United States
Environmental Protection
Agency

Robert S. Kerr Environmental
Research Laboratory
Ada OK 74820

Research and Development

EPA-600/S9-81-021 Feb. 1983

EPA

Project Summary

Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment

Thomas E. Short

This conference presented the latest information on combined municipal/industrial wastewater treatment. The sessions were intended to bring together experts from the United States, Canada, Europe, and South Africa who have first-hand experience in the field of combined wastewater treatment systems. The conference was for all engineers, scientists, officials, and operators who are involved in combined municipal/industrial wastewater treatment systems and seek to improve their knowledge and understanding of advanced treatment procedures for combined municipal/industrial wastewater treatment.

The curriculum of the conference covered methods for treatment of combined municipal/industrial wastewaters; industrial pretreatment; case histories of industrial pretreatment effluents and combined municipal/industrial wastewater treatment; data on presence and fate of priority pollutants in existing municipal/industrial wastewater systems; research, design, and operation of combined municipal/industrial wastewater treatment; sludge handling, utilization and disposal; water reuse and recycling.

This Project Summary was developed by EPA's Robert S. Kerr Environmental Research Laboratory, Ada, OK, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

A paper entitled "Compatibility Assessment of Municipal and Industrial Wastes for Combined Biological Treatment" was presented by Arthur W. Busch, Environmental Engineering Consultant. This paper considers the numerous chemical and hydraulic aspects of biological treatment of combined municipal and industrial wastewaters. Compatibility is affected by qualitative and quantitative characteristics of the wastes involved. Assessment should include reaction rates, phase distribution of organics, concentration effects, hydrographs, and relative volumes. One factor deserving special attention is the effect of transport time on wastes. There is also a dimension of "legal compatibility" for mixtures of wastes containing hazardous and/or toxic substances.

"Biological Inhibition Screening of Industrial Wastewaters" was presented by Enos L. Stover, Metcalf & Eddy, Inc., Boston, Mass. The possible presence of inhibitory or toxic compounds to biological treatment processes, especially nitrification, warrants concern where industrial wastewaters are discharged into municipal treatment systems. Quantitative assessment of inorganic and organic compounds possibly causing inhibition problems by atomic absorption and gas chromatograph-mass spectrophotometer analyses is a time-consuming and expensive proposition. A simpler method of inhibition screening in terms of required analyses time and

expense would be to conduct bioassay type procedures. A simple and inexpensive microbiological inhibition screening test procedure can be conducted by treatment plant personnel at municipal plants receiving industrial wastewater discharges to provide estimates of the threshold inhibition levels to both the carbonaceous and nitrification reactions. The factors affecting this inhibition screening procedure and important experimental design considerations are presented along with results from inhibition testing of various industrial wastewaters for both carbonaceous removal and nitrification.

"Treatment of Municipal Wastewaters Containing Biologically Hazardous Industrial Compounds by Conventional Activated Sludge and Extended Aeration" was presented by Don F. Kincannon, A. F. Gaudy, Jr., and T. S. Manickam, Oklahoma State University, Stillwater, Oklahoma. The overall objective of the research reported in this paper was to gain information on the effect of priority pollutants on the performance of publicly owned treatment works employing conventional activated sludge and extended aeration as the methods of secondary treatment. The general approach was to compare the performance of control systems with that of comparable systems dosed with various concentrations of priority pollutants. The results of four priority pollutants were reported in this paper. They are: phenol, 2-chlorophenol, methylene chloride, and 4-chloro, 3-methyl phenol. Internal recycle benchscale reactors were used for the study. The conventional activated sludge units were operated as θ_c = 5 days. The wastewater feed consisted of effluent from the primary clarifier of the Stillwater municipal sewage treatment plant.

