79/022b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 678 pp.

0087 1-55 2-60 3-22 5-33
EPA-440/1-79/023b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the timber products processing point source category. EPA-440/

1-79/023b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 427 pp.

0088 3-67
EPA-440/1-74/013a PB 238 609
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the tire and synthetic segment of the rubber processing point source category. EPA-440/1-74/013a. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974. 193 pp.

0089
EPA-440/1-75/046
U.S. Environmental Protection Agency. Development document for interim final and proposed effluent limitations guidelines and new source performance standards for the fruits, vegetables, and specialties segment of the canned and preserved fruits and vegetables point source category. EPA-440/1-75/046. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975. 520 pp.

0090
EPA-440/1-75/061
U.S. Environmental Protection Agency. Development document for interim final and proposed effluent limitations guidelines and new source performance standards for the ore mining and dressing industry point source category, Vol. I. EPA-440/1-75/061. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0091
EPA-440/1-75/061
U.S. Environmental Protection Agency. Development document for interim final and proposed effluent limitations guidelines and new source performance standards for the ore mining and dressing industry point source category, Vol. II. EPA-440/1-75/061. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0092
EPA-440/1-76/047a
U.S. Environmental Protection Agency. Development document for interim final and proposed effluent limitations guidelines and proposed new source performance standards for the bleached kraft, groundwood, sulfite, soda, deink, and non-integrated paper mills segment of the pulp, paper, and paperboard point source category, Vol. I. EPA-440/1-76/047a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976.

0093
EPA-440/1-76/047a
U.S. Environmental Protection Agency. Development document for interim final and proposed effluent limitations guidelines and proposed new source performance standards for the bleached kraft, groundwood, sulfite, soda, deink, and non-integrated paper mills segment of the pulp, paper, and paperboard point source category, Vol. II. EPA-440/1-76/047a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976.

0094
EPA-440/1-75/038
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the calcium carbide segment of the ferroalloy manufacturing point source category. EPA-440/1-75/038. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0095
EPA-440/1-76/060h
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the carbon black manufacturing point source category. EPA-440/1-76/060h. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976.

0096
EPA-440/1-76/057a
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and new source performance standards for the coal mining point source category. EPA-440/1-76/057a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976.

0097 3-119 5-18
EPA-440/1-76/060j
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the explosives manufacturing point source category. EPA-440/1-76/060j. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976. 215 pp.

0098
EPA-440/1-76/048b
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the forming, finishing, and speciality steel segment of the iron and steel manufacturing point source category, Vol. I. EPA-440/1-76/048b. Prepared for

Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976.

0099
EPA-440/1-76/048b
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the forming, finishing, and speciality steel segment of the iron and steel manufacturing point source category, Vol II. EPA-440/1-76/048b. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976.

0100
EPA-440/1-75/032a
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the lead segment of the non-ferrous metals manufacturing point source category. EPA-440/1-75/032a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0101
EPA-440/1-76/055a
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the oil and gas extraction point source category. EPA-440/1-76/055a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976.

0102
EPA-440/1-75/043
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the other non-fertilizer phosphate chemicals segment of the phosphate manufacturing point source category. EPA-440/1-75/043. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0103
EPA-440/1-76/0601
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the photographic processing subcategory of the photographic point source category. EPA-440/1-76/0601. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1976.

0104
EPA-440/1-75/044
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the raw cane sugar processing segment of the sugar processing point source category. EPA-440/1-75/044. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975. 291 pp.

0105 3-77
EPA-440/1-75/032b
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and new source performance standards for the primary copper smelting subcategory of the copper segment of the non-ferrous metals manufacturing point source category. EPA-440/1-75/032b. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975. 213 pp.

0106
EPA-440/1-75/032C
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the secondary copper subcategory of the copper segment of the nonferrous metals manufacturing point source category. EPA-440/1-75/032C. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0107 3-26
EPA-440/1-75/045
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and new source performance standards for the significant organic products segment of the organic chemicals manufacturing point source category. EPA-440/1-75/045. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975. 391 pp.

0108
EPA-440/1-75/032
U.S. Environmental Protection Agency. Development document for interim final effluent limitations guidelines and proposed new source performance standards for the zinc segment of the non-ferrous metals manufacturing point source category. EPA-440/1-75/032. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1975.

0109
EPA-440/1-74/030
U.S. Environmental Protection Agency. Development document for proposed effluent limitations guidelines and new source performance standards for the fabricated and reclaimed rubber segment of the rubber processing point source category. EPA-440/1-74/030. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1974.

0110
EPA-440/1-79/024a
U.S. Environmental Protection Agency. Draft development document for proposed effluent limitations guidelines and standards for the iron and steel manufacturing point source category, Volume I. EPA-440/1-79/024a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979.

0111
EPA-440/1-79/024a
U.S. Environmental Protection Agency. Draft development document for proposed effluent limitations guidelines and standards for the iron and steel manufacturing point source category, Volume II. EPA-440/1-79/024a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979.

0112
EPA-440/1-79/024a
U.S. Environmental Protection Agency. Draft development document for proposed effluent limitations guidelines and standards for the iron and steel manufacturing point source category, Volume IV.. EPA-440/1-79/024a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 446 pp.

0113
EPA-440/1-79/024a
U.S. Environmental Protection Agency. Draft development document for proposed effluent limitations guidelines and standards for the iron and steel manufacturing point source category, Volume VII. EPA-440/1-79/024a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 419 pp.

0114
EPA-440/1-79/024a
U.S. Environmental Protection Agency. Draft development document for proposed effluent limitations guidelines and standards for the iron and steel manufacturing point source category, Volume VIII. EPA-440/1-79/024a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 768 pp.

0115
EPA-440/1-74/036
U.S. Environmental Protection Agency. Development document for proposed effluent limitations guidelines and new source performance standards for the synthetic polymers segment of the plastics and synthetic materials manufacturing point source category. EPA-440/1-74/036. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1974.

0116
EPA-440/1-73/010
U.S. Environmental Protection Agency. Development document for proposed effluent limitations guidelines and new source performance standards for the synthetic resins segment of the plastics and synthetic materials manufacturing point source category. EPA-440/ 1-73/010. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1973.

0117
EPA-440/1-74/036a
U.S. Environmental Protection Agency. Addendum to development document for proposed effluent limitations guidelines and new source standards for the synthetic resins segment of the plastics and synthetic materials manufacturing point source category. EPA-440/1-74/036a. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974.

0119
EPA-440/1-74/033A
U.S. Environmental Protection Agency. Development document for proposed effluent limitations guidelines and new source performance standards for the wood furniture and fixture manufacturing segment of the timber products processing point source category. EPA-440/1-74/033A. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1974.

0120 3-73
EPA-440/1-78/085
U.S. Environmental Protection Agency. Development document for proposed existing source pretreatment standards for the electroplating point source category. EPA-440/1-78/085. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1978. 532 pp.

0121 2-27

U.S. Environmental Protection Agency. Technical review for the BAT analysis of the explosives industry (draft contractor's report). Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1979. 215 pp.

0122 1-31 2-6 3-4 5-5
EPA-440/1-79/007
U.S. Environmental Protection Agency. Draft development document including the data base for effluent limitations guidelines (BATEA), new source performance standards, and pretreatment standards for the inorganic chemicals manufacturing point source category. EPA-440/1-79/007. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1979. 934 pp.

0125
PB 198 519
Coughlin, R.W. Effect of surface groups on adsorption of pollutants. Prepared for the Water Quality Office, Environmental Protection Agency, 1970.

0129

Environmental assessment data systems. EADS.

0135
EPA-600/4-76/062 PB 265 470
Shackelford, W.M., and L.H. Keith. Frequency of organic compounds identified in water. EPA-600/4-76/062. Prepared for Environmental Research Laboratory, Research and Development, Athens, GA; 1976.

0136

Chen, Y.R., and A.G. Hashimoto. A generalized model for substrate utilization kinetics.

0137
W71-05157 PB 197 864
Bloom, R., C.B. Hopkins, and W.J. Weber, Jr. Granular carbon treatment of raw sewage. W71-05157. Prepared for the Federal Water Quality Administration, Department of the Interior. Cincinnati, OH; 1970.

0139 1-49 2-47 3-116 5-27
EPA-440/1-79/014b
U.S. Environmental Protection Agency. Development document for proposed effluent limitations guidelines, new source performance standards, and pretreatment standards for the petroleum refining point source category. EPA-440/1-79/014b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 366 pp.

0140
EPA-440/1-79/024a
U.S. Environmental Protection Agency. Draft development document for proposed effluent limitations guidelines and standards for the iron and steel manufacturing point source category, Volume V.

EPA-440/1-79/024a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 435 pp.

0141
EPA-440/1-79/024a
U.S. Environmental Protection Agency. Draft development document for proposed effluent limitations guidelines and standards for the iron and steel manufacturing point source category, Volume VI. EPA-440/1-79/024a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 389 pp.

0142
EPA-440/1-79/024a
U.S. Environmental Protection Agency. Draft development document for proposed effluent limitations guidelines and standards for the iron and steel manufacturing point source category, Volume IX. EPA-440/1-79/024a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 758 pp.

0144 3-88 5-23
EPA-600/2-79/080 PB 299 291
CoCo, J.H., E. Klein, D. Howland, J.H. Mayes, W.A Myers, E. Pratz, C.J. Romero, and F.H. Yocum. Development of treatment and control technology for refractory petrochemical wastes (draft report). EPA-600/2-79/080. Prepared for RSKERL, Office of Research and Development, Ada, Oklahoma; 1979. 220 pp.

0145 1-16

U.S. Environmental Protection Agency. Report on visit of D. Stephan and W. Cawley, U.S. Environmental Protection Agency, to Calgon Environmental Systems Division, Calgon Corporation, Pittsburgh, Pennsylvania; 1979. 132 pp.

0146
EPA-440/1-73/029
U.S. Environmental Protection Agency. Development document for proposed effluent limitations guidelines and new source performance standards for the steam electric power generating point source category. EPA-440/1-73/029. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974. 677 pp.

0147 3-94 5-3
EPA-600/2-78/177 PB 287 830
Kleper, M.H., R.L. Goldsmith, and A.Z. Gollan. Demonstration of ultrafiltration and carbon adsorption for treatment of industrial laundering wastewater. EPA-600/2-78/177. Prepared for IERL Office of Research and Development, Washington, D.C.; Cincinnati, Ohio; 1978. 109 pp.

0148
EPA-440/1-74/021a PB 238 835
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the dairy products processing point source category. EPA-440/1-74/021a. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1974. 167 pp.

0149 1-47 2-40 3-20 5-26

U.S. Environmental Protection Agency. Draft engineering report for development of effluent limitations guidelines for the paint manufacturing industry (BATEA, NSPS, pretreatment). Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1979.

0150 1-48 2-41 3-19 5-25

U.S. Environmental Protection Agency. Draft engineering report for development of effluent limitations guidelines for the ink manufacturing industry (BATEA, NSPS, pretreatment). Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1979.

0151 1-52 2-54
EPA-230/2-73/026 PB 256 313
U.S. Environmental Protection Agency. Economic analysis of effluent guidelines for the soap and detergent industry. EPA-230/2-73/026. Prepared for Effluent Guidelines Division, Office of Planning and Evaluation, Washington, D.C.; 1976.

0152 3-95 5-45
EPA-600/2-78/176 PB 287 823
Kleper, M.H., R.L. Goldsmith, T.V. Tran, D.H. Steiner, J. Pecevich, and M.A. Sakillaris. Treatment of wastewaters from adhesives and sealants manufacturing by ultrafiltration. EPA-600/2-78/176. Prepared for IERL, Office of Research and Development, Cincinnati, Ohio; 1978. 120 pp.

0153 3-96 5-41
EPA-600/2-77/170 PB 272 473
McNulty, K.J., R.L. Goldsmith, A. Gollan, S. Hossain, and D. Grant. Reverse osmosis field test: treatment of copper cyanide rinse waters. EPA-600/2-77/170. Prepared for IERL, Office of Research and Development, Cincinnati, Ohio; 1977. 89 pp.

0154 3-91
EPA-600/2-78/040 PB 280-944
Davis, H.J., F.S. Model, and J.R. Leal. PBI reverse osmosis membrane for chromium plating rinse water. EPA-600/2-78/040.

Prepared for IERL, Office of Research and Development, Cincinnati, Ohio; 1978. 28 pp.

0155 3-111 5-50
EPA-600/2-78/129 PB 285 060
U.S. Environmental Protection Agency. Effects of liquid detergent plant effluent on the rotating biological contactor. EPA-600/2-78/129. Prepared for IERL, Office of Research and Development, Cincinnati, Ohio; 1978. 58 pp.

0156 1-5
EPA-600/8-77/005 PB 268 029
U.S. Environmental Protection Agency. Manual of treatment techniques for meeting the interim primary drinking water regulations. EPA-600/8-77/005. MERL, Office of Research and Development, Cincinnati, Ohio; 1977. 73 pp.

0157 3-102 5-42
EPA-600/2-76/060 PB 251 188
Brandon, C.A., and J.J. Porter. Hyperfiltration for renovation of textile finishing plant wastewater. EPA-600/2-76/060. Prepared for IERL, Office of Energy, Minerals and Industry, Research Triangle Park, North Carolina; 1976. 147 pp.

0158 2-52 3-30
EPA-440/1-74/018a PB 238 613
U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and new source performance standards for the soap and detergent manufacturing point source category. EPA-440/1-74/018a. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1974. 202 pp.

0159 3-125 5-47
EPA-600/2-76/123 PB 262 979
Schimmel, C., and D.B. Griffin. Treatment and disposal of complex industrial wastes. EPA-600/2-76/123. Prepared for IERL, Office of Research and Development, Cincinnati, Ohio; 1976.

0160
EPA-440/1-74/18
U.S. Environmental Protection Agency. Development document for proposed effluent limitations guidelines and new source performance standards for the soap and detergent manufacturing point source category. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1973.

0161 1-29 2-4 3-1

U.S. Environmental Protection Agency. Development document for effluent limitations guidelines and standards for the auto and other laundries point source category. Prepared for Effluent

Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 157 pp.

0162 2-7
40CFR415
U.S. Environmental Protection Agency. Effluent guidelines and standards for inorganic chemicals (40CFR415; 39FR9612, March 12, 1974; amended as shown in Code of Federal Regulations, Vol. 40, revised as of July 1, 1976; 41FR51599 and 51601, November 23, 1976; 42FR17443, April 1, 1977, 42FR10681, February 23, 1977; 42FR37294, July 20, 1977).

0163 2-8 3-5 5-6
EPA-440/1-80/024b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source category; general. EPA-440/1-80/024b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 456 pp. Volume I.

0164 1-32 2-9 3-6
EPA-440/1-80/024b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source category; coke making subcategory, sintering subcategory, iron making subcategory. EPA-440/1-80/024b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 434 pp. Volume II.

0165 1-32 2-10 3-7
EPA-440/1-80/024b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source category; steel making subcategory, vacuum degassing subcategory, continuous casting subcategory. EPA-440/1-80/024b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 488 pp. Volume III.

0166 1-32 2-11 3-8
EPA-440/1-80/024b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source category; hot forming subcategory. EPA-440/1-80/024b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 374 pp. Volume IV.

0167 1-32 2-12 3-9
EPA-440/1-80/024b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source category; scale removal subcategory, acid pickling subcategory. EPA-440/1-80/024b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington D.C.; 1980. 512 pp. Volume V.

0168 1-32 2-13 3-10
EPA-440/1-80/024b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source category; cold forming subcategory, alkaline cleaning subcategory, hot coating subcategory. EPA-440/1-80/024b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 576 pp. Volume VI.

0169 2-15
40CFR425
U.S. Environmental Protection Agency. Effluent guidelines and standards for leather tanning and finishing. 40CFR425; 42FR15703, March 23, 1977.

0170 1-34 2-16 3-27 5-9
EPA-440/1-80/073a
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the aluminum forming point source category. EPA-440/1-80/073a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 604 pp.

0171 1-35 2-17 3-12 5-10
EPA-440/1-80/067a
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the battery manufacturing point source category. EPA-440/1-80/067a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 823 pp.

0172 1-36 2-18 3-16 5-11
EPA-440/1-81/071b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the coil coating point source category. EPA-440/1-81/071b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1981. 481 pp.

0173 1-37 2-20 3-31 5-12
EPA-440/1-80/075a
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the elec-

trical and electronic components point source category. EPA-440/1-80/075a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. Variously paginated.

0174 1-38 2-21 3-17 5-13
EPA-440/1-80/070a
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the foundries (metal molding and casting) point source category. EPA-440/1-80/070a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 860 pp.

0175 1-39 2-22 3-23 5-14
EPA-440/1-80/091a
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the metal finishing point source category. EPA-440/1-80/091a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. Variously paginated.

0176 2-23 3-3
EPA-440/1-79/003
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the electroplating point source category. EPA-440/1-79/003. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1979. 526 pp.

0177 1-40 2-24 3-32 5-15
EPA-440/1-80/077a
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the photographic equipment and supplies segment of the photographic point source category. EPA-440/1-80/077a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. Variously paginated.

0178 1-41 2-25 3-13 5-16
EPA-440/1-81/072b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the porcelain enameling point source category. EPA-440/1-81/072b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1981. 515 pp.

0179 2-28
40CFR457
U.S. Environmental Protection Agency. Effluent guidelines and standards for explosive manufacturing. 40 CFR457; 41FR10180, 1976.

0180 1-42 2-29 3-14 5-17

U.S. Environmental Protection Agency. Final development document for proposed effluent limitations guidelines, new source performance standards and pretreatment standards for the explosives manufacturing point source category; subcategory E, formulation and packaging of blasting agents, dynamite, and pyrotechnics. Performed by Hydro-science for the Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. Variously paginated.

0181 2-31
40CFR454
U.S. Environmental Protection Agency. Effluent guidelines and standards for gum and wood chemicals manufacturing. 40CFR454; 41FR20506, 1976.

0182 1-44 2-32 3-2 5-20
EPA-440/1-80/084a
U.S. Environmental Protection Agency. Contractor's engineering report for the development of effluent limitations guidelines and standards for the pharmaceutical manufacturing point source category. EPA-440/1-80/084a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. Variously paginated.

0183 2-34
40CFR439
U.S. Environmental Protection Agency. Effluent guidelines and standards for pharmaceutical manufacturing. 40CFR439; 41FR506 76, November 17, 1976; Amended by 42FR6813, February 1977.

0184 1-45 2-35 3-29 5-21
EPA-440/1-79/019a
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines and standards for the nonferrous metals manufacturing point source category. EPA-440/1-79/019a. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1979. 622 pp.

0185 2-36
40CFR421
U.S. Environmental Protection Agency. Effluent guidelines and standards for nonferrous metals. 40CFR421; 39FR12822, April 8, 1974; Amended by 40FR8514, February 27, 1975; 40FR48348, October 15, 1975; 41FR 54850, December 15, 1976.

0186 2-39
40CFR440
U.S. Environmental Protection Agency. Effluent guidelines and standards for ore mining and dressing. (40CFR440, November 6, 1975; 41FR21191, May 24, 1976; 42FR3165, January 17, 1977;

43FR29771 July, 11, 1978; 44FR7953, February 8, 1979; 44FR11546, March 1, 1979). p. 135:0881.

0187 2-42
40CFR446
U.S. Environmental Protection Agency. Effluent guidelines and standards for paint formulating. 40CFR446; 40FR31723, July 28, 1975.

0188 2-43
40CFR447
U.S. Environmental Protection Agency. Effluent guidelines and standards for ink formulating. 40CFR447; 40FR31723, July 28, 1975.

0189 1-50 2-48 3-18 5-29
EPA-440/1-80/025b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the pulp, paper and paperboard and the builders paper and board mills point source categories. EPA-440/1-80/025b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 632 pp.

0190 2-49
40CFR430
U.S. Environmental Protection Agency. Effluent guidelines and standards for the pulp, paper and paperboard point source category. 40CFR430; 42FR1399, January 6, 1977.

0191 2-51
40CFR428
U.S. Environmental Protection Agency. Effluent guidelines and standards for rubber processing. 40CFR428; 39FR6660, February 21, 1974 (amended by 39FR26423, July 19, 1974; 40FR2334, January 10, 1975; 40FR 18172, April 25, 1975 [effective May 27, 1975]; and 43FR6230, February 14, 1978).

0192 1-53 2-55 3-35 5-31
EPA-440/1-80/029b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the steam electric point source category. EPA 440/1-80/029b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 597 pp.

0193 2-56
40CFR423
U.S. Environmental Protection Agency. Effluent guidelines and standards for steam electric power generating point source category. 40CFR423; 40FR61619, Sept. 17, 1980.

0194 2-59

MRC internal sampling data on file at Effluent Guidelines Division of EPA, 1978.

0195 2-61

Clement Associates, Inc. Description of the organic chemicals and plastics industry, Section 4.0 (working paper). Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1981. 35 pp. plus appendices.

0196 2-62 3-37

Catalytic, Inc. Draft partial report on evaluation of organic chemicals and plastics and synthetics. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1981. Variously paginated.

0197 2-63 5-54

JRB Associates, Inc. Organic chemicals industry priority pollutant data; data listings, descriptive statistics and percent reduction. Memorandum, J. Ackermann, JRB, to C. Norwood, JRB, 8 June 1981; modified by EPA Effluent Guidelines Division. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1981. Variously paginated.

0198 2-64 5-55

Wise, Hugh E., and Paul D. Fahrenthold. Occurrence and predictability of priority pollutants in wastewaters of the organic chemicals and plastics/synthetic fibers industrial categories. Presented in part at the 181st American Chemical Society National Meeting, Division of Industrial and Engineering Chemistry, Symposium on Treatability of Industrial Aqueous Effluents, Atlanta, Georgia, March 29-April 3, 1981. 40 pp.

0199 2-65

Fahrenthold, Paul D., and Hugh Wise. Toxic pollutants in the organic chemicals industry. Presented at 52nd Annual Conference of the Water Pollution Control Federation, Session 24, October 9, 1979.

0200 5-60

Walk, Haydel & Associates, Inc. Contractors engineering report analysis of organic chemicals and plastics and synthetic resin industries; Conventional and nonconventional pollutant parameters, Volumes I and II. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; October 30, 1981. Variously paginated.

0201 2-67

JRB Associates, Inc. Priority pollutant analysis (with supplemental data listing). Memorandum, J. Ackerman, JRB, to M. Irizarry, EPA, 22 May, 1981; supplemented with additional data, October 1981. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1981. Variously paginated.

0202 1-1
NIOSH-78-104B
Fairchild, E.J., R. J. Lewis, Sr., and R. L. Tatken. Registry of toxic effects of chemical substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio; 1977.

0203 1-2
EPA-440/4-79/029a
Callahan, M.A., M.W. Slimak, N.W. Gabel, I.P. May, C.F. Fowler, et al. Water-related environmental fate of 129 priority pollutants, Volume I. EPA-440/4-79/029a. U.S. Environmental Protection Agency, Washington, D.C.; 1979.

0204 1-3

The Chemical Rubber Company. Handbook of chemistry and physics, 48th Edition. Cleveland, Ohio; 1967.

0205 1-4

The Chemical Rubber Company. Handbook of chemistry and physics, 58th Edition. Cleveland, Ohio; 1977.

0206 1-6

Verschueren, K. Handbook of environmental data on organic chemicals. Van Nostrand Reinhold Company, New York, New York; 1977.

0207 1-7
EPA-440/4-79/029b
Callahan, M.A., M.W. Slimak, N.W. Gabel, I.P. May, C. F. Fowler et al. Water-related environmental fate of 129 priority pollutants, Volume II. EPA-440/4-79/029b. U.S. Environmental Protection Agency, Washington, D.C.; 1979.

0208 1-8
EPA-600/8-80/023 PB80-197320
Dobbs, R.A., and J. M. Cohen. Carbon adsorption isotherms for toxic organics. EPA-600/8-80/023. U.S. Environmental Protection Agency, Cincinnati, Ohio; 1980. 332 pp.

0209 1-9

Merck and Co., Inc. The Merck index, Ninth Edition. Rahway, New Jersey; 1976.

0210 1-10

Fochtman, E.G., and W. Eisenberg. Treatability of carcinogenic and other hazardous organic compounds. Illinois Institute of Technology Research Institute, Chicago, Illinois; 58 pp.

0211 1-11
EPA-440/4-79/029c
Callahan, M.A., M. W. Slimak, N.W. Gabel, I.P. May, C. F. Fowler, et al. Water-related environmental fate of 129 priority pollutants, Volume III, ethers, phthalate esters, and nitrosamines. EPA-440/4-79/029c. U.S. Environmental Protection Agency, Washington, D.C.; 1979.

0212 1-12

Pitter, P. Determination of biological degradability of organic substances. Water Research 10:1-5, 1976.

0213 1-13

National Library of Medicine. Off-line bibliographic citation list generated from the toxicology data bank by MEDLARS II. National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland; 1979. Part I.

0214 1-14

McGraw Hill, Inc. Lange's handbook of chemistry, 12th Edition. New York, New York; 1979.

0215 1-15

Warner, H.P., J. M. Cohen, and J. C. Ireland. Determination of Henry's law constants of selected priority pollutants. U.S. Environmental Protection Agency, Cincinnati, Ohio; 1980. 14 pp.

0216 1-17

Spencer, W. F., and W. J. Farmer. Assessment of the vapor behavior of toxic chemicals. Contribution of Federal Research, SEA, USDA, and the University of California, Riverside, California.

0217 1-18

National Library of Medicine. Off-line bibliographic citation list generated from the toxicology data bank by MEDLARS II.

National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland; 1979. Part II.

0218 1-19

Tucker, E.S., V. M. Saeger, and O. Hicks. Activated sludge primary biodegradation of polychlorinated biphenyls. Monsanto Company, St. Louis, Missouri; 1975. 9 pp.

0219 1-20

Interscience Encyclopedia, Inc. Encyclopedia of chemical technology, Volume 5, 3rd Edition. New York, New York; 1978.

0220 1-21

Meister Publishing Co. 1976 farm chemicals handbook. Willoughby, Ohio; 1976.

0221 1-22
EPA-600/2-75/041
Ferguson, T. L., F. J. Bergman, G. R. Cooper, R. T. Li, and F. I. Honea. Determination of incinerator operating conditions necessary for safe disposal of pesticides. EPA-600/2-75/041. U.S. Environmental Protection Agency, Cincinnati, Ohio; 1975. 415 pp.

0222 1-23

Ouellette, R. P., and J. A. King. Chemical week pesticides register. McGraw-Hill Book Company, New York, New York; 1977.

0223 1-24
EPA-540/9-71/005
Guyer, G. D., P. Adkisson, K. DuBois, C. Menzie, and H. P. Nicholson. Toxaphene status report. EPA-540/9-71/005. U.S. Environmental Protection Agency, Washington, D.C.; 1971. p. 10.

0224 1-25

National Library of Medicine. Off-line bibliographic citation list generated from the toxicology data bank by MEDLARS II. National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland; 1979. Part III.

0225 1-26
EPA-540/1-75/004
Midwest Research Institute. Substitute chemical program-initial scientific and minieconomic review of methyl parathion. EPA-540/1-75/004. Criteria and Evaluation Division, Office of Pesticide Programs, Washington, D.C.; 1975. 187 pp.

0226 1-27

Jordan, T. E. Vapor pressure of organic compounds. Interscience Publishers, Inc., New York, New York; 1954. p. 104.

0227 1-28

Water Purification Associates. Removal of low concentrations of toxic pollutants from wastewaters by steam and air stripping, Appendix: Henry's Law constants (Draft Report). Prepared for U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Cincinnati, Ohio; 1981. Unpaginated.

0228 1-56
45 FR 231
45 Federal Register, No. 231. Water quality criteria documents: availability; Appendix A-Summary of water quality criteria. November 23, 1980. pp. 79318-79379.

0229 3-33

U.S. Environmental Protection Agency. Draft guidance document for effluent limitations guidelines (BATEA), new source performance standards, and pretreatment standards for the photographic processing point source category. Performed by Versar, Inc.; 1980. Variously paginated.

0230 3-38
EPA-625/1-75/003a
U.S. Environmental Protection Agency. Process design manual for suspended solids removal. EPA-625/1-75/003a. Technology Transfer Division; 1975.

0231 3-39

Nemerow, Nelson. Industrial pollution; origins, characteristics, and treatment. Addison-Wesley Publishing Company; 1978. 733 p.

0232 3-40
EPA-625/1-71/004a
U.S. Environmental Protection Agency. Process design manual for upgrading existing wastewater treatment plants. EPA-625/1-71/004a. Variously paginated.

0233 3-41
EPA-625/8-80/003
U.S. Environmental Protection Agency. Control and treatment technology for the metal finishing industry, sulfide precipitation. Summary report. EPA-625/8-80/003. Technology Transfer Division; 1980.

0234 3-42
EPA-625/5-79/016
U.S. Environmental Protection Agency. Economics of wastewater treatment alternatives for the electroplating industry. EPA-625/5-79/016. Prepared for Effluent Guidelines Division, Washington, D.C.; 1979.

0235 3-43
MOP/8
Water Pollution Control Federation. Wastewater treatment plant design, a manual of practice. MOP/8. Water Pollution Control Federation; 1977.

0236 3-44

Eckenfelder, W.W. Industrial water pollution control. New York: McGraw Hill Book Company; 1966.

0237 3-47
No. 76/22
Illinois Institute for Environmental Quality. Technology and economics of industrial pollution abatement. Illinois Institute for Environmental Quality No. 76/22; 1976. Variously paginated.

0238 3-48
EPA-600/2-81/028 PB81-191900
Pojasek, R.B. Making hazardous waste nonhazardous. Published in Proceedings of the Third Conference on Advanced Pollution Control for the Metal Finishing Industry. EPA-600/2-81/028. Cincinnati, Ohio; 1981. pp. 63-64.

0239 3-49

Nitrification and denitrification facilities. Technology transfer series; 1973.

0240 3-50

U.S. Environmental Protection Agency. Nitrogen control process design manual (draft); 1975.

0241 3-52

Metcalf and Eddy. Wastewater engineering: collection treatment disposal. New York: McGraw-Hill Book Co.; 1972.

0242 3-53
EPA-R2-72/110
Kincannon, C.B. Oily waste disposal cultivation process. EPA-R2-72/110. U.S. Environmental Protection Agency, Washington, D.C.; 1972.

0243 3-54
EPA-625/1-77/009
U.S. Environmental Protection Agency. Process design manual wastewater treatment facilities for several small communities. EPA-625/1-77/009. Technology Transfer Division; 1977.

0244 3-55

Pollution Engineering Practice Handbook. Ann Arbor: Ann Arbor Science Publisher, Inc.; 1976.

0245 3-56
EPA-625/1-77/008
U.S. Environmental Protection Agency. Process design manual for land treatment of municipal wastewater. EPA-625/1-77/008. Prepared for Office of Water Program Operations, Environmental Research Information Center, Technology Transfer Division; 1977.

0246 3-57

U.S. Environmental Protection Agency. Upgrading meat packing facilities to reduce pollution. 1973.

0247 3-58

U.S. Environmental Protection Agency. Land treatment of municipal wastewater effluents, design factors; 1976. Volume II.

0248 3-59

U.S. Environmental Protection Agency. Pollution abatement in the fruit and vegetable industry.

0249 3-60
EPA-625/1-79/011
U.S. Environmental Protection Agency. Process design manual sludge treatment and disposal. EPA-625/1-79/011. Prepared for Office of Research and Development; 1979.

0250 3-61

Sludge dewatering design manual. Research Report No. 72. Ministry of the Environment, Ontario, Canada.

0251 3-62
EPS 3-WP-76-4
Proceedings of seminars on water pollution abatement technology in the pulp and paper industry. Report EPS 3-WP-76-4, Environmental Protection Service, Environment Canada; 1976.

0252 3-63

Conway, Richard A., and Richard D. Ross. Handbook of industrial waste disposal. New York: Van Nostrand Reinhold Company; 1980.

0253 3-64

Powers, Philip W. How to dispose of toxic substances and industrial wastes. Park Ridge, NJ: Noyes Data Corporation; 1976.

0254 3-65 5-51
No. 68/01/4827
U.S. Environmental Protection Agency. Revised technical review of the best available technology, best demonstrated technology, and pretreatment technology for the timber products processing point source category. Contract 68/01/4827. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1978. Variously paginated.

0255 3-81
EPA-440/1-73/009
U.S. Environmental Protection Agency. Development document for proposed effluent limitations guidelines and new source performance standards for the major organic products segment of the organic chemicals manufacturing point source category. EPA-440/1-73/009. Prepared for Effluent Guidelines Division, Office of Air and Water Programs, Washington, D.C.; 1973. 369 pp.

0256 3-97

Brunotts, V.A., R.S. Lynch, and G.R. Van Stone. Granular carbon handles concentrated waste. Chemical Engineering Progress 6(8): 81-84; 1973.

0257 3-98

Anonymous. Putting powdered carbon in wastewater treatment. Environmental Science and Technology, Vol. II (9); 1977.

0258 3-99

De, J. and B. Paschal. The effectiveness of granular activated carbon in treatability of municipal and industrial wastewaters. In: Third National Conference on Complete Water Reuse, AIChE and EPA Technology Transfer. pp. 204-211.

0259 3-100

De, J., B. Paschal, and A. D. Adams. Treatment of oil refinery wastewaters with granular and powdered activated carbon. In: Thirtieth Industrial Waste Conference, Purdue University, IN; 1975. pp. 216-232.

0260 3-101

Argaman Y., and C. L. Weddle. Fate of heavy metals physical treatment processes. In: Water 1973 AIChE Symposium Series, Vol. 70, No. 136; 1974.

0261 3-104
EPA-600/2-76/260
Lang, W.C., J.H. Crozier, F.P. Drace, and K.H. Pearson. Industrial wastewater reclamation with a 400,000-gallon-per-day vertical tube evaporator. EPA-600/2-76/260. U.S. Environmental Protection Agency, Cincinnati, OH; 1976. 90 pp.

0262 3-105
EPA Contract No. 68-03-2610
Study of effectiveness of activated carbon technology for the removal of specific materials from organic chemical processes. EPA Contract No. 68-03-2610. Final report on pilot operations at USS Chemical, Nevella.

0263 3-113

Hamilton Standard. Compilation of lime and settling performance data base. Prepared for Effluent Guidelines Division, U.S. Environmental Protection Agency, Washington, D.C.; 1980.

0264 3-114

Ekenfelder, W.W. Water quality for practicing engineers. Barnes and Noble, New York; 1970.

0265 3-118
LCCCN 80-68821
Borchardt, J.A., W.J. Redman, G.E. Jones, and R.T. Spraque. Sludge and its ultimate disposal. Ann Arbor, MI; 1981. 286 pp.

