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FURTHER STUDIES ON THE FEASIBILITY OF ARTIFICIAL ALKALIZATION OF STONER LAKE, MICHIGAN

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Introduction

The alkalization of soft-water lakes by the addition of hydrated lime has been investigated by A. D. Hasler of the University of Wisconsin. Hasler's work is incomplete and his conclusions therefore tentative. The following information was obtained from Dr. Hasler at the 1951 Annual Meeting of the American Fisheries Society at Rochester, New York. He recommends that between 22 and 44 pounds of $Ca(OH)_2$ per acre-foot be added to increase the pH. The organic matter at the bottom adsorbs a considerable portion of this amount. His lakes average 20 to 30 feet deep and up to 12 acres in size. Twenty pounds of lime per acre-foot should increase the pH one unit. Considerable residual effects of added lime will result and the amount of yearly supplements to be added may be reduced to one half or one third of the original application.

In July, 1951, Dr. Robert C. Ball of Michigan State College requested the determination, by laboratory procedure, of the amount of lime necessary to neutralize water from Stoner Lake, Alger and Delta counties (T. 43, 44 N., R. 20 W., Sections 2, 35, and 36), Michigan. This lake previously had

received an application of about 20 tons of pebble-size limestone with no immediate discernable effect on either pH or methyl orange alkalinity. The methyl orange alkalinity at the time was 6 ppm. according to Dr. Ball.

In a communication to Dr. Ball (June, 1950) it was suggested that the failure of the limestone to change the pH was due to calcium adsorption by the organic matter of the bottom.

Hydrated lime is more soluble (1.0 gram per liter) than $CaCO_3$ (0.015 gram per liter). If limestone is used, a finely ground grade, 8-100 mesh, is preferred because it goes into solution more rapidly than coarser sizes. The selection of a liming material depends, of course, upon local conditions such as cost, ease of handling, method of application, etc.

The addition of 7.4 pounds of $Ca(OH)_2$ to 1,000,000 pounds of water (20.1 pounds per acre-foot) should result in an increase of 10 ppm. methyl orange alkalinity. A 75-acre lake like Stoner would need 7.5 tons of hydrated lime, or about 10 tons of limestone for every 10 feet of water to obtain a 10 ppm. change. It looks like the original application was on the right order of magnitude.

Experiments

The adsorption of calcium by pulpy peat was investigated. Lime requirement of this soil was determined by the method of Hardy and Lewis (1929) and found to be 0.685 milliequivalent per 100 ml., (16.8 milli-equivalent per 100 gm. air dried soil). Converted to pounds of $CaCO_3$ per acre, there are required 30.6 pounds (or 22.5 pounds of $Ca(OH)_2$) in order to neutralize a layer 1 cm. deep into the mud.

An experiment designed to test the assumption that neutralization of the mud to a depth of 1 cm. would effectively neutralize enough surface

material to prevent continued adsorption of calcium from the overlying water was performed.

Organic matter from the bottom of Stoner Lake was placed in three separate beakers: (1) to depth of 1 cm.; (2) and (3) to a depth of 5 cm. One liter of distilled water was added to each beaker. Enough $CaCO_3$ was added to beakers 1 and 2 to theoretically neutralize the 1 cm. of surface mud and increase the methyl orange alkalinity to 20 ppm. Beaker 3 was a control. Data obtained follows:

Parts per million of methyl orange alkalinity

Time (days)	Beakers		
	1	2	3
0	4	6	0
4	30	28	7
8	32	28	7
25	35	13	3
42	34	4	2

The fact that the alkalinity decreased in Beaker 2 with 5 cm. of mud while that of the beaker containing 1 cm. remained essentially constant suggests that more than the mud-water interface is active in calcium adsorption.

Recommendations

On the basis of the information given above the following recommendations are made:

1. Obtain biological and chemical data from Stoner Lake before and after alkalization with calcium compounds.

2. Add limestone or hydrated lime at levels herein suggested to alkalize the water (20 pounds $Ca(OH)_2$/Acre-foot).

3. Add 22.5 pounds $Ca(OH)_2$/Acre-cm. to neutralize top cm. of bottom mud.

4. Add 30.6 pounds/Acre-cm. $CaCO_3$ for slow dissolution to offset adsorption by mud. Suggest as a start enough limestone be added to neutralize top 3 cm.

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