

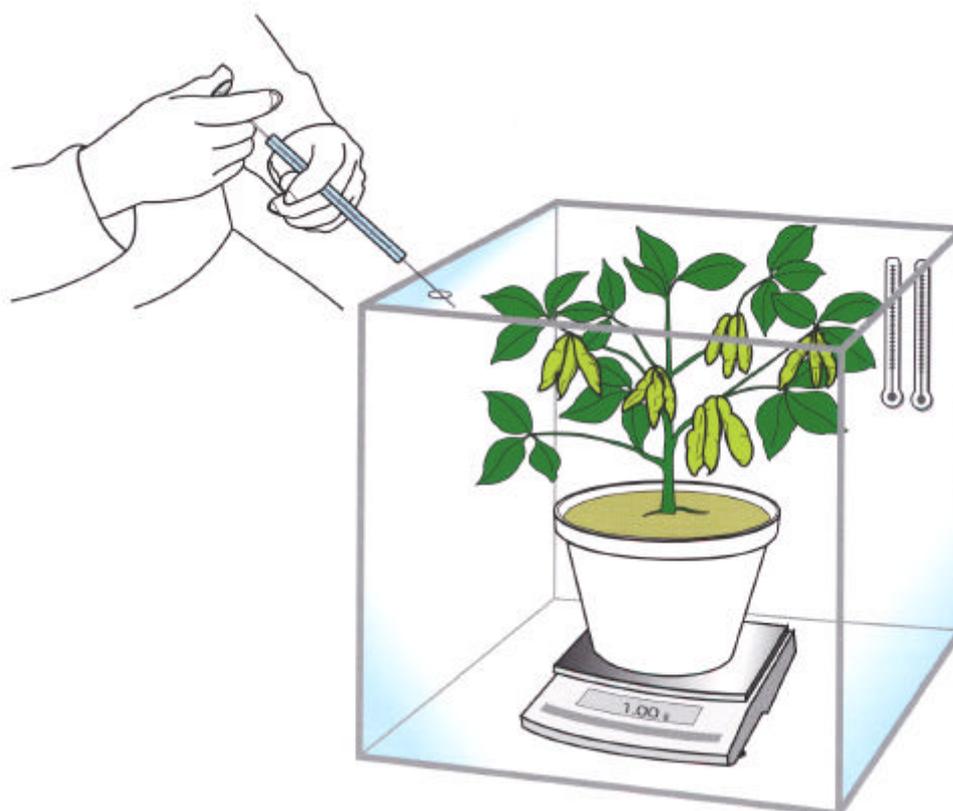
# TOC·TN

APPLICATION  
NEWS  
No. 7

## Total Carbon Measuring in the Gas samples

### With the TOC-5000A Gas Sample Measuring Kit

There is an increasing demand for equipment that quickly and easily measures TC (total carbon), TOC (total organic carbon) and carbon dioxide in small gas samples in various areas of analysis including cultivation chambers, fermentation chambers, plant cultivation, combustion tests, food products and management of medicines; management of container and package filler gas; and in various environment tests. The addition of the gas measuring kit to the Shimadzu Total Organic Carbon Analysis System TOC-5000A which is used to analyze aqueous or solid samples, enables the analysis of gas samples, thus broadening the application range of the system.



## Purpose

To measure several types of gases using the gas sample measuring kit, and introduce results obtained from the total carbon amount.

## Comparisons with Conventional Methods

Conventionally, most gas chromatography used for the above aim are capable of analyzing small-volume samples, but they require a fair amount of analysis time, which means they are unsuitable for speedy screening of numerous samples. Furthermore, with infrared type portable gas analysis systems, a continuous flow of sample gas to the analyzer is required, which can cause problems when gas measuring is being performed in limited spaces such as cultivation chambers for tests and gas sealed packages. In such cases, the TOC-5000A - with its gas sample analysis function - can quickly and simply measure the total amount of carbon in small samples drawn off by a micro-syringe.

## Measuring Conditions

The following conditions are for measuring three types of gas

Samples: methane(CH<sub>4</sub>), propane(C<sub>3</sub>H<sub>8</sub>) and carbon monoxide(CO),

Analyte : T C(total carbon)

Measuring method: 680 combustion Catalytic oxidation / NDIR

Sample : Manual injection using gastight syringe

Injection method : (Septum for gas chromatograph is employed as an injection inlet

Calibration method: An already known concentration of standard gas (normally carbon dioxide) conforming to the measuring concentration is drawn into the gastight syringe in the same way as the sample, measured, and a calibration curve created.

## Results

The results are follows. The TC measuring peaks for methane, propane and carbon monoxide are shown in figures 1, 2, and 3 respectively .

sample (concentration)	Gas	TC Theoretical Value	TC Analysis Result	Variable Coefficient
Methane (20.40%)	CH <sub>4</sub>	20.4%	20.63%	0.22%
Propane (0.241%)	C <sub>3</sub> H <sub>8</sub>	0.723%	0.725%	0.11%
Carbon monoxide CO (487ppm)		487ppm	484.5ppm	0.54%

Reproducibility at a favorable level of 1.0% or less was achieved for the variation coefficient in analysis of all samples. Note that the propane theoretical value reflects a three-fold propane concentration (C<sub>3</sub>H<sub>8</sub> : 3 carbon atoms in 1 molecule).