0266 1-65 2-53 3-120 5-56

U.S. Environmental Protection Agency. Project recommendations for the soap and detergent manufacturing industry (SIC 2814) BAT/Toxics Study. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1976. 26 pp.

0267 3-121
EPA-600/2-79/056 PB 299-206
U.S. Environmental Protection Agency. Survey of solidification/stabilization technology for hazardous industrial wastes. EPA-600/2-79/056. Cincinnati, Ohio; 1979. Variously paginated.

0268 3-122 5-59

Weishaar, Michael F. 1981. Letter, Michael F. Weishaar, Manager of Environmental Affairs, Monsanto, to Paul D. Fahrenthold, USEPA Washington Region; 1981. 12 pp.

0269 3-123

Dotson, G.K., R.B. Dean, W.B. Cooke, and B.A. Kennar. Land spreading, a conserving and non-polluting method of disposing of oily wastes. Proceedings of the 5th International Water Pollution Resource Conference, Pergamon Press, New York, NY; 1971.

0270 3-124

Francke, H.C., and F.E. Clark. Disposal of oil wastes by microbial assimilation. Oak Ridge Y-12 Plant, Oak Ridge, TN; 1974.

0272 3-126
LCCCN 78-71431
Vesiland, P.A. Treatment and disposal of wastewater sludges. Ann Arbor Science Publishers, Inc. Ann Arbor, MI; 1980. 323 pp.

0273 3-127

Dick, R.I., and K.W. Young. Analysis of thickening performance of final settling tanks, 27th Purdue University Industrial Waste Conference. Lafayette, IN; 1972.

0274 5-35

Clement Associates, Inc. Analytical methods development, Section 2.4.2.4, working paper for draft development document for effluent limitations guidelines and standards for the organic chemicals manufacturing and plastic and synthetic materials point source categories. Prepared for Organic Chemicals Branch, Effluent Guidelines Division; 1981.

0275 5-36

U.S. Environmental Protection Agency. Sampling and analysis procedures for screening of industrial effluents for priority pollutants. Environmental Monitoring and Support Laboratory, Cincinnati, OH; 1977. 69 pp.

0276 5-37

U.S. Environmental Protection Agency. Analytical methods for the verification phase of the BAT review. Effluent Guidelines Division, Washington, D.C.; 1977.

0277 5-38

American Public Health Association, et al. Standard methods for the examination of water and wastewater. 14th edition; 1975.

0278 5-39
EPA-600/4-79/020
U.S. Environmental Protection Agency. Methods for chemical analysis of water and wastes. EPA-600/4-79/020. Environmental Monitoring and Support Laboratory, Cincinnati, OH; 1979.

0279 5-40

Holtzclaw, P.W., and M.D. Neptune. Approach to quality assurance/quality control in the organic chemicals industry monitoring program. Presented in Journal of Environmental Science and Health, Vol. A15, No. 5. pp 525-543.

0280 5-53

U.S. Environmental Protection Agency. Handbook for analytical quality control in water and wastewater laboratories. Analytical Quality Control Laboratory, National Environmental Research Center, Cincinnati, OH; 1972. Variously paginated.

0281 5-57

Kloepfer, Robert P., Jerry R. Dias, and Billy J. Fairless. Priority pollutant methodology quality assurance review. Reprinted from Chemistry in Water Reuse, Volume 1, Chapter 9, edited by W.J. Cooper, Ann Arbor Science Publishers, Inc.; 1981. pp 207-227.

0282 5-58
Federal Register, Vol. 44
U.S. Environmental Protection Agency. Guidelines established test procedures for the analysis of pollutants; proposed regulations. Federal Register, Vol. 44, No. 233, pp. 69464-69575, as modified by Federal Register, Vol. 44, No. 244, pp. 75028-75052; December, 1979. 135 pp.

0283 1-57

Tabak, Henry H., Stephen Quave, Charles Mashni, and Edwin F. Barth. 1981. Biodegradability studies with organic priority pollutant compounds. In: Journal of the Water Pollution Control Federation; 1981. pp. 1503-1518.

0284 1-58

Sittig, Marshall (Editor). Priority toxic pollutants, health impacts and allowable limits. Noyes Data Corporation, New Jersey; 1980. 348 pp.

0285 1-59

Cohen, Jesse. Letter, M. Jesse Cohen, Chief, Physical-Chemical Treatment Section; Wastewater Research Division, USEPA, to Bob Stevens, WAPORA, 1981. 19 p.

0286 1-60

Tabak, Henry H. Biodegradability studies for predicting fate of organic priority pollutants. To be published in: Proceedings of ADAC Symposium on Test Protocols for Environmental Fate and Movement of Toxicants, 94th Annual ADAC Meeting; Arlington, VA; 1980.

0287 1-61

Bunch, R.L., and C.W. Chambers. A biodegradability test for organic compounds. In: Journal of the Water Pollution Control Federation, Vol. 39; 1967. p. 181.

0288 1-62
EPA-600/2-79/097
U.S. Environmental Protection Agency. Treatability of carcinogenic and other hazardous organic compounds. EPA-600/2-79/097. Prepared by IIT Research Institute; 1979.

0289 1-63
EPA-600/2-81/032 PB 81-171352
U.S. Environmental Protection Agency. Biodegradation and carbon adsorption of carcinogenic and hazardous organic compounds. EPA-600/2-81/032. Prepared by IIT Research Institute; 1980.

0290 1-43* 2-30* 3-144
EPA-440/1-79/078b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the gum and wood chemicals manufacturing point source category. EPA-440/1-79/078b. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1979. 246 pp.

0291 1-48* 2-41* 3-45
EPA-440/1-79/090b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the ink formulating point source category. EPA-440/1-79/090b.

Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1979.

0292 1-55* 2-60*
EPA-440/1-81/023
U.S. Environmental Protection Agency. Final development document for effluent limitations guidelines and standards for the timber products point source category. EPA-440/1-81/023. Prepared for Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, D.C.; 1981. 498 pp.

0293 2-66
Contract No. 68-01-5011
Catalytic, Inc. Preliminary performance data for selected classical pollutants. Contract 68-01-5011. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1981. 10 pp.

0294 1-30 2-5 3-34 5-4
EPA-440/1-81/057b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the coal mining point source category. EPA-440/1-81/057b. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1981. 429 pp. plus appendices.

0295
EPA-600/2-79/082 PB80-108400
Drummond, B.A., and A.H. Laube. Coke quench tower emission testing program. EPA-600/2-79/082. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1979. Variously paginated.

0296
EPA-600/2-79/093 PB80-102882
Hoogheem, T.J., and G.D. Rawlings. Analysis of priority pollutants at a primary zinc production facility. EPA-600/2-79/093. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1979. 46 pp.

0297
EPA-600/2-79/110 PB-300524
Barber, L.K., E.R. Ramirez, and W.L. Zemaitis. Processing chrome tannery effluent to meet best available treatment standards. EPA-600/2-79/110. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1979. 152 pp.

0298
EPA-600/2-79/118 PB80-113889
Gaddis, J.L., and H.G. Spencer. Evaluation of hyperfiltration for separation of toxic substances in textile process water. EPA-600/2-79/118. Prepared for U.S. Environmental Protection Agency,

Office of Research and Development, Washington, D.C.; 1979. 283 pp.

0299
EPA-600/2-79/166 PB80-133184
Caragay, A.B., and Levins, P.L. Evaluation of protocols for pesticides and PCB's in raw wastewater. EPA-600/2-79/166. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1979. 100 pp.

0300
EPA-600/2-79/172 PB80-100456
Humphrey, W.J., and E.R. Witt. Biological treatment of high strength petrochemical wastewater. EPA-600/2-79/172. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Ada, Oklahoma; 1979. 100 pp.

0301
EPA-600/2-79/177 PB80-100522
U.S. Environmental Protection Agency. Activated carbon treatment of industrial wastewaters selected technical papers. EPA-600/2-79/177. Prepared for U.S. Environmental Protection Agency, Office of Energy, Minerals, and Industry, Washington, D.C.; 1979. 286 pp.

0302
EPA-600/2-79/209 PB80-166622
McKinnon, J.T. Advanced filtration of pulp mill wastes. EPA-600/2-79/209. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1979. 100 pp.

0303
EPA-600/7-79/220 PB80-102767
Houle, E.H., S.C. May, A.N. Rogers, V.C. Van der Mast, and M.C. Weeks. Assessment of three technologies for the treatment of cooling tower blowdown. EPA-600/7-79/220. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1979. Variously paginated.

0304
EPA-600/7-79/248 PB80-181134
Goodman R., J.C. Lamb III, F.K. Pfaender, and P.C. Singer. Treatability and assessment of coal conversion wastewaters: phase I. EPA-600/7-79/248. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1979. 178 pp.

0305
EPA-600/9-79/034 PB80-106438
Barth, E.F., and R.L. Bunch. Biodegradation and treatability of specific pollutants. EPA-600/9-79/034. Prepared for U.S.

Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1979. 60 pp.

0306
EPA-440/5-80/015 PB81-117269
U.S. Environmental Protection Agency. Ambient water quality criteria for acenaphthene. EPA-440/5-80/015. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0307
EPA-440/5-80/016 PB81-117277
U.S. Environmental Protection Agency. Ambient water quality criteria for acrolein. EPA-440/5-80/016. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0308
EPA-440/5-80/017 PB81-117285
U.S. Environmental Protection Agency. Ambient water quality criteria for acrylonitrile. EPA-440/5-80/017. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0309
EPA-440/5-80/018 PB81-117293
U.S. Environmental Protection Agency. Ambient water quality criteria for benzene. EPA-440/5-80/018. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0310
EPA-440/5-80/019 PB81-117301
U.S. Environmental Protection Agency. Ambient water quality criteria for aldrin/dieldrin. EPA-440/5-80/019. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0311
EPA-440/5-80/020 PB81-117319
U.S. Environmental Protection Agency. Ambient water quality criteria for antimony. EPA-440/5-80/020. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0312
EPA-440/5-80/021 PB81-117327
U.S. Environmental Protection Agency. Ambient water quality criteria for arsenic. EPA-440/5-80/021. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0313
EPA-440/5-80/022 PB81-117335
U.S. Environmental Protection Agency. Ambient water quality criteria for asbestos. EPA-440/5-80/022. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0314
EPA-440/5-80/023 PB81-117343
U.S. Environmental Protection Agency. Ambient water quality criteria for benzidine. EPA-440/5-80/023. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0315
EPA-440/5-80/024 PB81-117350
U.S. Environmental Protection Agency. Ambient water quality criteria for beryllium. EPA-440/5-80/024. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0316
EPA-440/5-80/025 PB81-117368
U.S. Environmental Protection Agency. Ambient water quality criteria for cadmium. EPA-440/5-80/025. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0317
EPA-440/5-80/026 PB81-117376
U.S. Environmental Protection Agency. Ambient water quality criteria for carbon tetrachloride. EPA-440/5-80/026. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0318
EPA-440/5-80/027 PB81-117384
U.S. Environmental Protection Agency. Ambient water quality criteria for chlordane. EPA-440/5-80/027. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0319
EPA-440/5-80/028 PB81-117392
U.S. Environmental Protection Agency. Ambient water quality criteria for chlorinated benzenes. EPA-440/5-80/028. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0320
EPA-440/5-80/029 PB81-117400
U.S. Environmental Protection Agency. Ambient water quality criteria for chlorinated ethanes. EPA-440/5-80/029. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0321
EPA-440/5-80/030 PB81-117418
U.S. Environmental Protection Agency. Ambient water quality criteria for chloroalkyl ethers. EPA-440/5-80/030. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0322
EPA-440/5-80/031 PB81-117426
U.S. Environmental Protection Agency. Ambient water quality criteria for chlorinated naphthalene. EPA-440/5-80/031. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0323
EPA-440/5-80/032 PB81-117434
U.S. Environmental Protection Agency. Ambient water quality criteria for chlorinated phenols. EPA-440/5-80/032. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0324
EPA-440/5-80/033 PB81-117442
U.S. Environmental Protection Agency. Ambient water quality criteria for chloroform. EPA-440/5-80/033. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0325
EPA-440/5-80/034 PB81-117459
U.S. Environmental Protection Agency. Ambient water quality criteria for 2-chlorophenol. EPA-440/5-80/034. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0326
EPA-440/5-80/035 PB81-117467
U.S. Environmental Protection Agency. Ambient water quality criteria for chromium. EPA-440/5-80/035. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0327
EPA-440/5-80/036 PB81-117475
U.S. Environmental Protection Agency. Ambient water quality criteria for copper. EPA-440/5-80/036. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0328
EPA-440/5-80/037 PB81-117483
U.S. Environmental Protection Agency. Ambient water quality criteria for cyanides. EPA-440/5-80/037. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0329
EPA-440/5-80/038 PB81-117491
U.S. Environmental Protection Agency. Ambient water quality criteria for DDT. EPA-440/5-80/038. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0330
EPA-440/5-80/039 PB81-117509
U.S. Environmental Protection Agency. Ambient water quality criteria for dichlorobenzenes. EPA-440/5-80/039. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0331
EPA-440/5-80/040 PB81-117517
U.S. Environmental Protection Agency. Ambient water quality criteria for dichlorobenzidine. EPA-440/5-80/040. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0332
EPA-440/5-80/041 PB81-117525
U.S. Environmental Protection Agency. Ambient water quality criteria for dichloroethylene. EPA-440/5-80/041. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0333
EPA-440/5-80/042 PB81-117533
U.S. Environmental Protection Agency. Ambient water quality criteria for 2,4-dichlorophenol. EPA-440/5-80/042. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0334
EPA-440/5-80/043 PB81-117541
U.S. Environmental Protection Agency. Ambient water quality criteria for dichloropropane and dichloropropene. EPA-440/5-80/043. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0335
EPA-440/5-80/044 PB81-117558
U.S. Environmental Protection Agency. Ambient water quality criteria for 2,4-dimethylphenol. EPA-440/5-80/044. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0336
EPA-440/5-80/045 PB81-117566
U.S. Environmental Protection Agency. Ambient water quality criteria for dinitrotoluene. EPA-440/5-80/045. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0337
EPA-440/5-80/046 PB81-117574
U.S. Environmental Protection Agency. Ambient water quality criteria for endosulfan. EPA-440/5-80/046. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0338
EPA-440/5-80/047 PB81-117582
U.S. Environmental Protection Agency. Ambient water quality criteria for endrin. EPA-440/5-80/047. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0339
EPA-440/5-80/048 PB81-117590
U.S. Environmental Protection Agency. Ambient water quality criteria for ethylbenzene. EPA-440/5-80/048. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0340
EPA-440/5-80/049 PB81-117608
U.S. Environmental Protection Agency. Ambient water quality criteria for fluoranthene. EPA-440/5-80/049. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0341
EPA-440/5-80/050 PB81-117616
U.S. Environmental Protection Agency. Ambient water quality criteria for haloethers. EPA-440/5-80/050. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0342
EPA-440/5-80/051 PB81-117624
U.S. Environmental Protection Agency. Ambient water quality criteria for halomethanes. EPA-440/5-80/051. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0343
EPA-440/5-80/052 PB81-117632
U.S. Environmental Protection Agency. Ambient water quality criteria for heptachlor. EPA-440/5-80/052. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0344
EPA-440/5-80/053 PB81-117640
U.S. Environmental Protection Agency. Ambient water quality criteria for hexachlorobutadiene. EPA-440/5-80/053. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0345
EPA-440/5-80/054 PB81-117657
U.S. Environmental Protection Agency. Ambient water quality criteria for hexachlorocyclohexane. EPA-440/5-80/054. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0346
EPA-440/5-80/055 PB81-117665
U.S. Environmental Protection Agency. Ambient water quality criteria for hexachlorocyclopentadiene. EPA-440/5-80/055. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0347
EPA-440/5-80/056 PB81-117673
U.S. Environmental Protection Agency. Ambient water quality criteria for isophorone. EPA-440/5-80/056. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0348
EPA-440/5-80/057 PB81-117681
U.S. Environmental Protection Agency. Ambient water quality criteria for lead. EPA-440/5-80/057. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0349
EPA-440/5-80/058 PB81-117699
U.S. Environmental Protection Agency. Ambient water quality criteria for mercury. EPA-440/5-80/058. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0350
EPA-440/5-80/059 PB81-117707
U.S. Environmental Protection Agency. Ambient water quality criteria for naphthalene. EPA-440/5-80/059. Prepared for Effluen Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0351
EPA-440/5-80/060 PB81-117715
U.S. Environmental Protection Agency. Ambient water quality criteria for nickel. EPA-440/5-80/060. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0352
EPA-440/5-80/061 PB81-117723
U.S. Environmental Protection Agency. Ambient water quality criteria for nitrobenzene. EPA-440/5-80/061. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0353
EPA-440/5-80/062 PB81-117731
U.S. Environmental Protection Agency. Ambient water quality criteria for diphenylhydrazine. EPA-440/5-80/062. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0354
EPA-440/5-80/063 PB81-117749
U.S. Environmental Protection Agency. Ambient water quality criteria for nitrophenols. EPA-440/5-80/063. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0355
EPA-440/5-80/064 PB81-117756
U.S. Environmental Protection Agency. Ambient water quality criteria for nitrosamines. EPA-440/5-80/064. Prepared for

Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0356
EPA-440/5-80/065 PB81-117764
U.S. Environmental Protection Agency. Ambient water quality criteria for pentachlorophenol. EPA-440/5-80/065. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0357
EPA-440/5-80/066 PB81-117772
U.S. Environmental Protection Agency. Ambient water quality criteria for phenol. EPA-440/5-80/066. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0358
EPA-440/5-80/067 PB81-117780
U.S. Environmental Protection Agency. Ambient water quality criteria for phthalate esters. EPA-440/5-80/067. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0359
EPA-440/5-80/068 PB81-117798
U.S. Environmental Protection Agency. Ambient water quality criteria for polychlorinated biphenyls (PCB's). EPA-440/5-80/068. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0360
EPA-440/5-80/069 PB81-117806
U.S. Environmental Protection Agency. Ambient water quality criteria for polynuclear aromatic hydrocarbons. EPA-440/5-80/069. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0361
EPA-440/5-80/070 PB81-117814
U.S. Environmental Protection Agency. Ambient water quality criteria for selenium. EPA-440/5-80/070. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0362
EPA-440/5-80/071 PB81-117822
U.S. Environmental Protection Agency. Ambient water quality criteria for silver. EPA-440/5-80/071. Prepared for Effluent

Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0363
EPA-440/5-80/073 PB81-117830
U.S. Environmental Protection Agency. Ambient water quality criteria for tetrachloroethylene. EPA-440/5-80/073. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0364
EPA-440/5-80/074 PB81-117848
U.S. Environmental Protection Agency. Ambient water quality criteria for thallium. EPA-440/5-80/074. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0365
EPA-440/5-80/075 PB81-117855
U.S. Environmental Protection Agency. Ambient water quality criteria for toluene. EPA-440/5-80/075. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0366
EPA-440/5-80/076 PB81-117863
U.S. Environmental Protection Agency. Ambient water quality criteria for toxaphene. EPA-440/5-80/076. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0367
EPA-440/5-80/077 PB81-117871
U.S. Environmental Protection Agency. Ambient water quality criteria for trichloroethylene. EPA-440/5-80/077. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0368
EPA-440/5-80/078 PB81-117889
U.S. Environmental Protection Agency. Ambient water quality criteria for vinyl chloride. EPA-440/5-80/078. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0369
EPA-440/5-80/079 PB81-117897
U.S. Environmental Protection Agency. Ambient water quality criteria for zinc. EPA-440/5-80/079. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1980. Variously paginated.

0370
EPA-600/2-80/017 PB80-213143
Little, L., and E.D. Pellizzari. Collection and analysis of purgeable organics emitted from wastewater treatment plants. EPA-600/ 2-80/017. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1980. 203 pp.

0371
EPA-600/2-80/043 PB80-173941
Firth, W.J., L.W. Little, E.C. Monnig, and R.A. Zweidinger. Treatment technology for pesticide manufacturing effluents: atrazine, maneb, MSMA, and oryzalin. EPA-600/2-80/043. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1980. 256 pp.

0372
EPA-600/2-80/054 PB80-197569
DeFilippi, R.P., V.J. Kyukonis, M.Modell, and R.J. Robey. Supercritical fluid regeneration of activated carbon for adsorption of pesticides. EPA-600/2-80/054. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1980. 187 pp.

0373
EPA-600/2-80/058 PB80-190549
Frankel, I., and E. Juergens. Removal of fluorides from industrial wastewaters using activated alumina. EPA-600/2-80/058. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1980. 45 pp.

0374
EPA-600/2-80/059 PB80-186026
Goldsmith, R.L., D.C. Grant, J.R. Harland, and K.J. McNulty. Laboratory and field evaluation of NS-100 reverse osmosis membrane. EPA-600/2-80/059. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio, 1980; 28 pp.

0375
EPA-600/2-80/060 PB80-195738
Browning, M.E., and R.G. Rice. Ozone for industrial water and wastewater treatment a literature survey. EPA-600/2-80/060. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Ada, Oklahoma; 1980. 376 pp.

0376 3-139
EPA-600/2-80/064 PB80-197577
King, C.J., and N.L. Ricker. Solvent extraction of wastewaters from acetic-acid manufacture. EPA-600/2-80/064. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Ada, Oklahoma; 1980. 171 pp.

0377
EPA-600/2-80/074 PB80-196918
Coleman, R.T., J.D. Colley, R.F. Klausmeier, and K. Schwitzgebel. Sources and treatment of wastewater in nonferrous metals industry. EPA-600/2-80/074. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1980. 160 pp.

0378
EPA-600/2-80/077a PB81-129033
Little, L., E. Monnig, M. Murphy, and R. Zweidinger. Treatability studies of pesticide manufacturing wastewaters: Carbaryl. EPA-600/2-80/077a. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1980. 31 pp.

0379
EPA-600/2-80/096 PB81-144446
Goldsmith, R.L., A.T. Malarkey, and K.J. McNulty. Evaluation of hot acid treatment for municipal sludge conditioning. EPA-600/2-80/096. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1980. 162 pp.

0380
EPA-600/2-80/099 PB81-140659
Brown, J.C. Fine solids removal following combined chemical-trickling filter treatment. EPA-600/2-80/099. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1980. 26 pp.

0381
EPA-600/2-80/112 PB81-142663
Ott, C.R., and B.A. Segall. Monitoring septage addition to wastewater treatment plants, Volume II. Vacuum filtration of septage. EPA-600/2-80/112. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1980. 142 pp.

0382
EPA-600/2-80/125 PB80-211469
Bigger, J.M., and J.E. Huff. Cyanide removal from refinery wastewater using powdered activated carbon. EPA-600/2-80/125. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Ada, Oklahoma; 1980. 101 pp.

0383
EPA-600/2-80/149 PB81-142630
Andrews, D.C., S.E. Esmond, A.C. Petrasek Jr., and H.W. Wolf. The removal of metals and viruses in advanced wastewater treatment sequences. EPA-600/2-80/149. Prepared for U.S. Environ-

mental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1980. 239 pp.

0384
EPA-600/4-80/005 PB80-152879
Anderson, C.H., and J.M. Long. Interim method for determining asbestos in water. EPA-600/4-80/005. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Athens, Georgia, 1980. 34 pp.

0385
EPA-600/4-80/015 PB80-166911
Carreira, L.A., and L.B. Rogers. New liquid chromatographic detection system for environmental pollutants. EPA-600/4-80/015. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Athens, Georgia; 1980. 55 pp.

0386
EPA-600/7-80/006 PB80-137219
Olem, H., and R.F. Unz. Rotating disc biological treatment of acid mine drainage. EPA-600/7-80/006. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1980. 115 pp.

0387
EPA-600/7-80/173 PB81-153926
U.S. Environmental Protection Agency. Environmental, operational, and economic aspects of thirteen selected energy technologies. EPA-600/7-80/173. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1980. 223 pp.

0388
EPA-650/2-74/005 PB228-692
Grutzl, J.S., and W.T. McKean. Indigestor black liquor oxidation for odor control in kraft pulping. EPA-650/2-74/005. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1974. 113 pp.

0389
EPA-600/2-75/055 PB248-142/As
Rinker, T.L. Treatment of textile wastewater by activated sludge and alum coagulation. EPA-600/2-75/055. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1975. 203 pp.

0390
EPA-600/2-76/139 PB253-478/As
Froneberger, C.R., R.S. Noonan, and M.J. Pollock. Treatment of denim textile mill wastewaters: neutralization and color removal. EPA-600/2-76/139. Prepared for U.S. Environmental Protection

Agency, Office of Research and Development, Washington, D.C.; 1976; 105 pp.

0391
EPA-600/2-77/043 P271-990/As
Loven, A.W., and J.L. Pintenich. Industrial wastewater recirculation system: preliminary engineering. EPA-600/2-77/043. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1977. Variously paginated.

0392
EPA-600/2-77/136 PB273-362/As
Muggiolo, A., and J.H. Sayles. Automatic exchange resin pilot plant for removal of textile dye wastes. EPA-600/2-77/136. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1977. 54 pp.

0393
EPA-600/2-77/200 PB273-069/As
Brown, D.A., J.H. Mayes, C.J. Romero, and F. Yocum. Treatment of ammonia plant process condensate effluent. EPA-600/2-77/200. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1977. 85 pp.

0394
EPA-600/2-77/223 PB279-253
McMreary, J.J., C.J. Murin, and V.L. Snoeyink. Activated carbon adsorption of the trace organic compounds. EPA-600/2-77/223. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1977. 116 pp.

0395
EPA-600/2-78/011 PB280-563
McDonald, C.W. Removal of toxic metals from metal finishing wastewater by solvent extraction. EPA-600/2-78/011. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1978. 16 pp.

0396
EPA-600/2-78/032 PB279-572
Barbarika, H.F., and G.M. Monahan. Evaluation of three industrial particulate scrubbers. EPA-600/2-78/032. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1978. 88 pp.

0397
EPA-600/2-78/047 PB279-451/As
Brandon, C.A., J.J. Porter, and D.K. Todd. Hyperfiltration for renovation of composite wastewater at eight textile finishing plants. EPA-600/2-78/047. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1978. 237 pp.

0398
EPA-600/2-78/072 PB280-242/As
Kurbiel, J. Removal of color, detergents, and other refractory substances from textile wastewater. EPA-600/2-78/072. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1978. 459 pp.

0399
EPA-600/2-78/079 PB281-276/As
Eaddy, J.M., and J.W. Vann. Physical/chemical treatment of textile finishing wastewater for process reuse. EPA-600/2-78/079. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1978. 128 pp.

0400
EPA-600/2-78/085 PB283-792
Jasberg, B.K., L.L. Navickis, W.E. Rayford, and R.E. Wing. Removal of heavy metals from industrial wastewaters using insoluble starch xanthate. EPA-600/2-78/085. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1978. 106 pp.

0401
EPA-600/2-78/098 PB285-115
Horning, R.H. Textile dyeing wastewaters: characterization and treatment. EPA-600/2-78/098. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1978. 292 pp.

0402
EPA-600/2-78/125 PB284-537
Calimag, E.D., M. Sobleman, and K.H. Sweeny. Development of a DDT manufacturing and processing plant waste treatment system. EPA-600/2-78/125. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1978. 77 pp.

0403
EPA-600/2-78/127 PB285-434
Elicker, L.N., and R.W. Lacy. Evaporative recovery of chromium plating rinse waters. EPA-600/2-78/127. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1978. 42 pp.

0404
EPA-600/2-78/165 PB287-129
U.S. Environmental Protection Agency. Breakpoint chlorination/activated carbon treatment: effect on volatile halogenated organics. EPA-600/2-78/165. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1978. 78 pp.

0405
EPA-600/2-78/170 PB288-438
Chen, C., L.S. Directo, and R.P. Miele. Two-stage granular activated carbon treatment. EPA-600/2-78/170. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1978. 64 pp.

0406
EPA-600/2-78/200 PB288-211
Matthews, J.E. Treatment of petroleum refinery, petrochemical and combined industrial-municipal wastewaters with activated carbon. EPA-600/2-78/200. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Ada, Oklahoma; 1978. 92 pp.

0407
EPA-600/2-79/010 PB295-048
Finn, D.F., and J.D. Stockman. Survey of biological treatment in the iron and steel industry. EPA-600/2-79/010. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1979. 23 pp.

0408
EPA-600/2-79/024 PB294-356
Rajan, K.S. Survey of fouling, foam, corrosion, and scaling control in iron and steel industry recycle systems. EPA-600/2-79/024. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1979. 44 pp.

0409
EPA-600/2-79/025 P299-184
Huff, L.L., and J.D. Stockman. A cost index for BATEA achievement by the iron and steel industry. EPA-600/2-79/025. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1979. 39 pp.

0410
EPA-600/2-79/033 P292-758
Mickelson, D.P., Q.A. Narum, and N. Roehne. Disposal of an integrated pulp-paper mill effluent by irrigation. EPA-600/2-79/033. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1979. 119 pp.

0411
EPA-600/2-79/052 PB295-637
Jeffus, H.M. Manual of practice: the disposal of combined municipal/industrial wastewater residues (metals). EPA-600/2-79/052. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Ada, Oklahoma; 1979. 31 pp.

0412
EPA-600/2-79/066 PB295-780
McCrodden, B.A. Treatment of refinery wastewater using a filtration-activated carbon system. EPA-600/2-79/066. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Ada, Oklahoma; 1979. 80 pp.

0413
EPA-600/2-79/129 PB300-763
Murphy, J.M., and M. Roth. Evaluation of the ultraviolet-ozone and ultraviolet-oxidant treatment of pink water. EPA-600/2-79/129. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1979. 30 pp.

0414
EPA-600/2-79/195 PB80-119563
Ko, S.M., and J.A. Tevepaugh. Hyperfiltration processes for treatment and renovation of textile wastewater. EPA-600/2-79/195. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1979. 128 pp.

0415
EPA-600/7-79/133 PB297-587
Goldstein, D.J., R.E. Hicks, F.B. Seufert, and I.W. Wei. Wastewater treatment in coal conversion. EPA-600/7-79/133. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1979. 272 pp.

0416
EPA-600/2-80/041 PB80-175524
Mayfield, R.E., T.N. Sargent, and E.J. Schroeder. Technical and economic evaluation of BATEA textile guidelines. EPA-600/ 2-80/041. Prepared for U.S. Environmental Protection Agency, Office of Research and Development Washington, D.C.; 1980. 427 pp.

0417 3-140 5-61
EPA-600/2-80/055 PB80-181886
Brandon, C.A. Closed-cycle textile dyeing: full scale hyperfiltration demonstration (design). EPA-600/2-80/055. Prepared for IERL, Office of Environmental Engineering and Technology, Research Triangle Park, NC; 1980. 103 pp.

0418
EPA-600/7-80/052 PB80-216724
Carstea, D.D., and P.J. Rogoshewski. Evaluation of lime precipitation for treating boiler tube cleaning wastes. EPA-600/7-80/052. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1980. 103 pp.

0419
EPA-600/9-80/012 PB80-176258
Ayer, F.A. Proceedings: first symposium on iron and steel pollution abatement technology. EPA-600/9-80/012. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1980. 503 pp.

0420
EPA-600/2-76/231 PB265-454
Bursztynsky, T.A., J.D. Crane, R.H. Jones, and J.T. White. Treating wood preserving plant wastewater by chemical and biological methods. EPA-600/2-76/231. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1976. 98 pp.

0421
EPA-600/2-76/252 PB266-574
Bliss, F.R. Papermill wastewater treatment by microstraining. EPA-600/2-76/252. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1976. 118 pp.

0422
EPA-600/2-76/261 PB265-393
Donnelly, R.G., R.L. Goldsmith, D.C. Grant, K.J. McNulty, and M.Tan. Treatment of electroplating wastes by reverse osmosis. EPA-600/ 2-76/261. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1976. 96 pp.

0423
EPA-600/2-77/029c PB269-003
Cobbs, J.H., J.W. Field, W.D. Finley, L.R. Reeder, B.N. Rolfe, and S.C. Vokurka. Review and assessment of deep-well injection of hazardous waste. EPA-600/2-77/029c. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1977. 561 pp.

0424
EPA-600/2-77/031 PB279-872
Langlais, R.J., and R.H. Sayers. Removal and recovery of sulfide from tannery wastewater. EPA-600/2-77/031. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1977. 130 pp.

0425
EPA-600/2-77/038 PB266-929
Moser, J.G. Zinc sludge recycling after Kastone R treatment of cyanide-bearing rinse water. EPA-600/2-77/038. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1977. 30 pp.

0426
EPA-600/2-77/039 PB266-919
Goldsmith, R.L., A.Z. Gollan, and K.J. McNulty. Reverse osmosis field test: treatment of watts nickel rinse waters. EPA-600/2-77/039. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1977. 29 pp.

0427
EPA-600/2-77/049 PB267-284
Epstein, A.C., and R.M. Schlauch. Treatment of metal finishing wastes by sulfide precipitation. EPA-600/2-77/049. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1977. 76 pp.

0428
EPA-600/2-77/072 PB267-549
Wilson, D.J. Foam flotation treatment of heavy metals and fluoride-bearing industrial wastewaters. EPA-600/2-77/072. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1977. 76 pp.

0429
EPA-600/2-77/099 PB271-298
Novotny, C.J., and W.C. Trnka. Innovative rinse-and-recovery system for metal finishing processes. EPA-600/2-77/099. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1977. 25 pp.

0430
EPA-600/2-77/119 PB271-708
Lang, E.W., R.L. Miller, and J.W. Stephens. Activated carbon treatment of kraft bleaching effluents. EPA-600/2-77/119. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1977. 55 pp.

0431
EPA-600/2-77/127 PB270-090
Peterson, J.C. Closed loop system for the treatment of waste pickle liquor. EPA-600/2-77/127. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C. 1977. 55 pp.

0432
EPA-600/2-77/161 PB272-688
Bodamer, G.W. Electrodialysis for closed loop control of cyanide rinse waters. EPA-600/2-77/161. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1977. 35 pp.

0433
EPA-600/2-77/240 PB279-207
Lehr, J.H., and D.L. Warner. An introducton to the technology of subsurface wastewater injection. EPA-600/2-77/240. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1977. 345 pp.

0434
EPA-600/2-78/004f PB282-934
Hughes, T.W., and D.R. Tierney. Source assessment: reclaiming of waste solvents state of the art. EPA-600/2-78/004f. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1978. 54 pp.

0435
EPA-600/2-78/013 PB280-676
Boyle, W.C., and L.B. Polkowski. Biological treatment, effluent reuse, and sludge handling for the side leather tanning industry. EPA-600/2-78/013. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1978. 230 pp.

0436
EPA-600/2-78/058 PB284-247
U.S. Environmental Protection Agency. Proceedings of the second open forum on management of petroleum refinery wastewater. EPA-600/2-78/058. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Ada, Oklahoma; 1978. 558 pp.

