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Toward Cleaner Streams

Until recently, many of our rivers were deteriorating. Some had already become open sewers for municipal and industrial wastes. The long process of restoring the cleanliness of streams has now begun. In spite of the increasing urban population, the amount of organic matter discharged by municipalities into streams is actually diminishing. Moreover, new legislation skillfully sponsored by Senator Muskie of Maine unanimously passed both houses of Congress and has been signed into law. One of its terms is that matching funds be provided to help municipalities improve their sewage treatment. Thus, an accelerating program of waste management is in prospect.

Two types of sewage treatment are now used. The primary treatment removes sludge, skimmings, and the larger suspended solids. Secondary treatment involves such processes as the use of oxidation ponds, trickling filters, and activated sludge to destroy organic matter. Efficiently operated primary-secondary plants remove about 90 percent of the organic matter, giving rise to a biochemical oxygen demand. They simultaneously remove about 90 percent of the bacteria and 50 percent of the fixed nitrogen. Weinberger, Stephan, and Middleton* have discussed new methods of treating wastes and have provided data on the average composition of the better municipal secondary effluents. In parts per million, some values are as follows: gross organics, 55; biodegradable organics, 25; Na^+, 135; NH_4^+, 20; NO_3^-, 15; PO_4^{3-}, 25; Cl^-, 130; HCO_3^-, 300; SO_4^{--}, 100; and total dissolved solids, 730. About half the amount of solids is present in the water supply; the other half is added during use.

The Federal Water Pollution Control Administration is seeking better means to renovate water. This agency has been sponsoring research and pilot-plant operation to explore methods and to determine feasibility and costs. Most suspended and colloidal solids and phosphates can be removed from a good-quality secondary effluent by use of a coagulant such as alum. This treatment reduces the biological oxygen demand about tenfold and reduces phosphate to 1 to 2 parts per million. The cost, for a large installation, is estimated at $0.05 per 1000 gallons, exclusive of the cost of sludge disposal. After the colloidal and suspended solids have been removed, further purification can be effected with activated carbon. Such carbon, when used in counter-current-flow, fixed-bed contractors, will absorb 20 to 30 percent of its own weight in mixed organics. In a series of tests it was found that more than 98 percent of total organic matter was removed. Costs for treatment on the 100-million-gallons-per-day scale were estimated at $0.06 per 1000 gallons. Except for dissolved salts, these two treatments would restore effluent water to a chemical quality comparable to its quality before use.

By means of electrodialysis it would be feasible to cut the salt concentration in half. However, NH_4^+ presents a special difficulty. Only a few parts of NH_4^+ per million can be tolerated in a municipal water supply. Weinberger, Stephan, and Middleton suggest that this problem can be circumvented by operating secondary biological treatment plants under nitrifying conditions, so that NH_4^+ is converted to NO_3^-.

Progress is being made by municipalities in cleaning up their effluents, and further progress is likely. However, industry discards as much organic material into U.S. streams as the cities do. A recent Harris survey reports that public opinion has become aroused against pollution and that the public believes industry is the principal offender. Thus, industry will experience increasing pressure to reduce its contribution to pollution. Many years will pass before some streams are clean, but at last trends are in the right direction.—PHILIP H. ABELSON

* Leon W. Weinberger, David G. Stephan, and Francis M. Middleton, "Solving our water problems—water renovation and re-use," *Ann. N.Y. Acad. Sci.* **136**, 131 (1966).

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