

Selected Summaries of

WATER RESEARCH

Research and Development

Robert A. Taft Water Research Center, Cincinnati, Ohio

MAY 1969

AUTOMATED MONITORING (W68-26)

The use of manual sampling and standard laboratory analyses to record changes in water quality is impractical; therefore, a wide variety of automated instruments have been developed. Since the basic purpose is control of water pollution, rather than measurement, the use of monitoring equipment to sound an alarm or even to automatically initiate action by control mechanisms should be an essential part of the monitoring concept.

This discussion is confined to integrated (multiparameter) instruments for monitoring of water quality. With current designs, up to eight separate parameters can be measured simultaneously within the same instrument package.

Ballinger, D. G., "Automated Water Quality Monitoring," *Environmental Science & Technology*, 2, 606-610, August 1968.

NATURAL CYCLE REUSE (W68-27)

Self purification of flowing water and the sequential use of water by communities located one below another on a stream in the direction of flow is the classical cycle of waste disposal-water reuse in the United States. The natural purification forces of the river have in the past been called upon to perform the bulk of the waste treatment.

National awakening to the impracticability of future reliance on nature for purification of wastewaters has caused a reassessment of the treatment technology required to maintain our waters in a condition suitable for all legitimate uses. This article discusses the changes in concepts and treatment processes that are required to adequately control natural recycle and reuse of wastewater effluents.

Middleton, F. M., "Wastewater Treatment for Return to Natural Cycle Reuse," *Water and Wastes Engineering*, 5, No. 9, 61-64, 1968.

ULTIMATE DISPOSAL (W68-40)

There are only three places where it is practical to dispose of sludges and concentrates: air, land, or the oceans. Surface fresh waters are not available for disposal. The ocean has long been used for the ultimate disposal of human wastes. However, warning signs are appearing. There is some evidence that the ocean's assimilative capacity is not in-

initely large, and that the effluents from some ocean outfalls are not rapidly dispersed. Treatment of sludges and concentrates prior to disposal are discussed. Economic aspects of sludge are considered.

Dean, R. B., "Ultimate Disposal of Waste Water Concentrates to the Environment," *Environmental Science & Technology*, 2, No. 12, 1079-1086, 1968.

PHOSPHATE REMOVAL BY AL SALTS (W68-33)

The authors describe methods of removing phosphates from wastewater by aluminum salts and subsequent recovery of aluminum. Experimental procedures and chemical costs of recovery are discussed.

Farrell, J. B., Salotto, B. V., Dean, R. B., and Tolliver, W. E., "Removal of Phosphate From Wastewater by Aluminum Salts With Subsequent Aluminum Recovery," *Chemical Engineering Process Symposium Series*, 64, No. 90, 232-239, 1968.

IDENTIFICATION OF OIL POLLUTANTS

The urgency of oil pollution problem requires that detailed analytical procedures be developed to detect and identify petroleum pollutants, in order to establish responsibility for violations of water quality standards and to secure abatement of the pollution.

Many oil spills occur without eye witness. In such cases technical information and data will be necessary to facilitate locating and identifying the sources of the pollution created by petroleum products. Following identification, proper enforcement for control procedures may then be exercised.

This laboratory guide for the identification of petroleum pollutants has been prepared to provide the analyst with specific methods leading to a positive characterization of the waste material.

Kawahara, F. K., *Laboratory Guide for the Identification of Petroleum Products*, Robert A. Taft Water Research Center, Analytical Quality Control Laboratory, FWPCA, January 1969, 41 pp.

URBAN STORMWATER RUNOFF (W68-24)

This paper describes the results of tests from 9 storms during the period of November 1964, to March 1966, and discusses their effects on treat-

ment and disposal of urban stormwater runoff. Some bench-scale settling and chlorination experiments were undertaken to obtain preliminary design information.

Urban stormwater runoff has been shown to contain constituents of pollutional character hazardous to public health. Currently masked by gross pollution from raw or inadequately treated sewage, the impact of this urban runoff may not be apparent until the gross sources are eliminated.