0437
EPA-600/2-78/069 PB280-755
Ahlert, R.C., and F.A. Osamor. Oil/water separation state-of-the-art. EPA-600/2-78/069. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1978. 97 pp.

0438
EPA-600/7-78/125 PB285-596
Harrison, W., and L.A. Raphaelian. Trace organics variation across the wastewater treatment system of a class-B refinery. EPA-600/ 7-78/125. Prepared for U.S. Environmental Protection Agency, Office of Research and Development; 1978. Variously paginated.

0439
EPA-600/J-76/105 PB81-129561
Booth, R.L., and M.E. Gales. Automated 4AAP phenolic method. EPA-600/J-76/105. Prepared for U.S. Environmental Protection Agency, Office of Environmental Monitoring and Support Laboratory, Cincinnati, Ohio; 1976. 4 pp.

0440
EPA-560/13-79/013 PB80-128150
Going, J.E., and K. Thomas. Sampling and analysis of selected toxic substances task I: acrylamide. EPA-560/13-79/013. Prepared for U.S. Environmental Protection Agency, Office of Toxic Substances, Washington, D.C.; 1979. 39 pp.

0441
EPA-600/2-79/199 PB80-149933
Brimer, R.G., J.R. Denson, and H.E. Green. EPA/IERL-RTP procedures manual: level 2 sampling and analysis of selected reduced inorganic compounds. EPA-600/2-79/199. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Research Triangle Park, N.C.; 1979.

0442
EPA-600/J-79/056 PB80-177793
Shackelford, M.M., and R.G. Webb. Survey analysis of phenolic compounds in industrial effluents by gas chromatography-mass spectrometry. EPA-600/J-79/056. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Athens, Georgia; 1979.

0443
EPA-560/11-80/027 PB81-141616
Armstrong, G.I., R.H. Brink, and A. Leifer. Support document test data development standards, physical/chemical and persistence characteristics: density/relative density, melting temperature, vapor pressure, octanol/water partition coefficient, soil thin layer chromatography. EPA-560/11-80/027. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1980.

0444
EPA-600/2-80/047 PB80-142144
Franzen, A.E., J.F. Grutsch, R.Mallatt, and V.G. Skogan. Processing refinery wastewater by coagulation and flotation following biological oxidation. EPA-600/2-80/047. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Ada, Oklahoma; 1980. 315 pp.

0445
EPA-600/2-80/077c PB81-178840
Monnig, E., and R.A. Zweidinger. Treatability studies of pesticide manufacturing wastewaters: dinoseb and atrazine. EPA-600/2-80/077c. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Research Triangle Park, N.C.; 1980. 50 pp.

0446
EPA-600/2-80/107 PB81-159386
Geinopolos, A., J. Kane, R. Osantowski, and G. Rollinger. Physical/ chemical treatment of blast furnace wastewaters using mobile pilot units. EPA-600/2-80/107. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Research Triangle Park, N.C.; 1980. 342 pp.

0447
EPA-600/2-80/196 PB81-127813
Bishop, D.F. GC/MS methodology for priority organics in municipal wastewater treatment. EPA-600/2-80/196. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1980.

0448
EPA-600/2-80/210 PB81-129025
Bailey, D.G. Innovative destruction of complex industrial wastes - auto oxidation of tannery beamhouse wastewater. EPA-600/2-80/210. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1980.

0449
EPA-600/8-80/026 PB81-200792
U.S. Environmental Protection Agency. Industrial wastewater research summary. EPA-600/8-80/026. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.; 1980. 35 pp.

0450 3-143 5-62
EPA-600/9-80/046a PB81-124539
Miller, R.D., E.D. Smith, and Y.C. Yu. First national symposium/ workshop on rotating biological contactor technology. EPA-600/9-80/046a. Prepared for MERL, Office of Research and Development, Cincinnati, Ohio; 1980.

0451
EPA-600/J-80/004 PB80-184310
Borgwardt, R.H. Combined flue gas desulfurization and water treatment in coal-fired power plants. EPA-600/J-80/004. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Research Triangle Park, N.C.; 1980.

0452
EPA-600/J-80/216 PB81-165193
Fassel, V.A., G.D. Flesch, A.L. Gray, R.A. Houk, H.J. Svec. Inductively coupled argon plasma as an ion source for mass spectrometric determination of trace elements. EPA-600/J-80/216. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Athens, Georgia; 1980. 9 pp.

0453
EPA-430/9-81/001 PB81-193625
U.S. Environmental Protection Agency. Needs survey (1980): cost estimates for construction of publicly-owned wastewater treatment facilities. EPA-430/9-81/001. Prepared for U.S. Environmental Protection Agency, Facility Requirements Division, Washington, D.C.; 1981. 99 pp.

0454
EPA-600/1-81/005 PB81-135360
Chappell, W.R., R.H. Shapiro, and R.E. Sievers. The effect of ozonation of organics in wastewater. EPA-600/1-81/005. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981.

0455
EPA-600/2-81/011 PB81-172744
Beroza, M., and R.L. Caswell. Analytical reference standards and supplemental data for pesticides and other organic compounds. EPA-600/2-81/011. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Research Triangle Park, N.C.; 1980. 190 pp.

0456
EPA-600/2-81/019 PB81-150583
Osheka, J.W., A.P. Pajak, and A.J. Shuckrow. Concentration technologies for hazardous aqueous waste treatment. EPA-600/ 2-81/019. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 358 pp.

0457
EPA-600/2-81/027 PB81-161853
Copeland, L.G., J.D. DiFilippo, and K.M. Peil. Evaluation of powdered activated carbon for removal of trace organics at New Orleans, Louisiana. EPA-600/2-81/027. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 85 pp.

0458
EPA-600/2-81/040 PB81-172272
Jarnis, R.N. J.P. Long, and E.L. Stover. High-level ozone disinfection of municipal wastewater effluents. EPA-600/2-81/040. Prepared by U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 106 pp.

0459
EPA-600/2-81/043 PB81-172637
Condren, A.J., R.L. Walden, and B.K. Wallin. Removal of phenolic compounds from wood preserving wastewaters. EPA-600/2-81/043. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 150 pp.

0460
EPA-600/2-81/046 PB81-172306
DeWalle, F.B., J.B. Hatlen, D.M. Norman, J.F.C. Sung, T. and Zeisig. Analytical methods evaluation for applicability in leachate analysis. EPA-600/2-81/046. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 340 pp.

0461
EPA-600/2-81/053 PB81-206021
Geinopolos, A., R. Osantowski, and G. Rollinger. Physical/Chemical treatment of coke plant wastewater. EPA-600/2-81/053. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Research Triangle Park, N.C.; 1981. 207 pp.

0462
EPA-600/2-81/056 PB81-185621
Cooke, W.M., and J.W. Meuser. Fate of semivolatile priority pollutants in a wastewater treatment plant. EPA-600/2-81/056. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 62 pp.

0463
EPA-600/2-81/057 PB81-187197
Pirbazari, M., and W.J. Weber. Effectiveness of activated carbon for removal of toxic and/or carcinogenic compounds from water supplies. EPA-600/2-81/057. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 392 pp.

0464
EPA-600/2-81/064 PB81-190928
U.S. Environmental Protection Agency. Electroplating wastewater sludge characterization. EPA-600/2-81/064. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 97 pp.

0465
EPA-600/2-81/067 P81-199374
Burks, S.L. Evaluation of the effectiveness of granular activated carbon adsorption and aquaculture for removing toxic compounds from treated petroleum refinery effluents. EPA-600/2-81/067. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Ada, Oklahoma; 1980. 72 pp.

0466
EPA-600/2-81/078 PB81-196776
Beckmann, D.D., P.H. Boenig, W.A. Chudyk, V.L. Snoeyink, and T.J. Temperly. Bench scale evaluation of resins and activated carbons for water purification. EPA-600/2-81/078. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 62 pp.

0467
EPA-600/2-81/079 PB81-196784
Oulman, C. Trace organics removal using activated carbon and polymeric adsorbents. EPA-600/2-81/079. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 53 pp.

0468
EPA-600/4-81/017 PB81-172629
Cramer, P., A. Drinkwine, H. Miller, A. Shan, and G. Trischan. Development of analytical test procedures for organic pollutants in wastewater application to pesticides. EPA-600/4-81/017. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 90 pp.

0469
EPA-600/4-81/043 PB81-218315
Foerst, D.L. An evaluation of the Hewlett-Packard 5993B gas chromatograph-mass spectrometer. EPA-600/4-81/043. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 53 pp.

0470
EPA-600/7-81/017 PB81-163305
Chang, J.C.S. Effect of scrubbing operating conditions on adipic acid degradation. EPA-600/7-81/017. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Research Triangle Park, N.C.; 1981. 29 pp.

0471
EPA-600/7-81/029 PB81-179855
Harris, J.C., C.E. Rechsteiner, D.J. Sorlin, and K.E. Thrun. Methods for level 2 analysis by organic compound category. EPA-600/7-81/ 029. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Research Triangle Park, N.C.; 1981. 326 pp.

0472
EPA-600/7-81/033 PB81-172645
Grandt, A.F., and D.G. McDonald. Limestone-Lime treatment of acid mine drainage-full scale. EPA-600/7-81/033. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 205 pp.

0473
EPA-600/7-81/081 PB81-187288
Hoeflein, J.R., J.R. Klieve, and G.D. Rawlings. Assessment of oil shale retort wastewater treatment and control technology: phases I and II. EPA-600/7-81/081. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 100 pp.

0474
EPA-600/J-81/004 PB81 185704
Coleman, W.E., F.C. Kopfler, R.G. Melton, R.W. Slater, and S.J. Voto. Determination of organic contaminants by the grob closed-loop-stripping technique. EPA-600/J-81/004. Prepared for U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, Ohio; 1981. 9 pp.

0475
40 CFR 264 PB81 190001
U.S. Environmental Protection Agency. Standards applicable to owners and operators of hazardous waste treatment, storage, and disposal facilities under RCRA (Resource Conservation and Recovery Act), subtitle C, section 3004; standards for inspection (40 CFR 264.15) and interim status standards for inspection (40 CFR 265.15). Prepared for U.S. Environmental Protection Agency, Office of Solid Waste, Washington, D.C.; 1980. 26 pp.

0476
EPA-600/S2-81/228
Haugh, Richard, Salar Niku, E.D. Schroeder, and George Tchobanoglous. Performance of trickling filter plants: reliability, stability and variability. EPA-600/S2-81/228. Prepared for MERL, Office of Research and Development, Washington, D.C.; 1981.

0477
EPA-600/S2-81/231
James, Stephen C., and C.J. Touhill. Barrel and drum reconditioning industry assessment. EPA-600/S2-81/231. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1981.

0478
Contract No. 68-01-5052
JRB Associates. Assessment of the impacts of industrial discharges on publicly owned treatment works. Appendices included 68-01-5052. Prepared for USEPA, Office of Water Enforcement; 1981.

0479

U.S. General Accounting Office. EPA slow in controlling PCB's. Dec. 30, 1981.

0480

Committee on Energy and Commerce. Ocean-based incineration of hazardous wastes. Hearing notes from Committee Ninety-Seventh Congress. February 11, 1981. Serial No. 97-47.

0481

Ott, Charles R., and Burton A. Segall. Vacuum filtration of septage. Journal WPCF Vol. 54, No. 1 January 1981.

0482

Davis, John R., J.G. Lopez, J.W. McCutchan, and M.K. Stenstrom. Municipal wastewater reclamation by reverse osmosis - a three year study. Journal WPCF Vol. 54, No. 1. January 1981.

0483

Parker, Clinton E. Surrogate parameter analysis for organic priority pollutants. Journal WPCF Vol. 54, No. 1. January 1981.

0484

Cravens, Joe Bob, and M.E. Harrelson. Use of microscreens to polish lagoon effluents. Journal WPCF Vol. 54, No. 1. January 1981.

0485
EPA-600/J-75/002 PB80-196934
U.S. Environmental Protection Agency. Reprint: interlaboratory study of the cold vapor technique for total mercury. EPA-600/J-75/002. 1980.

0486
EPA-600/J-78/154 PB80-135163
U.S. Environmental Protection Agency. Reprint: application of high temperature hyperfiltration to unit textile process for direct recycle. EPA-600/J-78/154. 1980.

0487
EPA-600/J-78/176 PB81-129942
U.S. Environmental Protection Agency. Venturi scrubber performance model. EPA-600/J-78/176. 1981.

0488

Regional issue identification and assessment program (RIIA) a methodology for analyzing the water quality of cooling tower blowdown. 1979.

0489
EPA-450/4-80/015 PB81-119455
U.S. Environmental Protection Agency. Volatile organic compounds (VOC) species data manual. 2nd Edition. EPA-450/4-80/015. 1981.

0490
EPA-600/2-80/181 PB81-148587
U.S. Environmental Protection Agency. Analytical methodology for the determination of chlorophenols in human and environmental samples. EPA-600/2-80/181. 1980.

0491
EPA-600/2-80/189 PB81-106593
U.S. Environmental Protection Agency. Minimizing the pollution impact of kraft pulping through oxygen bleaching. EPA-600/2-80/189. Prepared for IERL, Cincinnati, OH; 1980.

0492
EPA-600/7-80/069
U.S. Environmental Protection Agency. Program status report oil shale 1980 update. EPA-600/7-80/069. Prepared for Office of Environmental Engineering and Technology, Washington, D.C.; 1980.

0493
EPA-905/4-80/008 PB81-155269
U.S. Environmental Protection Agency. Volatile organic compound emissions from solvent cleaning operations in the state of Illinois. EPA-905/4-80/008. 1980.

0494

U.S. National Science Foundation. Final report to the National Science Foundation high energy electron treatment of wastewater liquid residuals. Prepared by Massachusetts Institute of Technology; 1980. 354 pp.

0495
EPA-600/2-81/009 PB81-135378
U.S. Environmental Protection Agency. Assessment of organic emission in the flexible packaging industry. EPA-600/2-81/009. 1981.

0496
EPA-600/2-81/026 PB81-157943
U.S. Environmental Protection Agency. Emission of VOC from drum-mix asphalt plants. EPA-600/2-81/026. 1981.

0497
EPA-600/S2-81/196
U.S. Environmental Protection Agency. Project summary evaluation of a treatment lagoon for combined sewer overflow. EPA-600/S2-81/196. 1981.

0498

Garvey, Charlotte. Controlling PBC's, a new approach. EPA Journal 1981.

0499

Cost-effectiveness analysis for on-site wastewater treatment alternatives. 1982.

0500
EPA-600/2-79/184 PB80-105166
U.S. Environmental Protection Agency. Treatment of organic chemical manufacturing wastewater for reuse. EPA-600/2-79/184. 1979.

0501

U.S. Department of Commerce. Standard industrial classification (SIC) manual 1972. Prepared for Executive Office of the President, Office of Management and Budget, Washington, D.C.; 1972.

0502 3-138
EPA-440/1-82/007
U.S. Environmental Protection Agency. Final development document for effluent limitations guidelines and standards for the inorganic chemicals manufacturing point source category. EPA-440/1-82/007. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1982.

0503
EPA-440/1-82/022
U.S. Environmental Protection Agency. Final development document for effluent limitations guidelines and standards for the textile mills point source category. EPA-440/1-82/022. Prepared for Effluent Guidelines Division, Office of Water, Washington, D.C.; 1982. 509 pp.

0504 3-132
EPA-440/1-82/024
U.S. Environmental Protection Agency. Final development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source category; general. EPA-440/1-82/024. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; Volume I; 1982. 600 pp.

0505 3-133
EPA-440/1-82/024
U.S. Environmental Protection Agency. Final development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source category; cokemaking, sintering, iron making. EPA-440/1-82/024. Prepared for Effluent

Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; Volume II; 1982. 435 pp.

0506 3-134
EPA-440/1-82/024
U.S. Environmental Protection Agency. Final development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source category; steelmaking, vacuum degassing, continuous casting. EPA-440/1-82/024. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; Volume III; 1982. 468 pp.

0507 3-135
EPA-440/1-82/024
U.S. Environmental Protection Agency. Final development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source category; hot forming. EPA-440/1-82/024. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; Volume IV; 1982. 367 pp.

0508 3-136
EPA-440/1-82/024
U.S. Environmental Protection Agency. Final development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source category; salt bath descaling, acid pickling. EPA-440/1-82/024. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; Volume V; 1982. 505 pp.

0509 3-137
EPA-440/1-82/024
U.S. Environmental Protection Agency. Final development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source category; cold forming, alkaline cleaning, hot coating. EPA-440/1-82/024. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; Volume VI; 1982. 591 pp.

0510 1-46* 2-38* 3-130
EPA-440/1-82/061b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the ore mining and dressing point source category. EPA-440/1-82/061b. Prepared for Effluent Guidelines Division, Office of Water, Washington, D.C.; 1982.

0511 1-37* 2-69
EPA-440/1-82/075b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the electrical and electronic components point source category.

EPA-440/1-82/075b. Prepared for Effluent Guidelines Division, Office of Water, Washington, D.C.; 1982.

0512 1-39* 2-22*
EPA-440/1-82/091b
U.S. Environmental Protection Agency. Proposed development document for effluent limitations guidelines and standards for the metal finishing point source category. EPA-440/1-82/091b. Prepared for Effluent Guidelines Division, Office of Water Regulations and Standards, Washington, D.C.; 1982.

0513

Sturino, Emilo. Analysis of hazardous pollutants. Pollution Engineering, February 1982.

0514
PB 82 166984, 166976
Compendium on low and non-waste technology, monographs, Volumes I and II. Economic Commission for Europe. February 1982.

0515
No. 68-01-6462
U.S. Environmental Protection Agency. Draft development document for effluent limitations guidelines for the electrical and electronic components point source category. Contract No. 68-01-6462. Prepared for Richard Kinch and David Pearson, USEPA. 1982.

0516
No. 68-03-3038
U.S. Environmental Protection Agency. Cost of environmental control technologies granular activated carbon applications in water and wastewater treatment. Contract No. 68-03-3038. Prepared for IERL; 1982.

0517

Longley, K.E., B.E. Moore, and C.A. Sorber. Disinfection efficiencies of chlorine and chlorine dioxide in a gravity flow contactor. Journal WPCF, Volume 54, No. 2. February 1982.

0518
EPA-905/2-81/003
U.S. Environmental Protection Agency. Economics of BAT - equivalent control technologies, draft manual. EPA-905/2-81/003. 1982.

0519
Contract No. 68-01-5052
Calmon, C., J. Casana, H. Gold, WPA. Ion exchange and resin adsorption data for the removal of toxic contaminants from wastewaters. Contract No. 68-01-5052. Prepared for IERL, Cincinnati, OH; March 1982.

0520
Contract No. 68-01-5052
Calmon, C., J. Casana, H. Gold, WPA. Ion exchange and resin adsorption data for the removal of toxic contaminants from wastewaters. Contract No. 68-01-5052. Prepared for IERL, Cincinnati, OH; Sept. 1982.

0521
Contract Nos. 68-02-3153 and 68-02-2689
U.S. Environmental Protection Agency. Method 1624 volatile organic compounds by purge and trap isotope dilution GC-MS, Method 1625 semivolatile organic compounds by isotope dilution GC-MS, isotope dilution gas chromatography - mass spectrometry for the determination of priority pollutants in industrial effluents. Contract Nos. 68-02-3153 and 68-02-2689. Prepared for USEPA. 1982.

0522

Kobayashi, H., and B.E. Rittmann. Microbial removal of hazardous organic compounds. Environmental Science Technology, Volume 16, No. 3. 1982.

0523

Lane, D.A. Mobile mass spectrometry. Environmental Science Technology, Volume 16, No. 1. 1982

0524
Contract No. 68-01-5772
U.S. Environmental Protection Agency. Toxicity of leather tanning and finishing wastewaters internal working report. Contract No. 68-01-5772. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1982. 39 pp.

0525
Contract No. 68-01-5772
U.S. Environmental Protection Agency. Toxicity of leather tanning and finishing wastewaters final report-appendices. Contract No. 68-01-5772. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1982.

0526

U.S. Environmental Protection Agency. Final report, toxicity reduction manual for the textile manufacturing industry. Prepared for IERL, Office of Research and Development, Research Triangle Park, N.C.; 1982.

0527

Brueggemann, G., Y.J. Feng, A.F. Gaudy, Jr., and E.T. Gaudy. Treatment of cyanide waste by the extended aeration process. Journal WPCF, Volume 54, No. 2. February 1982.

0528

Boelter, D.H., D.S. Nichols. Treatment of secondary sewage effluent with a peat-sand filter bed. Journal of Environmental Quality, Volume II, No. 1. 1982.

0529

Seminar for analytical methods for priority pollutants. April 9, 1981. Held in Hershey PA, 1981.

0530

U.S. Environmental Protection Agency, Department of Energy. Solid wastes, sludges and residual materials: monitoring, technology and management international conference. 1981. 352 pp.

0531
Contract No. 68-03-2579
U.S. Environmental Protection Agency. Laboratory studies of priority pollutant treatability. Contract No. 68-03-2579. Prepared for IERL by Walk, Haydell and Associates, Inc. 1981.

0532

Kenson, Robert E. Rotary kiln incinerators for sludge disposal. Pollution Engineering, December, 1981.

0533

Refinery wastewater priority pollutant study-sample analysis and evaluation of data. Prepared for Environmental Affairs Department, American Petroleum Institute, Washington, D.C.; 1981.

0534

U.S. Environmental Protection Agency. Paragraph 8 exclusions USEPA. Prepared for Effluent Guidelines Division, Office of Water, Washington, D.C.; 1981.

0535

PB81 199176

Department of Energy. Determination of phenolic compounds in alternate fuel matrices. Final report. Prepared for National Bureau of Standards, Washington, D.C.; 1981.

0536
EPA-600/S1-81/005
U.S. Environmental Protection Agency. The effect of ozonation of organics in wastewater. EPA-600/S1-81/005. Prepared for Effluent Guidelines Division; 1981.

0537
EPA-600/S2-81/027
U.S. Environmental Protection Agency. Evaluaton of powdered activated carbon for removal of trace organics at New Orleans, Louisiana. EPA-600/S2-81/027. Prepared for Effluent Guidelines Division; 1981.

0538
EPA-600/S2-81/032
U.S. Environmental Protection Agency. Biodegradation and carbon adsorption of carcinogenic and hazardous organic compounds. EPA-600/S2-81/032. Prepared for Effluent Guidelines Division; 1981.

0539
EPA-600/S2-81/037
U.S. Environmental Protection Agency. Report of the interagency ad hoc work group for the chemical waste incineration ship program. EPA-600/S2-81/037. Prepared for USEPA; 1981.

0540
EPA-600/S2-81/043 PB81-172637
U.S. Environmental Protection Agency. Removal of phenolic compounds from wood preserving wastewaters. EPA-600/S2-81/043. Prepared for Effluent Guidelines Division; 1981.

0541
EPA-600/S2-81/044a PB81-178303
U.S. Environmental Protection Agency. Offshore platform hazardous waste incineration facility. Feasibility study summary. EPA-600/S2-81/044a. Prepared for IERL, Research Triangle Park, NC; 1981.

0542
EPA-600/S2-81/053 PB81-206021
U.S. Environmental Protection Agency. Physical/chemical treatment of coke plant wastewater. EPA-600/S2-81/053. Prepared for IERL, Research Triangle Park, NC; 1981.

0543
EPA-600/S2-81/064 PB81-190928
U.S. Environmental Protection Agency. Electroplating wastewater sludge characterization. EPA-600/S2-81/064. Prepared for IERL, Cincinnati, OH; 1981.

0544
EPA-600/S2-81/067 PB81-199374
U.S. Environmental Protection Agency. Evaluation of the effectiveness of granular activated carbon adsorption and aquaculture for removing toxic compounds from treated petroleum refinery effluents. EPA-600/S2-81/067. Prepared for RSKERL, Ada, OK; 1981.

0545
EPA-600/S2-81/086
U.S. Environmental Protection Agency. Evaluation of ion exchange technology for toxic and non-conventional pollutant reduction in bleach plant effluents. EPA-600/S2-81/086. 1981.

0546
EPA-600/S2-81/169
U.S. Environmental Protection Agency. Wastewater dechlorination state-of-the-art field survey and pilot studies. EPA-600/S2-81/169. 1981.

0547
EPA-600/8-79/018
U.S. Environmental Protection Agency. A standard procedure for cost analysis of pollution control operations, Volume I. User guide, Volume II, appendices. EPA-600/8-79/018. Prepared for IERL, Office of Research and Development, Research Triangle Park, NC; 1979.

0548
EPA-600/S2-81/229
U.S. Environmental Protection Agency. Performance testing of the diperna sweeper. EPA-600/S2-81/229. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1981.

0549
EPA-600/S7-81/033
U.S. Environmental Protection Agency. Limestone - lime treatment of acid mine drainage - full scale. EPA-600/S7-81/033. 1981.

0550

U.S. Environmental Protection Agency. Liquid chromatograph/mass spectrometer interface with continuous sample preconcentration. Published in Analytical Chemistry 53, February 1981. pp. 171-174.

0551
EPA-600/2-81/228 PB82-108143
U.S. Environmental Protection Agency. Performance of trickling filter plants: reliability, stability and variability final report. EPA-600/2-81/228. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1981. 111 pp.

0552
EPA-600/2-81/001a
U.S. Environmental Protection Agency. Environmental assessment of the at sea incineration of liquid silvex. Interim report. EPA-600/2-81/001a. Prepared for IERL, Office of Research and Development, Research Triangle Park, NC; 1981.

0553

Freilich, Danielle. Treatment of bleach effluents by dynamic membrane ultrafiltration, part 1. Prepared for Swedish Water and Air Pollution Research Institute. 1980.

0554

U.S. Environmental Protection Agency. Seminar for analytical methods for priority pollutants, Norfolk, VA. Prepared for Office of Water Programs, Washington, D.C.; 1980.

0555
LCCCN 77-91024
Modern pollution control technology, volume II, water pollution control, solid waste disposal. Prepared for Staff of Research and Education Association, New York, NY; 1980.

0556

Perry, R.H., and C.H. Chilton, eds. Chemical engineers' handbook. 5th edition. McGraw-Hill Book Company, New York, NY; 1973.

0557

U.S. Department of the Interior. Adsorption of heavy metal ions by xanthed sawdust. Prepared for the Bureau of Mines; 1980.

0558

Bissonnette, G.K., C.R. Jenkins, P.B. Huff, and G.W. Gillespie. Aerobic-media trickling filter for nitrogen control in wastewater treatment. Water Research Institute, West Virginia University; 1980.

0559
EPA-600/PS7-80/128
U.S. Environmental Protection Agency. Water filtration control to achieve mine water pollution control - the Dents Run watershed demonstration project. EPA-600/PS7-80/128. 1980.

0560
EPA-600/S2-80/107
U.S. Environmental Protection Agency. Physical/chemical treatment of blast furnace wastewaters using mobile pilot units.

EPA-600/S2-80/107. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1980.

0561
EPA-600/S2-80/196
U.S. Environmental Protection Agency. GC/MS methodology for measuring priority organics in municipal wastewater treatment. EPA-600/S2-80/196. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980.

0562
EPA-600/S2-80/210
U.S. Environmental Protection Agency. Innovative destruction of complex industrial wastes-auto oxidation of tannery beamhouse wastewater. EPA-600/S2-80/210. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1980.

0563

ENR index history. Engineering News-Record, 208 No. 11, March 18, 1982. pp. 116-123.

0564
EPA-600/2-80/161
U.S. Environmental Protection Agency. Truck washing terminal water pollution control. EPA-600/2-80/161. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1980. 81 pp.

0565
EPA-600/2-80/147
U.S. Environmental Protection Agency. Waste activated sludge processing. EPA-600/2-80/147. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980.

0566
EPA-600/2-80/139
U.S. Environmental Protection Agency. Sulfide precipitation of heavy metals. EPA-600/2-80/139. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1980. 106 pp.

0567
EPA-600/2-80/138
U.S. Environmental Protection Agency. Foam flotation treatment of industrial wastewaters, laboratory pilot scale. EPA-600/2-80/138. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1980.

0568
EPA-600/2-80/084
U.S. Environmental Protection Agency. Evaluation of reverse osmosis membranes for treatment of electroplating rinsewater. EPA-600/2-80/084. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1980. 43 pp.

0569

Aries, R.S., and R.D. Newton. In Uhl, 1979. Chemical engineering cost estimation. McGraw-Hill Book Company, Inc., New York, NY; 1955. 263 pp.

0570
EPA-600/2-80/077a PB81-129033
U.S. Environmental Protection Agency. Treatability studies of pesticide manufacturing wastewaters: dazomet EPA-600/2-80/077a. Prepared for IERL, Office of Research and Development, Research Triangle Park, NC; 1980.

0571
EPA-600/2-80/052
U.S. Environmental Protection Agency. Evaluation of sorbents for industrial sludge leachate treatment. EPA-600/2-80/052. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1980. 48 pp.

0572
EPA-600/2-80/003
U.S. Environmental Protection Agency. Upgrading primary tanks with rotating biological contactors. EPA-600/2-80/003. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980.

0573
EPA-600/2-80/005
U.S. Environmental Protection Agency. Evaluation of full-scale tertiary wastewater filters. EPA-600/2-80/005. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980.

0574
EPA-600/2-80/006
U.S. Environmental Protection Agency. Performance evaluation of the aerated lagoon system at North Gulfport, Mississippi. EPA-600/2-80/006. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980.

0575
EPA-530/SW-867c PB81-166340
U.S. Environmental Protection Agency. Evaluating cover systems for solid and hazardous waste (draft). EPA/530/SW-867c. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980. 57 pp.

0576
EPA-530/SW-868c PB81-166332
U.S. Environmental Protection Agency. Hydrologic simulation on solid waste disposal sites. EPA-530/SW-868c. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980. 111 pp.

0577
EPA-530/SW-869c PB81-166357
U.S. Environmental Protection Agency. Landfill and surface impoundment performance evaluation manual (draft). EPA-530/SW-869c. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980. 63 pp.

0578
EPA-530/SW-870c PB81-166365
U.S. Environmental Protection Agency. Lining of waste impoundment and disposal facilities (draft). EPA-530/SW-870c. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980. 385 pp.

0579
EPA-530/SW-872 PB81-181505
U.S. Environmental Protection Agency. Guide to the disposal of chemically stabilized and solidified waste (draft). EPA-530/SW-872. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980. 114 pp.

0580
EPA-530/SW-873 PB81-166894
U.S. Environmental Protection Agency. Closure of hazardous waste surface impoundments (draft). EPA-530/SW-873. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980. 103 pp.

0581
EPA-530/SW-871 PB81-189359
U.S. Environmental Protection Agency. Management of hazardous waste leachate (draft). EPA-530/SW-871. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980. 464 pp.

0582
EPA-440/1-80/301
U.S. Environmental Protection Agency. Fate of priority pollutants in publicly owned treatment works. EPA-400/1-80/301. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980. 180 pp.

0583
EPA-440/1-80/103
U.S. Environmental Protection Agency. Treatability studies for the inorganic chemicals manufacturing point source category. EPA-440/1-80/103. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1980.

0584
No. 68-01-3852
U.S. Environmental Protection Agency. Water-related environmental fate of 129 priority pollutants. Contract No. 68-01-3852.

Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; Volumes II - VI; 1979.

0585

Standard industrial classification (SIC) codes. U.S. Department of Commerce/National Bureau of Standards. 15 August 1979.

0586

Peters, M.S., and K.D. Timmerhaus. Plant design and economics for chemical engineers. 2nd edition. McGraw-Hill Book Company, New York, NY; 1968. 850 pp.

0587

U.S. Environmental Protection Agency. Seminar for analytical methods for priority pollutants. Norfolk, VA; March 1979.

0588

Pilot plant study for the American Bottoms Regional Wastewater Treatment Facility. Prepared by Russel and Axon, Inc.; 1979. 95 pp.

0589

Stover, Enos L. Removal of volatile organics from contaminated groundwater. Groundwater Monitoring Review, Fall 1982, Volume 2, No. 4; pp. 57-62.

0590

Minear, Roger A., and James W. Patterson. Pretreatment of metals for discharge into POTWs. February 1979.

0591
EPA-600/2-79/104 PB299 132
U.S. Environmental Protection Agency. Symposium proceedings: textile industry technology. EPA-600/2-79/104. Prepared for IERL, Office of Research and Development, Research Triangle Park, NC; 1979.

0592 1-66

U.S. Environmental Protection Agency. Pharmaceutical manufacturing, plant data. Effluent Guidelines Division, Public Record, Washington, D.C.; 1978/1979.

0593
EPA-600/2-79/175
U.S. Environmental Protection Agency. Indicatory fate study. EPA-600/ 2-79/175. Prepared for RSKERL, Office of Research and Development, Ada, OK; 1979. 93 pp.

0594
EPA-600/4-79/064
U.S. Environmental Protection Agency. Automated measurements of infrared spectra of chromatographically separated fractions. EPA-600/4-79/064. Prepared for Environmental Research Laboratory, Office of Research and Development, Athens, GA; 68 pp.

0595
EPA-600/2-79/204 PB80 125909
U.S. Environmental Protection Agency. Coagulation and precipitation of selected metal ions from aqueous solution. EPA-600/ 2-79/204. Prepared for IERL, Office of Research and Development, Research Triangle Park, NC; 1979.

0596
EPA-600/2-79/185 PB80-1187706
U.S. Environmental Protection Agency. Cost effectiveness model for pollution control at coking facilities. EPA-600/2-79/185. 1979.

0597 3-128

U.S. Environmental Protection Agency. Data gathered for ORD treatability manual for leather tanning and finishing industry. USEPA EGD, June 1982. Variously paginated.

0598 3-129

U.S. Environmental Protection Agency. Hazardous waste. 40 CFR Parts 122, 260, 264, 265. July 26, 1982.

0599 3-131

U.S. Environmental Protection Agency. Industrial site visit sheets (on record), gum and wood chemicals manufacturing. Effluent Guidelines Division, Washington, D.C.; 1978.

0600 3-141

U.S. Environmental Protection Agency. Industrial site visit sheets (on record), iron and steel manufacturing. Effluent Guidelines Division, Washington, D.C.; 1978-1979.

U.S. Environmental Protection Agency. Industrial site visit sheets (on record) inorganic chemicals manufacturing. Effluent Guidelines Division, Washington, D.C.; 1978.

0602 2-72

Miskimen, Thomas A. 1982 Letter, Thomas A. Miskimen, Utility Water Act Group, to William A. Cawley USEPA, 8 December 1982. 4 pp.

0603
EPA-600/2-78/130 PB-286210
U.S. Environmental Protection Agency. Aircraft industry wastewater recycling. EPA-600/2-78/130. Prepared for IERL, Office of Research and Development, Cincinnati, OH; 1978. 130 pp.

