

Selected Summaries of

WATER RESEARCH

Research and Development

Cincinnati Water Research Laboratory, Cincinnati, Ohio

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PESTICIDE CONTAMINATION OF SURFACE WATERS

Agricultural, hydrological, and water quality studies were conducted in Louisiana during the years 1961, 1962 and in 1964 to determine the methods, extent, and duration of surface water contamination by endrin used in sugar cane agriculture. The maximum concentration of endrin observed was 820 parts per trillion.

Surface runoff from fields was the main source of endrin contamination. Largest recoveries from streams occurred after the first precipitation and runoff following applications to the fields. After that, amounts recovered dropped rapidly. Endrin was also recovered from the water of treatment plants utilizing two streams as sources of supply.

Lauer, G. J., Nicholson, H. P., Cox, W. S., and Teasley, J. I., "Pesticide Contamination of Surface Waters by Sugar Cane Farming in Louisiana," *Transactions American Fisheries Society*, 95:3, 310-316, July 1966.

PESTICIDE-FREE FISH FOOD

Methods and procedures developed to extract pesticide residues from small quantities of commercially-available dry pelleted fish food are described. Repelletizing and dietary fortification techniques of the pesticide-free meal are given. Toxaphene and lindane were added to the reconstituted pellets at the rates of one and two parts per billion, respectively, and the analytical methods used for qualitative and quantitative detection of chlorinated hydrocarbon pesticides in fish food are outlined. Analyses of the dietary components of the reproduced fish food indicated the protein, fat, and fiber remained essentially unchanged from that found in the commercial food. Bluegills were maintained from seven months with no mortality occurring that could be directly attributed to dietary deficiencies.

Stober, Q. J. and Payne, W. R., Jr., "A Method for Preparation of Pesticide-Free Fish Food from Commercial Fish Food Pellets," *Transactions American Fisheries Society*, 95:2, 212-214, April 1966.

COTTON INSECTICIDES

This study indicated that insecticide usage on small cotton farms in northern Alabama is relatively constant with respect to the popularity of specific insecticides. However, the total quantity of insecticide used in the basin was quite variable among years because

of differences in insect infestations. From 1959 through 1963 the total insecticide usage estimates for the 400-square mile basin varied from a low of 12,000 lb technical in 1963 to a high of 139,000 lb technical in 1962. This points out the necessity of long-term studies in evaluating the water pollution potential associated with this type of agriculture. This would be equally true for other public health, agricultural, or economic parameters related to total insecticide use.

Grzenda, A. R., "A Five-Year Statistical Survey of Cotton Insecticide Usage in a Large Alabama Watershed," *Journal Georgia Entomology*, 1:2, 1-11, 1966.

EXPERIMENTAL TREATMENT OF LAKE ERIE WATER

The purpose of a one-year study conducted in a municipal water plant in Erie, Pennsylvania, was to observe the influence of the elimination of flocculators and sedimentation basins on effluent quality and on length of filtration runs. This objective was accomplished by using small experimental filters.

In this field study, the following conclusions were reached:

1. The addition of 5 to 15 mg/liter of alum to Lake Erie water followed by filtration through a dual-media filter consisting of 18 inches of coal over 6 inches of sand resulted in high-quality effluent, as measured by turbidity;
2. Effluent turbidity from the experimental filters was equal to or lower than the effluent turbidity from a full-scale filter;
3. The effluent quality of the dual-media filters was maintained at filtration rates ranging from 2 to 6 gpm/ft²;
4. Size of coal used in the dual-media filter had a small influence on effluent turbidity and a large influence on length of run;
5. The optimum coal size at the surface of the dual-media filter appears to be in the range of 1.2 to 1.4 mm;
6. Alum doses in excess of that necessary for the desired effluent clarity markedly reduced the length of run; and
7. Algae encountered during the test periods were easily removed and did not appear to have much influence on the length of run.