Evans, F. L. III, Geldreich, E. E., Weibel, S. R., and Robeck, G. G., "Treatment of Urban Stormwater Runoff," *Journal Water Pollution Control Federation*, 40, No. 5, Part 2, R162-R170, 1968.

PHENOLS IN SURFACE WATERS (W69-1)

Thin-layer chromatographic procedures for the determination of phenol and certain substitute phenols were applied to raw surface waters. Both water grab and carbon adsorption samples were analyzed. The concentrated solvent extracts of the samples were chromatographed on silica gel G thin layers and developed in benzene/cyclohexane/diethylamine (5:4:1) or chloroform. The first system provides for selective determination of the alkyl-phenols, since the chloronitro- and amino-phenols remain at or near the origin. Phenols developed with this system are detected with *p*-nitrobenzene-diazonium fluoroborate. Those developed with chloroform are detected with Gibbs' reagent.

Smith, D. and Lichtenberg, J. J., "Determination of Phenols in Surface Waters by Thin-Layer Chromatography," *Micro-organic Matter in Water, ASTM STP 448*, American Society for Testing and Materials, 78-95, 1969.

VIRUS DISEASES IN BLUE-GREEN ALGAE (W68-36)

Under favorable conditions viruses provide a valuable alternative to chemical treatment for pest control. So successful are some virus pesticides that chemical controls are no longer necessary. The introduction of the myxoma virus into the rabbit population of Australia is a classic example of the effectiveness of this approach (Fenner, 1959). No less dramatic has been the use of viruses in the control of insect pests (Rivers, 1964). This paper discusses virus diseases in algae.

Safferman, R. S., "Virus Diseases in Blue-Green Algae," *Algae, Man and the Environment*, Syracuse University Press, Syracuse, N. Y., 429-439, 1968.

PENTAFLUOROBENZYL ESTERS (W68-28)

This paper discusses the microdetermination of pentafluorobenzyl ester derivatives of organic acids by means of electron capture gas chromatography.

Traces of organic acids adversely affect the palatability of water. To aid in monitoring waterways, sensitive and rapid methods are necessary for measuring these compounds which constitute a small portion of the complex organic residue obtained by

evaporation of the chloroform extract of the carbon adsorption samples. Sufficient amount of activated carbon contained in a hollow cylinder effectively concentrates from metered water the numerous organic pollutants which are carried to the stream by runoff in domestic sewage, or in industrial wastes.

The adsorbed organic pollutants may be recovered from the activated carbon by means of extraction with chloroform. Evaporation of the extract leaves an organic residue. Details for determining the carbon chloroform extract of monitored surface waters are reported.

Kawahara, F. K., "Microdetermination of Pentafluorobenzyl Ester Derivatives of Organic Acids by Means of Electron Capture Gas Chromatography," *Analytical Chemistry*, 40, No. 13, 2073-2075, November 1968.

WASTEWATER TREATMENT (W68-35)

Several physical-chemical and biological wastewater treatment techniques have been investigated for technical and economic feasibility during recent years. The most promising of these are now being further developed in pilot-scale and full-scale plants. New approaches to wastewater treatment are not limited to new processes and are not necessarily intended to replace conventional treatment processes. In reflecting both the cost of treatment and the specificity of the process used, treatment by new approaches will generally be tailored to the individual waste involved and to the quality of effluent required.

This paper describes several new treatment systems now under development including modified conventional processes. In most cases the processes described are still experimental even though they are being proposed for full-scale or pilot-scale development. Evaluations are being conducted at plants treating municipal wastes in order to guarantee realistic results under actual operating conditions.

Stenburg, R. L., Convery, J. J., and Swanson, C. L., "New Approaches to Wastewater Treatment," *Journal of the Sanitary Engineering Division, ASCE*, 94, No. SA6, 1121-1136, December 1968.

