

Chemical Analysis of Water Samples from Three Lakes in the Greene-Sullivan State Forest and the Wabash River at Clinton, Indiana

JOSEPH R. SIEFKER and DAVID P. MCCLEARY

Department of Chemistry
Indiana State University
Terre Haute, Indiana 47809

Introduction

Chemical analyses were performed on samples of surface waters of three typical lakes in the Greene-Sullivan State Forest to ascertain the quality of the water in those lakes, to determine concentrations of substances not listed in available publications, and to compare results of the determinations for the three lakes to that of the Wabash River. Further, the determinations for the Wabash River were compared to results obtained in earlier published findings to determine if the quality of water was deteriorating or improving.

All three lakes are "strip-pit" lakes resulting from the natural filling of surface mining operations in the area. The common names of the lakes are Thousand Islands, Graveyard, and Airline Lake.

Experimental

Samples were taken by simply throwing a bucket into the lakes and retrieving the bucket as quickly as possible. Sites on the lakes were chosen so that natural mixing of the lakes insured a well-mixed sample.

The Wabash River samples were taken at a point approximately 100 meters south of the bridge on S.R. 163 in Clinton, Indiana.

Generally the methods of analysis used were from the publications of the American Public Health Association (1) and the Environmental Protection Agency (2). Chloride and fluoride ion selective electrodes were used with an Orion Model 801 Analyzer to determine the activities of chloride and fluoride ions. Both determinations were performed within 24 hours of sample collection. Sodium and calcium ion concentrations were determined using a Jarrell-Ash Model 82-270 Atomsorb atomic absorption spectrophotometer. All other substances were determined by colorimetric methods.

All samples were collected on Sunday and the determinations were performed on the following Monday except for sodium and calcium which were determined on two six-week intervals.

Results and Discussion

Samples were collected twelve times from September 7 through November 23, 1975. Averages of the twelve samples are given in the following paragraphs.

The concentration of aluminum seemed to have little or no correlation to rainfall at any of the sites. The concentration in the Wabash River was the highest (0.08 ppm), followed by Thousand Islands (0.07 ppm), Graveyard (0.03 ppm), and Airline (0.01 ppm).

The concentration of ammonia was considerably greater in the three lakes than in the Wabash River. The greatest concentration was in Airline Lake (6.98 ppm), followed by Graveyard (4.64 ppm), Thousand Islands (2.44 ppm), and the

Wabash River (0.69 ppm). The high concentrations in these lakes may indicate an absence of bacteria to oxidize the ammonia to nitrate. Another factor may be the reduction of nitrate to ammonia by metallic materials (perhaps iron, a common element in coal-containing soil). The results for the Wabash River (.69) are slightly higher than those given by Harmeson and Larson (3) in 1966. Their value for ammonia was 0.38 ppm. The value of ammonia was generally higher in all cases when rain was noted in the preceeding 72 hours.

The concentrations of calcium were greatest in the three lakes. Airline Lake had the highest (116.8 ppm) followed by Graveyard (91.7 ppm), Thousand Islands (78.0 ppm), and the Wabash River (53.6 ppm). As noted, in general, by an ongoing survey of ground-water resources by the Indiana Department of Conservation Division of Water Resources, the waters of Greene (6) and Sullivan (7) counties tend to contain large amounts of calcium and magnesium caused by the composition of the underlying rock in those counties. The value of calcium reported by Harmeson and Larson (3) in 1966 for the Wabash River averaged 75 ppm. Little correlation between rainfall and calcium concentrations was seen.

The chloride concentration for the Wabash River was highest at 18.7 ppm, followed by Thousand Islands (13.1 ppm), Graveyard (12.5 ppm), and Airline (11.2 ppm). The level of chloride as reported by the Indiana State Board of Health in 1972 (4) was 24 ppm at Terre Haute. Harmeson and Larson's value (3) in 1966 was 27 ppm for the Wabash River near Riverton, Indiana. Values for chloride listed in (6) and (7) for Greene and Sullivan counties are approximately 10-13 ppm, in excellent agreement with these results. In general, the overall results for chloride are in agreement with earlier work, within experimental error.

The concentrations of copper was highest in the Wabash River (0.53 ppm), followed by Thousand Islands (0.27 ppm), Graveyard (0.12 ppm) and Airline (0.06 ppm).