Dostal, K. A. and Robeck, G. G., "Experimental Treatment of Lake Erie Water, Erie, Pennsylvania, Water Plant," Project Report, *Federal Water Pollution Control Administration*, Cincinnati, Ohio, 1966, 80 pp.

COD STABILIZATION

A method has been developed that stabilizes the COD of primary wastewater effluents stored at room temperatures, (22 to 27° C) for 6 months or longer,

thereby permitting many tests on a uniform effluent either in a single laboratory or simultaneously in several laboratories. The method entails heating the effluents at 80° C for 1 hr to destroy nonsporing flora, and then adding an antibiotic (polymyxin B) to inhibit the spore-forming genera *Bacillus* and *Clostridium*. Some evidence suggested that divided applications of the antibiotic were more effective than a single application. Sensitive indicators demonstrated that COD's were increased by relatively large concentrations of the antibiotic. However, at stabilizing concentrations, the effect of the polymyxin B on the COD was negligible and barely demonstrable. A mold capable of growing luxuriantly under apparently anaerobic conditions was isolated from an effluent. It was identified as *Aspergillus fumigatus*. It is not clear whether the mold was originally present in the effluent or whether it was an airborne contaminant introduced into the effluent during experimental manipulations.

Berg, G., Stern, G., Berman, D., and Clarke, N. A., "Stabilization of Chemical Oxygen Demand in Primary Wastewater Effluents by Inhibition of Microbial Growth", *Journal Water Pollution Control Federation*, 38: 1472-1483, September 1966.

TASTE AND ODORS - RECENT DEVELOPMENTS

There are many difficulties and obstacles in the use of sensory testing to evaluate taste and odors, in addition to those cited in this paper. An instrumental method to replace the use of human sense organs would eliminate most of the difficulties. Such a method has long been sought but an instrument that can duplicate the sense of smell has not been even remotely approached. Instrumental-methods development in the field of odor must therefore be limited to improving the chemical analysis of all components contributing to odor. Progress in chemical analytic instrumentation is rapid; many instrumental methods, especially gas chromatography, are contributing to odor investigations. By combining the analytic results with our knowledge of the odor impact of each component, it is possible to relate instrumental data to sensory effects. This is the only direction in sensory testing in which progress is being made to supplant the vaguely responding, subjective, biased, but wonderfully sensitive and discriminating organ, the human nose.

Rosen, A. A., "Recent Developments in Sensory Testing," *Journal American Water Works Association*, 58: 699-705, June 1966.

ETHYLENE OXIDE BASED NONIONIC DETERGENTS IN SEWAGE

A sensitive analytical method has been developed for the determination of ethylene oxide based nonionic detergents in sewage. After suitable cleanup procedures, which are described, the detergent is complexed with phosphotungstic acid in the presence of excess reagent. The excess reagent is then decomposed by raising the pH to 5 while the complex remains stable for a short period. The complex is separated from reagent decomposition products by partition

between methyl ethyl ketone and dilute sodium chloride solution buffered to pH 5. Quantitative assay is made for tungsten since the amount of tungsten bears a stoichiometric relation to the ethylene oxide chain length.

Burttschell, R. H., "Determination of Ethylene Oxide Based Nonionic Detergents in Sewage," *Journal American Oil Chemists' Society*, 43: 366-370, June 1966.

SIGNIFICANCE OF COLIFORMS IN THE ENVIRONMENT

This compilation of previously published research papers by personnel of the Microbiological Activities, Basic and Applied Sciences Program, Cincinnati Water Research Laboratory, (Robert A. Taft Sanitary Engineering Center), brings together in one volume much of the information concerning fecal-coliform bacteria that has appeared in various scientific journals. The material is organized into seven chapters that include background; methodology; and occurrences in warm-blooded animals including man; fresh-water fish; vegetation and insects; and soil. The final section covers the interpretation and significance of fecal-coliform bacteria in water pollution studies. (This publication will be available after November 30, 1966).