0604
No. 68-03-2766 PB81-189359
U.S. Environmental Protection Agency. Management of hazardous waste leachate. Contract No. 68-03-2766. Prepared for MERL, Office of Research and Development, Cincinnati, OH; 1980. Variously paginated.

0605 2-71

Jordan, J. William. 1975. Memorandum, J. William Jordan EGD, to Bruce P. Smith, 17 June 1975. 4 pp.

0606 2-68

Gile, Rexford R. 1982 Letter, Rexford R. Gile EGD, to Robert P. Stevens, WAPORA, 4 Nov. 1982, 1 p.

0607 2-70

U.S. Environmental Protection Agency. Supplement to the addendum to development document for effluent limitations guidelines and standards of performance for the ore mining and dressing point source category-chemical analyses data supplement B-1. Prepared for Effluent Guidelines Division, Office of Water and Waste Management, Washington, D.C.; 1978.

0608 2-56
40CFR125
U.S. Environmental Protection Agency. Effluent guidelines and standards for steam electric power generating point source category 40CFR125 and 423, 47FR52290, Nov. 19, 1982.

0609

U.S. Environmental Protection Agency. Contractors engineering report, analysis of organic chemicals and plastic/synthetic fibers industries, toxic pollutants, Appendix L: computerized wastewater treatment model-technical documentation. Prepared for Effluent Guidelines Division, Washington, D.C.; 16 November 1981. 520 pp.

0610

U.S. Environmental Protection Agency. Detailed cost documentation for the USEPA cost model. Prepared for USEPA Effluent Guidelines Division, Washington, D.C. by Catalytic, Inc. [This reference includes the following files from the Public Record for the Organic Chemicals/Plastic and Synthetic Fibers Effluent Guidelines Rulemaking: Books I, III Part I, IV Part II, and V Part III, Equipment Sizing Calculations, 1978/1979, pp. 608000-609309; Backup for Unit Operations Costs, Parts I and II (no date), pp. 616468-617183; USEPA Guidelines Cost Estimates SES (no date), pp. 616001-616312; USEPA EF 650 Cost Program Listing (no date), USEPA Cost Model, no pagination; Operating Cost File, 1980, USEPA Cost Model, no pagination; and Capital Cost Curve File (no date), USEPA Cost Model, no pagination.]

0611 2-73 5-63

Utility Water Act Group. 1982. Utility Water Act Group Comments on the draft revised treatability manual, 14 July 1982. Variously paginated.

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3-4	0122	3-40	0232	3-76	0002	3-112	0047
3-5	0163	3-41	0233	3-77	0105	3-113	0263
3-6	0164	3-42	0234	3-78	0001	3-114	0264
3-7	0165	3-43	0235	3-79	0084	3-115	0052
3-8	0166	3-44	0236	3-80	0076	3-116	0139
3-9	0167	3-45	0291	3-81	0255	3-117	0011
3-10	0168	3-46	0034	3-82	0024	3-118	0265
3-11	0009	3-47	0237	3-83	0017	3-119	0097
3-12	0171	3-48	0238	3-84	0012	3-120	0266
3-13	0178	3-49	0239	3-85	0007	3-121	0267
3-14	0180	3-50	0240	3-86	0003	3-122	0268
3-15	0025	3-51	0044	3-87	0013	3-123	0269
3-16	0172	3-52	0241	3-88	0144	3-124	0270
3-17	0174	3-53	0242	3-89	0037	3-125	0159
3-18	0189	3-54	0243	3-90	0046	3-126	0272
3-19	0150	3-55	0244	3-91	0154	3-127	0273
3-20	0149	3-56	0245	3-92	0036	3-128	0597
3-21	0058	3-57	0246	3-93	0032	3-129	0598
3-22	0087	3-58	0247	3-94	0147	3-130	0510
3-23	0175	3-59	0248	3-95	0152	3-131	0599
3-24	0086	3-60	0249	3-96	0153	3-132	0504
3-25	0023	3-61	0250	3-97	0256	3-133	0505
3-26	0107	3-62	0251	3-98	0257	3-134	0506
3-27	0170	3-63	0252	3-99	0258	3-135	0507
3-28	0018	3-64	0253	3-100	0259	3-136	0508
3-29	0184	3-65	0254	3-101	0260	3-137	0509
3-30	0158	3-66	0016	3-102	0157	3-138	0502
3-31	0173	3-67	0088	3-103	0031	3-139	0376
3-32	0177	3-68	0005	3-104	0261	3-140	0417
3-33	0229	3-69	0021	3-105	0262	3-141	0600
3-34	0294	3-70	0010	3-106	0039	3-142	0601
3-35	0192	3-71	0006	3-107	0038	3-143	0450
3-36	0034	3-72	0060	3-108	0004	3-144	0290

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VOLUME V CROSS REFERENCE

VOL V	MF	VOL V	MF	VOL V	MF
5-1	0012	5-31	0192	5-61	0417
5-2	0011	5-32	0086	5-62	0450
5-3	0147	5-33	0087	5-63	0611
5-4	0294	5-34	0042		
5-5	0122	5-35	0274		
5-6	0163	5-36	0275		
5-7	0068	5-37	0276		
5-8	0009	5-38	0277		
5-9	0170	5-39	0278		
5-10	0171	5-40	0279		
5-11	0172	5-41	0153		
5-12	0173	5-42	0157		
5-13	0174	5-43	0047		
5-14	0175	5-44	0019		
5-15	0177	5-45	0152		
5-16	0178	5-46	0039		
5-17	0180	5-47	0159		
5-18	0097	5-48	0084		
5-19	0025	5-49	0002		
5-20	0182	5-50	0155		
5-21	0184	5-51	0254		
5-22	0015, 16	5-52	0034		
5-23	0144	5-53	0280		
5-24	0004	5-54	0197		
5-25	0150	5-55	0198		
5-26	0149	5-56	0266		
5-27	0139	5-57	0281		
5-28	0059	5-58	0282		
5-29	0189	5-59	0268		
5-30	0018	5-60	0200		

V.7 METHODS FOR SAMPLING, ANALYSIS AND STATISTICAL INTERPRETATION OF DATA

V.7.1 INTRODUCTION

The purpose of the Treatability Manual is to incorporate into one readily accessible and easily used source the readily available data on the occurrence and removability of toxic pollutants from wastewater streams. It is an equally important objective of the data collection and presentation effort to identify and adequately characterize the protocols utilized in the development of data that are incorporated into this Manual. The purpose of this section is to describe the factors that are critical in the data development process, to ensure that all users have the necessary support information to adequately interpret the significance of the incorporated data.

The Treatability Manual is designed to be updateable. This applies to the toxic pollutant data collected and to the information collected that describes the data development protocols (e.g., sampling, analyses). The protocol for developing precise and accurate data on toxic pollutants in wastewater has evolved considerably in the last few years. This is discussed to some extent in Section V.7.2, to allow a better understanding of the usefulness as well as limits of the data. The discussion also addresses the analytic methods that are available, mainly to the extent of presenting a basic description of the most generally used techniques. The discussion also provides a basis for better understanding the reasons for qualification of analytic results.

Brief descriptions of the protocols utilized in the preparation of data are presented for each industry discussed in Volume II. This industry-specific basis is consistent with the general organization of the Manual. The presentation and discussion of the protocols for the data in the Manual are organized according to the sets of data that were collected. The basis for this is that data collected for one program usually can be characterized by a protocol followed in the program. As used here, "data set" is a non-rigorous term that is used to describe a collection of analytical information that was obtained by similar sampling, analysis, and statistical interpretations, usually for wastewaters from one industry.

V.7.2 SAMPLING, ANALYTIC, AND STATISTICAL PROTOCOLS

The analytical data base development by USEPA for toxic wastewater pollutants in general was to proceed in two phases. The initial phase typically examined a limited number of wastewater streams (e.g., influent to and effluent from the treatment facility) at a processing plant. The usual objective was to qualitatively determine, with approximate quantification in a limited sampling program, which of the 129 priority pollutants were present. This "screening" would limit the number of pollutants considered during the subsequent stages of the program, thereby reducing the analytical cost.

The second phase generally quantified the pollutant concentrations and the performance of the treatment system. Where possible, this phase used the information obtained during the screening phase to: (1) limit the specific pollutants to be searched for to those identified as being present or possibly present, and (2) identify the best analytic techniques to quantify the pollutants (e.g., sample preparation, detection equipment).

Some significant aspects of the protocols used by USEPA are discussed in the next sections.

V.7.2.1 Sampling

Sampling industrial wastewaters requires that special precautions be taken to ensure that collected samples are representative of the wastewaters. The data collection program in support of the development of toxic pollutant control guidelines by the EPA Effluent Guidelines Division (EGD) followed the recommended procedure for sampling and analysis of industrial wastewaters [5-36].

Sampling programs were designed to meet the objectives of the study. For example, screening surveys may have involved grab samples, one day composite samples, or 72-hour composite samples. A verification study normally would consist of at least three days of sampling; in many cases, one of the day samples would be split for duplicate analysis. Longer-term sampling programs were also used when assessment of variability of pollutant loads was a major objective.

A specific sampling arrangement included as variables the number of sample points, the duration of the sample collection effort (number of days), the type of sample collected (grab or composite), the frequency of sampling (e.g., 15 minute interval, hourly, per batch), and the field handling of samples for preservation and shipping. Required handling of samples in the field included tasks such as sample splitting, preparation of field blanks, and

preparation of field spikes. Sample splitting represents a division of the sample into two or more portions for parallel analysis by independent laboratories. Splits may be developed for duplicate analysis (e.g., by EPA and the facility) or analysis of specific fractions (e.g., metals, organics). Field blanks represent water samples of known composition that are prepared in the field and handled in a manner similar to the other samples. These are used as a means of characterizing the contamination that occurs during the sample handling. Field spikes represent the addition of a known quantity of material to the sample in the field. The subsequent analysis of a field spike will identify the changes which occur due to the effect of sample instability as well as the effects due to the analytic method used in the laboratory. The stability effects can be determined by comparing the results of a field spike to the results of a laboratory spike (the laboratory spike characterizes the method effects only).

V.7.2.2 Analysis - General

The basic premise in the development of analytical chemistry techniques is that by establishing a rigorous protocol for the handling and analysis of the sample, the test results will be representative of the true concentration of the tested species within certain, well-defined statistical limits. The chemist may report the value measured in terms of a range, but it is common to present only one value.

The analysis of toxic pollutants in industrial wastewaters is complicated because the chemical nature of the sample may not be known and there usually are a large number of pollutants present. The relative levels and types of priority pollutants may vary at a plant from day-to-day, or even from one shift to another. An analytical method perfectly suited to one wastewater matrix may be less effective in a different matrix, despite the fact that the same priority pollutants, or a similar combination, are being analyzed. However, an industrial category where a relatively invariant wastewater is characteristic may not present this problem.

Quality assurance and quality control (QA/QC) during the analysis of toxic pollutants is required to ensure that all results have been developed using accepted methods and that the quality of the resulting measurements can be estimated. The quality of a particular method is characterized by estimates of the precision of the measurement and the accuracy of any such measurement. (Precision refers to the refinement with which a measurement can be determined. Accuracy refers to the degree to which the measurement conforms to the true concentration within the sample at the time of analysis). Validation of a measurement requires validation of the method by determining both the multiple laboratory operational precision and the pooled single operator precision. Also required is self-validation of the particular method in a given laboratory.

Precision determinations require that replicate analyses be performed so that statistical limits can be developed. Replicate analyses may be performed on aliquots (portions) of the sample to determine the range of analytical results.

Accuracy can be estimated by a series of analyses that use spiked samples. The sample can be divided into two aliquots, a known concentration of the material added to one sample (spiked sample), and the analyses performed. The test can then be interpreted to identify the "recovery" of the material as follows:

$$\% \text{ Recovery} = \frac{(\text{Amount in Spiked Sample}) - (\text{Amount in Unspiked Sample})}{(\text{Amount of Spike})} \times 100$$

The assumption is that the spike is recovered to the same extent that the material in the unspiked sample is recovered. By subtracting from the spike sample the contribution of the material in the sample, and dividing this by the total added spike, the resulting recovery represents the accuracy with which the measurement reflected the true concentration of the material.

The recovery estimate developed using the spike method may vary depending on the basis of the spike. For example, a recovery estimate developed using a field spike will represent the recovery of the material where the factors considered include (1) the stability of the material during sample handling, shipping, and storage; (2) the extraction or other laboratory preparatory steps prior to analysis; and (3) the accuracy of the instrumental analysis. A recovery estimate based on a laboratory spike also could vary according to the step at which the spike is added. In addition, the recovery estimate based on a spike can vary according to the degree with which the spike is embodied into the sample.

Several sources of errors affecting precision and accuracy are inherent in analysis by a published method. Sources of determinate error (i.e., errors with defined limits) may include operator inconsistency, matrix interference, and instrument (e.g., quality of the equipment). Operator error is minimized by making the analytical procedure, with its associated sample handling and preservation components, as invariant as possible. Compensation for matrix interferences is more difficult. Although contingency provisions are generally specified for expected matrix interferences, all possible interferences cannot be fully anticipated unless the procedure normalizes the matrix (e.g., by destructive pretreatment). While analysis of metals often entails normalization of matrices by destructive pretreatment, such methods are inappropriate for analysis of organic compounds. Therefore, matrix interference with organic compound analyses may require complex, non-routine analytic techniques to compensate for interferences. Such an approach must be supported by an intensive QA/QC program, but it might be the best or only practical means

of accurately quantifying the organic pollutants in the wastewater matrix.

A second and particularly difficult aspect for organic pollutant analyses is to determine the limits of detection for each pollutant (i.e., the lowest concentration of the pollutant that will give a signal on the analytical instrument that can be distinguished from background noise with a known degree of confidence). If no such signal is recorded, one could state that the pollutant is "not detected" by the analytical method used. A related aspect is to ascertain the limits of determination for each pollutant (i.e., the concentration above which one can state with a known degree of confidence that the pollutant is present in a specific concentration in the sample tested.) For signals between the limits of detection and limits of determination it is possible only to say that the pollutant is "detected but unconfirmed" by the analytical method used. This also may be referred to as "Below Detection Limits" (BDL), where the statment indicates that the pollutant was considered "detected" but not at a concentration that could be reliably quantified.

There is a significant difference between the problems of measuring organic toxic pollutants and inorganic toxic pollutants. Therefore, the considerations and techniques commonly employed for toxic pollutant analysis are described as follows under the broad categories of "organic" and "inorganic" analysis.

V.7.2.3 Analysis - Organic Pollutants

Throughout the screening and verification phases of the EPA BAT Survey, the sampling and analysis procedures for priority pollutants offered by the Environmental Monitoring and Support Laboratory (EMSL) in April 1977 [5-36], as noted in the Federal Register (Dec. 3, 1979, p. 69465), were used extensively by several branches within EPA's Effluent Guidelines Division (EGD). This source specified a protocol for the quantification of organic pollutants, metal pollutants, cyanides, and phenols. This is referred to as the "April 1977 EPA protocol" in this section. These discussions will address the organic pollutant protocols.

There are numerous analytic techniques available for the measurement of organic pollutants. Two methods were sufficiently developed and applicable to be generally recommended for the widespread analysis of a broad range of organic priority pollutants. These are gas chromatography-mass spectrometry (GC/MS) by purge and trap, and GC/MS by liquid-liquid extraction. These two methods are complementary to one another, but there is an area of overlap between the two and some compounds may be recovered by either method. Other methods include gas or liquid chromatography with detectors such as ultraviolet, electron capture, or halide specific.

Gas chromatography/mass spectrometry is a broad-spectrum technique by which a large number of compounds in a single sample can be identified and measured. The GC/MS system uses a gas chromatography column to separate the individual compounds extracted from a wastewater sample. The gas chromatograph involves passing the pollutants through a packed column using an inert carrier gas. The packing causes the pollutants to separate into zones, which based on previous calibration can be related to compounds or classes of compounds. The mass spectrometer is a detector which can be used to identify and measure organic compounds based on the mass characteristics of the compound or the functional groups of the compound. The mass spectograph for the sample when interpreted in conjunction with the gas chromatograph separation can identify a match between the characteristics of the sample and known materials. Thus, by a general calibration of the equipment and the use of computer interpretation techniques, a sample can be analyzed for several constituents at one time.

The actual constituents that can be determined by an analysis using the GC/MS is dependent upon the sample preparation. This includes the techniques that are used to isolate the organic materials from the sample matrix into characteristic fractions, and the clean up procedures used to remove interferences. The priority pollutants detected by the most common techniques are listed in Table 7.2-1. The purge and trap isolation technique is used to strip volatile compounds from the sample (i.e., purge) and then collect these volatile compounds in a trap. A sample of the materials in the trap are then injected into the GC/MS for analysis. Contamination and interferences are problems with this technique. Blanks are analyzed regularly to identify whether or not contamination exists. If contamination is detected and cannot be eliminated by flushing with blank water and baking the system, then the system must be completely dismantled for cleaning.

Liquid-liquid extraction is used to separate the non-volatile organics into two fractions: the base-neutral extractables and the acid extractables. The general technique is to use a considerable amount of solvent to isolate a substantial portion of the organics. A modification of the technique is to use a smaller quantity of solvent, and then estimate the efficiency of the recovery as discussed previously (this is referrred to as micro-extraction). The individual extraction fractions may be concentrated and then analyzed separately by the GC/MS, to identify the priority pollutants listed in Table 7.2-1.

Mechanical errors in the GC/MS system are minimized by daily calibration. The individual samples are spiked regularly with internal standards which are used to indicate mechanical problems during analysis as well as interferences inherent in the sample. When the recovery of the internal standard does not meet the requirements of the test, then the sample is reanalyzed.

TABLE 7.2-1. ORGANIC PRIORITY POLLUTANTS, PESTICIDES, AND PCB's BY SEPARATION TECHNIQUE FOR ANALYSIS BY GC/MS METHODS [5-58]

Volatile Organic Compounds by Purge and Trap Technique

- Acrolein
- Acrylonitrile
- Benzene
- Bromomethane
- Bromodichloromethane
- Bromoform
- Carbon tetrachloride
- Chlorobenzene
- Chloroethane
- 2-chloroethylvinyl ether
- Chloroform
- Chloromethane
- Dibromochloromethane
- Dichlorodifluoromethane
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- 1,1-Dichloroethene
- Trans-1,2-dichloroethene
- 1,2-Dichloropropane
- Cis-1,3-dichloropropene
- Trans-1,3-dichloropropene
- Ethylbenzene
- Methylene chloride
- 1,1,2,2-Tetrachloroethane
- Tetrachloroethene
- 1,1,1-Trichloroethane
- 1,1,2-Trichloroethane
- Trichloroethene
- Trichlorofluoromethane
- Toluene
- Vinyl chloride

Pesticides and PCB's by Liquid-Liquid Extraction Technique

- Aldrin
- a-BHC
- b-BHC
- d-BHC
- g-BHC
- Chlordane
- 4,4'-DDD
- 4,4'-DDE
- 4,4'-DDT
- Dieldrin
- Endosulfan I
- Endosulfan II
- Endosulfan sulfate
- Endrin
- Endrin aldehyde
- Heptachlor
- Heptachlor epoxide
- Toxaphene
- PCB-1016
- PCB-1221
- PCB-1232
- PCB-1242
- PCB-1248
- PCB-1254
- PCB-1260

Semi-Volatile Organic Compounds by Liquid-Liquid Extraction Base/Neutral Extractables

- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Benzo(a)pyrene
- Benzo(ghi)perylene
- Benzidine
- Bis(2-chloroethyl)ether
- Bis(2-chloroethoxy)methane
- Bis(2-ethylhexyl)phthalate
- Bis(2-chloroisopropyl)ether
- 4-Bromophenyl phenyl ether
- Butyl benzyl phthalate
- 2-Chloronaphthalene
- 4-Chlorophenyl phenyl ether
- Chrysene
- Dibenzo(a,h)anthracene
- Di-n-butyl phthalate
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 1,2-Dichlorobenzene
- 3,3'-Dichlorobenzidine
- Diethyl phthalate
- Dimethyl phthalate
- 2,4-Dinitrotoluene
- 2,6-Dinitrotoluene
- Dioctyl phthalate
- 1,2-Diphenylhydrazine
- Fluoranthene
- Fluorene
- Hexachlorobenzene
- Hexachlorobutadiene
- Hexachloroethane
- Hexachlorocyclopentadiene
- Indeno(1,2,3-cd)pyrene
- Isophorone
- Naphthalene
- Nitrobenzene
- N-nitrosodimethylamine
- N-nitrosodi-n-propylamine
- N-nitrosodiphenylamine
- Phenanthrene
- Pyrene
- 2,3,7,8-Tetrachlorodibenzo-p-dioxin
- 1,2,4-Trichlorobenzene

Semi-Volatile Organic Compounds by Liquid-Liquid Extraction, Acid Extractables

- 4-Chloro-3-methylphenol
- 2-Chlorophenol
- 2,4-Dichlorophenol
- 2,4-Dimethylphenol
- 2,4-Dinitrophenol
- 2-Methyl-4,6-dinitrophenol
- 2-Nitrophenol
- 4-Nitrophenol
- Pentachlorophenol
- Phenol
- 2,4,6-Trichlorophenol

The pesticides in Table 7.2-1 can be analyzed by a procedure involving an initial analysis of a sample extract using a gas chromatograph equipped with an electron capture (EC) detector. If a compound is present, then the extract is carefully evaporated to 0.5 ml and used for GC/MS confirmation.

Acrolein and acrylonitrile also are exceptions to the general GC/MS methods for organic priority pollutants. These materials may be analyzed by using the direct injection of the sample into the gas chromatograph (i.e., without sample preparation) for GC/MS analysis. Another method available is to use a heated purge and trap technique to separate the materials from the sample for analysis.

Alternative methods used in the analysis of organic priority pollutants have been used where interferences were encountered or where there was good reason to believe that specific pollutants would be present (e.g., based on the screening results). When a specific set of pollutants are reasonably certain to be present with the other priority pollutants reasonably certain to be absent, the judicious use of sample preparation techniques (e.g., extractions, separations) and detection systems can result in very reliable analytic results. A gas chromatograph, liquid chromatograph, or high pressure liquid chromatograph can be used to separate a known set of pollutants into fractions where characteristics other than mass can be used to confirm the pollutant identity and determine the concentration of the pollutant. Such methods may utilize: electron capture, halide specific, flame ionization, flame photometric, photoionization, or ultraviolet detectors.

Precision is determined with the GC/MS using blank samples spiked with compounds selected as internal standards (e.g., bromochloromethane, 2-bromo-1-chloropropane, and 1,4-dichlorobutane) and analyzed in replicate runs. The selection of internal standards is designed to cover the entire spectrum of a gas chromatograph (i.e., the compounds in the early, middle, and late fractions that are separated by the column).

Recovery estimates, as discussed previously, also are used with the analysis of organic priority pollutants. The recovery of a priority pollutant during an extraction may only approach 100 percent or recovery may exceed 100 percent when positive interferences from contaminations, reagents, chemical reactions, or the system supersede the negative effects associated with extraction inefficiencies. Spike samples can be used to estimate the actual recovery. A spike consists of the addition of a known amount of the material under investigation prior to sample preparation and analysis. A comparison of the resulting measured concentrations of the spiked and unspiked samples then leads to an estimate of the recovery. A modification to this technique involves use of a stable isotope of the material that has iden-

tical properties but a different mass. An example would be the use of deuterated phenol. The mass difference allows the separate detection of the isotope and the material in the same sample.

In addition to recovery considerations, the interpretation of organic priority pollutant analytic results is reliant upon the operator bias in identifying a match. Although a computerized system is used to establish a match, the criteria for considering a result to be a match must be established. The screening phase of the EPA toxic pollutant survey used criteria that were intentionally biased to exclude "false negatives" (i.e., results showing the absence of the pollutant when it actually existed) at the expense of including "false positives" (i.e., results showing the occurrence of the pollutant when it actually did not exist). The verification phase used refined criteria to confirm the results of the screening survey and to eliminate false positives *and false negatives*.

V.7.2.4. Analysis - Inorganic Pollutants

The inorganic toxic pollutants identified as being of major concern in wastewater included 13 metals, cyanide, and asbestos. The analysis for these inorganics represents the use of analytic methods that are well established and in common use. The method of most general use is the atomic absorption (AA) technique, with Inductively Coupled Argon Plasma (ICAP) spectrophotometry also used frequently. Colorimetric techniques also are available.

With the exception of mercury, the metals are divided into two groups for analysis by the AA. Beryllium, cadmium, chromium, copper, nickel, lead, and zinc are analyzed by flame atomic absorption (AA) and, if not detected, are then analyzed by flameless AA. Antimony, arsenic, silver, thallium, and selenium are analyzed by furnace AA. Mercury may be analyzed by cold vapor AA techniques.

In flame AA spectroscopy, a sample is aspirated into and atomized by a flame. A light beam from a hollow cathode lamp, whose cathode is made of the element that is to be determined, is directed through the flame into a detector that measures the amount of light absorbed. Absorption depends on the presence of free unexcited ground state atoms in the flame. Since the wavelength of the light beam is characteristic of only the metal being determined, the light energy absorbed by the flame is a measure of the concentration of that metal in the sample.

When performing furnace (flameless) AA, an aliquot of the sample is placed in a graphite tube in a furnace, evaporated to dryness, charred, and atomized. The principle is essentially the same as in flame AA, except a furnace, rather than a flame, is used to atomize the sample. Radiation is generated by a given excited metal and is passed through the vapor. The intensity of the

transmitted radiation decreases in proportion to the amount of the metal in the vapor. Because a greater percentage of the metal atoms in the sample are vaporized and dissociated for absorption in the graphite tube than in the flame, the use of small sample volumes or detection of low concentrations of metals is possible with the flameless AA.

To verify that the instrument is operating correctly within the expected performance limits, an appropriate standard is typically included between every ten samples. Spiked aliquots are analyzed with a frequency of 15% for the sample load for each metal determined by flame AA. If the recovery is not within $\pm$ 10% of the expected value the sample is analyzed by the method of standard addition (i.e., a spike is added to the aliquot prior to sample preparation).

In the determination of trace metals, contamination and loss are of primary concern. Dust in the laboratory, impurities in reagents, and impurities in apparatus are sources of contamination and are given special attention in the handling and analysis of metals samples.

The most troublesome interference in flame AA is "chemical" and is caused by lack of absorption of atoms bound in molecular combination in the flame. The addition of certain compounds overcomes some of these interferences. They are also eliminated by separation of the metal from the interfering material. When using furnace techniques, chemical reactions may occur at the elevated temperature, which may result in suppression or enhancement of the analysis. To ensure valid data, each matrix is examined for interference effects, and if detected, treated using either successive dilution, matrix modification, or the method of standard addition. When AA techniques do not provide adequate sensitivity, specialized procedures are used.

The Inductively Coupled Argon Plasma technique for metals analysis was used by the EPA Region V laboratory for the toxic pollutant survey. This method was used extensively for the data developed for the Machinery and Metals Branch of EPA Effluent Guidelines Division.

Cyanides are measured by first distilling to remove interferences and then analysis by colorimetric methods. Cyanide is released from cyanide complexes by means of a reflux-distillation operation and absorbed in a scrubber containing sodium hydroxide solutions. In colorimetric measurement, the cyanide ion in the absorbing solution is converted to cyanogen chloride (CNCl). After the reaction is complete, color is formed by addition of an appropriate reagent and the absorbance is read. Sample handling for cyanide measurement is important since degradation can lead to invalid laboratory results.

To demonstrate quantitative recovery with each distillation-digestion apparatus, distilled standards are compared to non-distilled standards. Typically at least one standard is distilled each day to confirm distillation efficiency and reagent purity. At least 15% of the cyanide analyses may consist of duplicate and spiked samples.

Asbestos is unique in definition and in sampling and analysis procedures. The term "asbestos" can encompass the fibrous, and in some cases, non-fibrous forms of several minerals. Chrysotile has been selected by USEPA Effluent Guidelines Division as the monitoring parameter, since resource constraints and available analytical technology prohibit the analysis of waste effluents for all asbestos morphologies. Grab samples are used for analysis. The measurement for the asbestos particles is performed using electron microscope techniques, with selected area electron diffraction used for identification of the fibers.

V.7.2.5 Summary of Toxic Pollutant Data Protocols

The generally available techniques for analysis of priority pollutants have been assembled by EPA into analytic plans for the evaluation of these materials. These plans are referred to in this manual as analytic protocols.

The earliest protocol for the analysis of priority pollutants commonly followed by EPA is referred to as the "April 1977 EPA protocol." This protocol is summarized in Table 7.2-2, and involved the general use of the GC/MS for most organic toxics and the AA for most metals. The quality assurance/quality control (QA/QC) program was not extensive, generally including limited spikes and duplicates for verification phase evaluations only. This protocol was developed as an approach for the qualitative and semi-quantitative determination of priority pollutants for a wide-range of unknown pollutants in varying wastewater matrices. The protocol was widely used in the BAT toxic survey because of the general applicability of the approach, and the relative cost-effectiveness of the analyses. As a disadvantage, this protocol represented developing analytic methods which were not widely used at the start of the survey. Also, the QA/QC procedures specified by the protocol were designed to control the performance of the equipment (quality control) and were not designed to predict the accuracy of the measurements developed by the methods (quality assurance).

Another suggested protocol for toxic pollutant analysis is referred to as the "June 1977 EPA protocol". This differs significantly from the April 1977 protocol in that the use of analytic devices other than the broad-based GC/MS are identified. As summarized in Table 7.2-3, these methods include the GC with detectors other than the mass spectrograph. The purpose and usefulness of the June 1977 protocol was that it could greatly reduce the cost of priority pollutant analysis when a limited

TABLE 7.2-2. APRIL 1977 EPA PROTOCOL [5-36]

General - Methods Addressed by Protocol

1. Organics by purge and trap, GC/MS.
2. Organics by liquid-liquid extraction, GC/MS.
3. Metals by atomic absorption.
4. Cyanides by distillation and colorimetric analysis.
5. Phenols by distillation and spectrophotometry.
6. Collection of samples.

Organics by Purge and Trap - Methods

1. Separation by purge and trap; analysis by gas chromotograph and mass spectrograph. Qualitative determination by extracted ion current profile, using selected ion monitoring for low concentrations. Quantitative determination by comparing response (area) to reference.

2. Quality assurance includes analysis of blank with each sample group to detect interference, baking and flushing the system with blank water between analyses. Internal standards are bromochloromethane, 2-bromo-1-chloro-propane, and 1,4-dichlorobutane. Precision determined by internal standard spikes, with quality control charts used to identify deviations greater than two standard deviations for reanalysis. Calibration daily for equipment.

3. Data reported to two significant figures or nearest 10 mg/L.

Organics by Liquid-Liquid Extraction

1. Base-neutral extraction at pH 11 or greater, with serial extractions using methylene chloride. Acid (phenols) extraction at pH 2 or less, with serial extractions using methylene chloride. Emulsions defined as broken when 85 percent of solvent is recovered, using any method (e.g., centrifugation, passing through glass wool, standing); continuous extraction used when emulsion cannot be broken. Analysis by gas chromatograph, mass spectrograph. Pesticides initially determined by gas chromatograph, electron capture, with GC/MS confirmation.

2. Quality assurance includes daily calibration of system with decafluorotriphenylphosphine, and benzidine or pentachlorophenol.

3. Data should be reported in ranges -- 10 mg/L, 100 mg/L and greater than 100 mg/L.

Metals

1. Flame AA and, if not detected, flameless AA analysis performed for Be, Cd, Cr, Cu, Ni, Pb, and Zn; flameless AA only for Ag, Sb, Se, and Tl; cold vapor AA for Hg.

2. Quality assurance includes standard used between every 10 samples, spiked sample analysis at frequency of 15 percent of the sample load, reagent blanks run to correct all analyses, the mercury analyses using a spike at five times the detection limit. If recovery of spiked sample analysis is not within 10 percent of expected value, then sample is reanalyzed.

3. Data reported to nearest mg/l when concentration is less than 10 mg/L, and two significant figures at greater concentrations.

TABLE 7.2-2. APRIL 1977 EPA PROTOCOL [5-36] (CONTINUED)

Cyanides

1. All samples distilled, with analysis by colorimetric techniques.

2. Quality assurance includes daily demonstration of distillation efficiency and purity of reagents, and analysis of duplicate and spiked samples at a minimum of 15 percent the sample load.

3. Data reported to nearest 0.01 mg/L for concentrations less than 1.0 mg/L (1000 mg/L), and two significant figures for greater concentrations.

Phenols

1. All samples distilled, with analysis using chloroform extraction and spectrophotometry for concentrations less than 1.0 mg/L, or direct photometry for concentrations greater than 1.0 mg/L.

2. Quality assurance similar to that for cyanide analysis.

3. Data reported to nearest mg/L for the first method, or for the second method to the nearest 10 mg/L at concentrations less than 1.0 mg/L (1000 mg/L) and two significant figures at greater concentrations.

Sample Collection

1. Liquid-liquid extraction samples to be composites with a maximum 30 minutes between aliquot collection, minimum aliquot size 100 mL, minimum sample 9.4 liters, field blanks collected by sampling equipment after flushing with blank water.

2. Phenol, cyanide, and volatile organic samples collected as grab samples. Cyanide sample collected in one liter plastic bottles, preserved if necessary, sealed, and stored on ice. Phenol sample collected in one liter glass bottle, acidified, sealed, and stored on ice. Volatile organic samples collected in glass containers in duplicate (with a sealed vial of blank water prepared for shipment with the sample), preserved if necessary, sealed, and stored on ice.

TABLE 7.2-3. JUNE 1977 EPA PROTOCOL [5-37]

General - Methods Addressed by Protocol

1. Analytical Quality Control
2. Phenolics
3. Benzidine and Dichlorobenzidine
4. Chlorinated Pesticide Analysis in Industrial Effluents
5. Total Cyanide
6. Acid Fraction of Organic Priority Pollutants
7. Nitrosamines
8. Asbestos
9. Vinyl Chloride in Water by Gas Chromatography
10. Polychlorinated Biphenyls
11. Dinitrotoluenes
12. Phthalate Esters
13. Polynuclear Aromatic Hydrocarbons (PAH), I
14. Polynuclear Aromatic Hydrocarbons (PAH), II
15. Dichlorobenzenes and Bis (2-chloro) Ethers
16. Liquid-Liquid Extraction Method for Volatile Organic Analysis
17. Volatile Organics Analysis

Analytical Quality Control

1. Sample handling and collection procedures accress common problems identified during screening sampling.

2. Supplies and reagent purity, and methods for preparation of stock solutions are described.

3. Quality assurance for measurements includes for purgeables the use of internal standards; for regulatory liquid-liquid extractions the use of field duplicates, laboratory duplicates, and dosed samples; for monitoring liquid-liquid extractions the use of an external control series using a standard laboratory matrix and quality control charts.

