Algae Control In Inland Water

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Looking Ahead

Copper sulfate is widely used to control algae in ponds. Present dosages give control. But findings in this study show that the concentration of copper sulfate obtained by present dosages do not reach recommended levels in some ponds. This happens when copper sulfate goes out of solution more rapidly than expected. Thus, more precise and possibly higher dosage rates than those now recommended may have to be used.

INLAND water, particularly man-made ponds, have become important nationwide. Some 2-million ponds are used for recreation, irrigation, fire protection, livestock, commercial fish production, and a host of related uses.

Such ponds are becoming more subject to pollution with the population buildup and increased use. Algae is a common problem. Because of this and the fact that copper sulfate is the primary control agent for algae in ponds, we made a special study of how copper sulfate behaves when applied to pond water.

We used an atomic absorption technique for direct, rapid analysis of water. Our goal was to measure the degree of stratification of dissolved copper in treated pond water.

We found that present rates of copper sulfate will control algae in ponds, but not in all cases. At times, proper concentration is not attained. We found that higher rates are needed in some cases since algae and bottom muds take copper out of solution too quickly for it to be effective. In other ponds, it may be necessary to use lower rates to prevent killing of fish or insects which the fish depend on for food.

New Jersey Ponds Used In Experiments

We conducted four series of experiments utilizing five different New Jersey ponds identified as A,B,C,D, and E. Ponds A,B and C are located in Warren County, New Jersey and ponds D and E in Monmouth County, New Jersey. Some ponds were treated once and others twice throughout the course of the study. Waters of all five ponds were characterized prior to treatment by determining pH values, conductivities and the concentration of thirteen different elements.

Material used was #8 mesh, granulated copper sulfate with a particle size varying from approximately ⅛ to ¼ inch. The copper sulfate was applied with a hand-operated granular spreader and it was observed that the particles sank immediately to the bottom. In one instance, the copper sulfate was dissolved prior to application and applied to the pond surface with a watering can.

Surface water samples were taken in plastic bottles directly from the top of the pond. Samples from other depths were taken with a 3-liter, plastic, Kemmerer-type water sampler. This device samples a column of water 20 inches high, so that samples from any given depth actually consisted of a column of water which extended 10 inches above and 10 inches below the stated depth.

On each date that water samples were collected, a vertical

Table I. Analyses of pond waters used for Cu SO_4 experiments.

	Pond A Top	Pond A Bottom	Pond B Top	Pond B Bottom	Pond C Top	Pond C Bottom	Pond D	Pond E
pH	6.5	7.0	8.2	8.4	7.5	7.5	8.8	7.4
Conductivity	128	142	400	400	170	155	300	220
Cl (ppm)	37.5	37.5	22.8	22.8	15.2	15.2	52.5	37.5
SO_4 "	15.0	15.0	90.0	90.0	30.0	30.0	80.0	70.0
Si "	12.0	10.0	3.0	3.0	2.0	2.5	6.0	2.0
Al "	0.08	0.05	0.05	0.03	0.10	0.05	0.06	0.13
Na "	10.4	14.0	4.0	4.2	3.5	3.5	7.8	9.2
K "	0.6	1.0	1.6	1.6	0.4	0.4	2.2	5.0
Ca "	4.6	6.0	25	25	10.6	10.6	11.2	8.0
Mg "	3.0	3.0	28	28	7.4	7.0	14.4	9.0
Cu "	0.012	0.023	0.009	0.012	0.009	0.023	0.012	0.015
Mn "	0.004	0.720	0.001	0.010	0.050	0.068	0.004	0.007
Zn "	0.008	0.078	0.008	1.40	0.013	0.013	0.008	0.032
Fe "	0.090	1.250	0.030	0.160	0.160	0.160	0.040	0.013
Ni "	0.001	0.003	0.006	0.018	0.001	0.003	0.004	0.005

temperature profile of the pond was determined at 1-foot intervals of depth. All samples were then filtered and analyzed.

Results of the analyses of the water in each of the five ponds before treatment are given in Table I. Temperature profiles revealed that no strong thermocline existed in any of the ponds during the investigation.