Geldreich, E. E., *Sanitary Significance of Fecal Coliforms in the Environment*, FWPCA Publication No. WP-20-3, 1966, 122 pp.

BACTERIAL POLLUTION INDICATORS

A study was made of the occurrence, distribution, and persistence of coliforms, fecal coliforms, and fecal streptococci in the intestinal tract of freshwater fish. A total of 132 fish representing 14 different species were used in various phases of these experiments. Examination of the intestinal contents of 78 fish from moderately polluted sections of the Little Miami River indicated that fecal coliform densities were lowest in bluegills (less than 20 per gram) and highest in catfish (1,090,000 per gram). Levels of fecal streptococci for these two species were 220 and 240,000 per gram, respectively. The occurrence of fecal coliforms in fish caught in this stream reflected the warm-blooded-animal-pollution level of water. All fish used in this phase of the study were caught during July, August, and September when the water temperature were between 13 and 18°C. The fate of fecal coliforms and *Streptococcus faecalis* in the fish intestine indicated that these organisms can probably survive and multiply when fish and water temperatures are 20°C or higher, but only when the organisms are retained in the gut for periods beyond 24 hr. Based on the biochemical reactions for 3,877 coliform strains isolated from 132 freshwater fish of 14 different species, 91.4% of all strains were composed of five IMViC types. In a similar study of the biochemical reactions of 850 streptococci isolated from the intestinal tract of 55 freshwater fish, the predominant strains included *S. faecalis* and various closely associated biotypes. No consistently recurring pattern for either coliforms or streptococci could be developed to identify species of fish investigated. The composition of the intestinal

flora is, however, related in varying degree to the level of contamination of water and food in the environment.

Geldreich, E. E. and Clarke, N. A., "Bacterial Pollution Indicators in the Intestinal Tract of Freshwater Fish," *Applied Microbiology*, 14: No. 3, 429-437, May 1966.

NITROGEN REMOVAL

The results of this survey show that removal of nitrogen by the conventional treatment processes is erratic and is not correlated with carbon or solids removal. Digester supernatant was shown to be a concentrated point source of nitrogen that often contributed a large percentage of the total load.

In each instance where active nitrification was found, subsequent loss of nitrogen by denitrification was indicated. The Archbold results show that efficient removal of nitrogen is possible with the activated sludge process; however, the Hamilton study makes it evident that more detailed knowledge of process controls is necessary. To remove nitrogen more effectively via the denitrification route, control of nitrification would be needed. The Lebanon results show that even with active nitrification, efficient nitrogen removal also will require control of the denitrification phase.

The inability to control process variables effectively in trickling filter treatment makes more efficient nitrogen removal by modification of existing structures appear unlikely. The results obtained did show, however, that denitrification was possible if oxidized nitrogen was present. Process design favorable to nitrification, by control of hydraulic and organic loading, would increase nitrogen removal. Osborn has reported 66-percent nitrogen removal on an actively nitrifying filter.

The rationale of both treatment systems indicates that recycle of oxidized nitrogen from the final effluent is not the most efficient method of operation for denitrification because oxidized nitrogen still would be discharged. The most favorable scheme would appear to be passing the entire effluent from the aeration unit through an anaerobic chamber with a balanced source of oxygen demand material, as suggested by Johnson and Wuhrmann.

Barth, E. F., Mulbarger, M., Salotto, B. V., and Ettinger, M. B., "Removal of Nitrogen by Municipal Wastewater Treatment Plants," *Journal Water Pollution Control Federation*, 38: 1208-1219, July 1966.

