Analyze Inland Water Before Any Aquatic Control

Dr. Stephen J. Toth, Soil Chemist, Rutgers University, uses a Perkin-Elmer Model 303 Atomic Absorption Spectrophotometer which determines the content of metallic elements in water samples down to parts per million level.

RED ALERT FOR SPRAYMEN

AQUATIC WEED CONTROL in inland water has become a complex operation. Spraymen cannot afford to treat haphazardly for aquatic weed control. Nor can they perform pest control measures with safety, unless they know the makeup of the water and the precise effect of pesticides on fish and wildlife.

Recreation and other uses of inland water have become economically important to residents of the area. The blame for any fish kill, if it follows treatment of any type, will surely fall on the professional sprayman who treated the water.

For protection, spraymen need to sample water before treatment. Samples from various areas of the stream or lake, with resulting analyses by a recognized laboratory, can help pin down the causes for any ensuing fish or wildlife kill. Analysis ahead of treatment will likely spot metallic elements which may be dangerous to certain species of fish. This can be particularly helpful in areas where fish are to be stocked for recreational purposes following clean up.

Soil Chemist Dr. Stephen J. Toth, Rutgers University, New Brunswick, N. J., has developed new data on the effects metallic elements have on fish in inland water. In one instance, Dr. Toth found that as little as 1/10 part per million of nickel killed trout. The entire 5500 trout released in a stream stocking program died within 3 days as a result of this small amount of nickel.

In his research, Dr. Toth uses an atomic absorption spectrophotometer. He measures the content of most metallic elements in water samples. The process is both fast and accurate. More than 50,000 water samples yearly can be processed through his single laboratory.

Light Spots Elements

Briefly, the spectrophotometer (a Perkin-Elmer Model 303 Atomic Absorption Spectrophotometer) works this way: atoms absorb light at certain frequencies which differ for each metallic element. The amount of light absorbed indicates the element present. It also shows the amount of the metal, or the sensitivity level in parts per million, or in some cases, in parts per billion.

Before development of this system, most analyses of water samples were confined to pH, hardness, turbidity, and the content of sulfates, chlorine, iron, and manganese. But with the new system, Dr. Toth has been

Table 1. Mean Composition of Surface Waters of New Jersey.

Constituent	Spring Flow				Summer Flow			
	North	Central	Southern Inner	Southern Outer	North	Central	Southern Inner	Southern Outer
				(ppm)				
Calcium	18.3	11.7	11.0	1.0	31.3	15.8	11.5	0.90
Magnesium	9.0	4.6	3.5	0.6	15.3	6.5	2.9	0.40
Potassium	1.0	1.3	2.6	0.7	1.3	2.6	3.6	0.60
Sodium	*	*	*	*	6.1	9.0	9.6	3.0
Iron	0.07	0.26	0.54	0.51	0.12	0.72	2.0	0.60
Aluminum	0.09	0.21	0.29	0.33	0.09	0.08	0.31	0.26
Silicon	3.5	8.2	11.2	3.6	3.7	9.3	12.1	4.5
Chlorine	20.0	13.0	16.0	8.5	12.8	15.5	15.4	6.7
Nickel	0.005	0.005	0.009	0.002	0.008	0.016	0.017	0.001
Copper	0.013	0.020	0.018	0.018	0.024	0.030	0.022	0.024
Manganese	0.020	0.052	0.055	0.013	0.022	0.056	0.034	0.011
Zinc	0.010	0.019	0.014	0.014	0.010	0.085	0.032	0.013
Chromium	0.002	0.003	0.003	0.001	0.011	0.013	0.013	0.025
Strontium	0.040	0.026	0.027	0.004	0.129	0.065	0.021	0.002

* not determined.

able to study much of the inland water makeup of the New Jersey area. He and his fellow researchers have found that metallic elements are important in determining fish productivity, and recreational or industrial usefulness of streams, lakes, and ponds.

New Jersey soils vary greatly in composition. Because of this, Dr. Toth reports the state was divided into North, Central, and Southern regions. The Southern region was subdivided into inner and outer coastal plains. Coastal plains are made up of sea deposits. In the tested areas, 4 major streams in each area were sampled at several sites. Samples were taken during both spring and summer flow periods. Results of these analyses can be seen in Table 1.

Dr. Toth cautions against taking a single sample of surface water. Waters vary, he says, according to the nature of the soils through which they flow. For example, Table 2 shows the findings at two sites of Big Flat Brook in the Northern region. Sampling site No. 1 lies in a calcareous soil area. Site No. 2 is in acidic soils. Result is that the calcium and magnesium content of the water sample at Site 1 is approximately 3 times higher than for the sample at Site 2.

Table 2. Composition of Big Flat Brook Water at Two Sites.

Element	(Calcareous) Site 1	(Acidic) Site 2
	(ppm)	
Calcium	35.0	11.2
Magnesium	7.5	2.4
Potassium	6.6	0.6
Sodium	3.7	2.5
Iron	0.08	0.03
Aluminum	0.07	0.10
Silicon	2.5	4.0
Chlorine	11.5	4.0
Nickel	0.006	0.001
Copper	0.016	0.022
Chromium	0.002	0.002
Manganese	0.016	0.008
Zinc	0.010	0.010
Strontium	0.500	0.030

More Elements At Low Water

Minor elements ranged from 0.001 to 0.129 ppm in the New Jersey area. Usually, the smaller water flow of summer periods had a tendency to increase the contents of these minor elements. For example, strontium is greater than zinc. Zinc is equal to copper. But copper proved to be greater than nickel which in turn was found in greater amounts than chromium.

