

Application News

No. 061

Total Organic Carbon Analysis

Carbon Analysis of Blue-Green Algae Suspensions

Eutrophication of lakes, marshes, and ponds near cities has progressed along side the development of economic activity and this has lead to cyanobacteria blooms, which are also known as "blue-green algae." Blue-green algae consist of a phytoplankton group called cyanobacteria, of which some types are toxic. For this reason, blue-green algae blooms cause concerns for the health of people and livestock who rely on water resources. In addition to eutrophication, high water temperatures and the stagnation time of lake water are also factors for blue-green algae blooms. Various water quality inspections on lake water are conducted in order to understand the environmental conditions that lead to blue-green algae blooms and to promote environmental conservation.

This time, utilizing the combustion catalytic oxidation method of the Shimadzu Total Organic Carbon Analyzer TOC-L, we measured the concentration of carbon components in a suspension sample containing blue-green algae collected from lake water. Because carbon component concentration can be used as an index for understanding the intensity of blue-green algae blooms, gathering measurement data from differing sampling locations and timings facilitates investigation into the causes of blooms and the measures that can be implemented to prevent them. The measurement method introduced here involves measuring diluted stock solution of the blue-green algae suspension using the TOC-L system, and measuring the stock solution using the TOC solid sample measurement system that comprises the TOC-L and SSM-5000A.

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■ Preparation of the Blue-Green Algae Suspension

Diluted sample

A sample of 100 ml was prepared by diluting the stock solution by a factor of 100, as shown in Fig. 1. The stock solution was sampled while stirring in order to keep concentration uniform. The diluted solution then underwent two minutes of crushing treatment by an ultrasonic homogenizer. Although particle aggregates floated to the surface, these were also fragmented by the crushing treatment.

Stock solution sample

The sample boat of the solid sample combustion unit was used to extract the sample directly, as shown in Fig. 2. Measurement was performed with ceramic fiber placed on the sample boat to prevent the sample from bumping during combustion.



Fig. 1 Diluted Sample



Fig. 2 Stock Solution Sample

■ Measurement of the Blue-Green Algae Suspension

The diluted sample of the blue-green algae suspension was measured using the TOC-L and the stock solution was measured using the TOC solid sample measurement system. Using the TOC solid sample measurement system that comprises the TOC-L and SSM-5000A allows measurement of both the stock solution and diluted solution.

**Table 1 Measurement Conditions 1
(diluted sample measurement)**

Analyzer	: Shimadzu Total Organic Carbon Analyzer TOC-L _{CPH}
Catalyst	: TC standard catalyst
Measurement item	: TC
Calibration curve	: Single point calibration curve using 100 mgC/L aqueous solution of potassium hydrogen phthalate
Sample	: Blue-green algae suspension (diluted by a factor of 100)

**Table 2 Measurement Conditions 2
(stock solution sample measurement)**

Analyzer	: TOC Solid Sample Measurement System (Total Organic Carbon Analyzer TOC-L _{CPH} and Solid Sample Combustion Unit SSM-5000A)
TC oxidation method	: Combustion catalytic oxidation (TC furnace at 900 °C)
Calibration curve	: Single point calibration curve using 1 % aqueous solution of C-glucose
Sample	: Blue-green algae suspension (stock solution)

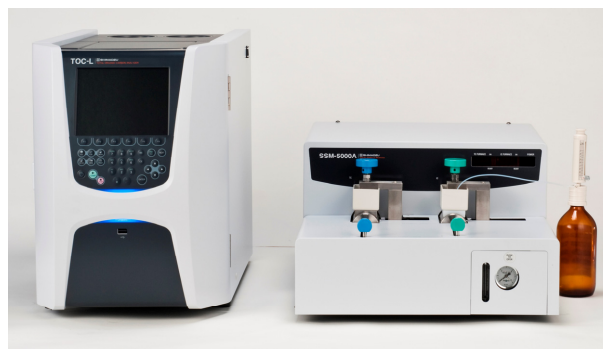


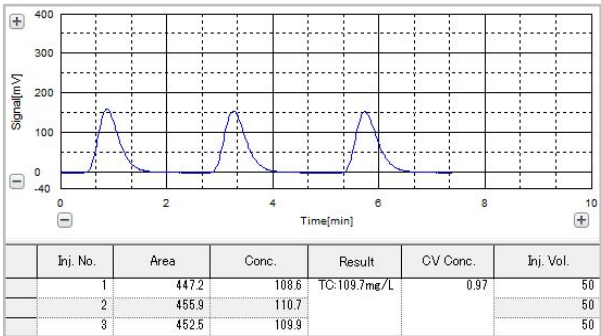
Fig. 3 TOC Solid Sample Measurement System

■ Measurement Results of Diluted Sample

Table 3 and Fig. 4 show the results of measuring the diluted solution of the blue-green algae suspension using the TOC-L. Since dilution was performed at a factor of 100, the carbon concentration of the stock solution is estimated to be the TC value acquired through measurement multiplied by 100 (1.097 %).

Table 3 Measurement Results of Diluted Sample

Sample name	TC [mgC/L]
Blue-green algae diluted sample	109.7



TC measurement results

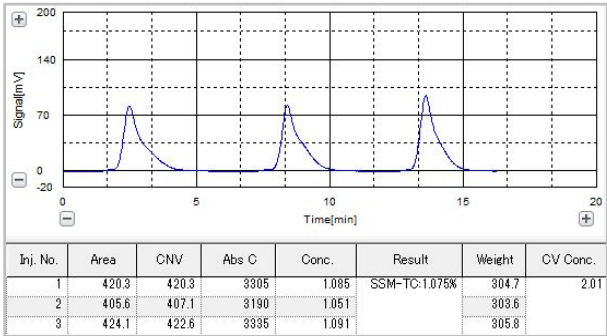
Fig. 4 Diluted Sample Measurement Data

■ Measurement Results of Stock Solution Sample

Table 4 and Fig. 5 show the results of measuring the stock solution of the blue-green algae suspension using the TOC-L and SSM-5000A (TOC solid sample measurement system). A carbon concentration of 1.075 % for the blue-green algae suspension was acquired from the measured sample weight and the absolute amount of carbon in the measurement results. This result is close to the carbon concentration value of the stock solution estimated from the measurement results of the diluted solution.

Table 4 Measurement Results of Stock Solution Sample

Sample name	TC concentration [%]
Blue-green algae stock solution sample	1.075



SSM-TC measurement results

Fig. 5 Stock Solution Sample Measurement Data

■ Summary of Blue-Green Algae Suspension Measurement

Using the Shimadzu Total Organic Carbon Analyzer TOC-L, we were able to precisely measure a blue-green algae suspension. A known method for measuring such samples with high turbidity is the dry weight method, in which the suspension is dried and the weight of the extract is measured. However, the fact that drying takes time and accuracy is not high is a disadvantage. In comparison, employing the method introduced here enables measurement to be performed easily by only requiring dilution and homogenizing. A method for direct measurement of the stock solution using the solid sample measurement system was also introduced. From the fact that equivalent values were acquired by these two methods, we were able to demonstrate the validity of the measurement results for the diluted solution obtained with the TOC-L.