4. Identification quality assurance includes daily calibration of the GC/MS, use of a method blank, and processing of mass spectra through a computerized search and match system.

Phenolics

1. Samples should be grabs, preserved at 4°C, and shielded from light.

2. Analysis by 4-aminoantipyrene (4-AAP) method.

Benzidine and Dichlorobenzidine

1. Sample collected in glass container and taken from composite.

2. Analysis involves cleanup and a color development through addition of chloramine-T, to oxidize benzidine.

3. Dichlorobenzidine is a positive interference, so if present, it is also measured and reported as benzidine.

TABLE 7.2-3. JUNE 1977 EPA PROTOCOL [5-37] (CONTINUED)

Chlorinated Pesticide Analysis

1. Sample collected in glass container and taken from composite.

2. Separation by liquid-liquid extraction, with analysis by gas chromatograph.

Total Cyanide

1. Samples should be grabs and preserved with NaOH at pH 12.

2. Analysis by procedures in Standard Methods, 13th Edition, involving colorimetric techniques.

Acid Fraction of Organic Priorit Pollutants

1. Sample should be chilled and shielded from light.

2. Analysis is by gas chromatograph only, with extensive clean-up and separation procedures.

3. Parameters measured include priority pollutants: 2,4,6-trichlorophenol, parachloro-m-cresol, 2-chlorophenol, 2,4-dichlorophenol, 2,4-dimethylphenol, 2-nitrophenol, 4-nitrophenol, 2,4-dinitrophenol, 4,6-dinitro-o-cresol, pentachlorophenol, phenol.

Nitrosamines

1. Sample should be composited and cooled.

2. Analysis is by a tentative method, employing a gas chromatograph with a thermal energy analyzer (TEA) detector.

3. Confirmation is by GC/MS, which can be used as the equivalent method if GC/TEA equipment not available.

Asbestos

1. Sample should be from composite.

2. Analytic methods are tentative, including: (a) extensive workup with determination by a transmission electron microscope, or (b) by a standard microscope. The first method can identify the number of asbestos fibers/liter, their length and width, the size distribution, total mass, and distinguish chrysotile from amphibole asbestos. The second method uses a 0.45 micrometer filter, measures all fibers with an aspect ratio greater than 3:1, and requires a staining technique to differentiate asbestos fibers from other fragments of similar morphology (e.g., diatom fragments, filamentous algae).

TABLE 7.2-3. JUNE 1977 EPA PROTOCOL [5-37] (CONTINUED)

Vinyl Chloride in Water by Gas Chromatography

1. Sample should be a grab, as for purgeable organic sampling.

2. Separation is by purge-and-trap (similar to April 1977 EPA protocol) with analysis by GC only.

3. Method applicable when vinyl chloride is only purgeable; GC/MS recommended when several purgeables are suspected.

Polychlorinated Biphenyls

1. Sample collected in glass container and taken from composite.

2. Separation is by liquid-liquid extraction and qualitative analysis by GC with an electron capture detector. Clean-up procedures are employed if organic chlorine pesticides, elemental sulfur, or complex interferences are present. Quantitative determination is by gas chromatography of cleaned sample.

3. Results are reported in microgram/liter without correction for recovery. The limit of detection is approximately 1 µg/L for each Arochlor mixture.

Dinitrotoluenes

1. Samples collected in glass container with limited preservation.

2. Analytic methods include: (a) a modified version of the chlorinated pesticide method (involving a modified GC temperature); and (b) a modified procedure for the GC measurement of explosive contaminants in water.

Phthalate Esters

1. Sample collected in glass container, taken from composite, cooled, and kept out of light.

2. Analysis uses the method for chlorinated pesticides in April 1977 EPA protocol, using electron capture detector.

Polynuclear Aromatic Hydrocarbons (PAH), I

1. Sampling must not use tygon tubing (phthalates represent an interference), and acid may be used as a preservative, although it may complicate analysis.

2. Analysis by a method that uses GC and ultraviolet spectroscopy.

3. Priority pollutants this applies to include: benzo(a)-anthracene, benzo(a)pyrene, 3,4-benzofluoranthene, benzo-(k)fluoranthene, chrysene, acenaphthylene, anthracene, benzo(ghi)perylene, fluorene, phenanthrene, dibenzo(a,h)-anthracene, indeno(1,2,3-cd)pyrene, and pyrene.

TABLE 7.2-3. JUNE 1977 EPA PROTOCOL [5-37] (CONTINUED)

Polynuclear Aromatic Hydrocarbons (PAH), II

1. Sample collected should be a composite, with minimal preservation.

2. Analysis by a method specifically designed for petroleum media (developed by American Petroleum Institute), employing GC and a method of partition chromatogrphy with a thin layer.

3. Priority pollutants this applies to are same as for PAH analysis, method I.

Dichlorobenzenes and Bis(2-chloro) ethers

1. Sample should be composite, collected in glass container, chilled, and protected from direft light.

2. Analysis involves extraction and concentration using the pesticides procedures in the April 1977 EPA protocol. Extract analysis uses a relatively nonpolar pesticide type GC column and a highly polar GC column.

Liquid-Liquid Extraction Method for Volatile Organic Analysis

1. Sample collection and handling should be same as for volatile organic sampling in April 1977 EPA protocol.

2. Separation of volatile organics from sample matrix uses a liquid-liquid extraction rather than the purge-and-trap in the April 1977 EPA protocol. Extraction solvent is added directly to the sample bottle, the sample mixed, and the organic layer removed for analysis.

3. Analysis is by GC/MS, with quantification made using the internal standard technique.

Volatile Organics Analysis

1. Sample collected as a grab in a glass container.

2. Separation involves centrifugation or filtration to remove suspended matter.

3. Analysis is by direct aqueous injection into GC, with detection by microcoulometric titration, electrolytic conductivity, or flame ionization.

4. Method can measure volatile organics to approximately 1 µg/L.

number of compounds were under investigation. However, it required some knowledge of the materials expected in the wastewater (such as might be developed during the screening phase, using the GC/MS). Based on this, the June 1977 protocol also is referred to at times by EPA as the June 1977 verification protocol. The QA/QC associated with the June 1977 protocol included some duplicates and spikes, but not for every sample.

EPA proposed guidelines for establishing test procedures for the analysis of priority pollutants in December 1979 (44 Federal Register 69464, 3 December 1979, and 44 Federal Register 75028, 18 December 1979). These are referred to as the "1979 EPA verification protocol." The proposed methods included general use of the GC with either mass spectrograph detection (Methods 624, 625 in Table 7.2-4) or other detectors (Methods 601 through 613, Table 7.2-4). The 1979 EPA verification protocol also included a sample QA/QC program. This describes a strong quality assurance and quality control program so that the reliability of data can be assessed. The procedure involves determination of precision and accuracy of the techniques for the wastewater of each industrial subcategory and use of internal standards, surrogate spikes, and labeled compounds to better quantify the data.

There are also analytic protocols available that do not require a specific regimen for sample preparation and analysis. These protocols have been developed on the principle that a competent analytic chemist can tailor the available analytic methods (using equipment readily available) to efficiently evaluate the priority pollutants in the wastewater. The lack of specificity and conformity in the analytic technique is compensated by the requirement of a very extensive QA/QC program. A typical program would require that the sample be spiked for every compound that is suspected to be present (to establish accuracy) and that replicate analyses be performed for the sample (to establish precision). This approach thus replaces a method precision and accuracy estimate with sample specific precision and accuracy. This approach has been used extensively by the Organic Chemicals Branch, Effluent Guidelines Division of EPA.

V.7.2.6 Statistical Interpretation of Analytic Data

The application of adequate QA/QC techniques during analysis should lead to recognition of the factors leading to variability in analytical test results, control of these factors to the greatest extent possible, and determination of the variance that remains in the test results [5-40]. The quality assurance aspect of the QA/QC program is the key to determining the error that is inherent in the applied test protocols, leading to the determination of the statistical reliability of the reported data. The quality control aspect of the QA/QC program is the key to identifying data that do not meet the established control limits for the test procedure. Therefore, an established and ongoing QA/QC

TABLE 7.2-4. DECEMBER 1979 EPA PROPOSED GUIDELINES ESTABLISHING TEST PROCEDURES FOR THE ANALYSIS OF POLLUTANTS [44FR 69464, 44FR 75028]

General - Methods Addressed by Protocol

1. Purgeable Hydrocarbons - Method 601
2. Purgeable Aromatics - Method 602
3. Acrolein/Acrylonitrile - Method 603
4. Phenols - Method 604
5. Benzidines - Method 605
6. Phthalate Esters - Method 606
7. Nitrosamines - Method 607
8. Organochlorine Pesticides and PDB's - Method 608
9. Nitroaromatics and Isophorone - Method 609
10. Polynuclear Armatic Hydrocarbons - Method 610
11. Haloethers - Method 611
12. Chlorinated Hydrocarbons - Method 612
13. 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) - Method 613
14. Purgeables - Method 624
15. Base/Neutrals, Acids, and Pesticides - Method 625
16. Quality Assurance and Quality Control (QA/QC) Procedures for Organic Priority Pollutants
17. Inductively Coupled Plasma Optical Emission Spectrometric Method (ICP) for Trace Elements Analysis of Water and Wastes

Purgeable Halocarbons - Method 601

1. Inert gas is bubbled through 5 ml of sample, halocarbons transferred to the vapor phase are trapped in a sorbent tube, the trap is heated to desorb halocarbons into the GC system, and detection is by a halide specific detector.

2. Method applies to 29 purgeable halocarbons.

Purgeable Aromatics - Method 602

1. Analysis is similar to Method 601, using a photoionization detector.

2. Method applies to seven halocarbons.

Acrolein and Acrylonitrile - Method 603

1. Inert gas is bubbled through 5 ml of sample in a heated purge chamber, acrolein and acrlonitrile are transferred to the vapor phase and trapped in a sorbent tube, the trap is heated to desorb materials into the GC system, and detection is by a flame ionization detector.

Phenols - Method 604

1. One liter of sample is acidified and extracted with methylene chloride, the extract is dried and concentrated to 10 ml or less, analysis is by GC, and detection is by flame ionization.

2. Method applies to eleven phenolic compounds.

3. Method also applies to pentafluorobenzylbromide (PFB) derivatives for electron capture gas chromatography with additional cleanup procedures.

TABLE 7.2-4. DECEMBER 1979 EPA PROPOSED GUIDELINES ESTABLISHING TEST PROCEDURES FOR THE ANALYSIS OF POLLUTANTS [44FR 69464, 44FR 75028] (CONTINUED)

Benzidines - Method 605

1. Benzidine and 3,3-dichlorobenzidine are extracted from the sample at pH 7-8 using chloroform, back extracted into acid, re-extracted into chloroform at neutral pH, concentrated, and determined using high performance liquid chromatography (HPLC) with electrochemical detection.

Phthalate Esters - Method 606

1. Analysis is similar to Method 604 (except sample not acidified) wtih determination by GC.

2. Method applies to six phthalate esters.

Nitrosamines - Method 607

1. Analysis is similar to Method 604 (except sample not acidified) with column cleanup procedures defined for determination by GC of various nitrosamines.

2. Method applies to three nitrosamines.

Organochlorine Pesticides and PCB's - Method 608

1. Analysis is similar to Method 604 (except sample not acidified) with determination by GC.

2. Method applies to 18 pesticides and seven PCB mixtures.

Nitroaromatics and Isophorone - Method 609

1. One liter of sample is extracted with methylene chloride, the extract is dried and exchanged to toluene while being concentrated to 1.0 ml. Isophorone and nitrobenzene are measured by flame ionization GC, and nitrotoluenes are measured by electron capture GC.

2. Method applies to four parameters.

Polynuclear Aromatic Hydrocarbons - Method 610

1. Analysis is similar to Method 604 (except sample not acidified) with measurement by GC or high performance liquid chromatography (HPLC).

2. Method applies to 15 parameters.

Haloethers - Method 611

1. Analysis is similar to Method 604 (except sample not acidified) with determination by GC and halide specific detector.

2. Method applies to five parameters.

Chlorinated Hydrocarbons - Method 612

1. Analysis is similar to Method 604 (except sample not acidified) with determination by GC.

2. Method applies to nine parameters.

TABLE 7.2-4. DECEMBER 1979 EPA PROPOSED GUIDELINES ESTABLISHING TEST PROCEDURES FOR THE ANALYSIS OF POLLUTANTS [44FR 69464, 44FR 75028] (CONCLUDED)

2,3,7,8 - Tetrachlorodibenzo-p-dioxin (TCDD) - Method 613

1. TCDD is extracted from one liter of sample using methylene chloride, the extract is dried and exchanged to hexane while being concentrated to 1.0 ml or less. Determination is with a capillary column GC/MS using internal standard techniques, with electron capture GC available to prescreen samples before GC/MC analysis.

Prugeables - Method 624

1. Inert gas is bubbled through 5 ml of sample, purgeables are transferred to the vapor phase and trapped in a sorbent tube, the trap is heated to desorb materials into the GC for separation, and detection is by mass spectrometer.

2. Method applies to 30 parameters.

Base/Neutrals, Acid, and Pesticides - Method 625

1. One liter of sample is extracted with methylene chloride, the extract is dried and evaporated to one ml, and determination is made using a GC/MS with the internal standard or external standard technique.

2. Method applies to 47 base-neutrals, 11 acid extractables, and 25 pesticide extractables.

QA/QC Procedures for Organic Priority Pollutants

1. QA/QC procedures apply to Methods 624 and 625.

2. Methodology requires validation for each industrial subcategory based on the assumed unique nature of wastewater on a subcategory basis.

3. Results of validation are used to establish initial QC limits for precision and accuracy, and to establish initial control limits.

4. Continuing QA/QC is required to confirm results are within control limits.

5. Routine QA/QC includes replicate analyses, method blanks, and field blanks.

6. Method validation includes spiked samples and replicate analyses, to define method precision and accuracy.

7. Continuing QA/QC includes sample spikes and comparison of results to control limits, with reanalysis and method checks required when results are outside limits.

ICP for Trace Elements Analysis of Water and Wastes

1. Sample is nebulized and the aerosol produced is transported to the plasma torch for excitation. Characteristic atomic line emission spectra are produced by a radio-frequency inductively coupled plasma (ICP). The spectra are dispersed by a grating spectrometer and the intensities of the lines are monitored by photomultiplier tubes. The photocurrents from the photomultiplier tubes are processed by a computer.

is required to establish the statistical confidence in analytic test measurements.

The precision and accuracy data developed from the statistical analysis of QA/QC data can be used to indicate that a laboratory can properly perform the extraction and analysis of the pollutants, to monitor subsequent analyses to ensure that the measurements are within the established control limits, and to determine the degree of confidence that can be placed in the data. For example, a laboratory can establish control limits for a compound or group of compounds based on initial analyses of recovery data for the specific wastewater matrix. Recovery of these compounds can then be monitored during subsequent routine analyses and used to identify questionable results (e.g., when a recovery measurement is outside the acceptable range). Reanalysis of the sample can then be initiated in an attempt to correct erroneous result.

The data collected during the QA/QC program also can be used in the interpretation of the reported results. The quantitation of specific compounds in a wastewater stream, for example, can be made more accurate by using a recovery-corrected estimate of the compound concentration. This use of recovery estimates, as determined during the QA/QC program, represents a judgement as to the relative value of the adjusted values versus the uncertainty and error associated with the recovery factor.

April 1977 EPA Protocol

The results of the BAT Toxic Pollutant Survey were developed for the purpose of characterizing and quantifying the priority pollutants in the sampled wastewater streams. The methods used were not validated prior to the initiation of the program due to the schedules imposed on EPA by the program requirements. (Validation means that the method was analyzed to determine the distribution of results using carefully controlled procedures, to establish confidence limits as to the accuracy of test results). The use of unvalidated protocols does not mean that the data were developed incorrectly; rather it means that the method used to generate the data was not characterized as to accuracy or precision prior to the data development process. The routine analyses performed under this protocol included limited spiking for the determination of recovery data. However, measurements reported are not corrected using recovery estimates, and therefore do not accurately reflect the "true" concentration of the material in the sample. This is significant. Due to the nature of the wastewater streams under analysis, the recovery of a specific pollutant from a specific wastewater matrix could vary considerably.

Since accuracy as reflected by the recovery estimate cannot be specifically defined for data developed using the April 1977 EPA protocol (where sample specific recovery data were not developed),

the user of these numerical data must be very cautious, that is, there is not a known accuracy for the data (accuracy refers to the degree to which a measurement conform to the true concentration within the sample at the time of analysis). The user could provide recovery data from an independent study to better estimate the accuracy of results developed using April 1977 protocol data, but caution is again advised.

There has been a limited study performed to identify the observed characteristics of recovery estimates developed using the April 1977 EPA protocol [5-57]. The study performed on the observed recovery of priority pollutant spikes involved in the analysis of about 10,000 measurements, for 116 of the priority pollutants. The sources used in the analysis included data from seven laboratories with four laboratories representing almost all of the data. The study used recovery data developed from POTW samples (Laboratory I); natural waterway sample (Laboratory II); composite of samples from the influent and effluent of treatment processes associated with coal mining, inorganic chemical manufacturing, leather tanning, pesticide manufacturing, and timber industries (Laboratory III); composite of samples from POTW and detergent and landfill-chemical disposal industries (Laboratory IV); and cresote waste samples from the wood preserving industry (Laboratory V).

Based on the overall recoveries for various classes of priority pollutants (Table 7.2-5) the data indicate that the volatile organic analysis method in the EPA protocol has been the most accurate. The acid and pesticide analysis method has been less accurate, and the base/neutral analysis method has been less successful on samples with severe matrix problems, e.g. from the leather tanning and timber industries. However, within each class of priority pollutants the individual compounds exhibit a wide fluctuation in recovery. Some of these fluctuations in recovery can be associated with the analytical protocol. For example, losses due to volatility can reduce the recoveries of the purgeable and acid compounds. Carryover of the base/neutral compounds into the acid fraction in the extraction phase can occur because of emulsions and high background concentrations. Long term continuous extraction amplifies the reactions of hydroxide with the base/neutral components.

The interlaboratory comparison of percent recovery data for the priority pollutant classes is shown in Table 7.2-6. This comparison shows that there was a difference in the accuracy of data reported for the classes of compound, based on the laboratory performing the evaluation.

The results of the QA/QC analysis indicate the performance of the basic methodology and indicate that analytical results developed using the April 1977 protocol are semi-quantitative representations of priority pollutants concentrations. The tendency for most compounds is to exhibit an average recovery below 100 percent.

TABLE 7.2-5. SUMMARY OF OVERALL ANALYTICAL RECOVERIES FOR VARIOUS CLASSES OF PRIORITY POLLUTANTS [5-57]

Compounds	Method Standard Analysis		Matrix Spiked Analysis	
Class/Number	P±Sp/N(a)	Range/L(b)	P±Sp/N(a)	Range/L(b)
Purgeables/30	90±20/785	59-106/4	92±27/2161	32-111/4
Acids/11	84±23/360	61-96/4	76±26/862	54-102/5
Base/Neutrals/43	84±30/1415	56-142/3	68±29/2762	27-105/5
Pesticides/18	78±16/505	65-85/3	59±15/960	42-76/4
Metals/13	108±34/385	83-136/2	96±26/1638	79-106/3
Cyanide	103±7/65	103-103/2	96±14/70	93-101/2
Total Phenols	101±8/58	97-107/3	96±11/85	93-98/3
All Organics/102	85±25/3065	56-142/5	73±26/6745	32-111/5

(a)N is the total number of measurements used to compute the cited average recovery (P) and standard deviation (Sp).
(b)The range of average recoveries for the compounds in a class and the number of contributing laboratories (L) is given in this column.

Table 7.2-6. Interlaboratory comparison of percent recovery data for priority pollutant fractions analyzed using the April 1977 EPA protocol (a) [5-57]

Priority Pollutant Fraction(b)	Lab I	Lab II	Lab III	Lab IV	Lab V	Lab VII	Average
Volatile (MS)	88±21	95±5		100±8			90±13
Volatile Sample Spike	82±24	101±9	93±13	107±9			92±15
Acid (MS)	90±18	89±5		67±14	82±16		84±13
Acid Sample Blank	92±34	72±10	62±12	60±15	84±17		76±19
B/N-(MS)	95±25	78±41		77±15			84±25
B/N Sample Spike	84±18	61±22	55±24	68±16		63±13	68±21
Pesticide (MS)	73±8	74±19		88±8			78±11
Pesticide Sample Spike	69±7	51±18	33±10	93±5			59±11
Metals (MS)	113±37			103±8			108±22
Metals Sample Spike	100±20	103±14		92±7			96±11
Cyanide (MS)	103±14			103±8			103±7
Cyanide Sample Spike	101±12			93±16			96±14
Phenolics (MS)	10±13	97±6		100±7			101±8
Phenolics Sample Spike	93±15	98±10		97±9			96±11

(a) The values are in units of percent recovery plus or minus (±) one standard deviation. Percent recovery and standard deviation are weighted averages based on the number of data points contributed by each laboratory.
(b) MS refers to the method standard or the standard addition to blank water. Sample spike refers to the standard addition to a sample.

This indicates that most data are probably reported at concentra tion lower than actually existed.

June 1977 EPA Protocol

The June 1977 EPA protocol included a QA/QC requirement similar to that required for the April 1977 protocol. The precision and accuracy of the data developed using this protocol have not been defined by the sources used in preparing this manual.

December 1979 EPA Protocol

This protocol includes as a fundamental requirement the validation of the analytic methods prior to their use for routine analysis of a wastewater matrix. EPA is sponsoring validation studies that are to establish the accuracy and precision of the methods. However, these studies have not been completed.

The protocol also includes a requirement that each laboratory establish control limits for evaluating the reliability of the methods during routine analysis. The sources of data used in this manual have not reported any results of these laboratory-specific validation and QA/QC programs.

An evaluation of the precision, bias and comparability of the inductively coupled plasma method ICP with that of flame atomic adsorption AA was made by the EPA Effluent Guidelines Division in 1980 for total metals (iron, chromium, copper, nickel, lead and zinc) in mine effluents. This study, while limited in scope, was an inter-laboratory round-robin conducted in accordance with ASTM D2777-77, "Standard Practice for Determination of the Precision and Bias of Methods of Committee D-19 on Water." The limits of detection and of determination in mine effluents based on inter-laboratory precision for the ICP method were several times higher than those for flame AA in the 0-1 mg/L range for all of the above mentioned elements except chromium.

V.7.3 INDUSTRIAL DATA ANALYSES

The following discussions summarize information on the methods used in developing the data presented in the Manual for each industry.

V.7.3.1 Auto and Other Laundries

Volume II Reference: Section II.2

Data Sets:

1. BAT Survey (Screening)
   Sampling: Monsanto Research Corp. (MRC) and others
   Analysis: Monsanto and others
   Reference: 5-1
   Date: Unspecified

2. Sampling Program (Car wash)
   Sampling: Jacobs Environmental Division of Jacobs Engineering
   Analysis: Jacobs Engineering
   Reference: 5-2
   Date: April 26, 1979 to May 20, 1979

3. Ultrafiltration Study
   Sampling: Walden Research Division of Abcor, Inc.
   Analysis: Abcor
   Reference: 5-3
   Date: March 15, 1976 to March 14, 1977

Procedures: Data Set 1 - BAT Survey (Screening)

The BAT screening survey encompassed 35 laundries. MRC performed 4 of these tasks, the remaining 31 jobs went to previous Effluent Guidelines Division contractors. The sampling and analysis used by the other contractors followed established EPA protocol. In this study MRC and the other contractors analyzed for all 129 pollutants except for asbestos and 2,3,7,8-tetrachloridibenzo-p-dioxin (TCDD).

Sampling followed the April 1977 EPA Protocol with minor modifications. Samples taken by MRC were composited over a two day period as opposed to the established three day period. Nonvolatile organic priority pollutants were hand composited rather than with automatic samplers. Volatile organic priority pollutants were hand grabbed as recommended by EPA protocol. Four grab samples of each of these fractions were collected over the two day sampling period. MRC also composited cyanide and phenol samples.

Analysis of wastewater followed the April 1977 EPA protocol. Volatile organic pollutants were analyzed using the Bellar purge and trap technique. Nonvolatile organic pollutants were analyzed using GC/MS. The metals were analyzed by the inductively coupled argon plasma (ICAP) excitation technique (antimony, beryllium, cadmium, chromium, copper, lead, nickel, silver, and zinc) or by conventional atomic absorption techniques (arsenic, mercury, selenium, and thallium).

Procedures: Data Set 2 - Sampling Program (Car Wash)

The contractor studied various types of car washes used in this industry. Six facilities were visited and sampled. Priority pollutants were sampled and analyzed with only those identified above 10 µg/L recorded.

Sampling techniques included grab samples for the supply water and equal volume composite samples for the untreated and treated effluent. Analysis of sampled wastewater was done according to the April 1977 EPA protocol.

Procedures: Data Set 3 - Ultrafiltration Study

Abcor performed a pilot scale study of ultrafiltration and carbon adsorption. Sampling and analysis was performed by Abcor at their own analytical laboratories. The data were obtained for classical pollutants and heavy metals.

Sampling techniques followed by Abcor entailed composite portions of pilot effluents. Exact sampling techniques were not specified.

Analysis of samples collected followed protocol established in "Standard Methods for the Examination of Water and Wastewater" (1975) and "Manual of Methods for Chemical Analysis of Water and Wastes" (EPA 1974). Metal analysis was done using atomic absorption techniques.

V.7.3.2 Coal Mining

Volume II Reference: Section II.3

Data Sets:

1. BAT Survey (Screening Phase)
   Sampling: Versar Inc./Radian Corp.
   Analysis: EPA Region V Lab and three contractors
   Reference: 5-4
   Date: April 1977 to June 1977

2. BAT Survey (Verification Phase)
   Sampling: Versar Inc./Radian Corp.
   Analysis: Unspecified
   Reference: 5-4
   Date: Unspecified

3. Engineering Site Visit Data
   Sampling: Radian, Hydrotechnic, Frontier Technical
   Analysis: Unspecified
   Reference: 5-4
   Date: September 1979 to November 1979

4. EPA Regional Studies
   Sampling: EPA Regional Sampling Teams Region 4 & 8
   Analysis: EPA Laboratories
   Reference: 5-4
   Date: March-May 1979

5. Pilot Scale Study RBC
   Sampling: Pennsylvania State University, Department of Civil Engineering
   Analysis: Pennsylvania State University, Department of Civil Engineering
   Reference: 5-43
   Date: May 1974-March 1975

Procedures: Data Set 1 - BAT Survey (Screening Phase)

Sampling and analysis for all 129 pollutants was conducted at 44 coal mining locations. Sampling and analysis techniques followed in this study were the April 1977 EPA protocol.

Versar Inc. as well as Radian did the sampling for the screening as well as the verification phase of this study. 24-hour composite samples were taken for metals, pesticides, solids, TOC, and COD. Grab samples were collected for volatile organics, phenol, and cyanide analysis. Composites were taken automatically where possible and manually when necessary.

Analysis of data was performed by the EPA Region V analytical laboratory and three EPA analytical contractors. One contractor conducted analyses for classical water quality parameters as well as for phenols, cyanides, pesticide and PCB's. The same contractor also analyzed for four priority metals (antimony, arsenic, selenium, and thallium) using atomic absorption spectroscopy. The remaining metals were analyzed by EPA Region V using inductively coupled argon plasma (ICAP) emission spectroscopy. The two other contractors analyzed the samples for organics using the GC/MS techniques in the April 1977 protocol.

Gulf South Research Institute (GSRI) was also part of the screening program. They performed duplicate analyses of the screening samples originally analyzed for metals by the EPA Region V analytical lab. GSRI analyzed 39 samples from 19 mines with a spark source mass spectrometer to compare to EPA analyses.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

Nineteen plants, including 10 from the screening survey, were sampled during the verification phase of the study. Sampling and analytic methods were the same as those used for the screening survey, the April 1977 protocol.

Prior to the start of verification sampling, EPA organized a sample control center to coordinate the efforts of the EPA Project Officers, the sampling teams, and the analytical laboratories. Controls were an integral part of the first and third programs at 8 mines.

Procedures: Data set 3 - Engineering Site Visit Data

The engineering site visits were carried out primarily to collect cost data for verifying and supplementing costs previously developed for the coal mining industry. Fourteen separate mines were contacted and visited in the fall of 1977.

Grab samples of raw and treated effluents were collected and analyzed for the classical parameters, TSS, Fe, Mn, pH, turbidity, alkalinity/acidity, settleable solids, and total dissolved solids. The thirteen toxic metals were also analyzed for using inductively coupled argon plasma (ICAP) emission spectrometry and atomic absorption.

Procedures: Data Set 4 - EPA Regional Studies

EPA sampling teams from Regions 4 and 8 conducted surveys at three coal mines. Grab samples were collected and analyzed for the currently regulated parameters, priority metals, and a number of classical pollutants. These data were forwarded to the Effluent Guidelines Division and incorporated into the data base.

Procedures: Data Set 5 - Pilot Study

The data set encompasses a pilot study carried out at Penn. State University on the effectiveness of a rotating biological contactor. Sampling and analysis procedures were not specified by protocol. The sampling phase of the study consisted of grab samples taken through a manifold sluice grate arrangement. Sampling was staggered to allow for retention time in each stage of treatment. The analysis of the wastewater concerned only classical pollutants.

V.7.3.3 Electroplating

Data on the electroplating industry are included with Section V.7.3.13, Metal Finishing.

V.7.3.4 Inorganic Chemicals

Volume II Reference: Section II.5

Data Sets:

1. BAT Survey (Screening Phase)
   Sampling: Jacobs Engineering
   Analysis: Jacobs Engineering
   Reference: 5-5
   Date: 1978

2. BAT Survey (Verification Phase)
   Sampling: Jacobs Engineering
   Analysis: Jacobs Engineering
   Reference: 5-5
   Date: 1978

Procedures: Data Set 1 - BAT Survey (Screening Phase)

In the screening phase of the sampling program, the specific objective was the detection and quantification of water-borne waste constituents included on the list of 129 toxic pollutants. Each sample of an individual raw waste stream, a combined waste stream, or a treated effluent was collected where possible by an automatic, time series compositor over a single 72-hour sampling period. Where automatic compositing was not possible, grab samples were taken at intervals during the same sampling period and composited manually. Each sample was divided into several portions and preserved, as required for different types of analysis, in accordance with the April 1977 EPA protocol. Samples were also taken from the composites, or as individual grabs, for the analysis of the classical pollutants.

The analytical methods used for the screening of toxic pollutants were those described in the April 1977 EPA protocol. The metals were analyzed using atomic absorption methods except mercury which was analyzed by the cold vapor method. Organic toxic pollutants were determined by gas chromatography - mass spectrometry (GC/MS). The pesticides were analyzed by electron capture gas chromatography followed by GC/MS confirmation. Volatile organics were extracted by the purge and trap method and analyzed by GC/MS. Cyanide was analyzed by the wet chemical analysis of total cyanide. The diphenylcarbazide colorimetric method was used to determine hexavalent chromium.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

The objective of verification sampling was to confirm the first observations from screening and further quantify the concentrations and waste loadings of the toxic pollutants and conventional

and nonconventional pollutants. Where any toxic pollutant metals were found during screening sampling of a particular plant, analyses were made for all toxic pollutant metals during the verification sampling.

Verification phase sampling required the collection of three 24-hour composites at each sampling point. Where composites could not be taken with automatic samplers, grab samples were taken periodically over the same time period and composited manually.

Analysis of toxic pollutants followed the April 1977 EPA protocol. The specified analytical methods were modified for metals analysis during verification in order to avoid the excessive matrix interference experienced during screening. The modified protocol for metals was:

1. Six elements were determined by flame AA only (Ag, Be, Cu, Cr, Ni, and Zn).

2. Four elements were determined by the graphite furnace AA (Cd, Pb, Tl, and Sb). If interference occurred, Cd, Pb, Tl, and Sb were determined by flame AA.

3. Hg was analyzed by the cold vapor method.

This modification reduced the number of preparations per sample from three to two and achieved adequate detection limits to meet the verification criteria levels.

Additional modifications were made during the verification program to improve the reproducibility and precision for Hg, As, and Se. These were:

1. The cold vapor procedure for Hg was modified to eliminate the pump and allow dilution and rerun from the same sample. This saved time and increased reproducibility.

2. Selenium and arsenic were determined by hydride generation using sodium borohydride. This greatly minimized problems associated with matrix interference. The method is very reproducible and the detection limits were at levels well below the verification criteria for these two elements.

Analysis of all other pollutants followed the methods in the protocol.

V.7.3.5 Iron and Steel

Volume II Reference: Section II.6

Data Sets:

1. BAT Survey (Screening)
   Sampling: Rice Division of NUS
   Analysis: Rice Division of NUS, EPA Region V
   Reference: 5-6
   Date: February 1977 to 1979

2. Original Guidelines
   Sampling: Rice Division of NUS
   Analysis: Rice Division of NUS
   Reference: 5-6
   Date: 1973 to March 1976

Procedures: Data Set 1 - BAT Survey (Screening)

This survey consisted of sampling and analysis of 114 iron and steel plants. The data base covers every subcategory included in this industry.

The screening phase of the data set detected and quantified wastewater constituents included on the list of 129 toxic pollutants. Wherever possible, each sample of an individual raw wastewater stream, a combined waste stream, or a treated effluent was colleced by automatic, time series compositing over three 24-hour sampling periods. Where automatic compositing was not possible, grab samples were taken and composited manually.

Analysis of sample data followed techniques described in the April 1977 EPA protocol for all 129 priority pollutants. All metals analysis, except mercury and cyanide, was performed by atomic absorption spectrophotometry. Mercury and cyanide were analysed by the standard cold vapor method with slight modifications to avoid excessive matrix interference. Asbestos fibers were analysed by the use of a transmission electron microscope with selected area diffraction.

Procedures: Data Set 2 - Original Guidelines

This survey included an analysis of raw wastewater and treated effluent for classical as well as a limited number of toxic metal pollutants. One hundred fourteen steel manufacturing operations were visited. The work was divided into two phases with NUS doing the work for both studies. The combined data from these two studies were used with data obtained during the BAT survey (Data Set 1).

V.7.3.6 Leather Tanning

Volume II Reference: Section II.7

Data Sets:

1. BAT Survey (Screening Phase)
   Sampling: Midwest Research Institute (MRI)
   Analysis: MRI
   Reference: 5-8
   Date: September 1976 to October 1976
   February 1977 to March 1977

2. BAT Survey (Verification Phase)
   Sampling: MRI
   Analysis: MRI
   Reference: 5-8
   Date: Unspecified

3. Original Guidelines
   Sampling: Stanley Consultants
   Analysis: Stanley Consultants
   Reference: 5-7
   Date: 1972

Procedures: Data Set 1 - BAT Survey (Screening Phase)

In order to determine the toxic pollutant content of leather tannery wastewater, the Agency developed a two phase wastewater sampling and analysis program. Twenty-two tanneries and two POTWs were involved, the latter with substantial tannery wastewater flows. The study was designed to sample for all 129 priority pollutants.