"Physical-Chemical Treatment of Combined Municipal-Industrial Wastewater for Reuse in South Africa" was presented by Hans Van Leeuwen, National Institute for Water Research, Pretoria, South Africa. Wastewaters often contain appreciable proportions of industrial effluents. The influence of certain industrial pollutants on the reuse potential of reclaimed water is a matter of great concern in a water-scarce country such as South Africa. Experience of over a decade was gained on four experimental and pilot plants with wastewater of mainly domestic origin. The efficacy of these plants in the treatment of domestic and industrial wastes was evaluated by analyzing for about 60 organic and inorganic pollutants with possible health implications at various stages of the processes. It was found that although most contaminants could be removed to a major extent by activated sludge treatment, chemical clarification (with lime or ferric chloride) before biological treatment could improve removal as well as protect the biological system. Chlorination removed some contaminants. Activated carbon could remove most of the remaining contaminants and was a definite necessity for the removal of some.

"Use of Granular Activated Carbon to Treat Municipal Wastewater Receiving Industrial Flow" was presented by Paschal B. DeJohn, Robert W. Edwards, and James P. Black, ICI Americas, Inc., Wilmington, Delaware. Many municipal wastewater treatment plants receive flow from numerous industrial sources that create special problems for the treatment plant operator. Wastewater from industrial sources often contains toxic chemicals that are not readily removed via standard treatment practices and may, in fact, be detrimental to critical processes. Granular activated carbon is one treatment method that may be employed to overcome these difficulties. This paper discussed the application of GAC — when, where, why, and how it should be employed — and discussed results from several municipal plants using GAC.

"Full Scale Experience with Activated Carbon Treatment of Joint Municipal-Industrial Wastewater" was presented by James L. Taylor, Fitchburg Wastewater Treatment Facilities, Fitchburg, MA. In the late 60's, Fitchburg, like many communities, found itself faced with a serious water pollution problem. An engineering firm was hired to recommend and design a solution to the problem. Their recommendation resulted in the construction of two new advanced wastewater treatment facilities. One of these facilities, the West plant, is a physical-chemical plant designed mainly to service the area's paper manufacturing facilities. Since plant startup in mid-1975, numerous mechanical and process difficulties have occurred. The plant has operated in a continuous mode for only a relatively short period of time. It appears there are numerous applications for activated carbon in wastewater treatment, but they are dictated by specific conditions. If carbon adsorption is to be considered for a major role in wastewater treatment in the future, significant changes will be required in the way process evaluations and facility designs are conducted.

"Textile Waste Treatment at a Municipal PACT Facility" was presented by Charles A. Pitkat, Water Pollution Control Facility, Vernon, Connecticut, and Craig L. Berndt, Zimpro Inc., Rothschild, Wisconsin. The town of Vernon, Connecticut, recently placed into operation a 24,500 M^3/day (6.5 MGD) design average flow wastewater treatment facility incorporating the first U.S. municipal application of Powdered Activated Carbon Treatment (PACT) with Wet Air Regeneration of excess powdered carbon/biomass solids. The PACT process was selected at Vernon due to the difficult-to-treat domestic and highly colored industrial wastes expected and the stringent effluent quality required by the NPDES permit. The paper describes briefly the PACT startup and discusses the initial year of operation of the PACT and Wet Air Regeneration Systems. Design and performance of those systems are presented. The operation and performance of the PACT system have demonstrated the substantial improvement in effluent quality that was expected when employing the combination of biological solids and powdered activated carbon over more conventional treatment processes in treating this difficult-to-treat wastewater.

"Review of the Use of Ozone for Improving Combined Municipal-Industrial Wastewater Treatment" was presented by Rip G. Rice, Jacobs Engineering Group, Washington, D.C. In wastewater treatment, ozonation is being developed primarily as an alternative disinfection treatment process to chlorination. As many as 36 U.S. sewage treatment plants are in operation, under construction, or are being designed with ozone disinfection. In many installations, however, the economics of ozone disinfection are affected adversely by ozone-demanding industrial components. Several detailed pilot plant studies have been conducted in the U.S.A. utilizing ozone oxidation of combined municipal-industrial wastewater in earlier treatment stages than the (terminal) disinfection step. Experiences at the Cleveland Regional Sewer District using ozone were reviewed, as were ozonation studies at Chino Basin, California (suspended solids removal) and Dalton, Georgia (treatment of textile wastes combined with municipal sewage). An assessment was also presented of

the potential benefits which may be attainable in removing priority pollutants from industrial, municipal, or combined municipal/industrial wastewaters by following chemical oxidation with adsorption and concurrent biological oxidation.