The fluoride concentration of Airline Lake was the highest (0.391 ppm), followed by the Wabash River (0.304 ppm), Graveyard (0.265 ppm), and Thousand Islands (0.237 ppm). The value for fluoride reported by Lesniak, Tavenner and Siefker in 1972 (5) was 0.25 ppm for the Wabash River at Terre Haute. The fluoride ion concentration showed an inverse relationship to amounts of rainfall.

The concentration of iron was highest in the Wabash River (1.16 ppm), followed by Airline (0.93 ppm), Thousand Islands (0.44 ppm), and Graveyard (0.37 ppm). The values reported in earlier data (3, 4, 5) are in good agreement with this value for the Wabash River. Also the values for iron reported in (6) and (7) for Greene and Sullivan counties are in good agreement with the values for the three lakes. The iron content of the samples was generally higher after rainfall.

The nitrate concentration in the Wabash River was greatest (22.9 ppm) followed by Graveyard (15.2 ppm), Airline (14.0 ppm), and Thousand Islands (11.8 ppm). Again agreement between this value and earlier reports for the Wabash River (3, 5) is excellent. One reason for the higher concentrations of nitrate in the Wabash River is probably from the use of nitrate fertilizers on the farmland drained by the Wabash River.

Likewise, the concentration of nitrite was highest for the Wabash River (0.083 ppm). The concentrations of nitrite in Thousand Islands (0.064 ppm), Graveyard (0.056 ppm), and Airline (0.051 ppm) were all lower. No correlation between rainfall and concentration of nitrite was discernable.

The concentration of sodium was found to be higher in the Wabash River (54.6

ppm) than had previously been reported (3, 5). The earlier reports indicated values of about 20 ppm. The values for sodium concentrations in the lakes were lower than those for the Wabash River. The value for Thousand Islands (30.7 ppm) was highest, followed by Graveyard (28.4 ppm), and Airline (17.6 ppm). Little correlation between rainfall and concentration of sodium was noted.

The phosphate concentration of the Wabash River (0.86 ppm) was highest, followed by Graveyard (0.73 ppm), Thousand Islands (0.68 ppm), and Airline (0.25 ppm). The value of phosphate in the Wabash River in 1972 as reported by the Indiana State Board of Health (4) was 1.1 ppm. In general, the phosphate level was slightly higher after rainfall.

The concentration of surfactants (methylene blue active substances) was highest in the Wabash River (0.23 ppm) followed by Thousand Islands (0.22 ppm), Graveyard (0.14 ppm), and Airline (0.14 ppm).

The analyses showed a higher concentration of most substances in the Wabash River. The least amount of substances generally was found in Airline Lake. The overall results agree fairly well with earlier work with a few specific exceptions. The known data indicate that the condition of the Wabash River is relatively stable, and that for the substances determined the concentrations are within limits set for drinking water.

Literature Cited

1. AMERICAN PUBLIC HEALTH ASSOCIATION. 1971. Standard methods for the examination of water and wastewater, 13th edition, Washington, DC 874 p.
2. ENVIRONMENTAL PROTECTION AGENCY. 1971. Methods of chemical analysis of water and wastes. Water Quality Office, Analytical Quality Control Lab., Cincinnati, OH 312 p.
3. HARMESON, R. H., and T. E. LARSON. 1969. Quality of surface water in Illinois, 1956-1966. Ill. State Water Sur. Bull. 54:175-180.
4. INDIANA STATE BOARD OF HEALTH AND STREAM POLLUTION CONTROL BOARD. 1972. Indiana water quality: monitor station records-rivers and streams. 116 p.
5. LESNIAK, D. G., M. C. TAVENNER, and J. R. SIEFKER. 1973. Quantitative chemical analysis of specific components of the waters of Lost Creek and the Wabash River, Vigo County, Indiana. Proc. Indiana Acad. Sci. 82:176-179.
6. WATKINS, F. A., and D. G. JORDAN. 1962. Ground-water resources of west-central Indiana, preliminary report, Greene County. Bulletin no. 11 of the Indiana Department of Conservation Division of Water Resources. 343 p.
7. WATKINS, F. A., and D. G. JORDAN. 1962. Ground-water resources of west-central Indiana, preliminary report, Sullivan County. Bulletin no. 14 of the Indiana Department of Conservation Division of Water Resources. 255 p.