Raw wastewater samples were obtained either before any treatment or following minimal pretreatment depending on accessibility to the wastewater stream. Treated effluent samples were taken either following plant pretreatment or secondary treatment. Automatic samplers and flow recorders were used to account for short term fluctuations in concentration. Samples were taken every 15 minutes, and 24-hr. composite aliquots were removed to satisfy the sample requirements of the basic water quality parameters. The remaining volume from the composite was used for the 72-hr. composite. Blanks were collected from the water supply. Sampling requirements after secondary treatment involved either grab samples taken three times a day and the entire sample retained, or an automatic sampler employed and the collected samples mixed for the composite.

The primary method used for anlaysis of the volatiles, base/neutrals, and acidic organics was gas chromatography/mass spectrometry (GC/MS). To avoid interference problems an additional selectivity factor, selected ion monitoring (SIM), was adopted. A GC was employed for pesticides with limited MS confirmation.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

The verification program followed directly from the initial BAT screening survey. The purpose of this phase of the program was to confirm and further quantify the results obtained during the screening phase.

The sampling techniques used during the verification phase were the same as those used during screening. Analysis of wastewater was also esentially the same as the protocol employed during screening. Minor modifications were made in the program for certain types of pollutants, as follows.

Base/neutrals: These compounds were assayed in the tannery wastewaters by extracting basified and acidified aliquots, concentrating the extracts, and analyzing them by GC/MS.

Acid Organics: Acidic extracts were prepared from a duplicate water sample in a manner identical to the base/neutrals except that the samples were acidified to pH 1 with HCl prior to extraction. The extracts were then analyzed by GC/MS.

Pesticides: Samples were liquid/liquid extracted and the solvent layer was run through a series of clean up procedures. The resulting extract was then injected into a gas chromatograph equipped with an electron capture detector.

Total Phenols: The samples were distilled and the distillate assayed for phenolic compounds by the 4-aminoantipyrene complëxation procedure.

Metals: The priority pollutant metals were assayed by atomic absorption spectrometry (AA) following appropriate digestion of the sample.

Cyanide: Samples were analyzed for cyanide by a colorimetric method. Sulfides were removed before distillation.

Procedures: Data Set 3 - Original Guidelines

The original guidelines study divided the tannery industry into six subcategories and representative plants from each subcategory were sampled. Analysis was for classical pollutants, using standard methods.

V.7.3.7 Aluminum Forming

Volume II Reference: Section II.8.1

Data Sets:

1. Initial BAT Survey (Screening Phase)
   Sampling: Sverdrup and Parcel and Associates
   Analysis: Cyrus William Rice Division of NUS Corporation (NUS Corp.), EPA Region V Laboratory
   Reference: 5-9
   Date: 1978-1979

2. BAT Survey (Verification Phase)
   Sampling: Sverdrup and Parcel and Associates
   Analysis: Radian Corporation
   Reference: 5-9
   Date: 1978-1979

Procedures: Data Set 1 - Initial BAT Survey (Screening Phase)

The aluminum forming sampling program included 22 plants. The screening phase involved collection of samples from most waste streams in the aluminum forming category (109 streams sampled). The samples were collected and analyzed according to the April 1977 EPA protocol.

The sampling program involved one time grab samples and 24-hour, 48-hour, or 72-hour manual and automatic composite samples. The samples were collected through teflon and tygon tubing, with a tubing blank collected during the sampling program. Blanks for the volatile organic acid (VOA) samples were also collected. They were prepared by pouring organic-free water into sample bottles while at the sampling site, thereby giving an indication of the VOA concentrations present in the atmosphere during sampling. Samples of the source water used as make-up in the production process were collected so that the concentration of pollutants present in the background could be determined.

The screening samples were split at NUS Corporation for metals analysis. One aliquot of each sample received by NUS Corporation was sent to EPA Region V laboratories for analysis using coupled argon plasma emission spectrophotometry (ICAP) (Ca, Mg, Na, Ag, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sn, Ti, V, Y, Zn). NUS Corporation analyzed using AA spectrophotometry (Sb, As, Se, Tl, Hg).

Procedures: Data Set 2 - BAT Survey (Verification Phase)

The verification phase was intended to investigate only the priority pollutants identified during the screening phase but due

to time constraints, the verification samples were analyzed for almost all of the priority pollutants. The protocol for sampling and analysis during the verification phase was the April 1977 EPA protocol.

Verification samples were analyzed for metals using the AA. Only metals shown to be significant in the aluminum forming categories or those expected to consume large amounts of lime were analyzed (Sb, As, Ca, Mg, Na, Al, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sn, Ti, V, Y, Zn, Hg). All of the organic priority pollutants were analyzed in the verification phase as well as the screening phase (with the exception of TCDD) using the April 1977 EPA protocol. The seven polychlorinated biphenyls (PCB's) on the list of priority pollutants for analytical identification and quantification are difficult to separate for analyses. For that reason, the concentrations of the polychlorinated biphenyls are reported by the analytical laboratory in two groups: one group consists of PCB-1242, PCB-1254 and PCB-1221; the other group consists of PCB-1232, PCB-1248, PCB-1260, and PCB-1018. For convenience, the first group is referred to as PCB-1254 and the second as PCB-1248.

V.7.3.8 Battery Manufacturing

Volume II Reference: Section II.8.2

Data Sets:

1. Initial BAT Survey (Screening Phase)
   Sampling: Hamilton Standard
   Analysis: Several contractors
   Reference: 5-10
   Date: Summer 1978

2. BAT Survey (Verification Phase)
   Sampling: Hamilton Standard
   Analysis: Several contractors
   Reference: 5-10
   Date: Summer 1978

Procedures: Data Set - Initial BAT Survey (Screening Phase)

The battery manufacturing industry sampling program was conducted at 19 plants. For the screening phase, influent water, raw wastewater, and treated effluent samples from a single plant in each subcategory were analyzed for all of the priority pollutants under consideration. Sampling and analysis used the April 1977 EPA protocol.

Samples were obtained for the total process wastewater before and after treatment. At plants where a single combined raw waste

stream or treated effluent did not exist, samples from each discrete waste source were flow proportionally composited to represent the total waste streams for screening.

Samples were collected at each site on three successive days. Except where production or wastewater discharge patterns precluded it, 24-hour flow proportioned composite samples were obtained. Composite samples were prepared either by using continuously operating automatic samplers or by compositing grab samples obtained manually once each hour. For batch operations the samples were prepared by compositing grab samples from each batch. Wastewater flow rates, pH, and temperature were measured at each sampling point on an hourly basis or for batch operations, when each sample was taken. At the end of each sampling day, aliquots of each composite sample were taken for analysis for organic priority pollutants, metals, and for TSS, cyanide, ammonia, and oil and grease. Grab samples were taken for analysis for volatile organic compounds and for total phenols because these parameters would not remain stable during compositing.

Analysis for metals used plasma arc spectograph techniques. Analysis for organic priority pollutants was performed by gas chromatograph-mass spectrometer techniques as described in the April 1977 EPA protocol. Analysis was not performed for dioxin, alkyl expoxides, and xylenes because established analytic techniques were not available.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

The data collected during the verification phase were developed to provide a characterization of process wastewater from each distinct process operation, the total waste stream, and the effluent from waste treatment. The sampling methods used were similar to those for the screening phase survey, the April 1977 EPA protocol.

Analysis was performed for a limited number of the priority pollutants during the verification phase. The results of the screening phase were used to delete from the analyses the priority pollutants not found in the industry. As a result, sixteen parameters were studied for the cadmium subcategory, twenty-eight for the lead subcategory, sixteen for the Leclanche subcategory, and thirty-three for the zinc subcategory.

The analytic methods during the verification phase included atomic absorption for metals analyses. The organic priority pollutants were analyzed using either the GC-MS or a gas chromatograph alone. The sampling and analysis were performed using April 1977 EPA screening protocol.

V.7.3.9 Coil Coating

Volume II Reference: Section II.8.3

Data Sets:

1. Initial BAT Survey (Screening Phase)
   Sampling: Hamilton Standard
   Analysis: Several contractors
   Reference: 5-11
   Date: Summer 1978

2. BAT Survey (Verification Phase)
   Sampling: Hamilton Standard
   Analysis: Several Contractors
   Reference: 5-11
   Date: Summer 1978

Procedures: Data Set 1 - Initial BAT Survey (Screening Phase)

Screening samples of incoming water, total raw waste, and final effluent were obtained using the April 1977 EPA protocol for one plant in each subcategory (steel, galvanized, and aluminum) for a total of three plants. For all sampling programs, flow proportioned composite samples, or the equivalent for batch operations, were taken while the plant was in operation. Blank samples were taken to detect pollutants introduced by the sampling equipment. Where applicable, incoming water samples were also collected and analyzed.

Analysis for all parameters followed the April 1977 EPA protocol with the exception of certain metals analyses. The ICAP method was used for beryllium, cadmium, chromium, copper, lead, nickel, and zinc.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

Verification sampling was done at 2 of the 3 plants where screening was done, and at 10 additional plants for a total of 12 plants. The method of gathering, shipping, and analyzing the samples for verification followed the June 1977 EPA verification protocol. Verification samples were taken for every operation which discharges or uses process water. The inlet water also was analyzed for background pollutant levels.

The analysis of organic priority pollutants followed the April 1977 EPA protocol methodology for all pollutants analyzed except as follows. The June 1977 EPA verification protocol was followed for 1,1-dichloroethane, 1,1,2-trichloroethane, 1,2-trans-dichloroethylene, 1,4-dimethylphenol, and phenol. Metals were analyzed using atomic absorption.

V.7.3.10 Copper Forming

These data will be included when this industry is included in Volume II.

V.7.3.11 Electrical and Electronic Components

Volume II Reference: Section II.8.5

Data Sets:

1. Unpublished EPA Study
   Sampling: Unspecified
   Analysis: Unspecified
   Reference: 5-12
   Date: Unspecified

2. BAT Survey
   Sampling: Hamilton Standard
   Analysis: Several Contractors
   Reference: 5-12
   Date: 1979-1980

Procedures: Data Set 1 - Unpublished EPA Study

A preliminary and unpublished EPA study of the electrical and electronics components category included sampling visits to nine plants. These visits included facilities in the product areas: transformers, carbon and graphite products, semiconductors (three plants), capacitors (two plants), and electric lamps (two plants).

Procedures: Data Set 2 - BAT Survey

Sampling visits were made to 24 plants in the industry. The sampling program consisted of up to three days of sampling. Sampling and analysis were performed according to the April 1977 EPA protocol.

Samples were flow proportioned composites or the equivalent grab sample composite taken over the period the plant was in operation. Sample points included raw wastewater, treated effluent, and process steps of interest. Analysis included the on-site determination of flow, pH, and temperature. A laboratory in the vicinity analyzed for total cyanide, fluoride, total organic carbon, biochemical oxygen demand, oil and grease, phenols, and total suspended solids within 24 hours of sample collection. Metals and organic priority pollutants were analyzed by EPA contractors selected by the Effluent Guidelines Division Sample Control Center.

V.7.3.12 Foundries

Volume II Reference: Section II.8.6

Data Sets:

1. Original Guidelines Survey
   Sampling: NUS Corporation
   Analysis: NUS Corporation
   Reference: 5-13
   Date: 1974

2. BAT Survey (Verification Phase)
   Sampling: NUS Corporation
   Analysis: NUS Corporation
   Reference: 5-13
   Date: 1976

Procedures: Data Set 1 - Original Guidelines Survey

The original guidelines survey included sampling and analysis for 19 facilities. The metals data associated with that survey were developed using Standard Methods. The data are presented along with the BAT survey data in the source.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

The BAT Survey was conducted at 23 facilities. The sampling and analysis followed the April 1977 EPA protocol. The first day of each sampling effort was used only to determine the presence in the wastewater for all 129 priority pollutants. The following two day sampling effort was intended to verify the screening results, quantify the pollutant loads, and determine treatment effectiveness.

Analysis for metals in the first day screening samples included all metals in the list of 129 priority pollutants. Only metals detected in the screening sample were analyzed for in the verification samples. All organic priority pollutants were analyzed for in both the screening and verification samples.

V.7.3.13 Metal Finishing

Volume II Reference: Section II.8.7

Data Sets:

1. BAT Survey (Screening and Verification Phases)
   Sampling: Hamilton Standard
   Analysis: Several
   Reference: 5-14
   Date: 1978 - 1979

2. Previous EPA Studies
   2a. Machinery and Mechanical Products Manufacturing Category
   2b. Electroplating Category
   2c. Electroless Plating and Printed Circuit Board Manufacturing Segments of the Electroplating Category
   2d. Printing and Publishing Category
   2e. Mechanical and Electrical Products Category
   2f. Copper and Copper Alloy Manufacturing Category
   2g. Aluminum and Aluminum Alloy
   2h. Iron and Steel Manufacturing Category
   Reference: 5-14

3. Pilot Plant Study
   Sampling: Abcor, Inc.
   Analysis: Walden Research Division of Abcor, Inc.
   Reference: 5-41
   Date: 1977

Procedures: Data Set 1 - BAT Survey (Screening and Verification Phases)

A total of 198 manufacturing facilities were visited during the survey. The survey was performed in two analysis groups. For the first group, analyses included on-site, local laboratory, EPA laboratory, GC/MS laboratory, and a central laboratory. The second group used on-site, local laboratory, and EPA contracted metals and GC/MS laboratory analysis. Sampling and analysis were performed using the April 1977 EPA protocol.

Samples consisted of 24-hour composites for each sample point for two or three consecutive days. On-site measurements performed for both groups included flow rate, pH, and temperature. Special grab samples were collected on a selective basis from certain plants to obtain data related to specific unit operations, process variations, or rinsing operations.

Analysis was performed within a 24-hour period by a local laboratory for total cyanide, cyanide amenable to chlorination, TSS, oil and grease, and phenols, for the first analysis group. The second analysis group also used a local laboratory to analyze within a 24-hour period, for total cyanide, oil and grease, ammonia nitrogen, TOC, TSS, BOD, and phenols. Metals were analyzed in the first analysis group by an EPA laboratory for a screening analysis to establish metals present in the samples. Metals in the second analysis group were analyzed by an EPA contractor laboratory.

Analysis for organic priority pollutants for the first analysis group included a screening analysis of selected samples, using GC/MS, and independent analysis of all samples by a central con-

tractor laboratory to verify the levels of metals, organics, and total dissolved solids. The second analysis group samples all were analyzed for organic priority pollutants by an EPA contractor laboratory.

Procedures: Data Set 2 - Previous EPA Studies

The previous EPA studies provided information on the process raw wastes generated by the metal finishing operations, the degree of segregation within the industry, and the treatment utilized by the industry. The protocols used in developing these data are not described in the reference.

Procedures: Data Set 3 - Pilot Plant Study

Field tests were performed at two sites to investigate use of reverse osmosis in a complete recycle scheme for copper cyanide plating wastes. The pilot feed was continuously collected from the operating plating systems and fed to the pilot RO unit. Samples from the pilot unit were obtained for the permeate stream, feed stream, and concentrate stream in that order, through valves in the system.

Analytic methods included a pH meter for pH, gravimetric techniques for total solids, atomic absorption for copper, and an ion selective electrode for free cyanide.

V.7.3.14 Photographic Equipment and Supplies

Volume II Reference: Section II.8.8

Data Sets:

1. BAT Survey (Screening)
   Sampling: Hamilton Standard
   Analysis: Hamilton Standard
   Reference: 5-15

2. BAT Survey (Additional Sampling)
   Sampling: Hamilton Standard
   Analysis: Hamilton Standard
   Reference: 5-15

Procedures: Data Set 1 - BAT Survey (Screening)

A total of 26 plants were visited during this program and a wastewater sampling program was conducted at 16 of these plants. The screening survey sampled and analyzed for all 129 priority pollutants except TCDD. Classical pollutants were also tested for during this program. The sampling and analysis performed during this study followed the April 1977 EPA protocol.

The object of screening was to determine by sampling and analysis which pollutants were present in plant wastewater in each product subcategory. Each sample was a 72-hour flow proportioned composite sample except for the thermal subcategory. Thermal plant samples were composited over a 24-hour period. Where automatic samplers could not be used grab samples were taken at intervals during the sampling period and composited manually.

Screen sample analysis was performed both at on-site laboratories and local labs. Organic pollutants were analyzed by the April 1977 EPA protocol GC/MS method and metals by the ICAP technique.

Procedures: Data Set 2 - BAT Survey (Additional Sampling)

The object of additional sampling (beyond screening) was to provide a quantitative data base to describe the discrete wastewater sources and effectiveness of various treatment systems for the photographic segment. Up to five plants were sampled for up to three days per subcategory; the plants in the screening survey also were subjected to this additional sampling.

Sampling involved collection of 24 hour flow proportioned samples or the equivalent (for batch operations) of incoming plant water, total raw waste, final effluent to silver recovery units, R&D wastes, and testing wastes. At some plants, additional samples were collected to segregate other industrial waste streams from total raw wastes collected. In the photographic chemicals subcategory, grab samples were collected from tank washdowns of major product mixes. Sampling used the April 1977 protocol.

The analysis of the samples used the April 1977 EPA protocol. A central laboratory analyzed for only those parameters which were found during the screening analysis and parameters delineated as applicable from responses to EPA data collection portfolio (dcp) requests.

V. 7.3.15 Plastics Processing

These data will be included when this industry is included in Volume II.

V.7.3.16 Porcelain Enameling

Volume II Reference: Section II.8.10

Data Sets:

1. Initial BAT Survey (Screening Phase)
   Sampling: Hamilton Standard
   Analysis: Several contractors
   Reference: 5-16
   Date: Summer 1978

2. BAT Survey (Verification Phase)
   Sampling: Hamilton Standard
   Analysis: Several contractors
   Reference: 5-16
   Date: Summer 1978

Procedures: Data Set 1 - Initial BAT Survey (Screening Phase)

The screening survey was performed at one facility in each basis material subcategory. The sampling was done during the first day of a three day visit (the other two days were associated with the verification phase evaluations). Analysis was performed on all 129 priority pollutants for the screening survey. The purpose of the survey was to limit the number of priority pollutants requiring analysis during the verification phase. Sampling and analysis were performed according to the April 1977 EPA protocol.

Sampling was done for one day using flow proportional composite samplers. A total raw wastewater sample, treated wastewater sample, and raw water sample were obtained and analyzed. Metals were analyzed using the ICAP method, with a GC/MS used for organics analysis.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

Verification sampling was done at 15 plants. For five of these plants, verification sampling represented the remaining two days of the three-day screening-verification program. At all of the plants, samples were taken of the plant incoming water, final effluent, and discrete raw wastewater sources. Flow proportioned composite samples or the equivalent (for batch operations) were taken over the time period that the plant was in operation, and were analyzed according to the April 1977 EPA protocol.

Analysis varied according to the stability of the parameters to be analyzed. On-site analysis was performed by the sampler at the facility for flow rate, pH, and temperature. A laboratory in the vicinity of the subject plant analyzed for total cyanide, cyanide amenable to chlorination, oil and grease, phenols (4-AAP method), and total suspended solids. The analyses were performed by the local laboratory within a six hour period after each day's composite sample was prepared.

The remaining analyses were performed by a central laboratory. Analysis involved only those parameters which were selected after screening for verification analyses. In addition, special samples were taken of various process solutions to determine their organic or metals content and these samples were analyzed at the central laboratory. Analysis of metals involved the atomic absorption method. Analysis of organic priority pollutants used the April 1977 EPA protocol for 21 pollutants. The June 1977 EPA verification protocol was used for: 1,1-dichloroethane, 1,1,2-trichloroethane, 1,2-trans-dichloroethylene, 2,4-dimethylphenol, phenol, toluene, and trichloroethylene.

V.7.3.17 Adhesives and Sealants

Volume II Reference: Section II.9.1

Data Sets:

1. Grace Pilot Plant Study
   Sampling: Abcor, Inc.
   Analysis: Abcor, Inc.
   Reference: 5-45
   Date: 1976-1977

2. San Leandro Pilot Plant Study
   Sampling: W.R. Grace; Abcor, Inc.
   Analysis: Abcor, Inc.
   Reference: 5-45
   Date: 1976-1977

Procedures: Data Set 1 - Walden Pilot Plant Study

This data set concerns a pilot study performed at the Grace Chicago Plant. Reverse osmosis tests were run on the wastewater samples from this plant. Data concerning classical pollutants were gathered using unspecified methods.

Procedures: Data Set 2 - San Leandro Pilot Plant Study

A pilot scale study on the effectiveness of sedimentation treatment technology was performed on-site at the San Leandro, California, adhesives and sealants plant. Wastewater was sampled at the influent and effluent to the pilot plant. The analytic methods were not specified.

V.7.3.18 Explosives Manufacture

Volume II Reference: Section II.9.2

Data Sets:

1. BAT Survey (Screening Phase)
   Sampling: Hydroscience
   Analysis: Hydroscience
   Reference: 5-17
   Date: 1978-1979

2. BAT Survey (Verification Phase)
   Sampling: Hydroscience
   Analysis: Hydroscience
   Reference: 5-17
   Date: 1978-1979

3. Original Guidelines
   Sampling: Roy F. Weston, Inc.
   Analysis: Weston, Inc.
   Reference: 5-18
   Date: 1974

Procedures: Data Set 1 - BAT Survey (Screening Phase)

The screening phase of this program was established in order to develop BAT data for the explosives industry. Sampling and analysis methods were the April 1977 EPA protocol. EPA requested that, in addition to the list of 129 priority pollutants, analyses also be done for conventional pollutants and other "compounds of concern." The chemicals that comprised these compounds of concern included: ammonia, inorganic nitrate, elemental phosphorus, nitrated organics (TNT, RDX, HMX, nitrocellulose, nitroglycerin, dinitroglycerin, PETN, nitroguanidine, styphnates, picrates, tetryl, nitrated toluene isomers, amino-nitrotoluene isomers, nitrodiphenylamine, other nitrated organics), and diphenylamine.

Samples of continuously flowing effluents were collected by means of automatic samplers when safety considerations permitted. When this was not possible, a series of grab samples were collected manually. Unit operations involving batch wastewater discharges were sampled by use of a single grab sample or a series of grab samples from several batches, depending on the frequency of discharge.

Analysis of the samples used the April 1977 EPA protocol methods. Organic priority pollutant analyses were performed using GC/MS. Mercury analysis was done by the cold vapor technique. Phenol levels were determined by the 4-AAP method. Cyanide analysis was done by the colorimetric method. Approved EPA procedures were used for analyses for classical pollutants, except for nitrate, which was done by an alternative method. Quality assurance procedures in the April 1977 EPA protocol were followed throughout the analytical program.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

After the screening analysis was completed for the various plant sites, the results were reviewed with EPA and specific pollutants were selected for verification analysis. Selections were based not on concentration in the wastewater but primarily on the mass quantities of pollutants being discharged. In addition, specific pollutants were selected that were commonly found in the wastewaters from the subcategory or were indicated to be present in the raw materials used. In many cases it was decided not to verify low levels of organic priority pollutants in small-volume wastewaters. Volatile organic acid (VOA) results that indicated high levels of methylene chloride were not verified in most cases because the screening samples were found to have been inadvertently contaminated during sampling. (For wastewaters from plants manufacturing explosives (nitroglycerin) the VOA vials were filled with diluted wastewater from larger sample bottles, which had been rinsed with methylene chloride as part of the bottle preparation procedure.)

Sampling and analysis procedures used the April 1977 EPA protocol.

Procedures: Data Set 3 - Original Guidelines

Weston Inc. compiled data on classical pollutants and raw waste loads in this original guidelines survey. The program covered four subcategories: manufacture of explosives, manufacture of propellants, load assemble and pack plants, and manufacture of initiating compounds.

V.7.3.19 Gum and Wood Chemicals

Volume II Reference: Section II.9.3

Data Sets:

1. BAT Survey (Screening Phase)
   Sampling: Environmental Science and Engineering (ESE)
   Analysis: ESE
   Reference: 5-19
   Date: April 1978 to May 1978

2. BAT Survey (Verification Phase)
   Sampling: ESE
   Analysis: ESE
   Reference: 5-19
   Date: March 1978 to October 1978

Procedures: Data Set 1 - BAT Survey (Screening Phase)

Five plants were sampled during the screening sampling, representing six of the seven major Gum and Wood Chemicals subcategories. A single 24-hour composite sample was collected for analysis. Sampling was conducted according to April 1977 EPA protocol.

Analysis followed the April 1977 EPA protocol except that the principal analytical method for identification and quantification of organic priority pollutants was repetitive scanning gas chromatography/electron capture detector (GC/ECD). The metals were analyzed by atomic absorption spectroscopy.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

The verification sampling and analysis program was intended to obtain quantitative data for each subcategory on the priority pollutants selected during the screening program. The plants for sampling were chosen to represent the full range of in-place process and wastewater treatment technology for each subcategory. Nine plants were sampled during verification sampling.

Sampling methods used the April 1977 EPA protocol. Three consecutive 24-hour composite samples of the raw wastewater, final treated effluent, and in appropriate cases, effluent from intermediate treatment steps were obtained at each plant. A single grab sample of incoming fresh process water was also obtained at each plant.

Analysis followed the methods in the June 1977 EPA protocol.

V.7.3.20 Pesticide Manufacturing

Volume II Reference: Not included at this time.

Data Sets:

1. Various Studies
   Sampling: Environmental Science and Engineering
   Analysis: ESE
   Reference: 5-44
   Data: Unspecified

Procedures: Data Set 1 - Various Studies

Data from various studies were assembled, representing a mixture of historical data as well as data obtained more recently. The sampling and analysis techniques employed during this study were not clearly defined. Classical pollutant parameters were sampled and analyzed for during this study.

V. 7.3.21 Pharmaceutical Manufacturing

Volumn II Reference: Section II.9.5

Data Sets:

1. Initial BAT Survey (Screening Phase)
   Sampling: EPA Regional Personnel
   Analysis: Several Contractors
   Reference: 5-20
   Date: 1978-79

2. BAT Survey (Verification Phase)
   Sampling: EPA Regional Personnel
   Analysis: Hydroscience
   Reference: 5-20
   Date: 1978-79

Procedures: Data Set 1 - Initial BAT Survey (Screening Phase)

The screening survey program was designed to determine the presence of priority pollutants in the industry wastewaters. The sampling and analysis were performed using the April 1977 EPA protocol. The survey included 26 plants in the industry.

Sampling normally involved collection of 24-hour samples. However, a shorter sampling period was used (typically 8 hours) when operations were less than 24-hour, as well as a longer sampling period (generally on the order of 48 hours) when plant operations fluctuated to an extent that a shorter time would not be adequate. Samples were collected at the influent to and effluent from the treatment facility, as well as other inplant locations.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

The verification program was designed to confirm the data obtained during the screening program and to quantify the concentrations, loadings, and percent reduction of the pollutants identified. The survey involved five plants.

Sampling generally involved the collection of three days of 24-hour composite samples. Sampling followed the methods in the April 1977 EPA protocol.

Analysis followed the April 1977 EPA protocol, but with a more detailed QA/QC program. The program included analyses of duplicate extractions for samples collected on the first day of verification sampling. Samples taken on the second and third days of verification sampling were extracted and analyzed, spiked with appropriate amounts of pollutants, and reanalyzed for pollutants

3. RBC Pilot Scale Study
   Sampling: Swanson - Oswald Assc.
   Analysis: Swanson - Oswald Assc.
   Reference: 5-62
   Date: November 1977 - March 1978

Procedures: Data Set 3 - RBC Pilot Scale Study

A pilot scale study of rotating biological contactors was conducted at a gum and wood chemicals manufacturing plant. Sampling and analysis followed standard methodology, outlined in Standard Methods for the Analysis of Water and Wastewater, 14th edition, American Public Health Organization, with a few modifications.

Sampling consisted of, at the minimum, bi-weekly grab samples. Collected samples were preserved on ice until arrival at the laboratory. Pollutant analysis consisted of standard method procedures from the above mentioned protocol as well as parallel and additional analysis using other established methods. The purpose of multiple analysis was to quantify the accuracy of methods chosen when presenting data as well as to further develop the data base. Data are a representation of these analytical methods without analysis specific designation.

identified above detectable limits. Spike recoveries were calculated from the data generated during these analyses. All samples not analyzed, spiked, and reanalyzed within 72 hours of sample collection were subjected to an additional spiking, holding, and analysis.

V.7.3.22 Nonferrous Metals

Volume II Reference: Section II.10

Data Sets

1. BAT Survey (Screening Phase)
   Sampling: Sverdrup and Parcel and Associates
   Analysis: NUS Corporation
   Reference: 5-21

2. BAT Survey (Verification Phase)
   Sampling: Sverdrup and Parcel and Associates
   Analysis: NUS Corporation
   Reference: 5-21

Procedures: Data Set 1 - BAT Survey (Screening Phase)

The screening phase was initiated in order to identify which priority pollutants were present in the wastewaters from production of various metals. This study was conducted at 13 plants. Sampling and analysis methods used the April 1977 EPA protocol.

Sampling methods employed during this study were 72-hour or three 24-hour composites where possible. Grab samples were taken where automatic sampling was not possible. Tubing blanks were collected in the field by passing approximately one gallon of organic-free water through new tubing just before samples were collected.

The methods for organics analysis were the April 1977 EPA protocol. Metals were analyzed by atomic absorption (antimony, arsenic, selenium, silver, and thallium) and inductively coupled argon plasma emission spectrometric analysis (beryllium, cadmium, chromium, copper, lead, nickel, and zinc). Mercury was detected by cold vapor flameless atomic absorption spectrometry. Asbestos was analyzed using the transmission electron microscope.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

The verification phase was used to determine whether the pollutants identified by screen sampling were present throughout a subcategory, and if so, at what concentrations. Sampling and analysis procedures used the April 1977 EPA protocol.

Sampling methods followed the April 1977 EPA protocol. Tubing blanks were collected in the laboratory by passing three gallons of organic-free water through segments of tubing in a 72-hour period. The intake water to the treatment plant was also sampled during the verification phase.

The analysis of the verification samples used the April 1977 EPA protocol, with metals analyzed by AA and ICAP techniques as during screening. No analysis was performed for asbestos.

V.7.3.23 Ore Mining and Dressing

Volume II Reference: Section II.11

Data Sets:

1. BAT Survey (Screening Phase)
   Sampling: Calspan Advanced Technology Center
   Analysis: Calspan, Gulf South Research Inst., Teledyne Isotopes
   Reference: 5-22
   Date: 1977-1979

2. BAT Survey (Verification Phase)
   Sampling: Calspan
   Analysis: Calspan, GSRI, Teledyne
   Reference: 5-22
   Date: 1977-1979

3. Additional Sampling (Screen and nonscreen)
   Sampling: Calspan
   Analysis: Calspan, GSRI, Teledyne
   Reference: 5-22
   Date: Unspecified

4. Monitoring Program
   Sampling: Calspan
   Analysis: Calspan
   Reference: 5-22
   Date: August 1978

Procedures: Data Set 1 - BAT Survey (Screening Phase)

The screening phase of this study encompassed 20 facilities. Sampling and analysis used the April 1977 EPA protocol.

Automatic sampling equipment was employed where practicable and on all effluent waste streams. Samples were composited on a 24-hour basis for one, two, or three days. Sampling and analysis of raw and treated effluent streams, process source water, and intermediate process or treatment steps were performed.

Analysis included 123 elements and organic compounds on the priority pollutants list, as supplied to the contractor by EPA in the spring of 1977. Seven additional parameters were also analyzed for as requested by EPA:

pH	TOC
TSS	radium 226 (total)
VSS	radium 226 (dissolved)
COD	

Metals analysis was done by atomic absorption with beryllium also measured by inductively coupled argon plasma emission technique (ICAP). The pesticides were analyzed by gas chromatography using the electron capture detection method. Organic pollutants were detected using the gas chromatography/mass spectrometry (GC/MS) method. Radium detection was accomplished by a radioassay method using a scintillation counter or proportional counter. The transmission electron microscope was used to determine the asbestos concentration. Classical pollutants were analyzed by approved standard analytical methods.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

The verification phase of this study encompassed 6 facilities including 3 from the screening phase. Sampling procedures followed the April 1977 EPA protocol. The procedures used during the verification phase were the same as for Data Set 1. The first sample of a three day 24-hour sampling program was used for screening the 123 pollutants. The other two samples taken were used for the verification of pollutants detected during the initial screen.

Analysis for priority pollutants was reported to follow the April 1977 EPA protocol or the June 1977 EPA protocol. The source does not distinguish between the compounds analyzed by the alternative protocol methods.

Procedures: Data Set 3 - Additional Sampling

Two sites were sampled after completion of the verification sampling trips. At one molybdenum/tungsten/tin mine/mill operation, a complete screen-sampling effort was performed to determine the presence of priority pollutants as well as to collect data on treatment performance. A uranium mine/mill operation was sampled to collect data on a facility practicing removal of radium 226 by ion exchange.

Sampling and analysis procedures used during this phase of the study were the April 1977 EPA protocol. Samples at the uranium mine/mill were not analyzed for organic priority pollutants.

Procedures: Data Set 4 - Monitoring Program.

In August 1978, comprehensive studies of the treatability of wastewater streams from ore mining and milling facilities were initiated by Calspan Corporation under contract to EPA. The primary purpose of this program was to delineate the capabilities of "polishing" treatment technologies, mine-water treatment technology, technologies for the treatment of uranium mill wastewater, and generally to expand the data base in areas for which little or no information was previously available. In addition, operating conditions of the pilot-scale system used in the studies were varied at each site to clarify engineering and economic considerations associated with the design and cost analysis of fullscale versions of the treatment schemes investigated.

The EPA sponsored study was conducted at seven facilities. The Calspan Mobile Environmental Treatment Plant was used in the on-site pilot scale study. Fifteen parameters (pH, total suspended solids, and the 13 metals identified as priority pollutants by EPA) were monitored at all sites. Additional parameters of significance, such as iron, aluminum, molybdenum, vanadium, radium 226, and uranium were also monitored at pertinent sites.

Sampling and analysis procedures used in the pilot-scale study followed the April 1977 EPA protocol.

