Some Notes on Oil Refinery Pollution[1, 2]

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The literature concerning biological aspects of stream pollution is voluminous (cf. the many literature reviews of the U. S. Public Health Service). A good survey has been published by the California State Water Pollution Control Board (1).

Doudoroff, et al, (3), Clemens and Summers (2), Turnbull, DeMann, and Weston (4), and many others have made bioassay tests of various types of wastes to establish their toxicity under local or standardized conditions. Some bioassay tests have shown that a toxic chemical required 100 times as great a concentration to kill fishes as was required in some other tests. The primary impact of these data is perhaps discouraging until it is noted that waters used to dilute the wastes differed tremendously from place to place and that such diluent waters greatly affected the toxicity results.

When practical use is to be made of bioassay data it is recommended that the procedure be the only thing standardized (3). The fishes, water, and wastes to be actually concerned in a specific location are used to get bioassay data for the given station only. If other locations are used, other bioassay data must be secured.

Since the bioassay data thus obtained are of limited use and cannot be binding on industries with the same waste in another area, it becomes increasingly important to turn to something other than local bioassay data for enforcement policies in pollution control.

A study of significance to the long term, cross-industrial regulation of waste disposal has been instituted at the Oklahoma A. and M. College. This study proposes to establish tolerance limits for individual waste chemicals. The tolerance limits will include ranges of toxicity and specific toxicity data that should be industry-wide in application to Oklahoma waters.

The first portion of this bioassay study is concerned with wastes from oil refinery processing. Since it was felt that wastes from oil production constitute the major sources of pollution in Oklahoma, the wastes from such plants needed to receive early consideration. The chemical components of refinery wastes are not fully listed. Many of the components have not been isolated. However, it was felt that if toxic components can be rated on a comparative basis, singly and in combination, the wastes could receive only a partial chemical analysis with adequate regulation of waste disposal and a saving of time for the chemist.

Petroleum refinery wastes have varying compositions, both among the different refineries and within an individual refinery at different times. Some compounds are found in the wastes at all times whereas other chemicals are rarely present. Leaks, spills and many kinds of process changes will cause the waste composition to vary.

Oil refinery waste waters may contain chemicals falling into many different categories. Sludges consist of complex hydrocarbons, insoluble salts and sediment. Scrubbing solutions often include sodium carbonate, sodium phenolate, sodium thioarsenate, potassium phosphate, and mono-or diethanol amines. Condensate waters are composed of organic and inorganic sulfides; normal or acid sulfites, sulfates and salts; mercaptans; napthenic acids; phenols; amines; amides; quinolines; pyridines; ammonia; caustic

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soda; calcium hydroxide; suspended matter such as coke, ferrous sulfide, and silica, metallic oxides, soaps, emulsions, sulfonic acids, and insoluble mercaptides. Chemical catalysts may include diethylene glycol, various metallic oxides, metallic salts, phosphoric acid, and coke. Wastes from chemical treatment are composed of acid sludge, acidulous waters, waste caustic solutions or sludges, waste plumbite solutions, and clay slurries. The acid sludges may contain oil, sulfuric acid, sulfonic acids, nitrogenous compounds and complex hydrocarbons. The caustic wastes are composed of sodium hydroxide, sulfides, sulfites, sulfates, thiosulfates, mercaptides, sulfonates, napthenates, phenylates, nitrogenous compounds, sodium plumbite, mercaptides, lead sulfide, clays, fuller's earth, bentonite, bauxite, free or emulsified oil, wax, and wax tailings.

These chemicals may affect the water in several harmful ways. Some of the chemicals are directly harmful to humans and domestic animals. Some chemical wastes produce unsightly colors, tastes, or sludges. Some wastes produce strong or unpleasant odors. Some of the wastes remain in the water and necessitate expensive methods of removal when the water is reused.

It is likely that some of the wastes are helpful in natural waters. Some of the organic materials may contribute to bacterial growth and thus to an increased plankton and fish crop. Some of the chemicals combine with suspended clays to precipitate both. In many parts of Oklahoma there are times when the waste waters contribute the entire flow of a stream and if the water is reusable it may aid in solving problems of water shortage.

The present study is concerned especially with the kinds of polluting wastes that settle turbidity due to clay particles in the water. Preliminary data show that turbid waters may receive more polluting wastes without killing fishes than clear waters as recorded elsewhere (1, 3, 4,). Some of the wastes precipitate soil particles without killing fishes; thus the chemicals increase the depth of light penetration in the water and potentially increase plankton production and fish production.

During the study, considerable attention will be devoted to an evaluation of sedimentation in the disposal of wastes. As combinations of wastes and turbidity take place, neutralization occurs and the particles settle to the bottom of the body of water. The question of the significance of wastes in sediments is a major one, and is as yet unanswered. We are attempting to determine a solution to this problem.

Literature Cited

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