"The Use of Solar Energy for Combined Municipal-Industrial Wastewater Treatment" was presented by Aurel J. Acher, Utah State University, Logan, Utah. The material presented represents research on a new method for using solar energy for municipal and industrial wastewater treatment. This research seeks to develop economical methods of disinfection and detoxification of wastewaters which would result in the reuse of effluents for crop irrigation. Aerated municipal or industrial wastewaters containing dye-sensitizers were exposed to solar irradiation for various periods of time. The influence of the solar energy, absorbed by these sensitizers in the visible range, on the organic matter and anionic surfactants in secondary effluents was checked by determining the COD and MBAS values of treated wastewater.

The disinfection potential of this method was followed by bacteriological analyses of running water or secondary effluents, previously contaminated or enriched, respectively, with laboratory cultures of *E. coli,* bacteriophages and polio virus. The results of these experiments demonstrate the effectiveness of such a method (total kill of bacteria and viruses). The influence of this photo-oxidative method was also studied on eutrophic algae present in the Lake of Galilee. It was found that the conditions under which disinfection proceeds also support algicidal processes, causing lethal damage of algal cultures.

"Land Treatment of Combined Municipal-Industrial Wastewaters" was presented by Charles E. Pound and Ronald W. Crites, Metcalf and Eddy, San Bernardino, California. An overview of the mutual benefits of land treatment for combined municipal-industrial wastewater was given. The discussion used pertinent examples from several different projects where decisions were made to either combine or separate the two wastewater streams. In most cases decisions depended on the relative waste loads contributed by each and the relative costs of separate versus combined treatment.

"The Utilization of Sewage Sludges on Cropland" was presented by L.E. Sommers, Purdue University, W. Lafayette, Indiana. Numerous studies have indicated that comparable crop yields can be obtained by fertilizing soils with either sewage sludges or conventional inorganic fertilizer materials. However, sewage sludges also contain other constituents, primarily of industrial origin, which may limit their application rate on cropland. The sludge components of greatest concern include pathogens, slowly degraded organics (e.g., PCB's) and non-essential heavy metals (nickel, cadmium, and lead). Approaches being developed for land application of sewage sludges are based on maintaining the productivity of agricultural cropland and the quality of the environment. Developing a land application system involves the following considerations: (1) pathogens; (2) nitrate and heavy metal leaching into ground waters; (3) effects on human health resulting from cadmium accumulation in crops; (4) phytotoxicity due to increased soil levels of copper, zinc, and nickel; (5) contamination of crops with persistent organics such as PCB's.

"Utilisation of Activated Sludge from Combined Municipal-Industrial Wastewater Treatment for Animal & Poultry Feed" was presented by Amatzya Eyal, Matmor, Central Feed Mill Corporation, Doar Naa Evtach, Israel. The sewage of the Haifa municipality is directed to a special area and then undergoes treatment on the methane fermentation system. The end product consists of organic matter which passed several stages of fermentation and sterilization. This product has been successfully applied in livestock feed at the rate of 2.0-2.5% rate of inclusion. The main problem with this product in livestock feed is the excessively high amount of ash (about 50%). Another product has been successfully introduced and is based on sludge originating from the open oxidation ponds of Tel Aviv municipality and passed radiation treatment. After a range of nutritional trials it was established that this sludge has nutritional value and may be successfully applied in feed for livestock and poultry.

"Water Pollution: Industry and Government Working Together. A Case Study of Muncie, Indiana's Industrial Pretreatment Program" was presented by John M. Craddock, Muncie Sanitary District, Muncie, Indiana. With new laws and regulations being instituted on the local, state, and federal level, the ability for industry to remain cognizant of all new requirements in the field of water pollution is becoming almost impossible. Muncie, Indiana, established as of March 10, 1972, a Division of Water Quality which is a testing and enforcement agency. The three main functions of the Division are testing the wastewater treatment plant, industrial monitoring and control of waste being discharged to the system, as well as the prevention of stream pollution in this geographic area. Since 1972 metals in the sludge, raw, and final effluent of the treatment plant have been reduced by 80%. This has been accomplished by a good working relationship between the local regulatory agency and the industrial community.