Series I Tests

Granulated copper sulfate was applied to pond A to yield 0.187 ppm copper and to ponds B and C to yield 0.250 ppm copper. During the summer of 1966, treatments were made on June 14 and samples taken June 15, 16, 20, 24 and 30 and July 7. Copper content at the depths and dates indicated is given in Table II. From this table, two facts are apparent. First, copper concentration in the water never approached the theoretical stratification of 0.187 and 0.250 ppm. Second, the expected stratification with a heavy concentration at the bottom did not occur, or if it did occur, it did not persist for 24 hours at which time the first samples were taken. In ponds A and C an inverse stratification was observed at 24 hours.

Series II Tests

Granulated copper sulfate was applied to ponds D and E to yield 0.50 ppm copper. Treatments were made August 8 and samples taken August 9, 10, 12, 15 and 17. Copper content of the water at depths and dates indicated is given in Table III. Again, the theoretical value of 0.50 ppm copper was not even approached. In pond D a stratification of copper was observed after 24 hours, with a slightly heavier concentration at the bottom than at the top. This condition was not observed after 48 hours. In pond E no significant degree of stratification was observed.

Table II. Copper contents in ppm of pond waters treated with granular copper sulfate in Series I.

Pond	Depth	Time in Days: 1	2	6	10	16	23	Initial Cu Content
	Surface	0.07	0.04	0.03	0.02	0.02	0.01	
Pond A*	3′	0.07	0.08	0.06	0.04	0.04	0.03	Top = 0.01
	6′	0.04	0.05	0.03	0.03	0.03	0.03	Bottom = 0.02
	9′	0.02	0.02	0.01	0.05	0.02	0.01	
	Surface	0.12	0.12	0.10	0.07	0.03	0.01	
Pond B**	2′	0.12	0.18	0.10	0.10	0.04	0.03	Tops = 0.01
	4′	0.12	0.18	0.09	0.08	0.03	0.03	Bottom = 0.01
	6′	0.12	0.18	0.09	0.08	NS***	NS	
	Surface	0.08	0.09	0.02	0.01	0.01	0.01	
Pond C**	2′	0.09	0.10	0.02	0.01	0.02	0.02	Top = 0.01
	4′	0.09	0.09	0.09	0.01	0.02	0.02	Bottom = 0.01
	6′	0.04	0.08	0.02	0.01	0.02	0.02	

*Treated with Cu $SO_4 \cdot 5H_2O$ to yield 0.187 ppm Cu — Applied 6/14
**Treated with Cu $SO_4 \cdot 5H_2O$ to yield 0.250 ppm Cu
***No sample—water level went down and pond was only a little over 4 feet deep.

Series III Tests

Since little or no stratification of copper was observed in the first two series of tests, Series III was conducted to determine whether or not stratification occurred within the first few hours after treatment. Granular copper sulfate was applied to pond C on August 23 to yield 0.375 ppm copper. Samples were taken after 1,2,4 and 24 hours. The results of the copper analyses are given in Table IV, which shows a slight degree of stratification at 2 and 4 hours. As in the previous two series of tests, there is a large difference between the theoretical copper concentration expected in the water and that which was actually found to be present.

Series IV Tests

In this series, copper sulfate was not applied in the granular form, but was dissolved in water and sprinkled on the water surface with a sprinkling can. Treatments were made on ponds D and E to yield 0.50 ppm copper. Samples for copper analysis were taken after 2, 4, 24, 48 and 72 hours. Results of the analysis are given in Table V. It can be seen from this table that the copper concentration in pond D came much closer to the theoretical value than in any of the previous tests. The concentration in pond E was slightly closer to the calculated value but not necessarily as close as in pond D. This can probably be attributed to the fact that pond E had a heavy bloom of algae at the time of treatment and pond D did not. It appears that the algae in pond E absorbed the copper very quickly and removed it from solution. Another indication of the difference in actual copper concentrations is that large numbers of fathead minnows and northern brown bullheads died in pond D while no fish died in E. No fish were killed during the first three series of tests.

Conclusions

From our investigations, the following conclusions can be drawn:
1. When copper sulfate is applied to ponds in the form of granules

which sink to the bottom, the amount of copper which actually gets into solution is much lower than the expected theoretical value. We suspect that this is associated with absorption by bottom muds.

