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Application News

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Total Organic Carbon Analysis

# Measurement of Total Carbon in Soil and Compost by TOC Solid Sample Measurement System

Soil contains a large amount of organic matter such as plant residue that can be decomposed by microorganisms. This organic matter plays a key role in plant growth by maintaining good chemical and physical conditions in soil and is useful in improving and stabilizing the productivity of agricultural crops. Compost, a type of fertilizer in which organic matter is decomposed by microorganisms, improves the condition of soil by supplying diverse substances and has the function of improving the growing condition of crops. Accordingly, determining the organic carbon content in soil provides a useful index for stable growth of agricultural crops and plants.

The Shimadzu TOC-L total organic carbon analyzer and SSM-5000A solid sample combustion unit comprise a system that enables measurement of the carbon content in solid samples. This article introduces an example of measurement of the total carbon content in soil and compost samples by using this Shimadzu TOC solid sample measurement system.

A. Goto

## TOC Solid Sample Measurement System

The TOC solid sample measurement system (Fig. 1), consisting of a Shimadzu TOC-L total organic carbon analyzer and SSM-5000A solid sample combustion unit, quantifies the carbon content of a solid sample by combustion oxidation of the sample and detection of the formed carbon dioxide. Simple and quick analysis of the total carbon content is possible because extraction and other complicated, time-consuming pretreatment processes are not necessary.

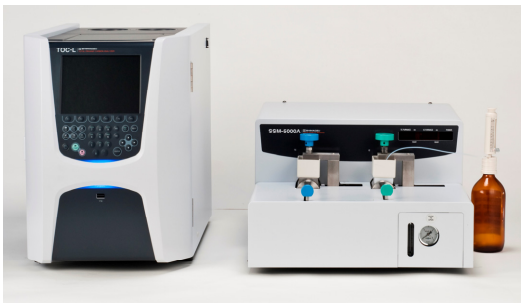


**Fig. 1 TOC Solid Sample Measurement System**

## Analysis Method

In this experiment, two types of soil samples (soils A and B) and one type of compost sample were prepared. Fig. 2 shows the appearance of soil B. Approximately 100 mg of each sample was weighed in a sample boat (Fig. 3), and TC (total carbon) was measured. Table 1 shows the measurement conditions.

**Fig. 2 Soil B Used in Measurement (Commercial Product)**

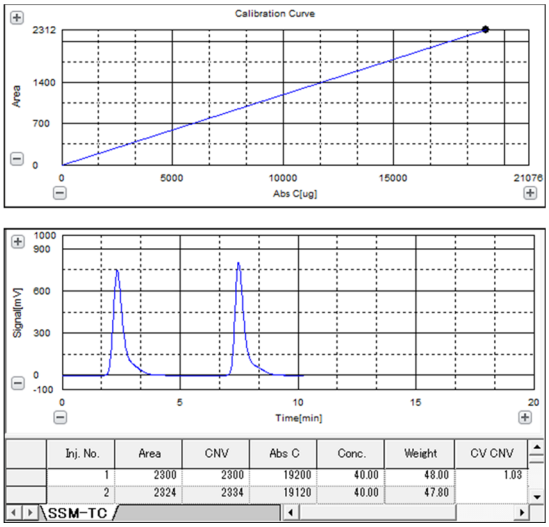
**Fig. 3 Weighing in Sample Boat**

**Table 1 Measurement Conditions**

| | | |
|---|---|---|
| Analyzer | : | TOC solid sample measurement system<br>TOC-$L_{CPH}$ total organic carbon analyzer +<br>SSM-5000A solid sample combustion unit |
| Cell length | : | Short cell |
| SSM carrier gas | : | Oxygen gas, 500 mL/min |
| TC oxidation method | : | Catalytically aided combustion oxidation<br>(TC oven temp.: 900 °C) |
| Measurement item | : | TC (Total carbon) |
| Calibration curve | : | One-point calibration curve using glucose<br>powder reagent (Carbon concentration: 40%) |
| Samples | : | Soil A: Collected from farm field<br>Soil B: Commercial product<br>Compost: Commercial product |

## Calibration Curve

A calibration curve for calibration of the analyzer was prepared by collecting and placing a glucose powder reagent (carbon concentration: 40%) in a sample boat and measuring its TC. Fig. 4 shows the measurement data.




| Inj. No. | Area | CNV | Abs C | Conc. | Weight | CV CNV |
|---|---|---|---|---|---|---|
| 1 | 2300 | 2300 | 19200 | 40.00 | 48.00 | 1.03 |
| 2 | 2324 | 2334 | 19120 | 40.00 | 47.80 | |

**Fig. 4 Measurement Data for Calibration Curve**

## Sample Measurement Results

Fig. 5 shows the measurement data for the two soil samples (soils A and B) and the compost sample. Table 2 shows the measurement results for the three samples. Compost, being a fertilizer in which organic matter is decomposed by microorganisms, showed the highest TC concentration. It is thought that the commercial soil B displayed a higher TC concentration than soil A, which was collected from a farm field, because soil B is produced by blending fertilizer with the soil. Measurement with good repeatability was possible in all cases, as the coefficient of variation was 3% or less.

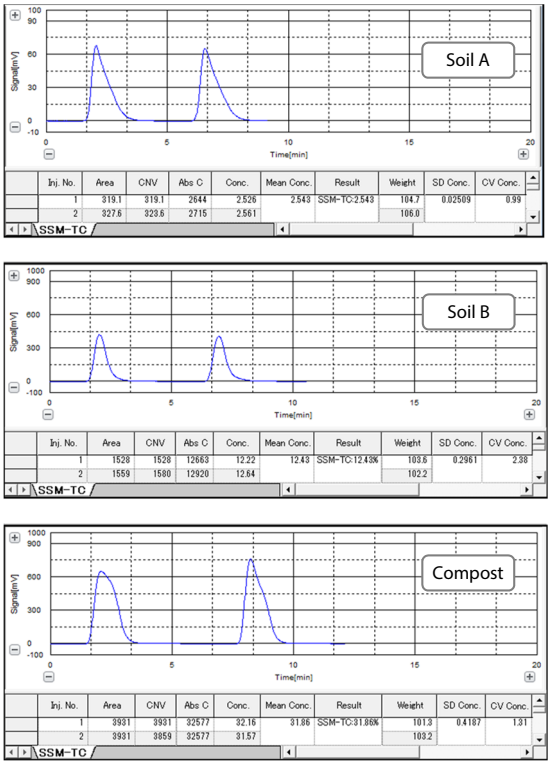



**Fig. 5 Sample Measurement Data**

**Table 2 Measurement Results**

| Sample | TC concentration (%) | Coefficient of variation (%) |
|---|---|---|
| Soil A | 2.543 | 0.99 |
| Soil B | 12.43 | 2.38 |
| Compost | 31.86 | 1.31 |

## Conclusion

Use of the Shimadzu TOC solid sample measurement system made it possible to evaluate the differences in the total carbon content in soil and compost without extraction or other pretreatment procedures. Because simple and quick determination of the TOC in soil is possible, the system is expected to be useful in improving the productivity of agricultural products.

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