BENTHIC MACROINVERTEBRATES (W68-16)

A basket sampler for collecting benthic macroinvertebrates in large streams is described. It is easy to install and collections can be made by persons of varying experience and training. The sampler is durable, corrosion resistant, and inexpensive.

Samples obtained during the period of warmer water contained many more organisms than samples collected during the period of colder water.

A major advantage of the sampler is that a uniform, attractive surface is provided for the attachment of bottom fauna. It collects a larger number and variety of immature aquatic insects than the Petersen dredge. It particularly is effective in collecting certain midges, caddisflies, mayflies, stoneflies, coelenterates, and bryozoans. However,

relatively few oligochaetes, mollusks, and some of the sediment inhabiting midges and mayflies are collected.

The capability of the basket sampler to collect a more complete representation of benthic macro-invertebrates is of great value in water pollution investigations.

Anderson, J. B. and Mason, W. T. Jr., "A Comparison of Benthic Macroinvertebrates Collected by Dredge and Basket Sampler," *Journal Water Pollution Control Federation*, 40, No. 2, Part 1, 252-259, 1968.

C/N RELATIONSHIPS OF CULTURE MEDIA (W68-17)

Four basic nutrient types are described and discussed in special reference to the ratios between carbon source materials and nitrogen source materials. These include habitat, natural nutrients, semi-synthetic nutrients and synthetic nutrients. Special emphasis is placed on the use of such nutrients in agar media for the primary isolation of fungi from various types of habitat materials such as soils and sewage.

It is suggested that a basic C:N ratio for such nutrient agars lies at about 9 or 12 to 1, that increasing this ratio tends to over-enrich the culture, thus encouraging the formation of intracellular or extracellular carbon-carrying compounds, and that decreasing the ratio, tends to encourage the formation of nitrogen-carrying storage products.

Co-cke, W. B., "Carbon/Nitrogen Relationships of Fungus Culture Media," *Mycopathologia et Mycologia Applicata*, 34, Nos. 3/4, 305-316, May 13, 1968.

BLUE-GREEN ALGAL VIRUS SM-1 (W69-4)

The purification of a new blue-green algal virus SM-1, which infects only unicellular forms is described. The new virus appears to be a polyhedron with no obvious tail. Several characteristics indicate that this virus is distinct from the blue-green algal virus LPP-1.

Two infectious nucleoproteins were usually found in sucrose-density gradients. The faster component aggregated readily, and its instability appeared to account for the variations in the relative proportion of the two components. The new SM-1 virus, unlike the algal virus, LPP-1, does not appear to resemble basic morphological phage types.

Safferman, R. S., Schneider, I. R., Steere, R. L., Morris, M. E., and Diener, T. O., "Phycovirus SM-1: A Virus Infecting Unicellular Blue-Green Algae," *Virology*, 37, No. 3, 386-395, 1969.

ENUMERATION OF BACTERIAL VIRUSES (W68-34)

A relatively simple method that can be used to demonstrate the activity of a bacterial virus is discussed. The bacteriophage enumeration procedure described was successfully used by the participants in a Seminar in Microbiology for High School

Science Teachers. If a teacher can obtain a stock suspension of the bacteriophage from a nearby college or research institute, the phage production step can be omitted, and the test procedure reduced to a demonstration of the plaque technic for enumeration of a bacterial virus.

Berman, D., "The Enumeration of Bacterial Viruses by Plaque Technique," *The American Biology Teacher*, 30, No. 6, 486-487, August 1968.

OPERATIONS RESEARCH ACTIVITIES (W68-46)

Operations research activities at CWRL (now the Robert A. Taft Water Research Center) are directed towards first, development of adequate mathematical models to represent the performance and cost of all practicable wastewater treatment processes and second, using this information to advance the state-of-the-art in the areas of planning, design, and control of wastewater treatment systems.