"The City of Chattanooga Industrial-Municipal Pretreatment Program" was presented by Eugene G. Wright, George E. Kurz, and David Summers, Department of Public Works, Chattanooga, Tennessee. Faced with stringent 201 grant requirements to accomplish industrial waste control for protection of its 50-million-dollar wastewater plant expansion, the City of Chattanooga has developed an innovative and comprehensive pretreatment program. The goal of the strict compliance schedule in the grant agreement is to achieve control of industrial wastes by 1983 so that the plant expansion scheduled to be completed then will be able to meet its NPDES permit conditions. The pretreatment program that evolved from the grant conditions is unique since it was developed simultaneously with the promulgation of EPA's General Pretreatment Regulations and has been tailored to meet the requirements of EPA's National Pretreatment Strategy. Although there have been larger cities that have developed successful pretreatment programs for plant protection, the program developed by Chattanooga additionally incorporated the National Categorical Standards now being issued by EPA and is one of the few cities to have sufficient data to apply to EPA for Local Removal Credits.

"Pretreatment Technology for Pesticide Manufacturing Waste Effluents" was presented by Edward C. Monnig, Research Triangle Institute, Research Triangle Park, N.C. This project is designed to investigate the suitability of individual pesticide manufacturing wastewaters for discharge to biological treatment systems, whether public owned treatment works (POTW) or on-site systems. The approach taken with each pesticide manufacturing wastewater is hierarchical in nature, that is,

less costly, more available methods of treatment are investigated first. The preferred method of treatment is assumed to be biological treatment. If the pesticide is judged suitable to biological treatment based on chemical and toxicological evaluation of the waste before and after treatment, additional options are not investigated. If pesticide manufacturing wastewater disrupts biological treatment systems, the possibility of pretreating the waste prior to biological treatment is investigated. If pretreatment does not improve the performance of activated sludge systems, adsorption techniques may be investigated.

"Los Angeles County Experience in the Control and Treatment of Industrial Wastewater Discharges" was presented by Leon S. Directo, Charles W. Carry, and Jay G. Kremer, County Sanitation Districts of Los Angeles County, Whittier, California. Because of the highly industrialized area served by the Los Angeles County Sanitation Districts, the various Districts' treatment facilities have to treat both sanitary and industrial wastewater discharges. Although combined treatment can be mutually beneficial to both the industrial and residential users, it can also require additional planning and administration to successfully operate the sewerage system and sewage treatment facilities. Thus, recognizing the need to serve the industrial community while at the same time meeting Federal and State water quality goals, the LACSD Board of Directors adopted on April 1, 1972, an ordinance regulating industrial wastewater discharges. This ordinance established a number of industrial waste regulatory programs including an industrial waste permit program, industrial surcharges, plant inspections, wastewater monitoring, and enforcement activities. The effectiveness of the source control program in the JOS was discussed by examining the influent pollutant concentrations at the Districts' Joint Water Pollution Control Plant (JWPCP).

"The Treatment of Cotton Waste in the Mersey Basin" was presented by G. M. Doughty, Sheffield City Polytechnic, Sheffield, England. Severe pollution of the River Goyt is caused by the unsatisfactory effluent discharged from the Whaley Bridge Effluent Treatment Works (E.T.W.). Although the works was extended in 1967 and receives less than its design dry weather flow, the acceptance of strong liquors from the kiering operation of a nearby cotton processor has resulted in a gross organic overload. After hydraulic balancing and neutralization at the trade premises, a highly colored liquor with a BOD of about 8,000 mg/l is sewered to the E.T.W. In current extensions of the E.T.W. by North West Water Authority, the present biological stage of standard rate trickling filters is to be supplemented by high-rate filters and pure oxygen activated sludge (UNOX). To aid dilution of the trade effluent, two outdated downstream E.T.W.s are to be closed and their process flows pumped upstream to Whaley Bridge. A high degree of flexibility is incorporated in the design with only the highly polluted flows passing through all the biological stages.