V.7.3.24 Organic Chemicals

Volume II Reference: Section II.12

Data Sets:

1. Pilot Study
   Sampling: Gulf South Research Institute
   Analysis: Gulf South Research Institute
   Reference: 5-23

2. Pilot Study
   Sampling: University of California Dept. of Chemical Engineering
   Analysis: U.C. Department of Chemical Engineering
   Reference: 5-24
   Date: 1975

3. BAT Survey (Verification Data)
   Sampling: No fixed protocol
   Analysis: Protocol varied in the extent of QA/QC. Initial QC program consisted of one spike every three samples and increased to one spike or duplicate each sample.
   Reference: 5-54
   Date: 1978-1979

4. Generic Process Long-Term Sampling
   Sampling: Unspecified
   Analysis: Unspecified
   Reference: 5-55
   Date: 1979

5. Data Collection Portfolio Analyses
   Sampling: Self-sampling by industry
   Analysis: Self-analyses by industry
   Reference: 5-60
   Date: Unspecified

Procedures: Data Set 1 - Pilot Study

The pilot-scale study encompassed three technologies: activated carbon adsorption, steam stripping, and chemical oxidation.

The chemical oxidation treatment technology used a stirred tank reactor for an ozonation study. The stirred tank reactor was operated in the semibatch mode, and ozone gas was fed continually to a constant volume of wastewater. The standard potassium iodide method was used to analyze the ozone concentration in the feed and exit gases and in the liquid. Liquid samples were analyzed for total organic carbon with a Beckman 915 TOC analyzer and for composition with a gas chromatograph.

The steam stripping pilot study was developed to evaluate its effectiveness in removing trace contaminants. The overhead samples were composited hourly along with a grab sample. The bottoms from the steam stripper were monitored through a sight glass and valve on the column. The feeds for the pilot steam stripper were received in 210-liter drums and fed to the stripper. Steam rate to the pilot stripper was measured by a U-type manometer across an orifice plate.

Carbon adsorption treatment technology was tested on a pilot scale at three facilities. Tests were run to obtain breakthrough data for different types of carbon columns. The pilot scale units were operated at the process effluent streams. Since removal of organics would be indicated by a reduction in oxygen demand, total carbon and total oxygen demand (TOD) measurements on the influent to and effluent from the carbon column were made. Chlorinated hydrocarbons were detected by a gas chromatograph.

Procedures: Data Set 2 - Pilot Study

Pilot-scale studies were conducted at the University of California on the effectiveness of solvent extraction. Samples taken from the effluent streams were analyzed using a gas chromatograph. The sampling and analysis was centered around detection of the volatile organics and a few selected classical pollutants.

Procedures: Data Set 3 - Biological Treatment Study (excerpted from Verification Data)

The BAT survey data involved 28 plants with 600 observations. The survey used a heavy QA/QC, including 600 values to identify accuracy. The data for organic priority pollutants are corrected for recovery estimates, as determined by the QA/QC program. The data for metals and cyanides are not recovery corrected.

Sampling followed a flexible but targeted protocol. Composite samples were obtained. For continuous processes, a composite of 6, 8, or 12 hours was developed. For batch processes, a flow-weighted composite was developed. One sample was taken each day for three days. Flow was measured or estimated at each sampling point.

Analysis did not follow a fixed protocol. The detection and quantitation of the organic priority pollutants used gas chromatograph-conventional detector techniques, supplemented by a QC program. The rigid QA/QC procedure for the analysis of the three composite samples for each sampling location included two composites spiked and one duplicated. GC/MS analysis was done on a small percentage of the samples (~10%) to confirm that the compound being quantified had been accurately identified.

Procedures: Data Set 4 - Generic Process Long-Term Sampling

This study included a 30 day analysis at one plant and a 20 day analysis at a different plant. Samples were developed for a production area within the plants, where a variable mix of 50-75 product/processes were being operated concurrently every day. The sample represented a 24-hour composite of the combined effluent from the product/processes. The sampling methods used were not specified.

The analytical protocol used GC/MS methods. Quality assurance/ quality control was provided using the "stable-label" technique. This involves the spiking of samples with isotopes of the priority pollutants, for concurrent analysis and recovery estimates.

Procedures: Data Set 5 - Data Collection Portfolio Analyses

The data collection portfolio (dcp) request was developed by EPA under the authority of Section 308 of the Clean Water Act. Included in responses to the dcp request were data on the performance of in-place wastewater treatment systems. The sampling and analysis methods for the reported data were not specified in the evaluation of the data.

V.7.3.25 Paint and Ink

Volume II Reference: Section II.13

Data Sets:

1. BAT Survey
   Sampling: Burns and Roe
   Analysis: Unspecified
   Reference: 5-25, 26
   Date: Unspecified

Procedures: Data Set 1 - BAT Survey

This program was initiated in order to detect the priority pollutants in the industry wastewaters. Sampling took place at 22 paint facilities and 6 ink plants. Sampling and analysis procedures followed "EPA Draft Analytical Protocol for the Measurement of Toxic Substances," October 1976, for both paint and ink facilities.

Sampling involved composite samples taken at the plants. Since most paint and ink process wastewater is collected over a period of time for batch treatment, grab samples were taken at the majority of the plants.

The analysis of all pollutants followed directly from the methods in the 1976 protocol.

V.7.3.26 Petroleum Refining

Volume II Reference: Section II.14

Data Sets:

1. Initial BAT Survey (Screening Phase)
   Sampling: RSKERL, B&R
   Analysis: RSKERL, B&R, MRI, NUS, GSRI, RETA
   Reference: 5-27
   Date: Unspecified

2. BAT Survey (Verification Phase)
   Sampling: RSKERL, B&R
   Analysis: RSKERL, B&R, MRI, NUS, GSRI, RETA
   Reference: 5-27
   Date: Unspecified

3. Historical Data
   Sampling: RSKERL, API
   Analysis: RSKERL, API
   Reference: 5-28
   Date: 1972

4. Pretreatment Sampling Program
   Sampling: Burns and Roe
   Analysis: West Coast Technical Service, Pomeroy, Johnston and Bailery
   Reference: 5-27
   Date: August 16, 1978 to August 18, 1978

5. Surveillance and Analysis (Screening)
   Sampling: EPA Regional Teams
   Analysis: EPA
   Reference: 5-27
   Date: Unspecified

6. Solvent Extraction Pilot Study
   Sampling: University of California, Department of Chemical Engineering
   Analysis: University of California, Department of Chemical Engineering
   Reference: 5-24
   Date: Unspecified

Procedures: Data Set 1 - BAT Survey (Screening Phase)

The Robert S. Kerr Environmental Research Lab (RSKERL) sampled 12 plants and Burns and Roe (B&R) sampled five plants to form this data set. Analysis of samples was performed by Ryckman, Edgerly, Tomlinson and Associates (RETA), Midwest Research Institute (MRI), NUS, Gulf South Research Institute (GSRI) as well as RSKERL and B&R. The program was designed to analyze raw wastewater and final effluent for the presence of toxic pollutants and measure the effectiveness of in-place treatment in removing toxic pollutants. The study was performed according to the April 1977 EPA protocol.

Sampling for classical and toxic pollutants generated 24-hour composites. The individual laboratories combined aliquots from these samples to obtain 72-hour composites for toxic pollutant analysis. Grab samples were taken for volatile organics, total phenols, and cyanides.

Screening analysis for toxic organics and pesticides was carried out with a GC/MS. Total phenols were analyzed by the 4-AAP method. Toxic metals were analyzed by atomic absorption spectrometry, with flame or graphite furnace atomization following appropriate digestion of samples. Duplicate samples were analyzed using the ICAP technique after appropriate digestion. Cyanide analysis was done by a colorimetric method. Asbestos was analyzed by the use of an electron microscope. Classical pollutants were analyzed according to "Methods for Chemical Analysis of Water and Wastes" (EPA 625/6-74-003).

Procedures: Data Set 2 - BAT Survey (Verification Phase)

The verification phase sampling study contained the 17 plants visited during screening. Analysis was performed by the same laboratories as those in Data Set 1.

Sampling procedures for the verification segment of this study were identical to those used in the screening survey.

Analysis of data entailed further confirmation and quantification of priority pollutants by GC/MS. All other analysis procedures were the same as procedures used for screening analysis.

Procedures: Data Set 3 - Historical Data

Classical pollutants were sampled in the raw wastewaters from five petroleum subcategories. Analyses followed the EPA guidelines, "Methods for the Chemical Analysis of Water and Wastes 1971."

Procedures: Data Set 4 - Pretreatment Sampling Program

The Pretreatment Sampling program of six indirect discharge refineries was a continuation of the RSKERL B&R study. Sampling and analysis techniques employed in this study are identical to those used in Data Set 2.

Procedures: Data Set 5 - Surveillance and Analysis (Screening)

The Surveillance and Analysis program also used the established protocol followed in the RSKERL, B&R study, Data Sets 1,2. EPA regional teams sampled 8 plants for priority pollutants in conjunction with their regular monitoring activity.

Procedures: Data Set 6 - Solvent Extraction Pilot Study

The study involved the sampling and analysis of a solvent extraction pilot plant. The study encompassed five pollutants: phenol, benzene, acetone, methyl ethyl ketone, and paracresol. Sampling at the pilot process involved 50 ml samples removed from the bottom of the equilibrium cell, after purging twice. Analysis involved six aliquots, five microliters each, which were then introduced into the gas chromatograph. The chromatograph used two hydrogen-flame-ionization detectors with linear temperature-programming capability.

V.7.3.27 Plastic and Synthetic Materials Manufacturing

Volume II Reference: Section II.12

Data Sets:

1. Historical Data
   Sampling: Unspecified
   Analysis: Unspecified
   Reference: 5-48
   Date: Unspecifid

Procedures: Data Set 1 - Historical Data

These data were collected to characterize classical pollutants in the various plastic and synthetic materials plants. The sampling and analysis procedures used in this study are not specified. Sampling was done for both influent and effluent streams.

V.7.3.28 Pulp and Paperboard Mills and Converted Products

Volume II Reference: Section II.16

Data Sets:

1. Initial BAT Survey (Screening Phase)
   Sampling: E.C. Jordan, Inc.
   Analysis: Gulf States Research Institute
   Reference: 5-29
   Date: 1978-1979

   (Supplemental Phase)
   Sampling: EPA Surveillance and Analysis
   Analysis: Unspecified
   Reference: 5-29
   Date: 1979

2. BAT Survey (Verification Phase)
   Sampling: E.C. Jordan, Inc.
   Analysis: Gulf States Research Institute
   Reference: 5-29
   Date: 1979

Procedures: Data Set 1 - Initial BAT Survey (Screening and Supplemental Screening Phase)

The screening phase included evaluations at 11 plants by the EPA contractor and the supplemental phase included 47 plants sampled by EPA Surveillance and Analysis teams. Three locations were sampled, including raw intake water, untreated wastewater, and treated wastewater. The April 1977 EPA protocol was used.

Sampling included both composite and grab samples during the 3-day survey. Composite sampling was conducted for a period of 72 consecutive hours at the untreated and treated wastewater locations. Grab samples also were taken once daily at these locations, and one grab sample was taken during the second day on the raw water. The composite and grab samples were split in the field and a set given to representatives of the National Council for Air and Stream Improvement (NCASI).

Analysis included the 129 priority pollutants plus 14 non-conventional pollutants. Organic compounds were analyzed using the GC/MS. Metals were analyzed using the AA.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

The program investigated 48 priority pollutants and 16 nonconventional pollutants at 60 mills. Screening studies were conducted simultaneously with the verification study for several mills that were in categories not surveyed by the earlier screening program.

Sampling included collecting composite and grab samples during a 3-day survey, with 24-hour samples collected. These samples were divided into five aliquots for analysis. A grab sample was collected once per day at each location for analysis of volatile organics, mercury, and cyanide. The samples were split with the NCASI.

Analysis was generally performed using the April 1977 EPA protocol. However, analysis involved the modification of the referenced protocol for the semivolatile organic compounds. This involved: (1) acid extraction using methylene chloride at a pH other tan 2; (2) derivatization of acid-neutral extracts prior to GC/MS analysis to allow analysis of widely diverse types of organic compounds in a single injection; (3) use of SCOT capillary gas chromatograph columns to increase the resolution of the chromatographic patterns.

Routine addition of 3 ppb of Antifoam C to all samples was performed, as recommended by The National Council for Air and Stream Improvement. No interference was observed due to this.

V.7.3.29 Rubber Processing

Volume II Reference: Section II.17

Data Sets:

1. Initial BAT Survey (Screening Phase)
   Sampling: Envirodyne
   Analysis: Several contractors
   Reference: 5-30
   Date: 1977-1978

2. BAT Survey (Verification Phase)
   Sampling: Envirodyne
   Analysis: Several Contractors
   Reference: 5-30
   Date: 1978

Procedures: Data Set 1 - Initial BAT Survey (Screening Phase)

The screening survey covered 10 subcategories of the rubber processing industry. The sampling and analysis were performed using the April 1977 EPA protocol.

Sampling was performed using automatic samplers, where possible, over a 72-hour period. Where automatic sampling was not possible, grab samples were composited over the first operating shift. A raw water intake grab sample was collected during the second day. The influent and effluent to the wastewater treatment facility were sampled. A field blank using organic free water was run through the sampling equipment prior to sampling.

Analysis used the April 1977 EPA protocol with the exceptions: acrolein and acrylonitrile were analyzed by purge and trap; d-chloroform was used as the internal standard for volatile organics; and a 6 meter SC-30 capillary column was used to separate phenols. Metals were analyzed using AA for arsenic, selenium, antimony, thallium, and silver, with the remaining analyzed using ICAP.

Quality assurance included duplicate samples collected in the field, for random sites. A laboratory standard was added to sample sets as a blind quality control check on laboratory performance. A standard also was analyzed with the duplicate and field blank for each sample set. Any results for these samples that were outside established limits resulted in reanalysis of the sample set.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

The verification survey included 6 plants in the industry. The sampling and analysis program included in the collection of wastewater samples within production processes, treatment influent and effluent, and raw water intake.

Sampling was performed using the April 1977 EPA protocol. Additional grab samples were collected the first day at each sample site to allow development of specific analytic methods, if required.

Methods used for analysis are listed in the reference. These included: 4-AAP method for total phenols, GC/EC method for phthalate esters and pesticides, GC/NPD method for volatile nitrosamines, AA for metals, liquid-liquid extraction method for volatile organics, Fritz-Chriswell GC method for phenols, GC method for polynuclear aromatic hydrocarbons, and direct aqueous injection method for acrolein and acrylonitrile.

Quality assurance included instrument standards, method blanks, and spikes. The spikes were prepared for the third set of composite samples. The calculated recovery factors for the parameters are summarized in Table 7.3.28-1.

V.7.3.30 Soap and Detergent Manufacture

Volume II Reference: Section II.18

Data Sets:

1. Initial BAT Survey (Screening Phase)
   Sampling: E.C. Jordan Company
   Analysis: E.C. Jordan Company
   Reference: 5-56
   Date: 1977

2. Additional Sampling (Screening)
   Sampling: E.C. Jordan, EPA Region VII
   Analysis: E.C. Jordan, EPA Region VII
   Reference: 5-56
   Date: 1979

3. Pilot Plant Study
   Sampling: Unspecified
   Analysis: Unspecified
   Reference: 5-50
   Date: 1976

Procedures: Data Set 1 - Initial BAT Survey (Screening Phase)

The screening study was conducted in 1977 to determine the absence or presence of toxic compounds in wastewaters discharged from the various subcategories of the soap and detergent industry. Data were obtained from eight of the thirteen subcategories. Deviation from the standard protocol during this study resulted in suspect data for all subcategories sampled except for the spray dried detergents.

The sampling and analysis procedures followed during the study of the spray dried detergents subcategory followed the April 1977 EPA protocol.

TABLE 7.3.28-1. SUMMARY SPIKE RECOVERY DATA FOR PRIORITY POLLUTANT ANALYSES IN THE RUBBER PROCESSING INDUSTRY

Priority Pollutant	Number of Locations	Recovery (Percent)		
		Minimum	Maximum	Median
Cadmium	5	50	110	110
Chromium	5	90	118	101
Copper	2	97	105	101
Lead	1	-	-	118
Mercury	15	40	380	122
Nickel	2	108	137	122
Zinc	1	-	-	92
Bis(2-ethylhexyl)phthalate	34	21	1030	106
Dimethyl phthalate	13	27	267	76
Acrylonitrile	3	89	126	109
N-nitrosodiphenylamine	4	56	95	84
2,4-Dimethylphenol	7	0	206	82
2-Nitrophenol	6	24	147	63
Phenol	34	1	222	94
Benzene	24	0	419	58
Ethylbenzene	21	0	111	42
Nitrobenzene	4	24	76	52
Toluene	29	0	412	46
Acenaphthylene	7	0	32	5
Fluorene	7	0	1100	78
Naphthalene	7	0	300	21
Phenanthrene	7	0	262	55
Pyrene	7	53	354	72
Carbon tetrachloride	8	70	270	108
Chloroform	25	20	164	62
Dichlorobromomethane	6	23	91	72
1,1-Dichloroethylene	4	63	170	101
Methylene chloride	22	3	189	39
Tetrachloroethylene	8	68	100	93
1,1,1-Trichloroethane	4	61	91	81
1,1,2-Trichloroethane	4	130	305	290
Trichloroethylene	4	104	271	226

Note - Median value represents the median of the average recovery for each sampling location; minimum and maximum values are based on reported data.

Procedures: Data Set 2 - Additional Sampling (Screening)

The additional screening study was conducted in 1979. The April 1977 EPA protocol was followed for all sampling and analysis work performed during this study. Nine of the thirteen subcategories were included in the study. The survey was initiated in order to determine the concentration of toxic compounds in the industry's raw wastewater.

Procedures: Data Set 3 - Pilot Plant Study

This study was initiated in order to determine the effectiveness of the rotating biological contactor in pollutant removability. The sampling method was unspecified.

Analysis of organics utilized a gas chromatograph with a flame ionization detector, using methods defined by American Society for Testing Materials, Methods D-3328-#aT and D-3257-73, USA. Atomic absorption was used for metals analyses. The organics QA/QC program included the spiking of raw wastewater samples with the organic species to confirm detectability by the method used.

V.7.3.31 Steam Electric Power Plants

Volume II Reference: Section II.19

Data Sets:

1. Initial BAT Survey (Screening Phase)
   Sampling: Hittman Associates, NUS Corporation
   Analysis: Carborundum
   Reference: 5-31
   Date: 1977

2. BAT Survey (Verification Phase)
   Sampling: Hittman Associates
   Analysis: Richardson Associates, EPA
   Reference: 5-31
   Date: 1977

3. Surveillance and Analysis
   Sampling: EPA Regional Teams
   Analysis: EPA
   Reference: 5-31
   Date: Unspecified

Procedures: Data Set 1 - Initial BAT Survey (Screening Phase)

The program included analysis at eight plants. The EPA study was paralleled by the electric power industry, including the separate sampling and analysis by industry-contracted laboratories.

Sampling involved the collection of grab samples and 24-hour composite samples using automatic equipment. The April 1977 EPA protocol was used for sampling.

Analysis used analytical procedures that included the GC/MS for organic pollutants and the AA for metals.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

Sixteen plants were included in this program initially with two plants added later to the data base by EPA, since the data were collected by similar methods and format.

Sampling was performed using the April 1977 EPA protocol. The collected samples were split with the power industry for their parallel analysis. The analytic methods used included the GC/MS or GC for the organic priority pollutants. The inorganics were analyzed by AA or inductively coupled plasma ICP. Mercury was analyzed by cold-vapor AA, selenium by fluorometry, and cyanide by a colorimetric procedure.

Procedures: Data Set 3 - Surveillance and Analysis

The EPA regional Surveillance and Analysis program included periodic visits to power plants to determine compliance with NPDES permits. Priority pollutant sampling was conducted at eight plants. The sampling and analysis procedures were similar to those used in the screening and verification programs. Analytical methods included GC/MS for organics and ICAP for inorganics.

V.7.3.32 Textile Mills

Volume II Reference: Section II.20

Data Sets:

1. Comprehensive Field Sampling Program (Screening and Verification Survey, Four Phases)

   a. Phase 1 - Joint ATMI/EPA Mobile Plant Project
      Sampling: ATMI; Monsanto Research Corporation (MRC)
      Analysis: ATMI; MRC
      Reference: 5-32
      Date: March - May 1977

   b. Phase 2 - Untreated and Treated Wastewater plus Pilot Plant Advanced Treatment
      Sampling: Sverdrup and Parcel; EPA
      Analysis: MRC

Reference: 5-32
Date: May - July 1977

c. Phase 3 - Continuation of Untreated and Treated Wastewater plus Pilot Plant Advanced Treatment
Sampling: Sverdrup and Parcel; EPA
Analysis: MRC
Reference: 5-32
Date: September - November 1977

d. Phase 4 - Full Scale Advanced, Physiochemical Treatment Technologies
Sampling: MRC
Analysis: MRC
Reference: 5-32
Date: October 1978

2. Original Guidelines Survey
Sampling: Unspecified
Analysis: Unspecified
Reference: 5-32
Date: Unspecified

3. Pilot Plant Study
Sampling: Texidyne
Analysis: Texidyne
Reference: 5-42
Date: 1975

Procedures: Data Set 1 - Comprehensive Field Sampling Program (Screening and Verification Phases)

The field sampling program was designed to characterize textile effluents with respect to the 129 toxic pollutants, for the first three phases. The fourth phase was designed to evaluate the effectiveness of advanced treatment technologies in removing or reducing the levels of toxic pollutants. The four phases of the survey involved a total of 50 mills. Phase 1 involved 23 locations in conjunction with the EPA/ATMI pilot plant program, phase 2 involved 8 additional locations and various advanced treatment modes at 1 location, phase 3 involved 13 additional locations and various advanced treatment modes at 1 location (previously studied), and phase 4 involved an additional 10 locations sampled to investigate day-to-day fluctuation in raw waste and treated waste. The sampling and analysis followed the April 1977 EPA protocol.

Samples were collected by composite and grab sampling techniques. A field blank was collected to monitor contamination of field equipment. Grab samples were used for raw water samples. At some mills, eight equally spaced grab samples were used to develop a composite.

Analysis of the 129 priority pollutants followed the April 1977 EPA protocol. The GC/MS was used for volatile and non-volatile organics. Metals were analyzed by ICAP methods (antimony, cadmium, chromium, copper, lead, nickel, silver, and zinc) and AA (arsenic, beryllium, mercury, selenium, and thallium). Cyanide, conventional, and non-conventional pollutants were measured according to "Standard Methods for the Examination of Water and Wastewater, 14th Edition."

Procedures: Data Set 2 - Original Guidelines Study

These data represent sampling and analysis to characterize raw wastewater characteristics. The data represent analysis for classical pollutants. The sampling and analysis methods are not specified in the reference.

Procedures: Data Set 3 - Pilot Plant Study

This data set is a compilation of information gathered during a pilot plant test at a Lafrance Industries textile plant. The analysis of the treated effluent followed procedures established in "Standard Methods for the Analysis of Waste and Wastewater," Thirteenth Edition, A.P.H.A. 1971.

During the sampling phase several one liter samples of raw wastewater were collected during work hours and the samples were mixed at the end of the week to yield a composite sample of wastewater.

Analysis was carried out on-site for pH, color, turbidity, and conductivity. Stable parameters were measured at the laboratory. Analysis was performed for classical pollutants using standard methods. Toxic metals were analyzed using the atomic absorption (AA) technique. Mercury was also analyzed using the AA but by the flameless method.

V.7.3.33 Timber Products Processing

Volume II Reference: Section II.21

Data Sets:

1. Initial BAT Survey (Screening Phase)
   Sampling: Unspecified
   Analysis: Unspecified
   Reference: 5-33
   Date: November - December 1976

2. BAT Survey (Verification Phase)
   Sampling: Unspecified
   Analysis: Unspecified
   Reference: 5-33
   Date: 1977 - 1978

4. Pilot Plant Study
   Sampling: CARRE, Inc.
   Analysis: Clemson University, Texidyne
   Reference: 5-61
   Date: Sept. 23, 1977 - Sept. 22, 1978

Procedures: Data Set 4 - Pilot Plant Study

This data set is comprised of pilot plant data generated in the 1978 hyperfiltration study conducted at a La France Industries textile mill. Sample analysis followed standard procedure.

Sampling consisted of one gallon plastic bottle samples collected periodically and sent to the lab for analysis.

Analysis of membrane flux, color and conductivity rejections were monitored on site. Color comparisons where determined through the use of a Bausch and Lomb Spectronic 20 while conductivity measurements were made using a Balsbaugh conductivity bridge and dip cell. All other samples were collected and delivered to the laboratory where analysis was done in accordance with quality assurance procedures approved for this project.

3. Historical Data
   Sampling: Various
   Analysis: Various
   Reference: 5-51
   Date: Various

Procedures: Data Set 1 - Initial BAT Survey (Screening Phase)

The survey involved seventeen plants in eleven subcategories. Sampling and analysis were performed using the EPA protocols: "Sampling Protocol for Measurement of Toxics," USEPA, October 1976, and the first draft, "Protocol for the Measurement of Toxic Substances," USEPA Environmental Monitoring and Support Laboratory, Cincinnati, October 1976.

Sampling involved preparation of a single 24-hour composite for the raw and treated wastewater. Analysis was for 124 toxic pollutants, representing the list available at the time of the survey. Organics were analyzed using GC/MS, with the exception of phenol, analyzed using GC/FID. Pesticides and PCB's were analyzed using GC/ECD. Metals were analyzed using the ICAP method, except mercury analyzed by the cold vapor technique.

Procedures: Data Set 2 - BAT Survey (Verification Phase)

The verification survey was designed to obtain quantitative data on the toxic pollutants identified during the screening program. The survey included seven wood preserving plants (three sampled twice), five insulation-board plants (three sampled twice), and seven hardboard plants (three sampled twice). The sampling and analysis were performed using the April 1977 EPA protocol.

Sampling involved the collection of three consecutive 24-hour composite samples of the raw wastewater, final treated effluent, and in some facilities, at intermediate treatment steps. A grab sample was collected for raw intake water.

Analysis of the organic pollutants used the GC/MS method. Pesticides and PCB's were analyzed by the use of the GC/ECD. Metals were analyzed using the AA.

Procedures: Data Set 3 - Historical Data

These data represent a compilation of previous studies. The data were assembled in conjunction with the BAT Survey.

V.7.3.34 Publicly Owned Treatment Works

Volume II Reference: Section II.22

Data Sets:

1. Priority Pollutant in POTW Fate Study
   Sampling: Burns and Roe
   Analysis: Burns and Roe
   Reference: 5-34
   Date: July - August 1978

Procedures: Data Set 1 - Priority Pollutant in POTW (Fate Study)

This study was designed to select the parameters and procedures for subsequent evaluations. This was a two-plant pilot study. Sampling extended over a seven-day period, developing 24-hour composite samples for the influent, effluent before chlorination, effluent after chlorination, and combined sludge. Grab samples were obtained for volatile organics analysis.

Analysis of metals used the ICAP method. Organics were analyzed using GC/MS, following liquid-liquid or purge-and-trap extraction. Pesticide analysis involved electron capture gas chromatography.

V.7.3.35 Miscellaneous

Volume II Reference: None

Data Sets:

1. Biodegradation Techniques for Organic Material Disposal
   Sampling: SCS Engineers
   Analysis: SCS Engineers
   Reference: 5-52
   Date: December 11, 1977 to December 15, 1977

2. Pilot Study of Complex Industrial Waste Treatment
   Sampling: Reichhold Chemical, Inc.; Calgon Inc.
   Analysis: RCI, Calgon
   Reference: 5-47
   Date: July 30, 1970 to March 31, 1971

3. Full Scale Application of Ion Exchange
   Sampling: Monsanto Chemical Intermediates Co.
   Analysis: Monsanto Chemical Intermediates Co.
   Reference: 5-59
   Date: 1 July 1979 through 31 July 1980

Procedures: Data Set 1 - Biodegradation Techniques

The study involved the sampling and analysis of wastewater from treatment facilities and the performance of their organic material removal efficiency. Procedures used in this study were the April 1977 EPA protocol.

Sampling techniques involved gathering manual and automatic composite samples as well as grab samples where necessary. Samples were taken at both influent to and effluent from the treatment facility.

Analysis of all 129 priority pollutants was performed. The organic materials were analyzed using gas chromotography - mass spectroscopy (GC/MS).

Procedures: Data Set 2 - Pilot Study

A pilot study was initiated at the Reichhold Chemical Company of Alabama to develop guidelines in the treatment of various classical pollutants. 24-hour composite samples were taken at the influent to and effluent from the pilot plant. The protocol followed during this study evolved from established procedures in "Standard Methods for the Examination of Water and Wastewater," Thirteenth edition.

Procedures: Data Set 3 - Full Scale Application of Ion Exchange

Monsanto has operated an ion exchange system for the removal of chromium from a cooling tower blowdown. Sampling and analysis of discharge from the system have been performed in support of the NPDES permit.

APPENDIX A

NUMBER OF SOURCE/TREATMENT

TECHNOLOGY DATA SETS

TABLE A-1. NUMBER OF SOURCE/TREATMENT TECHNOLOGY DATA SETS

Industry/control technology	Data Sets: Full scale	Pilot scale	Bench scale
Adhesives and sealants			
Chemical oxidation		1	
Reverse osmosis		1	
Sedimentation		1	
Auto and other laundries			
Activated carbon adsorption-granular	1	1	
Chemical precipitation	1		
Filtration	3		
Flotation	10		
Ultrafiltration		5	
Coal mining			
Sedimentation	7		
Rotating biological contactors		1	
Coil coating			
Chemical precipitation	6		
Filtration	1		
Sedimentation	2		
Inorganic chemicals manufacturing			
Chemical oxidation	2		
Chemical precipitation	5		
Chemical reduction	1		
Filtration	4		
Sedimentation	3		
Stripping-air	1		
Iron and steel manufacturing			
Chemical precipitation	1		
Coagulation and flocculation	5		
Filtration	4		
Neutralization	1		
Oil separation	1		
Sedimentation	8		
Solvent extraction	1		
Ultrafiltration	1		
Activated sludge	1		
Leather tanning and finishing			
Sedimentation	1		
Activated sludge	8		
Lagoon	2	1	
Trickling filters	1		

TABLE A-1. NUMBER OF SOURCE/TREATMENT TECHNOLOGY DATA SETS (CONTINUED)

Industry/control technology	Data Sets: Full scale	Pilot scale	Bench scale
Battery manufacturing			
Chemical precipitation	1		
Electrical and electronic components			
Activated carbon adsorption-granular	1		
Chemical precipitation	1		
Chemical reduction	1		
Coagulation and flocculation	1		
Filtration	3		
Oil separation	1		
Foundries			
Chemical precipitation	1		
Filtration	1		
Sedimentation	9		
Metal finishing			
Chemical precipitation	28		
Chemical reduction	5		
Reverse osmosis		1	
Sedimentation	2		
Aluminum forming			
Chemical precipitation	1		
Chemical reduction	1		
Coagulation and flocculation	2		
Oil separation	2		
Sedimentation	1		
Ultrafiltration	1		
Copper forming			
Chemical precipitation	3		
Filtration	1		
Plastics processing			
Activated sludge	1		
Porcelain enameling			
Chemical precipitation	1		
Gum and wood chemicals			
Activated carbon adsorption-granular	1		
Sedimentation	1		
Lagoon	3		
Rotating biological contactor		2	

TABLE A-1. NUMBER OF SOURCE/TREATMENT TECHNOLOGY DATA SETS (CONTINUED)

Industry/control technology	Data sets		
	Full scale	Pilot scale	Bench scale
Pesticide manufacturing			
Activated carbon adsorption-granular	1		
Pharmaceutical manufacturing			
Activated sludge	3		
Lagoon-aerated	2		
Nonferrous metals manufacturing			
Chemical precipitation	2		
Ore mining and dressing			
Activated carbon adsorption-granular		1	
Chemical oxidation	1	2	
Chemical precipitation	6	4	
Filtration		5	
Ion exchange	1	1	
Sedimentation	14	2	
Organic chemicals			
Activated carbon adsorption-granular		14	
Chemical oxidation		3	
Ion exchange	1		
Stripping-steam		6	
Solvent extraction		13	
Paint and ink formulation			
Chemical precipitation	11		
Filtration	2		
Sedimentation	3		
Lagoon	1		
Petroleum refining			
Activated carbon adsorption - powdered	1	4	
Activated carbon adsorption - granular		6	2
Filtration		6	
Flotation	1		
Solvent extraction		4	

TABLE A-1. NUMBER OF SOURCE/TREATMENT TECHNOLOGY DATA SETS (CONTINUED)

Industry/control technology	Data Sets		
	Full scale	Pilot scale	Bench scale
Pulp and paperboard mills			
Activated carbon adsorption			
- Powdered	1		
- Granular		1	
Filtration	1		
Flotation	1		
Activated sludge	2		
Trickling filter	1		
Rubber processing			
Ultrafiltration		2	
Activated sludge	1		
Soap and detergent manufacturing			
Rotating biological contactor		1	
Steam electric power plants			
Chemical precipitation	1		7
Reverse osmosis			6
Sedimentation	2		
Textile mills			
Activated carbon adsorption			
- Powdered	1		10
- Granular		12	
Chemical oxidation		2	
Chemical precipitation	1	3	2
Coagulation and flocculation		2	
Filtration	1	12	
Flotation	1		
Reverse osmosis		11	
Ultrafiltration		3	
Activated sludge	33		
Lagoon	4		
Sedimentation		1	
Timber products processing			
Reverse osmosis		1	
Ultrafiltration		1	
Activated sludge	1		2
Lagoon	1		
Trickling filter		2	

TABLE A-1. NUMBER OF SOURCE/TREATMENT TECHNOLOGY DATA SETS (CONCLUDED)

Industry/control technology	Data sets		
	Full scale	Pilot scale	Bench scale
Miscellaneous and Unspecified			
Activated carbon adsorption-granular		1	
Solvent extraction		2	
Activated sludge	1	1	
Organic and inorganic			
Chemical oxidation			1
Chemical precipitation		1	
Filtration		1	
Activated sludge	2		
Totals	248	133	30

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

ATE: October 2, 1980

ECT: "Treatability Manual" source documents

OM: JoAnn Johnson
Chief, Library Services

TO: Regional Librarians

You recently received a five volume set titled "Treatability Manual" (EPA 600/8-80-042 a-e). When this manual was first being developed the Cincinnati Library agreed to maintain a deposit collection of the source documents and to establish a backup microfiche file.

After we had designed a rather unsophisticated system, using a four digit accession number (preceded by 05BT) it was decided that fiche copies of the source documents should be distributed to the Regional Libraries. You will be receiving the fiche within the next week.

Attached you will find a copy of the bibliography from vol. 5 of the "Treatability Manual" annotated with the accession numbers, which is how the fiche collection is arranged.

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If you have any problems using the collection, feel free to call me at 513/684-7701.

SECTION V.6

BIBLIOGRAPHY

A. REFERENCES USED IN VOLUMES I-IV

References Used in Volume I

The Chemical Rubber Company. Handbook of Chemistry and Physics, 48th Edition. Cleveland, Ohio, 1967.

CRC Press, Inc. CRC Handbook of Chemistry and Physics, 58th Edition. Cleveland, Ohio, 1977.

