Abatement of Stream Pollution Caused By Industrial Wastes

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INDUSTRIAL wastes, varied in nature and potent in strength, have been with us for a long time. But in recent years they have been increasing in volume and variety at a rapid rate.

Legislation is pressing industry and municipalities to abate the pollution of streams by controlling or treating their wastes. The times call for rational, economical decisions. To make them, every sanitary engineer needs to know a great deal more about the fundamentals of the sanitary engineering profession and its relationship to industrial wastes.

Throughout the years, sanitary engineers and sanitary scientists have developed and put into practice treatment processes involving chemical, physical, and biological phenomena characteristic of domestic sewage. Domestic sewages do not differ much, unless mixed with industrial wastes. And many civil engineers, with only a rudimentary knowledge of design criteria for treatment plants, can adopt the regulations of State health departments and proceed with plant designs. Through the efforts of sanitary engineers in these departments, design criteria have been made sufficiently liberal to insure adequate treatment under average conditions.

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Changing Needs

In recent years special problems have put new demands upon the ingenuity of sanitary designers and operating personnel. This is particularly true in cities having appreciable proportions of industrial wastes mixed with domestic sewage. Research has led to more economical and more easily operated processes, and many excellent treatment plants are in operation. Furthermore, many sanitary engineers are set to meet new demands from industry. But it must be conceded that rule-of-thumb engineering no longer applies successfully to the design of treatment plants for sewage and industrial wastes. This method may have done a good general civil engineering job for municipalities, but it may fail to abate water pollution if it is applied to industrial wastes.

Rarely will wastes from similar industrial establishments be exactly the same from plant to plant. They may fall into similar categories, but the concentrations and individual components may be far apart. Each waste requires special analysis and an approach based upon a sound knowledge of each unit operation which may be applicable in a treatment process. Rule-of-thumb approaches may lead to plants which may not operate properly or may not even accomplish the assigned task.

Engineer Cooperation

Many industrial wastes can be eliminated by process revisions within the industrial plant. In many cases, this is within the province of the chemical engineer. The field of wet-process engineering, particularly within chemical and allied industries, is the province of the chemical engineer. This profession is gradually coming to realize that cutting down the volume and strength of industrial wastes is their responsibility.

Sanitary engineers must cooperate with chemical engineers in this work, and it is necessary for them to learn enough about the chemical engineering field to make that cooperation intelligent and beneficial. After chemical engineers have completed process changes within the limits of economics, many plants find it necessary to discharge liquid wastes having sufficient concentration of pollutants to require treatment. The determination of the economics of process changes versus treatment of wastes, either individually or when mixed with municipal sewage, can best be accomplished by close cooperation between chemical engineers and sanitary engineers.

The sanitary engineer has wide experience with chemical and biological processes for the removal of dilute concentrations of solids, both organic and inorganic, from liquids and the processing of these solids for ultimate disposal. His is also the best qualified profession to deal with problems of stream sanitation, including the biochemical processes of stabilization of organic matter in streams. Toxicity of the constituents of industrial wastes to the biological population of streams has been the subject of extensive studies by sanitary engineers and sanitary scientists. One of the most important contributions of the sanitary engineer to the economics of waste treatment is his knowledge of the capacity of municipal sewage treatment plants and of streams to absorb organic pollutants. Thus, his education and experience can be utilized for the evaluation of the extent of treatment required before industrial wastes may be discharged into municipal sewers or directly into streams and for the design of plants to accomplish this treatment.

Tailor-Made Solutions

There can be no pat formulas, no magic keys to success, for solutions to the hundreds of categories of industrial wastes which must be treated and bodies of water which must be protected. The quality of sanitary engineering service will be judged by the thoroughness with which each problem is approached and the ingenuity with which economical processes are developed and effective treatment plants designed. In most cases, satisfactory solutions can only be attained by complete chemical and physical analyses of the wastes, which are correlated with existing information in the literature of sanitary engineering and followed by laboratory and perhaps pilot plant tests. The day of reference to time-worn design criteria for a general class of wastes is past. Each problem demands particular attention and a tailor-made solution.

Each unit operation of the sanitary engineer must be based on the application of sound principles of the fundamental sciences of chemistry, biology, physics, and mathematics if effective and economical processes are to be developed. Therefore, the sanitary engineer must not only be qualified by his basic education in civil engineering to conceive and construct hydraulic structures, but he must also be well educated in the sanitary sciences built upon biology and chemistry. The major difference between a chemical engineer and a sanitary engineer is the primary reliance of the former on physical and chemical phenomena in his operations, whereas the sanitary engineer has command of biological as well as physical and chemical actions in the unit operations employed in sanitary engineering processes. In some instances, the sanitary engineer may be classified as a biochemical engineer to distinguish him from the chemical engineer.

Therefore, sanitary engineers of the present and of the future must be far ahead in the field of biochemistry. They can only achieve this knowledge by a concentrated program of scientific education in colleges and continued study while engaged in the practice of sanitary engineering. The sanitary engineer cannot go it alone. He must have qualified sanitary chemists and sanitary biologists as members of his team. With the right combination of talents in these three major realms of sanitary engineering, this team can give distinguished service to industry and government in the abatement of stream pollution by the control and treatment of industrial wastes.

Research Uses

This team of engineers, chemists, and biologists must not only be devoted to the solution of existing problems by known unit operations in the design and operation of treatment processes, but must also be constantly striving for effective utilization of the phenomena of the fundamental sciences. Research in sanitary engineering has led to the present high standards of treatment of sewage and industrial wastes. The field for research is open for the development of rapid methods for the fermentation of organic wastes by aerobic and anaerobic processes. Witness the great strides being made by biochemists and soil microbiologists in the fermentation processes employed for the production of antibiotics. In a few short years, they have succeeded in increasing rates of production tenfold. Can we say the same for our biochemical processes? We should be and must be able to accomplish rapid fermentation so that processes may be economical and widely applicable to many wastes now outside the realm of treatment by our various unit operations.

We are necessarily faced with expanding horizons for our research workers who must incorporate many of the unit operations utilized by chemical engineers, such as absorption, extraction, distillation, evaporation, and others. The sanitary engineer and the chemical engineer must cooperate in developing processes utilizing the best of knowledge and experience from both professions.

Conclusion

Our keenest brains must be applied to the problems encountered in the treatment of industrial wastes and the abatement of stream pollution. Engineers must also divest themselves of any lingering illusion that they can quietly go their own fixed ways of applying empirical formulas to categorical problems. But we must be prepared to be patient and persistent in the pursuit of knowledge of the fundamental sciences to be applied to the critical problems of so very many different industrial wastes. We cannot afford to be thrown off balance by the demand for quick answers and simple methods. Proper solutions take time and cost money. Therefore, consulting engineers must be prepared to educate their clients to the need for sufficient funds and time to do the job thoroughly.

Allies in the fields of chemistry, biology, and chemical engineering must team up to make the changes deemed economical and necessary within the plant and then to apply their joint talents to the treatment of the liquids which must be discharged to streams of municipal sewers and treatment plants. Through knowledge of the principles of physical, biological, and chemical unit operations, and of stream sanitation, sanitary engineers must demonstrate that they can by economical design and operation make streams safe from the standpoint of public health, recreation, and beneficial use of water for the industries and cities downstream.

The key to future success lies in continued development through the application of the fundamental sciences. The cost of failure of the rule-of-thumb engineer to understand these fundamentals may be staggering. Therefore, let the sanitary engineer team up with the chemist, the biologist, the physicist, and the chemical engineer, and the future will hold great promise for more economical treatment processes and effective abatement of stream pollution.

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