"Case History of a Potato Chip Producer Discharging to a Small Municipal Treatment System" was presented by A. Warren Wilson, of Reid, Crowther & Partners Limited, Con Mills, Ontario, Canada. A technical investigation of the impact of the wastewater discharges from the Hostess Food Products Limited plant in Cambridge, Ontario on the operation of the local municipal wastewater treatment plant was made. The investigation included a review of historical data, a detailed sampling and analytical program to establish contaminant materials balances, and treatability studies on selected wastewater streams.

"Joint Treatment Design and Operation Problems with a Fine Paper Making Wastewater" was presented by Jerry D. Lowry, University of Maine, Orono, Maine. This paper describes the efforts to solve problems encountered in a joint treatment facility located in Brewer, Maine. The 3.0-MGD facility receives wastewater from the city (10,000 population) and industry (fine paper making) and has been plagued with operational problems since its startup in 1976.

"Uniroyal Chemical's Experience of Combined Municipal-Industrial Wastewater Treatment at Elmira, Ontario, Canada" was presented by Ken C. Bradley, Uniroyal Chemical, Elmira, Ontario, Canada. The Chemical Division of Uniroyal Lts. produces in Elmira, Ontario, Canada, a wide range of organics for use in the agricultural and rubber chemical industries. Process wastewaters from this chemical complex are combined with raw sewage from the town of Elmira, Ontario, Canada, prior to primary clarification and secondary treatment in a joint municipal-industrial treatment system. Changes made, and proposed, to upgrade treatment include modifications to the aeration system, improved equalization, activated carbon pretreatment, and effluent filtration.

"Industrial Compatibility with the POTW in Tampa, Florida, through City/Industry Cooperation" was presented by David W. Pickard, Advanced Wastewater Treatment Plant, Tampa, Florida. A comprehensive industrial waste monitoring section was started on a full scale basis in 1973, five years before the new AWT plant construction was complete. The Tampa AWT plant treats waste from a service area with a population of 300,000 and approximately 50 key industries. Industries include breweries, food processors, lead storage battery manufacturing, electroplating, and printed circuit board manufacturing. Most pretreatment programs have involved industrial process changes in place of treatment plants, thus producing little toxic residue. Pilot plants of the AWT process selected for Tampa were run for approximately 2 years to verify the treatability of the wastewater by the process of choice. Through planning and industrial cooperation, Tampa has maintained a combined wastewater that is compatible with the POTW.

"Sources of Toxic Chemicals in POTW" was presented by D. Ehreth, U.S. EPA, Washington, D.C. The purpose of the project was to determine the origin of, and magnitude of, the problem of toxic substances in Publicly Owned Works (POTW). Data sources include results from the Monitoring and Data Support Division (MDSD) studies of sources of toxics in collection systems and Effluent Guidelines Division studies of toxics in secondary treatment plants. These data sources relied heavily on monitoring data to identify concentrations of toxic substances from sources and in POTW influents, sludges, and effluents. Comparisons of these toxic concentrations with available inhibition, sludge use, and water quality criteria and guidelines show that many toxic pollutants are present in quantities which could cause problems in POTW's.

"Treatment of Industrial Priority Pollutants in POTW's" was presented by Howard D. Feiler and Paul J. Storch, Burns and Roe Industrial Services Corp., Paramus, New Jersey, and Arthur Shattuck, U.S. Environmental Protection Agency, Washington, D.C. EPA has embarked on a program to study the occurrence and fate of priority pollutants, which encompass

129 selected toxic organic and inorganic pollutants, at 40 Publicly Owned Treatment Works (POTW's). At present, approximately 25 percent of the program is complete. POTW's sampled have included plants with a broad range of industrial contributions and treatment sequences. The data provide a basis for evaluating pollutant removals relevant to establishing pollutant removal credits and possible treatment of industrial wastes in POTW's.

"Behavior of Selected Organic Compounds in Wastewater Collection and Treatment Systems" was presented by Albert C. Petrasek, Jr., U.S. Environmental Protection Agency, Cincinnati, Ohio. The major objective of this research effort is to evaluate the behavior of the organic "priority pollutants" in conventional wastewater collection and treatment systems. The responses of specific compounds are being studied so that it will be possible to determine the ultimate sink for each chemical, and data are being collected which will permit the quantification of the removals of these materials in the classical unit processes/unit operations employed in publicly owned treatment works.

