lb. per day of organics, which at a value of $0.05 per pound would be equivalent to a loss of about $1,000,000 per year. Obviously, all of this material cannot be recovered as valuable product or by-product. The profit motive certainly must be minimized if the problem is to be approached realistically.

Profits From Wastes

This aspect has been thoroughly discussed at many of the industrial waste meetings on record. However, it is nonetheless a pleasure to report that through the proper engineering approach it has been possible on some occasions to derive benefit by recovery of materials previously lost to the river. Examples of this are of fairly recent occurrence. In the production of certain high-boiling chemicals, final purification is accomplished by evaporation under a pressure of less than 1 mm. Hg. It was generally accepted that after the vapors were condensed and cooled, in the most efficient type of condenser with minimum frictional loss, the vapor pressure would be so low that vent losses through the steam jet vacuum pumps would be negligible. However, lengthy operating tests indicated that losses were occurring and as a consequence the direct contact barometric condensers were replaced with surface types. One may well imagine the satisfaction derived when it was found that the losses recovered are even greater than anticipated. Because of this finding, literally dozens of the direct contact type barometric condensers have been replaced with the surface types. In many cases the losses which will be recovered will be insignificant from a profit standpoint. However, in the aggregate there will be a substantial recovery of materials now lost to the sewer and which should represent a significant reduction in the B.O.D. loading of the river.

There is another problem in the disposal of waste material which is not actually a stream pollution problem, but which nevertheless is of great concern and cost. This is the disposal of fly ash produced by the combustion of pulverized coal for the generation of steam. Some of the boilers in the South Charleston plant, for example, are equipped to generate steam by pulverized coal combustion, which at capacity will consume as much as 1,000 tons per day if operated entirely on coal. All are equipped with electrostatic precipitators, which collect at least 90 per cent of the fly ash leaving the boilers. By actual measurement it has been determined that the ratio of recovered ash to coal consumed is approximately 0.2225. The settled ash has a density of 1,100 lb. per cubic yard, so the company is faced with the task of disposing of more than 100,000 cu. yd. of fly ash per year. To this end the ash, suspended in water, is piped to various low spots throughout the valley where the ash settles out and is compacted while the water flows back into the river. Examination of this effluent has shown it to be wholly unobjectionable as far as its effect on the Kanawha River is concerned (5). All of the areas in current use are nearly full and a new site is being developed at South Charleston which should last 50 years.

Acrylonitrile Plant Wastes

Efforts toward abatement and prevention of air and water pollution are expended not just on old and existing processes. All new installations are now designed with full attention to adequate waste control and treatment operations. An outstanding example of this relates to the acrylonitrile plant installed at the Company's works at Institute, W. Va. The project was publicly announced in 1953. Shortly thereafter specifications for the full treatment of all effluents from these operations were submitted to the State Water Commission (6). In part, the report outlined policies, as follows:

Extraordinary and costly steps have been taken in the design and construction plans for the Acrylonitrile Plant to prevent any release of toxic materials. The additional costs incurred in comparison to the cost of a plant designed in accordance with normal practices will approach $1,000,000. The special design features include among others:

1. Closed cycle process water systems with all streams subjected to stripping distillations.
2. Two separate systems for treatment of the stripped process water streams to destroy (by chlorination and by other methods) any toxic contaminants.
3. Retention tanks to receive the treated process water streams and permit examination and treatment before discharge to the process waste sewer.
4. Facilities for retreatment when necessary.
5. Curbed concrete pavement under all processing equipment and storage tanks with drainage pipes to carry all spillages, fire water, rain water, etc., from these areas to the retention tanks for examination before they are released to the sewer.
6. Facilities for handling contaminated drainages collected in these tanks by either chemical treatment or return to the processing equipment.

These facilities are constantly scrutinized to ensure that they are adequate and fully accomplish their intended objective. The installation has received the full approval of the Commission. The same procedure is being followed for an installation for the manufacture of acrolein, now under construction.

The pilot-plant experimental program aimed at prevention of discharge of phenolics, which can be high taste- and odor-producing factors in public water supplies, is described elsewhere (7).

W. Va. Water Commission

These and other methods under continual review by management will enable the Carbide and Carbon Chemicals Company ultimately to meet with the minimum requirements for the Kanawha River which have been adopted by the West Virginia Water Commission. These are set forth by the Commission as follows:

No sewage, industrial wastes or other substances allowed to enter any of the waters of the state shall cause therein or materially contribute to any of the following conditions thereof:

1. Distinctly visible floating or settleable solids, scum, foam or oily slecks of unreasonable kind or quantity.
2. Objectionable bottom deposits or sludge banks.
3. An unreasonable degree of treatment for the production of potable water or prevent the production of potable water by modern water treatment processes as commonly employed; objectionable odors in the vicinity of the waters.
4. Toxic or poisonous conditions that affect man, animal or fish life.
5. The dissolved oxygen concentration to be less than 3.0 parts per million at the point of maximum depletion.