TOXICITY OF ABS AND LAS TO FATHEAD MINNOW EGGS

The detergent industry of the United States has converted from the use of alkyl benzene sulfonate (ABS) to more readily biodegradable products in which linear alkylate sulfonate (LAS) is the major detergent. Bioassays were conducted with ABS and LAS to determine the relative toxicity of these surface-active agents to eggs of the fathead minnow. In these continuous-flow tests, the toxicity of both detergents increased (TL_m value lowered) with an increase in time of exposure. Using the combined results of four

tests the 9-day TL_m value of 6.4 mg ABS/l. was about one-half of the 1-day TL_m value. The toxicity of LAS increased from a 1-day TL_m value of 3.4 mg LAS/l. to a 9-day TL_m value of 2.3 mg/l. Survival of fathead minnow eggs and the hatched fry was similar to the controls in the test concentrations of 0.90 mg LAS/l. and 2.4 mg. ABS/l. On the basis of 9-day tests, LAS/l is more than twice as toxic as ABS.

Pickering, Q. H., "Acute Toxicity of Alkyl Benzene Sulfonate and Linear Alkylate Sulfonate to the Eggs of the Fathead Minnow, *Pimephales Promelas*," *Air and Water Pollution International Journal*, 10: 385-391, April 1966.

TOXICITY OF ENDRIN TO FISH

Channel catfish, *Ictalurus punctatus* (Rafinesque), were exposed to continuously renewed solutions of endrin in water. Analyses of the fish blood by gas chromatography revealed a well-defined threshold concentration of endrin in the blood, approximately 0.30 microgram per gram, that, if exceeded, results in death. Fish exposed to lethal concentrations of endrin in water for periods of time insufficient to cause death had blood-endrin concentrations markedly lower than those that died from exposure to the same water. There was little overlap in range of endrin concentration in blood between dead and living exposed fish.

Mount, D. I., Vigor, L. W. and Schafer, M. L., "Endrin: Use of Concentration in Blood to Diagnose Acute Toxicity to Fish," *Science*, 152: No. 3727, 1388-1390, June 3, 1966.

DEEP-WELL INJECTION

Deep-well injection is a promising method for permanently storing some liquid wastes. The influence of reactions between injected and interstitial waters on aquifer permeability is a problem of significant interest. A theoretical and laboratory study has shown that, under specified conditions, the amount of reaction between injected and interstitial solutions can be anticipated if the dispersive character of the porous medium is known. Laboratory evidence also showed that permeability loss resulting from the formation of some precipitates may not be as great as has been suggested. Others have proposed that, where reaction between injected waste and interstitial water is undesirable, a zone of non-reactive water can be injected between the waste and the aquifer water. This buffer-zone concept was substantiated in the laboratory and equations are proposed for the design of such zones in field situations.

Warner, D. L., "Deep-Well Waste Injection — Reaction with Aquifer Water," *J. Sanitary Engineering Division, Proceedings of the Am. Soc. Civil Engineers*, 92, No. SA4, 45-69, August 1966.

PETROCHEMICAL TOXICITY TO FISH

Static bioassays conducted to determine the acute toxicity of certain petrochemicals to several species of fish in both hard and soft water showed that the mean tolerance limit (TL_m) at 96 hr for most of the

chemicals fell in the range of 12 to 97 mg/l. Several compounds were less toxic. For most of the compounds, 96-hr TL_m was not significantly less than the 24-hr TL_m . Bluegills generally were the most sensitive species tested, followed by fatheads, goldfish, and guppies, although variation in sensitivity was small. A few of the compounds appeared slightly more toxic in soft water than in hard water.

Pickering, Q. H. and Henderson, C., "Acute Toxicity of Some Important Petrochemicals to Fish," *Journal Water Pollution Control Federation*, 38: 1419-1429, September 1966.

WATER RENOVATION PILOT PLANT, LEBANON, OHIO

This brochure describes the advanced waste-treatment processes under study at the AWTR Pilot Plant in Lebanon, Ohio. The processes being evaluated and developed at the Lebanon facility to remove the suspended solids, organic materials, and dissolved salts are the following: microscreening, coagulation-sedimentation-filtration, powdered carbon adsorption and electro dialysis.

U. S. Department of the Interior, Federal Water Pollution Control Administration, *New Water for Old*, Washington, D. C., WP-19.

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