"Effect of Combined Municipal and Industrial Treatment on Trace Substances in POTW Effluents" was presented by Foppe B. DeWalle and David A. Kalman, University of Washington, Seattle, Washington, and Edward S.K. Chian, Georgia Institute of Technology, Atlanta, Georgia. The present study evaluated the presence of priority pollutants in sewage and sludges collected from 25 publicly owned treatment works. The plants with sizes varying between 3.8 mgd and 276 mgd were selected to reflect various percentages (0-73%) and types of industrial discharge into the sewer network. Priority pollutant analysis measured volatile organics with a purging/adsorption technique while acid, neutral, and base organics were obtained by methylene chloride extraction, followed by gel permeation chromatography and gas chromatographic analysis using capillary columns. Identification occurred with a mass spectrometer interfaced with the GC.

"Flow of Metals in a Municipal Waste Treatment System" was presented by K. J. Yost and R. W. Wukasch, Purdue University, West Lafayette, Indiana. The Kokomo, Indiana, municipal waste treatment system has been surveyed for the purpose of characterizing the flow of heavy metals from specific sources through the collection system and treatment plant. The survey involved quantifying inputs of Cu, Ni, Cr, Cd, Zn and Pb to the collection system from commercial/industrial sources, trunkline sampling to determine metal flows within various segments of the collection system, and a metals balance on the treatment plant. The design of the trunkline sampling program was such that metal inputs from residential neighborhoods could be measured.

"Heavy Metals in Municipal Wastewater Treatment Plant Influents: An Analysis of the Data Available from Treatment Plants" was presented by Mark W. Cantrell, Richard L. Church, and Roger A. Minear, The University of Tennessee, Knoxville, Tennessee; Sidney A. Hannah, U.S. EPA, Cincinnati, Ohio; and Roy O. Ball, Roy F. Weston, Inc., West Chester, Pennsylvania. A study has been conducted over the last 2 years in which municipal wastewater treatment facilities have been surveyed to determine which plants possess data on heavy metals concentrations in their plant influent. A large proportion of those plants with data have supplied these data upon request in conjunction with other information; flow, percent industrial contribution, extent of combined sewers, and a coarse estimate of infiltration and inflow. Furthermore, a large proportion of the laboratories providing data have been visited and evaluated in terms of a lab quality index.

"Problems with Metals in the Residue from Combined Municipal/Industrial Waste Treatment" was presented by H. M. Jeffus, University of Arkansas, Fayetteville, Arkansas. Metals occur in the wastewater from many industrial processes. There are also some notable examples of metals in wastewater from municipal residential areas. These metals tend to concentrate in the residues from waste treatment. The disposal of these residues requires careful planning and monitoring if adverse consequences are to be avoided later. Metals limit biological treatment and disposal alternatives. Alternatives for disposal are: burial, landspreading, incineration, and encapsulation with subsequent burial.

Conclusions

The Conference on Combined Municipal/Industrial Wastewater Treatment was held March 25-27, 1980, at The Conference Center, University of Texas at Dallas, Richardson, Texas. Dr. Aharon Netzer, of the University of Texas at Dallas, was the conference General Chairman.

Recommendations

Conferences dealing specifically with Industrial/Municipal wastewater treatment should be held on a regular continuing basis.

*The EPA author is **Thomas E. Short** (also the EPA Project Officer, see below) with the Robert S. Kerr Environmental Research Laboratory, Ada, OK 74820.*
The complete report, entitled "Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment," (Order No. PB 83-142 133; Cost: $40.00, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
Robert S. Kerr Environmental Research Laboratory
P. O. Box 1198
U.S. Environmental Protection Agency
Ada, OK 74820

☆U. S. GOVERNMENT PRINTING OFFICE: 1983/659-095/580

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati OH 45268

Postage and
Fees Paid
Environmental
Protection
Agency
EPA 335

Official Business
Penalty for Private Use $300

PS 0000329
U S ENVIR PROTECTION AGENCY
REGION 5 LIBRARY
230 S DEARBORN STREET
CHICAGO IL 60604