It is not believed that these objectives are impossible of attainment, although it is obvious that concerted action is imperative on the part of all industries and municipalities in the Kanawha Valley.

Laboratory investigations are currently studying the comparative advantages of three methods of disposal by biological methods. These are: (a) the high-rate trickling filter; (b) the activated sludge method; and (c) the dispersed seed method described by Heukelekian (8).

Concurrent with the aforementioned laboratory studies, gaging and sampling stations have been set up on the back channel of the Kanawha River in order to cooperate with the West Virginia Water Commission in attempting to establish a reliable means of evaluating the total B.O.D. of the wastes discharged to the river. This computation cannot be based on an estimate of the materials accounted for in the plant materials balance be-

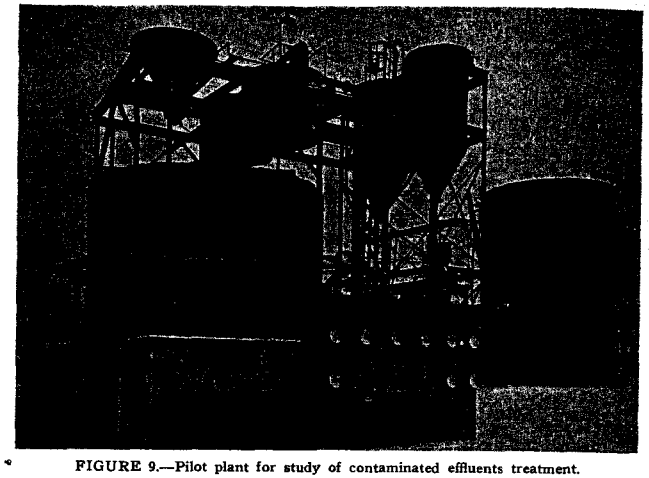


FIGURE 9.—Pilot plant for study of contaminated effluents treatment.

cause the oxygen equivalent of the constituents of the many diverse streams entering the river cannot be evaluated. The objective of such a reliable river sampling and surveying method would be to establish a yardstick, so that there is a firm basis for evaluating progress and improvement in the matter of stream pollution abatement.

Pilot Treatment Plant

Before serious thought can be given to abatement of the pollution by treatment beyond reduction at the source, the myriad streams must be segregated from the uncontaminated effluents, such as cooling water, storm water, etc. The polluted streams can then be directed to an interceptor sewer, which will convey them to a central point for mixing, neutralizing, examination and treatment. The first stages of this program are already completed. Operation of a pilot plant or semi-works unit, which will be an experimental laboratory for evaluation of various methods of chemical and biochemical treatment of the irreducible residues, was first recently begun. The data obtained here will be employed for the design of an eventual, full-scale treatment plant to provide the required degree of reduction of the B.O.D. load discharged to the Kanawha River. Figure 9 is a general view of the pilot plant, which contains a 20-ft. diameter trickling filter.

Summary

In summary, the following statement on pollution which appears in the "Facts Book" of the Manufacturing Chemists' Association (1953) is most appropriate:

Wherever there is a concentration of human activity, waste products from manufacturing operations may create a pollution problem. When the capacity of air and water to assimilate these wastes satisfactorily is overtaxed, all sources contributing to the nuisance must reduce their emission of gaseous and liquid by-products to unobjectionable levels.

The control of water and air pollution is a continually changing problem due to the constant change of industrial processes. Furthermore, because of differences in weather conditions, terrain and the polluting substances, there is no standard formula to solve an individual area's problem. Study of each area's unique situation must precede remedial action. Conscious of their responsibilities as good neighbors, chemical manufacturers are constantly studying conditions in their localities to lessen pollution.

The chemical industry is playing a leading role in the prevention and abatement of air pollution by the following activities:

1. Chemical companies engineer new plants so that waste products will not be objectionable.
2. Chemical companies are spending more than $1 million a year in research to study the nature of air and water pollution and processes for minimizing pollution.
3. Chemical companies are spending at least $10 million annually to install new devices to abate pollution in older plants and to operate existing equipment.
4. The chemical industry, through the Air and Water Pollution Abatement Committees of the Manufacturing Chemists' Association, is working closely with other industries and regulatory officials toward the solution of regional problems.
5. The chemical industry is taking a leading part in exchanging technical information on pollution control. Through the MCA it sponsors conferences and issues informative publications on recent technical developments in all phases of pollution control.

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