Dobbs, R.A., and J.M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, April 1980.

Dobbs, R. A., R. S. Middendorf, and J. M. Cohen. Carbon Adsorption Isotherms for Toxic Organics. U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978.

Fairchild, E. J., R. J. Lewis, Sr., and R. L. Taken. Registry of Toxic Effects of Chemical Substances, Volume II. NIOSH-78-104B, National Institute for Occupational Safety and Health, Cincinnati, Ohio, 1977.

Ferguson, T.L., Bergman, F.S., Cooper, G.R., Li, R.T., and F.I. Honea. Determination of Incinerator Operating Conditions Necessary for Safe Disposal of Pesticides. Contract 68-03-0286. U.S. Environmental Protection Agency, Cincinnati, Ohio, July 1975

Fochtman, E. G., and W. Eisenberg. Treatability of Carcinogenic and Other Hazardous Organic Compounds. Illinois Institute of Technology Research Institute, Chicago, Illinois. 58 pp.

Initial Scientific and Minieconomic Review of Methyl Parathion, Criteria and Evaluation Division, Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C., 1971.

Interscience Encyclopedia, Inc. Encyclopedia of Chemical Technology, Volume 5, 3rd Edition. New York, New York, 1978.

Jordan, T. E. Vapor Pressure of Organic Compounds. Interscience Publishers, Inc., New York, New York, 1954.

McGraw Hill, Inc. Lange's Handbook of Chemistry, 12th Edition. New York, New York, 1979.

Manual of Treatment Techniques for Meeting the Interim Primary Drinking Water Regulations. EPA-600/8-77-005, U.S. Environmental Protection Agency, Cincinnati, Ohio, May 1977. 73 pp.

Meister Publishing Co. 1976 Farm Chemicals Handbook. Willoughby, Ohio, 1976.

Merck and Co., Inc. The Merck Index, Ninth Edition. Rahway, New Jersey, 1976.

The National Research Council of the U.S.A. International Critical Tables of Numerical Data, Physics, Chemistry, and Technology, Volume III. McGraw-Hill, New York, New York, 1928.

Off-line Bibliographic Citation List Generated from the Toxicology Data Bank by MEDLARS II, National Library of Medicine's National Interactive Retrieval Service, Bethesda, Maryland, 11 June 1979.

Pitter, P. Determination of Biological Degradability of Organic Substances. Water Research, 10:~~1-5~~ 231-5, 1976.

Quellette, R. P., and J. A. King. Chemical Week Pesticides Register. McGraw-Hill Book Company, New York, New York, 1977.

Report on visit of D. Stephan and W. Cawley, U.S. Environmental Protection Agency, to Calgon Environmental Systems Division, Calgon Corporation, Pittsburgh, Pennsylvania, 9 April 1979. 132 pp.

Tabak, H. H., and E. F. Barth. Biodegradability of Benzidine in Aerobic Suspended Growth Reactors. Journal of the Water Pollution Control Federation, March 1978. 7 pp.

Tucker, E. S., V. W. Saeger, and O. Hicks. Activated Sludge Primary Biodegradation of Polychlorinated Biphenyls. Monsanto Company, St. Louis, Missouri, March 1975. 9 pp.

Versar, Inc. Water Related Environmental Fate of 129 Priority Pollutants, Volume I. U.S. Environmental Protection Agency, Waghington, D.C., 1979.

Versar, Inc. Water Related Environmental Fate of 129 Priority Pollutants, Volume II. U.S. Environmental Protection Agency, Washington, D.C., 1979.

Verschueren, K. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York, 1977.

Warner, H.P., Cohen, J.M., and J.C. Ireland. Determination of Henry's Law Constants of Selected Priority Pollutants, Cincinnati, Ohio, April 1980. 14pp.

References Used in Volume II

Auto and Other Laundries --

NRDC Consent Decree Industry Summary - Auto and Other Laundries.

Status Report on the Treatment and Recycle of Wastewaters from the Car Wash Industry (draft contractor's report). Contract 68-01-5667, U.S. Environmental Protection Agency, Washington, DC, July 1979.

Technical Support Document for Auto and Other Laundries Industry (draft contractor's report). Contract 68-03-2550, U.S. Environmental Protection Agency, Washington, D.C., August 1979.

Coal Mining --

Development Document for Interim Final Effluent Limitations Guidelines and New Source Performance Standards for the Coal Mining Point Source Category. EPA 440/1-75/057 Group II, U.S. Environmental Protection Agency, Washington, D.C., October 1975.

NRDC Consent Decree Industry Summary - Coal Mining.

Technical Assistance in the Implementation of the BAT Review of Coal Mining Industry Point Source Category (draft contractor's report). Contracts 68-01-3273, 68-01-4762, and 68-02-2618, U.S. Environmental Protection Agency, Washington, D.C., March 1979.

Electroplating --

Environmental Protection Agency Effluent Guidelines and Standards for Electroplating. Environment Reporter, 135:0341-0351, as of 5 May 1980.

Final Development Document for Existing Source Pretreatment Standards for the Electroplating Point Source Category. EPA 440/1-79/003, U.S. Environmental Protection Agency, Washington, D.C., August 1979. 526 pp.

NRDC Consent Decree Industry Summary - Electroplating.

Inorganic Chemicals Manufacturing --

Development Document for Effluent Limitations Guidelines and NSPS for the Major Inorganic Products Point Source Category. EPA-440/1-74-007-a, U.S. Environmental Protection Agency, Washington, D.C., March 1974.

Draft Development Document for Inorganic Chemicals Manufacturing Point Source Category - BATEA, NSPS, and Pretreatment Standards (draft contractor's report). Contract 68-01-4492, U.S. Environmental Protection Agency, Effluent Guidelines Division, Washington, D.C., April 1979.

Environmental Protection Agency Effluent Guidelines and Standards for Inorganic Chemicals (40CFR415; 39FR9612, March 12, 1974; amended as shown in Code of Federal Regulations, Vol. 40, revised as of July 1, 1976; 41FR51599 and 51601, November 23, 1976; 42FR17443, April 1, 1977, 42FR10681, February 23, 1977; 42FR37294, July 20, 1977).

NRDC Consent Decree Industry Summary - Inorganic Chemicals Industry.

Supplement for Pretreatment to the Development Document for the Inorganic Chemicals Manufacturing Point Source Category. EPA-400/1-77/087A, U.S. Environmental Protection Agency, Washington, D.C., July 1977.

Iron and Steel Manufacturing --

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume I - General. U.S. Environmental Protection Agency, Washington, DC, October 1979.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume II - By-Product Cokemaking and Beehive Cokemaking Subcategories. U.S. Environmental Protection Agency, Washington, DC, October 1979.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume III - Sintering and Blast Furnace Subcategories. U.S. Environmental Protection Agency, Washington, DC, October 1979.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume IV - Basic Oxygen Furnace and Open Hearth Furnace Subcategories. U.S. Environmental Protection Agency, Washington, DC, October 1979.

5 Draft Development Document for Proposed Effluent Limitations and Standards for the Iron and Steel Manufacturing Point Source Category, Volume V - Electric Arc Furnace, Vacuum Degassing, and Continuous Casting Subcategories. U.S. Environmental Protection Agency, Washington, DC, October 1979.

6 Draft Development Document for Proposed Effluent Limitations and Standards for the Iron and Steel Manufacturing Point Source Category Volume VI.- Hot Forming-Primary, Hot Forming Section, Hot-Forming-Flat, and Hot Forming-Pipe and Tube Subcategories, U.S. Environmental Protection Agency, Washington, D.C., October 1979.

3 Draft Development Document for Proposed Effluent Limitations and Standards for the Iron and Steel Manufacturing Point Source Category-Volume VII - Pipe and Tube, and Cold Rolling Subcategories. U.S. Environmental Protection Agency, Washington, D.C. October 1979.

4 Draft Development Document for Proposed Effluent Limitations and Standards for the Iron and Steel Manufacturing Point Source Category - Volume VIII - Sulfuric Acid Pickling, Hydrochloric Acid Pickling, and Combination Acid Pickling Subcategories. U.S. Environmental Protection Agency, Washington, D.C., October, 1979.

2 Draft Development Document for Proposed Effluent Limitation and Standards for the Iron and Steel Manufacturing Point Source Category - Volume IX - Hot Coatings, Scale Removal, and Alkaline Cleaning Subcategories. U.S. Environmental Protection Agency, Washington, D.C., October, 1979.

10 NRDC Consent Decree Industry Summary - Iron and Steel Industry.

Environmental Protection Agency, Effluent Guidelines and Standards for Iron and Steel Manufacturing (40CFR420; 39FR24114, June 28, 1974; Amended by 41 FR 13004, March 29, 1976; 41 FR 32218, August 2, 1976).

Leather Tanning and Finishing Industry --

9 Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Leather Tanning and Finishing Point Source Category. U.S. Environmental Protection Agency, Effluent Guidelines Division, Washington, D.C., July 1979.

Effluent Guidelines and Standards for Leather Tanning and Finishing. U.S. Environmental Protection Agency, 40 CFR 425; 39 FR 12958, April 9, 1974.

30 NRDC Consent Decree Industry Summary. Leather Tanning and Finishing Industry.

Coil Coating --

Development Document for Effluent Limitations Guidelines and Standards for the Coil Coating paint Source Category. EPA 440/1-79/071a, U.S. Environmental Protection Agency, Effluent Guidelines Division, Washington, D,C., August 1979.

NRDC Consent Decree Industry Summary - Coil Coating Industry.

Foundries --

Foundry Industry (Contractor's Draft Report). Contract 68-01-4379, U.S. Environmental Protection Agency, Washington, D.C., May 1979.

NRDC Consent Decree Industry Summary - Foundries.

Porcelain Enameling --

Development Document for Effluent Limitations Guidelines and Standards for the Porcelain Enameling Point Source Category. EPA-440/1-79/072a, U.S. Environmental Protection Agency, Washington, D.C., August ~~1975~~. 1979.

NRDC Consent Decree Industry Summary - Porcelain Enameling Industry.

Explosives Manufacture --

Environmental Protection Agency Effluent Guidelines and Standards for Explosives Manufacturing. 40 CRF 457; 41 FR 10180, March 9, 1976.

NRDC Consent Decree Industry Summary - Explosive Manufacturing.

Technical Review of the BAT Analysis of the Explosives Industry (draft contractor's report). U.S. Environmental Protection Agency, Washington, D.C., April 1979.

Gum and Wood Chemicals --

NRDC Consent Decree Industry Summary - Gum and Wood Chemicals Industry

Technical Review of the Best Available Technology, Best Demonstrated Technology, and Pretreatment Technology for the Gum and Wood Chemicals Point Source Category (draft contractor's report) Environmental Science and Engineering, Inc.

Pharmaceutical Manufacturing --

Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Pharmaceutical Manufacturing Point Source Category. EPA 400/1-75/060. U.S. Environmental Protection Agency, Washington, D.C., December 1976. 344 pp.

Effluent Limitations Guidelines for the Pharmaceutical Manufacturing Industry (draft contractor's report). U.S. Environmental Protection Agency, Washington, D.C., May 1979.

Environmental Protection Agency Effluent Guidelines and Standards for Pharmaceutical Manufacturing. 40 CFR 439; 41 FR 50676, November 17, 1976; Amended by 42 FR 6813, February, 1977.

Supplement to the Draft Contractor's Engineering Report for the Development of Effluent Limitations Guidelines for the Pharmaceutical Industry (BATEA, NSPS, BCT, BMP, Pretreatment). U.S. Environmental Protection Agency, Washington, D.C., July 1979.

Nonferrous Metals Manufacturing --

Draft Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category, Effluent Guidelines Division, Office of Water and Waste management, U.S. Environmental Protection Agency, September 1979.

Environmental Protection Agency - Effluent Guidelines and Standards for Nonferrous Metals. 40 CRF 421; 39 FR 12822, April 8, 1974; Amended by 40 FR 8514, February 27, 1975; 40 FR 48348, October 15, 1975; 41 FR 54850, December 15, 1976.

NRDC Consent Decree Industry Summary - Nonferrous Metals Manufacturing Industry.

Ore Mining and Dressing --

Development Document for BAT Effluent Limitations Guidelines and New Source Performance Standards for the Ore Mining and Dressing Industry, (draft contractor's report). Contract No. 68-01-4845, U.S. Environmental Protection Agency,Washington, D.C., 25 September 1979.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Ore Mining and Dressing Point Source Category, Volumes I and II. U.S. Environmental Protection Agency, Washington, D.C., July 1978.

Environment Reporter, EPA Effluent Guidelines and Standards for Ore Mining and Dressing (40CRF440, November 6, 1975; 41 FR 21191,

May 24, 1976; 42 FR 3165, January 17, 1977, 43 FR 29771, July 11, 1978; 44 FR 7953, February 8, 1979; 44FR11546, March 1, 1979), pg. 135:0881.

5 NRDC Consent Decree. Industry Summary - Ore Mining and Dressing.

Paint and Ink Formulation --

Environmental Protection Agency Effluent Guidelines and Standards for Ink Formulating. 40 CFR 447; 40 FR 31723, July 28, 1975.

Environmental Protection Agency Effluent Guidelines and Standards for Paint Formulating. 40 CFR 446; 40 FR 31723, July 28, 1975.

10 NRDC Consent Decree Industry Summary - Paint and Ink Formulation.

Technical Study Report BATEA-NSPS-PRETREATMENT, Effluent Limitations Guidelines for the Ink Manufacturing Industry (draft contractor's report). Contract 68-01-3502, U.S. Environmental Protection Agency, Washington, D.C., January 1979.

Technical Study Report BATEA-NSPS-PRETREATMENT, Effluent Limitations Guidelines for the Paint Manufacturing Industry (draft contractor's report). Contract 68-01-3502, U.S. Environmental Protection Agency, Washington, D.C., January 1979.

Petroleum Refining --

9 Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Petroleum Refining Point Source Category. EPA-440/1-74-014-a, U.S. Environmental Protection Agency, Washington, D.C., April 1974. 195 pp.

7 Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Petroleum Refining Point Source Category. EPA 440/1-79/014-b, U.S. Environmental Protection Agency, Washington, D.C., December 1979.

8 Draft Development Document Including the Data Base for the Review of Effluent Limitations Guidelines (BATEA), New Source Performance Standards, and Pretreatment Standards for the Petroleum Refining Point Source Category. U.S. Environmental Protection Agency, Washington, D.C., March 1978.

0 Interim Final Supplement for Pretreatment to the Development Document for the Petroleum Refining Industry Existing Point Source Category. EPA-440/1-76/083A, U.S. Environmental Protection Agency, Washington, D.C., March 1977. 115 pp.

10 NRDC Consent Decree Industry Summary - Petroleum Refining.

Pulp, Paper, and Paperboard Mills --

Environmental Protection Agency Effluent Guidelines and Standdards for Pulp, Paper and Paperboard (40 CFR 430; FR 18742, May 12, 1974; Amended as shown in Volume 40 Code of Federal Regulations, Revised as of July 1, 1976; 41 FR 27732, July 6, 1976; 42 FR 1398; January 6, 1977).

NRDC Consent Decree Industry Summary - Pulp, Paper, and Paperboard Industry.

Preliminary Data Base for Review of BATEA Effluent Limitations Guidelines, NSPS, and Pretreatment Standards for the Pulp, Paper, and Paperboard Point Source Category. Prepared for USEPA by E. C. Jordan Co., Inc., Portland, Maine 04112. Contract No. 68-01-4624, June 1979.

Rubber Processing --

Review of Best Available Technology for the Rubber Processing Point Source Category (draft contractor's report). Contract 68-01-4673, U.S. Environmental Protection Agency, Washington, D.C., July 1978.

Environmental Protection Agency Effluent Guidelines and Standards for Rubber Processing. 40 CFR 428; 39 FR 6660, February 21, 1974 (amended by 39 FR 26423, July 19, 1974; 40 FR 2334, January 10, 1975; 40 FR 18172, April 25, 1975 [effective May 27, 1975]; and 43 FR 6230, February 14, 1978).

NRDC Consent Decree Industry Summary - Rubber Processing.

Soaps and Detergents --

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Soap and Detergent Manufacturing Point Source Category. EPA-440/1-74-018a, U.S. Environmental Protection Agency, Washington, D.C. April 1974.

Economic Analysis of Effluent Guidelines for the Soap and Detergent Industry. EPA-230/2-73-026(PB 256 313), U.S. Environmental Protection Agency, Washington, D.C., July 1976.

Project Recommendations for the Soap and Detergent Manufacturing Industry (SIC 2841) BAT/Toxics Study. U.S. Environmental Protection Agency, Washington, D.C., November 1979.

Steam Electric Power Generating --

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Steam Electric Power Generating Point Source Category. EPA-440/1-74/029-a. U.S.

Environmental Protection Agency, Washington, D.C., October 1974. 842 pp.

Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Steam Electric Power Generating Point Source Category. EPA-440/1-73/029, U.S. Environmental Protection Agency., Washington, D.C., March 1974. 677 pp.

Draft Technical Report for Recision of Steam Electric Effluent Limitations Guidelines. U.S. Environmental Protection Agency, Washington, D.C., September 1978. 607 pp.

Environmental Protection Agency Effluent Guidelines and Standards for Steam Electir Power Generating. 40 CFR 423; 39FR 36186, October 8, 1974, effective November 7, 1974; 40 FR 7095, February 19, 1975; 40 FR 23987, June 4, 1975; 42 FR 15690, March 23, 1977; 43 FR 43025, September 22, 1978; 43 FR 44848, September 29, 1978.

NRDC Consent Decree Industry Summary - Steam Electric Power Generating Industry.

Supplement for Pretreatment to the Development Document for the Steam Electric Power Generating Point Source Category. EPA-400/1-77/084, U.S. Environmental Protection Agency, Washington, D.C., April 1977. 244 pp.

Textile Mills --

MRC internal sampling data on file at Effluent Guidelines Division of EPA, 1978.

NRDC Consent Decree Industry Summary - Textile Mills.

Technical Study Report BATEA-NSPS-PSES-PSNS - Textile Mills Point Source Category (draft contractor's report). Contracts 68-01-3289 and 68-01-3884, U.S. Environmental Protection Agency, Washington, D.C., November 1978.

Timber Products Processing --

NRDC Consent Decree Industry Summary - Timber Products Processing.

Revised Technical Review of the Best Available Technology. Best Demonstrated Technology, and Pretreatment Technology for the Timber Products Processing Point Source Category (draft contractor's report). Contract 68-01-4827, U.S. Environmental Protection Agency, Washington, D.C., October 1978.

Publicly Owned Treatment Works (POTW'S) --

Fate of Priority Pollutants in Publicly Owned Treatment Works -Pilot Study. EPA-440/1-79-300, U.S. Environmental Protection Agency, Washington, D.C., October 1979.

References Used in Volume III

Argaman, Yerachmiel, and C. L. Weddle. Fate of Heavy Metals Physical Treatment Processes. In: AIChE Symposium Series, Volume 70, No. 136.

Bollyky, L. J. Ozone Treatment of CyanideBearing Plating Waste. EPA-600/2-77-104, U.S. Environmental Protection Agency, Cincinnati, Ohio, June 1977. 43 pp.

Brandon, C. A., and J. J. Porter. Hyperfiltration for Renovation of Textile Finishing Plant Wastewater. EPA-600/ 2-76-060, U.S. Environmental Protection Agency, Triangle Park, North Carolina, March 1976. 147 pp.

Brunotts, V. A., R. S. Lynch, G. R. Van Stone. Granular Carbon Handles Concentrated Waste. Chemical Engineering Progress, 6(8):81-84, 1973.

Chian, E. S. K., M. N. Aschauer, and H. H. P. Fang. Evaluation of New Reverse Osmosis Membranes for the Separation of Toxic Compounds from Wastewater. Contract No. DADA 17-73-C-3025, U.S. Army Medical Research and Development Command, Washington, D.C., October 1975. 309 pp.

CoCo, J. H., E. Klein, D. Howland, J. H. Mayes, W. A. Myers, E. Pratz, C. J. Romero, and F. H. Yocum. Development of Treatment and Control Technology for Refractory Petrochemical Wastes (draft report). Project No. S80073, U.S. Environmental Protection Agency, Ada, Oklahoma. 220 pp.

Davis, H. J., F. S. Model, and J. R. Leal. PBI Reverse Osmosis Membrane for Chromium Plating Rinse Water. EPA-600/2-78-040. U.S. Environmental Protection Agency, Cincinnati, Ohio, March 1978. 28 pp.

De, J., B. Paschal, and A. D. Adams. Treatment of Oil Refinery Wastewaters with Granular and Powdered Activated Carbon. In: Thirtieth Industrial Waste Conference, Purdue University, Indiana, May 1975. pp. 216-232.

De, J. and B. Paschal. The Effectiveness of Granular Activated Carbon in Treatability Municipal and Industrial Wastewater. In: Third National Conference on Complete Water Reuse, AIChE and EPA Technology Transfer, June 1976. pp. 204-211.

Development Document for BAT Effluent Limitations Guidelines and New Source Performance Standards for Ore Mining and Dressing Industry. No. 6332-M.1, A Division of Calspan Corporation, Buffalo, New York, 1979.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Dairy Products Processing Point Source Category. EPA-440/1-74-021a, U.S. Environmental Protection Agency, Washington, D.C., May 1974. 167 pp.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Fish Meal, Salmon, Bottom Fish, Clam, Oyster, Sardine, Scallop, Herring, and Abalone, Segment of the Canned and Perserved Fish and Seafood Processing Industry, Point Source Category. EPA-440/1-75-041a, U.S. Environmental Protection Agency, Washington, D.C., September 1975. 485 pp.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Leather Tanning and Finishing Point Source Category. EPA-440/1-74-016a, U.S. Environmental Protection Agency, Washington, D.C., March 1974. 157 pp.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Plywood, Hardboard and Wood Preserving Segment of the Timber Products Processing Point Source Category. EPA-440/1-74-023a, U.S. Environmental Protection Agency, Washington, D.C., April 1974.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Synthetic Resins, Segment of the Plastics and Synthetic Materials Manufacturing Point Source Category. EPA-440/1-74-010a, U.S. Environmental Protection Agency, Washington, D.C., March 1974. 238 pp.

Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Tire and Synthetic Segment of the Rubber Processing Point Source Category. EPA-440/1-74-013a, U.S. Environmental Protection Agency, Washington, D.C., February 1974. 193 pp.

Development Document for Effluent Limitations Guidelines and Standards for the Leather Tanning and Finishing Point Source Category. EPA-440/1-79-016. U.S. Environmental Protection Agency, Washington, D.C., July 1979. 381 pp.

Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Manufacturing Point Source Category. EPA-440/1-79-019a, U.S. Environmental Protection Agency, Washington, D.C., September 1979. 622 pp.

Development Document for Effluent Limitations Guidelines and Standards for the Pesticide Chemicals Manufacturing Point Source Category. EPA-440/1-78-060e, U.S. Environmental Protection Agency, Washington, D.C., April 1978. 316 pp.

Development Document for Interim Final and Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Fruits, Vegetables, and Specialties Segment of the Canned and Preserved Fruits and Vegetables Point Source Category. EPA-440/1-75-046, U.S. Environmental Protection Agency, Washington, D.C., October 1975. 520 pp.

Development Document for Interim Final Effluent Limitations Guidelines and New Source Performance Standards for the Primary Copper Smelting Subcategory of the Copper Segment of the Non-ferrous Metals Manufacturing Point Source Category. EPA-440/1 1-75-032b, U.S. Environmental Protection Agency, Washington, D.C., February 1975. 213 pp.

Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Gum and Wood Chemicals Manufacturing. EPA 440/1-76, U.S. Environmental Protection Agency, Washington, D.C., April 1976.

Development Document for Interim Final Effluent Limitations, Guidelines and Proposed New Source Performance Standards for the Hospital Point Source Category. EPA-440/1-76-060n, U.S. Environmental Protection Agency, Washington, D.C., April 1976. 131 pp.

Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Pharmaceutical Manufacturing, Point Source Category. EPA-440/1-75-060, U.S. Environmental Protection Agency, Washington, D.C., December 1976. 331 pp.

Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Raw Cane Sugar Processing Segment of the Sugar Processing Point Source Category. EPA-440/1-75-044, U.S. Environmental Protection Agency, Washington, D.C., February 1975. 291 pp.

Development Document for Interim Final Effluent Limitations Guidelines and New Source Performance Standards for the Mineral Mining and Processing Industry Point Source Category. EPA-440/1-76-059a, U.S. Environmental Protection Agency, Washington, D.C., June 1976. 432 pp.

Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Major Organic Products Segment of the Organic Chemicals Manufacturing Point Source Category. EPA-440/1-73-009, U.S. Environmental Protection Agency, Washington, D.C., December 1973. 369 pp.

Development Document for Proposed Existing Source Pretreatment Standards for the Electroplating, Point Source Category. EPA-440/1-78-085, U.S. Environmental Protection Agency, Washington, D.C., February 1978. 532 pp.

Draft Contractor's Engineering Report for Development of Effluent Limitations Guidelines for the Pharmaceutical Manufacturing Industry (BATEA, NSPS, BCT, BMP, Pretreatment), July 1979, U.S. Environmental Protection Agency, Washington, D.C.

Draft Development Document for Inorganic Chemicals Manufacturing Point Source Category - BATEA, NSPS, and Pretreatment Standards (contractor's draft report). Contract 68-01-4492, U.S. Environmental Protection Agency, Effluent Guidelines Division, Washington, D.C., April 1979.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacutring Point Source Category, Volume I. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 220 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume II. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 272 pp.

Draft Development Document for Proposed Effluent Limitation Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume III. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 308 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume IV. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 446 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume V. EPA-440/1-79/024a, U.S. Environmental Protection AGency, Washington, D.C., October 1979. 435 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume VI. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 389 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume VII. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 419 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume VIII. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 768 pp.

Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Volume IX. EPA-440/1-79/024a, U.S. Environmental Protection Agency, Washington, D.C., October 1979. 758 pp.

Draft Technical Report for Revision of Steam Electric Effluent Limitations Guidelines, September 1978, U.S. Environmental Protection Agency, Washington, D.C.

Effects of Liquid Detergent Plant Effluent on the Rotating Biological Contactor. EPA-600/2-78-129, U.S. Environmental Protection Agency, Cincinnati, Ohio, June 1978. 58 pp.

Effluent Limitations Guidelines (BATEA), New Source Performance Standards and Pretreatment Standards for the Petroleum Refining Point Source Category, March 1978, U.S. Environmental Protection Agency, Washington, D.C.

Effluent Limitations Guidelines for the Ink Manufacturing Industry (BATEA, NSPS, Pretreatment), January 1979, U.S. Environmental Protection Agency, Effluent Guidelines Division, Washington, D.C.

Effluent Limitations Guidelines for the Paint Manufacturing Industry, January 1979, U.S. Environmental Protection Agency, Washington, D.C.

Extraction of Chemical Pollutants from Industrial Wastewaters with Volatile Solvents. EPA-600/2-76-220, U.S. Environmental Protection Agency, Ada, Oklahoma, December 1976. 510 pp.

Foundry Industry (contractor's draft report). Contract No. 68-01-4379, U.S. Environmental Protection Agency, Washington, D.C., May 1979.

Interim Final Supplement for Pretreatment to the Development Document for the Petroleum Refining Industry Existing Point Source Category. EPA-440/1-76, U.S. Environmental Protection Agency, March 1977.

2 Kleper, M. H., A. Z. Gollan, R. L. Goldsmith and K. J. McNulty. Assessment of Best Available Technology Economically Achievable for Synthetic Rubber Manufacturing Wastewater. EPA-600/2-78-192, U.S. Environmental Protection Agency, Cincinnati, Ohio, August 1978. 182 pp.

7 Kleper, M. H., R. L. Goldsmith, and A. Z. Gollan. Demonstration of Ultrafiltration and Carbon Adsorption for Treatment of Industrial Laundering Wastewater. EPA/2-78-177, U.S. Environmental Protection Agency, Cincinnati, Ohio, August 1978. 109 pp.

7 Kleper, M. H., R. L. Goldsmith, T. V. Tran, D. H. Steiner, J. Pecevich, and M. A. Sakillaris. Treatment of Wastewaters from Adhesives and Sealants Manufacturing by Ultrafiltration. EPA-600/2-78-176, U.S. Environmental Protection Agency, Cincinnati, Ohio, August 1978.

7 Klieve, J. R., and G. D. Rawlings. Source Assessment: Textile Plant Wastewater Toxics Study Phase II. Contract No. 68-02-1874, U.S. Environmental Protection Agency, Washington, D.C., April 1979. 127 pp.

Lang, W. C., J. H. Crozier, F. P. Drace, and K. H. Pearson. Industrial Wastewater Reclamation with a 400,000-gallon-per-day Vertical Tube Evaporator. EPA-600/2-76-260, U.S. Environmental Protection Agency, Cincinnati, Ohio, October 1976. 90 pp.

3 McNulty, K. J., R. L. Goldsmith, A. Gollan, S. Hossain, and D. Grant. Reverse Osmosis Field Test: Treatment of Copper Cyanide Rinse Waters, EPA-600/2-77-170, U.S. Environmental Protection Agency, Cincinnati, Ohio, August 1977. 89 pp.

.7 Olem, H. The Rotating Biological Contactor for Biochemical Ferrous Iron Oxidation in the Treatment of Coal Mine Drainage. No. W77-05337, Penn State University, Pennsylvania, November 1975.

1 Petersen, R. J., and K. E. Cobian. New Membranes for Treating Metal Finishing Effluents by Reverse Osmosis. EPA-600/2-76-197, U.S. Environmental Protection Agency, Cincinnati, Ohio, October 1976. 59 pp.

4 Preliminary Data Base for Review of BATEA Effluent Limitations Guidelines, NSPS, and Pretratment Standards for the Pulp, Paper, and Paperboard Point Source Category, June 1979, U.S. Environmental Protection Agency, Washington, D.C.

-5 Priority Pollutant Treatibility Review, Industrial Sampling and Assessment. Contract 68-03-2579, U.S. Environmental Protection Agency, Cincinnati, Ohio, July 1978. 47 pp.

Putting Powdered Carbon in Wastewater Treatment. Environmental Science and Technology, Volume II, No. 9, September 1977.

Rawlings, G. D. Evaluation of Hyperfiltration Treated Textile Wastewaters. Contract 68-02-1874, U.S. Environmental Protection Agency, Washington, D.C., November 1978.

Rawlings, G. D. Source Assessment: Textile Plant Wastewater Toxics Study Phase I. EPA-600/2-78-004h, U.S. Environmental Protection Agency, Triangle Park, North Carolina, March 1979. 153 pp.

Review of the Best Available Technology for the Rubber Processing Point Source Category, July 1978, U.S. Environmental Protection Agency, Washington, D.C.

Revised Technical Review of the Best Available Technology, Best Demonstrated Technology, and Pretreatment Technology for the Timber Products Processing Point Source Category (draft contractors report). Contract 68-01-4827, U.S. Environmental Protection Agency, Washington, D.C., October 1978.

Schimmel, C., and D. B. Griffin. Treatment and Disposal of Complex Industrial Wastes. EPA-600/2-76-123. U.S. Environmental Protection Agency, Cincinnati, Ohio, November 1976.

Selected Biodegradation Techniques for Treatment and/or Ultimate Disposal of Organic Materials. EPA-600/2-79-006, U.S. Environmental Protection Agency, Cincinnati, Ohio, March 1973. 377 pp.

Study of Effectiveness of Activated Carbon Technology for the Removal of Specific Materials from Organic Chemical Processes. EPA Contract No. 68-03-2610. Final report on Pilot Operations at USS Chemical, Nevella.

Technical Assistance in the Implementation of the BAT Review of the Coal Mining Industry Point Source Category, March 9, 1979, Environmental Protection Agency, Washington, D.C.

Technical Review of the Best Available Technology, Best Demonstrated Technology, and Pretreatment Technology for the Gum and Wood Chemicals Point Source Category. No. 77-094, Environmental Science and Engineering Incorporation, Gainesville, Florida, 1978.

Technical Study Report BATEA-NSPS-PSES-PSNS: Textile Mills Point Source Category, November 1978. U.S. Environmental Protection Agency.

Technical Support Document for Auto and Other Laundries Industry (draft contractor's report). Contract 68-03-2550, U.S. Environmental Protection Agency, Washington, D.C., August 1979.

Treatment and Recovery of Fluoride Industrial Wastes. No. PB 234 447, Grumman Aerospace Corporation. Bethpage, N.Y., March 1974.

References Used in Volume IV

Innovative and Alternative Technology Assessment Manual, EPA-430/9-78-009 (draft), U.S. Environmental Protection Agency, Cincinnati, Ohio, 1978. 252 pp.

Metcalf and Eddy. Wastewater Engineering: Collection Treatment, Disposal. McGraw-Hill Book Co., New York, New York, 1972. pp. 662-667.

Physical, Chemical, and Biological Treatment Techniques for Industrial Wastes, PB 275 287, U.S. Environmental Protection Agency, Washington, D.C., November 1976.

B. REFERENCES EXAMINED BUT NOT USED

Chen, Ching-lin, and R. P. Miele. Wastewater Demineralizing by Continuous Countercurrent Ion Exchange Process. EPA-600/2-77-152 (PB 272 301), U.S. Environmenental Agency, Cincinnati, Ohio, September 1977. 50 pp.

Clark, D. P., L. W. Poulter, O. W. Wilson, and W. N. Christensen. The Treatment and Analysis of Cyanide Wastewater. AFCEC-TR-74-5, Air Force Civil Engineering Center, Tyndall AFB, Florida, February 1975. 122 pp.

Cochrane, W., J. Burm, and A. Dostal. Cannery Wastewater Treatment with Rotating Biological Contactor and Extended Aeration. EPA-R2-73-024 (PB 221 333), U.S. Environmental Protection Agency, Corvallis, Oregon, April 1973. 62 pp.

Eaddy, J. M. Jr., and J. W. Vann. Physical/Chemical Treatment of Textile Finishing Wastewater for Process Reuse. EPA-600/2-78-079 (PB 281 276), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, April 1978. 141 pp.

Ellerbusch, F., and H. S. Skovronek. Oxidative Treatment of Industrial Wastewater. EPA-600/J-77-057 (PB 276 268), US. Environmental Protection Agency, Cincinnati, Ohio. 11 pp.

Gardner, F. H., Jr., and A. R. Williamson. Naval Stores Wastewater Purification and Reuse by Activated Carbon Treatment. EPA-600/2-76-227, U.S. Environmental Protection Agency, Cincinnati, Ohio, October 1976. 45 pp.

Handling, Treatment, and Disposal of Wastewater Sludge. In: The USA/USSR Symposium on Handling, Treatment, and Disposal of Wastewater Sludge, Moscow, USSR, 1975. 155 pp.