2. Copper which does get into solution in the water, mixes rapidly throughout the entire depth of the pond and does not form a uniform, heavy concentration near the bottom.

3. If copper sulfate is dissolved in water and applied to the surface of a pond, the amount of copper found in solution in the pond is greater than if the copper sulfate is applied in granulated form.

4. A heavy bloom of algae appears to have the capacity to rapidly reduce the amount of copper in the water of a treated pond.

Table III. Copper contents in ppm of pond water treated with granular copper sulfate to yield 0.50 ppm Cu. Applied 8/8/66.

		Time in Days					
Pond	Depth	1	2	4	7	9	Cu Initial Content
D	Top	0.05	0.04	0.03	0.02	0.01	0.01
	Bottom	0.09	0.04	0.03	0.02	0.01	
E	Top	0.04	0.03	0.03	0.03	0.01	0.01
	Bottom	0.04	0.03	0.02	0.02	0.02	

Table IV. Pond C—Treated with granular $CuSO_4$ August 23, 1966 to yield 0.375 ppm Cu.

	Copper, ppm			
	Surface	2 Feet	4 Feet	6 Feet
Initial (before treatment)	0.01	0.03	0.02	0.01
1 Hour	0.10	0.11	0.09	0.11
2 Hours	0.11	0.13	0.17	0.09
4 Hours	0.11	0.11	0.15	0.17
24 Hours	0.11	0.11	0.11	0.11

Table V. Copper contents of pond waters treated with copper sulfate to yield 0.50 ppm Cu. Applied in solution form to water surface. Treated September 6, 1966.

		Copper, ppm					
		Initial	2 hrs.	4 hrs.	24 hrs.	48 hrs.	72 hrs.
Pond D	Top	0.05	0.42	0.31	0.26	0.23	0.19
	Bottom	0.03	0.22	0.20	0.20	0.21	0.20
Pond E	Top	0.05	0.14	0.14	0.13	0.11	0.11
	Bottom	0.03	0.06	0.06	0.13	0.13	0.09

Herbicides Offer Practical Weed Control For Industrial Sites

In most cases, weed control by herbicides is cheaper and more effective around industrial areas. The main consideration is using chemicals safely, a Humble Oil and Refining Company official said during the recent Industrial Weed Control Conference at Texas A&M University, College Station, Tex.

The official, James W. Hammond of Houston, said Humble found that it could save about 60 percent in costs by utilizing herbicides over hand and machine cutting. The herbicides also removed fire-spreading stubble.

"Chemical method of weed control is a way of industrial operation," he said. "Therefore, we need to learn to use these substances safely."

Hammond, director of industrial hygiene for Humble, said the firm's review of herbicides included more than 90 different commercial chemicals and several hundred mixtures of these substances. Those selected combined safety and efficiency.

Factors other than worker's risk also were studied. These included livestock, land poisoning, economic crops, fish and wildlife, children and pets.

He said there are ways to measure worker exposure to chemicals. Urinary lead, arsenic, mercury, pentachlorophenol and dinitrophenol are related to exposure levels. These results, like the anti-cholinesterase agents, may be used to keep tab on degree of exposure on an integrated basis.

Organic herbicides, Hammond said, have a minimum degree of hazard associated with normal use. Chemical manufacturers give sufficient data on container labels to allow use without danger.

"As with all chemicals, human, livestock, wildlife, fish and economic plant exposures should be carefully evaluated on each application," the speaker cautioned.

"These exposures should be kept to the minimum practical to accomplish the task at hand."

The Humble official outlined precautions to take in protecting eyes, skin and lungs. And he also touched on the subject of public liability.

"Some substances, like the hormone types, carry more public liability than others because of the danger of drifts to economic crops and by producing unpalatable flavor in drinking water and the fish that may live in these streams and lakes," Hammond said.

Another speaker, Roy S. Rodman, supervising landscape architect for the Texas Highway Department, said Texas highway landscaping can be divided into four broad classes: Erosion control, landscaping, wildflowers and rest areas.

Of primary importance is establishment of grass or turf on

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