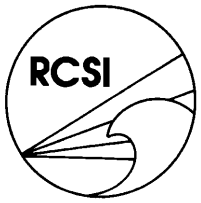

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Water Temperature and Dissolved Oxygen in Irondequoit Bay

By: Robert Bubeck
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Water Temperature and Dissolved Oxygen in Irondequoit Bay

by

Robert Bubeck*

Summary:

Irondequoit Bay, despite some pollution problems, behaves in many ways like a typical lake, and is not the stagnant, inactive body of water which many people believe it to be. The bay is characterized by at least one thermal mixing event in the fall. This occurrence, known as fall overturn, mixes the entire water mass in the bay and thoroughly distributes oxygen throughout the lake system. There is further evidence from observations made in early spring 1969 that the bay may also mix completely each spring after its ice cover thaws. If this latter observation is correct, then the bay can be said to resemble several upstate New York lakes in that it mixes twice a year. This encouraging behavior of Irondequoit Bay means that the deep oxygen deficient waters of the bay which develop in the summer are replenished with oxygen each fall and each spring. This redistribution of oxygen may last from periods of six to eight months. The statement often used in reports and conversation that the bay is devoid of oxygen below 20 feet (although it is an undesirable condition at any time) appears to be a summertime condition, occuring only during the period of summer thermal stratification of the bay.

Problem:

The proximity of Irondequoit Bay to the population center of Monroe County and its position adjacent to Lake Ontario have made the bay a popular and desirable recreation asset for the community. This same proximity, unfortunately, has historically provided the community with a basin into which it has dumped various forms of sanitary, industrial, and storm sewage, together with a variety of other forms of surface run-off (such as nutrients from farm and home fertilizers and salt from the de-icing of streets during winter months). The result is that the bay has accumulated a very high organic and inorganic chemical load. The biological nutrients (organics) found in the water further allow over-abundant algae crops to develop during the summer months. The subsequent death and decomposition of high density algae populations utilize dissolved oxygen in the lake waters during composition. Thus, an over productive lake such as Irondequoit Bay becomes deficient in oxygen as decomposition occurs, and the water quality of the lake is further degraded.

It is sometimes possible for a lake to build up its chemical load to a point where a chemical density barrier can develop in the water body. This type of barrier may prevent a lake from circulating completely to the bottom during the usual time of spring and fall overturn. Under these conditions, a stagnant, inactive bottom water zone develops which gains no oxygen at any time of the year and which often

*This is a summary report, prepared by the investigator. The full report is in R.C.S.I. files and will be furnished on request.

becomes concentrated with hydrogen sulfide (a poisonous gas). The results of this study show that a year 'round stagnant condition has not developed in the bay and that the bay's natural mixing devices are working satisfactorily. This observation suggests that there is much hope for the improvement of the water quality of the bay, but it does not mean that the bay is presently in a state of desirable water quality.

Methods and Results:

Since spring 1969, a study of the water temperature and dissolved oxygen content at selected sites in Irondequoit Bay has been conducted on a weekly basis. Temperature has been measured by means of a thermistor probe and cable for every foot of depth at a position 75 feet deep in the northern part of the bay basin. Dissolved oxygen (D.O.) has been measured every 5 feet by retrieving water samples and chemically analyzing them by means of the modified Winkler method, as outlined in (2). These measurements are part of a continuous study of Irondequoit Bay which is being conducted over a period of 12 to 18 months. From weekly or biweekly temperature and D.O. data, one can plot the variation of these measurements with time, and one can detect the trends of behavior of a particular body of water.

These data provided information on the development of the summer stratification of the bay. From late June through September, the D.O. approached 0 to 1 part per million (ppm) oxygen between 25 and 30 feet of depth. Below the 0 to 1 ppm level, an undesirable reducing environment characterized by the presence of hydrogen sulfide gas dominated the basin. From late September through October, overturn of the cooling, heavier surface waters began. As the heavier surface waters sank, D.O. was carried deeper and deeper into the water column. By 17 November, oxygen on the order of 6.5 ppm was distributed throughout the water column of the deepest part of the basin, providing a D.O. saturation of about 55%. By 9 December the D.O. concentration was on the order of 10.5 ppm or 81% saturation throughout. Thus, organic debris in the water column and bottom sediments had been provided an oxidation environment for at least two months up to the time of this writing. How long into the winter this oxygen will dominate the bottom water of the basin remains to be seen. The rate of oxygen depletion, if any, during the winter, will be very interesting to observe. Possible oxygen depletion and observations of the bay's circulation behavior in the spring are necessary to complete the yearly picture.

Discussion:

Irondequoit Bay appears to be a lake system with built-in natural mixing devices which we observe operating satisfactorily. The bay may be an excellent example of a functioning natural system whose major problem is that man has been overstressing it. These stresses resulted in undesirable water quality. Recently, however, there have been some serious attempts to relieve these stresses. Improved operation of sewage treatment plants which outfall into the bay or to one of its tributaries has lowered the input to the bay of disease-producing bacteria. Also, the proposed transfer of sewage loads from the small, local plants to the new regional interceptor system in the next year or two, should remove a significant portion of man-made undesirable biochemical input from the bay's tributaries. However, the bay will continue to be the recipient of home and farm fertilizers, salt from city and town streets, and a host of miscellaneous chemical inputs from the streams in its watershed. The result: even with the advent of the sewer interceptor system, the bay we see today is the bay we will see for sometime in the future.

An important decision to be made is whether we wish to preserve the bay in its present condition, or whether we wish to attempt to modify it further. A suggestion has been made to modify the bay by deepening its outlet to Lake Ontario through the construction of a deep-dredged channel. Before attempts are made to modify the bay boundary, engineers and scientists should be strongly encouraged to study the bay as a system, over an extended period of time. Some questions to consider would be the following: What will happen if we modify the present opening to Lake Ontario? Is there a natural mechanism to produce a driving force that will cause exchange of bay and lake waters? If there is an exchange mechanism, do we really want increased exchange of bay surface waters with lake surface waters? Will the water quality of the bay improve after this modification? Will it be degraded? Or will nothing change at all? Are the waters of the two lakes already mixing as much as we can expect they will under any modification proposed so far?

As of now there is little scientific data known to this writer which would suggest confident answers to these questions.

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