In the Northern region of New Jersey, such major elements as calcium and magnesium were high during both spring and summer than other regions. This is because of the high limestone content of the particular soils these streams pass through. Other differences, some not related to soil base, were traced to specific agricultural practices in an area. Soils which are high in leaching losses will likely show

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Meeting Dates

Keystone State Association of Cemeteries, Spring Convention, Shawnee on the Delaware, June 9-12.

Turfgrass Sprinkler Irrigation Conference, University of California Extension Conference Center, Lake Arrowhead, Calif., June 21-23.

Tri-County Chapter, California Landscape Contractors' Association, 17th Annual Convention, Ojai Valley Inn and Country Club, Ojai, Calif., June 25-29.

Landscape Seminar, Associated Landscape Contractors of America, Inc., for Michigan and Ohio, Dearborn Inn, Dearborn, Mich., July 13.

National Fertilizer Solutions Association, 1968 NFSA Round-Up, Regency Hyatt House, Atlanta, Ga., July 25-26.

Lawn and Utility Turf Growers Field Day, Rutgers University, College of Agriculture and Environmental Science Campus, New Brunswick, N. J., July 30.

Golf and Fine Turf Growers Field Day, Rutgers University, College of Agriculture and Environmental Science Campus, New Brunswick, N. J., July 31.

Midwestern Nurserymen's Summer Meeting, Zelenka Evergreen Nursery, Grand Haven, Mich., August 13-14.

1968 Turfgrass Field Day, Pennsylvania State University, Joseph Valentine Turfgrass Research Center, Campus, noon August 21-noon August 22.

Lawn and Ornamentals Days, Ohio Agricultural Research and Development Center, Wooster, Ohio, September 10-11.

1968 Southern California Equipment and Materials Educational Exposition, City Park, Lynwood, Calif., October 16-17.

American Society of Agronomy, 1968 Annual National Meeting, Jung and Roosevelt Hotels, New Orleans, La., Nov. 10-15.

Weed Science Society of America, Annual Meeting, Las Vegas, Nev., February 10-13.

Red Alert for Spraymen

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less calcium, or other elements in water samples.

The question among spraymen who deal with aquatic weed control is how to apply findings such as these. The answers, once water samples are analyzed are simple. For example, Dr. Toth reports that rainbow trout and other fish suffer from nickel and other heavy metals. Rainbow trout do not survive in water with more than 0.1 ppm of nickel. But at the same time, brook and brown trout can survive in water at this level of nickel content.

Dr. Toth reports that, based on atomic absorption analysis of water, his research group can accurately predict what water can be stocked with certain fish in order to assure maximum productivity and eliminate fish kill. For the spraymen who treats water for weed control before a restocking program, such information based on water analysis may prevent many later problems.

Sterile Lakes Are Problem

Further, Dr. Toth says, the damning of a stream to form a lake without checking the tributary water may lead to creation of a sterile impoundment. This is illustrated in the case of Matawan Lake at Matawan, N. J. Two tributaries to this lake contribute sufficient sulphuric acid and soluble aluminum to kill almost all of the animal and plant life. The pH of this lake has been as low as 2.8 with soluble aluminum content exceeding 25 to 30 ppm and with an iron content of 12 to 25 ppm. It is obvious that water of this type is unsuitable for recreational or industrial use.

Establishment of farm ponds in the New Jersey inner coastal plains area often leads to conditions similar to that in Matawan Lake. Use of water from such ponds for irrigation of lettuce, tomatoes, and peppers can lead to severe crop damage. Waters of this type, however, can be treated with superphosphate and lime to raise the pH and precipitate the heavy metals.

Dr. Toth reports that his group can analyze with atomic absorption and accurately predict what water can be used effectively for irrigation of crops and golf greens. Burning of golf greens after irrigation has been common in the past. Recently, Dr. Toth reports, he analyzed irrigation water used on a golf course which was suffering burned greens. Water being used was high in copper and acid, thus causing the burning. Analysis of the water before irrigation could have prevented this situation and others like it.

Establishment of farm ponds in the New Jersey coastal plains area of the Southern region also creates problems when these ponds are used for recreation. The low content of bases and other nutrients in water of this region requires that the waters be periodically limed and fertilized for fish production. Large natural or impounded lakes and ponds in this region cannot be treated economically in this manner and must be considered as having very low fish productivity ratings.

Attempts to modify the composition of stream waters in this area using limestone or basic slag beds have not been successful.

WTT is indebted to Dr. Stephen J. Toth, Department of Soils and Crops, Rutgers University, New Brunswick, N. J., for his assistance in the foregoing presentation. Dr. Toth reports that his laboratory can process water samples on a custom basis, at cost, if commercial laboratories are unable to do so. Work is performed by graduate students who receive the fee. Spraymen, irrigation contractors, golf course superintendents, and turf specialists may contact him directly at Rutgers.