Two principal types of mathematical models are studied. The first type, sometimes called a quasi steady-state model, is based on 24-hour composite measurements and is intended for planning and design of wastewater treatment systems to accomplish a specific treatment task at a minimum cost. The second type is the time-dependent model which is of interest primarily as a tool to study the practicability of various schemes for controlling processes which receive highly variable or intermittent loads.

By means of process control, the variability of the effluent stream quality and the average performance of the process can be improved. It is hoped that cost savings in power or chemicals can also be realized.

Smith, R., "Operations Research Activities at Cincinnati Water Research Laboratory," *Proceedings of the National Symposium on the Analysis of Water-Resource Systems*, American Water Resources Association, Denver, Colorado, July 1-3, 1968, 241-262.

ATOMIC RADIATION FOR WASTEWATER TREATMENT (W69-7)

The rationale for considering radiation as a wastewater treatment technique rests on a number of documented facts which may be described as follows:

1. Radiation has the ability to alter the structure of organic and inorganic molecules.
2. Radiation is capable of initiating oxidation of organic molecules.
3. Radiation has the ability to kill bacteria and other microorganisms.
4. Radiation can produce electrical effects in colloidal systems.

Thus, radiation may convert refractory pollutants to a form which is more readily degradable, may lower the chemical and biological oxygen demand of waste streams, may disinfect bacteria and

viral-contaminated streams, and may produce favorable effects on sludges and waste solids.

This paper defines four principal applications of radiation to water pollution control.

Ballantine, D. S., Miller, L. A., Bishop, D. F., and Rohrman, F. A., "The Practicality of Using Atomic Radiation for Wastewater Treatment," *Journal Water Pollution Control Federation*, 41, No. 3, Part 1, 445-458, 1969.

CHLORINATED HYDROCARBON PESTICIDES (W69-6)

The use of pesticides has become a routine practice in modern agriculture. While these compounds have great advantages in the control of predatory insects, they represent a possible danger to the aquatic environment when present in even trace concentrations.

The National Technical Advisory Committee on Water Quality Criteria has recommended "that environmental levels . . . not be permitted to rise above 50 nanograms/l." Many of the states have incorporated pesticide criteria in their water quality standards. Therefore, the monitoring of surface waters for pesticides is an essential part of our measurement of water quality.

The Analytical Quality Control Laboratory, assisted by FWPCA scientists experienced in the determination of pesticides, has prepared a method for chlorinated hydrocarbon pesticides. In the opinion of the AQC Laboratory and its advisors, this method is the best available procedure at this time.

FWPCA Method for Chlorinated Hydrocarbon Pesticides in Water and Wastewater, FWPCA Publication, Analytical Quality Control Laboratory, Cincinnati, Ohio, April 1969, 29 pp.

CHARACTERIZATION AND IDENTIFICATION OF OIL AND ASPHALT POLLUTANTS (W69-5)

To determine the chemical nature of the heavy petroleum products involved in the 1967 Lake Michigan oil spill, a procedure for the characterization and identification of the oily, tarlike materials was needed. Samples from beach water were analyzed by infrared spectrophotometry. The unknown spectra could not be matched with the known spectra, since autoxidation caused changes in the unknown specimen. By comparative ratios of infrared absorbances, the identity of the critical unknown samples was established. Even though asphalt and heavy residual oil have similar infrared spectra, there is a sharp distinction. Samples from seven petroleum companies were tested, using this new method for rapid characterization.

Kawahara, F. K., "Identification and Differentiation of Heavy Residual Oil and Asphalt Pollutants in Surface Waters by Comparative Ratios of Infrared Absorbances," *Environmental Science & Technology*, 3, No. 2, 150-153, 1969.

OHIO BASIN REGION BROCHURE

The Office of Information, Ohio Basin Region, FWPCA, has published a two-color 5" x 8" brochure describing regional and national FWPCA programs and a profile of the 11-state Region. The brochure also contains a brief guide to the locations of Regional offices and laboratories. Copies are available from the Office of Information, Ohio Basin Region, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

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