## Benefits

The following can be achieved with the gas sample kit.

- Screening work with a gas chromatograph can be reduced by replacing individual carbon index with total carbon index.
- Measuring is fast (2 to 3 minutes per 1 measurement).
- Gas measuring in limited space such as test cultivation

chambers and gas sealed packages is possible.

- Operation is extremely simple.
- Interference from other elements is minimal as the NDIR (non-dispersive infrared) detection system is excellent at discerning carbon dioxide.

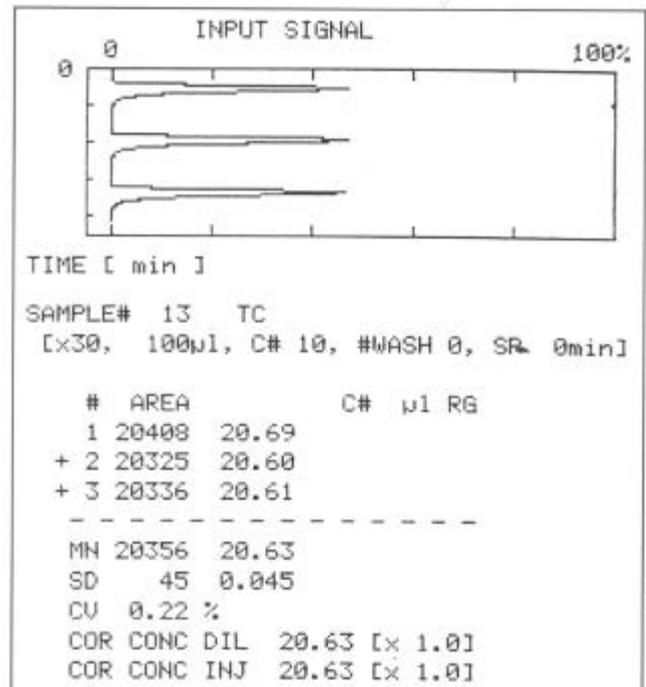


Fig. 1 Methane TC measuring peak

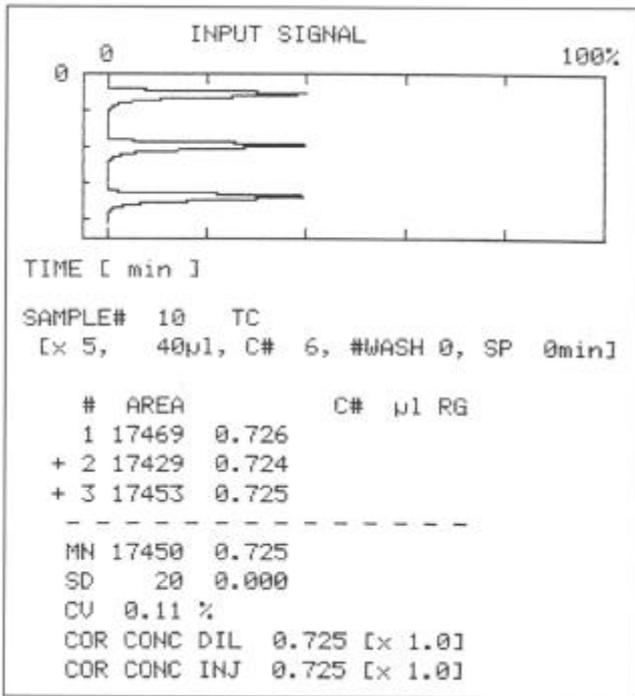


Fig. 2 Propane TC measuring peak

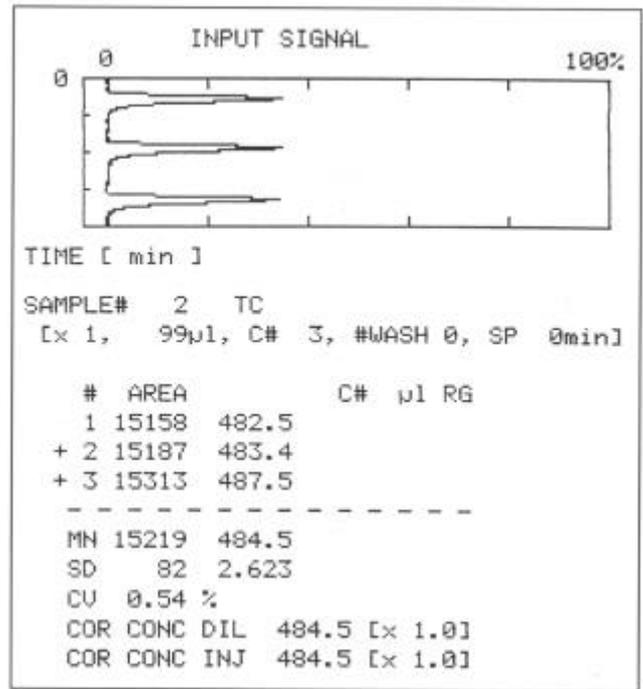
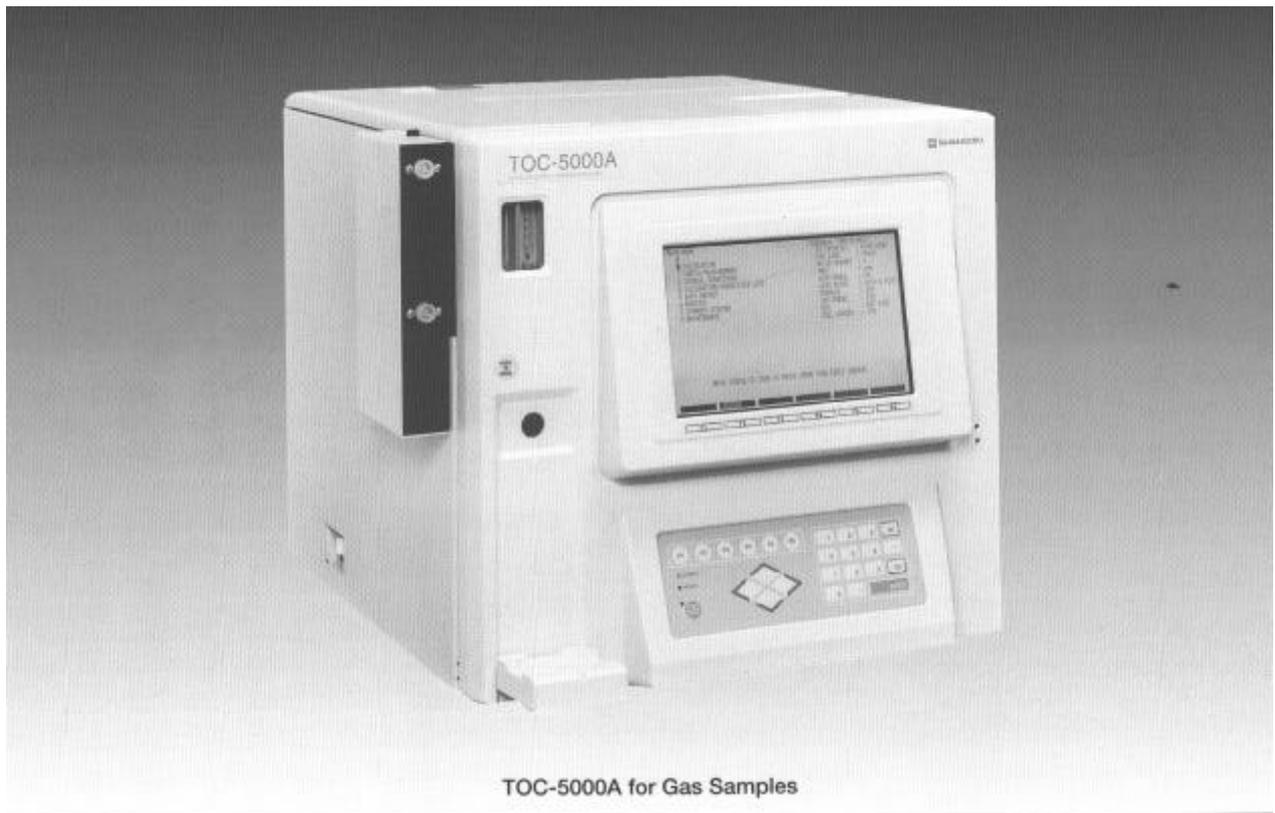


Fig. 3 Carbon monoxide TC measuring peak



## Features of the TOC-5000A for Gas Samples

- Micro samples (from several fl L to several mL) can be measured.
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- Continuous sampling with a pump is not needed as sampling and measuring is performed easily with a gaslight syringe.
- A wide range of concentrations can be dealt with from several ppm to 100%.
- Operation is easy.
- The NDIR detection system minimizes interference from other elements through superior detection of carbon dioxide.
- Measuring is fast (2 to 3 minutes per 1 measurement).
- Maintenance is reduced and easier as separation columns, adsorbents and absorbent are not used for separating other element gases.
- Changing over to water sample measuring is extremely easy.

## Specifications

Analytes	TC (total carbon) TOC (total organic carbon) Carbon Dioxide
Measuring method	TC: 680 combustion catalytic oxidation / NDIR detection TOC: obtained as the difference between TC and carbon dioxide (gases comprising inorganic carbons other than carbon dioxide - such as carbon monoxide - are included as TOC) Carbon dioxide: NDIR detection
Measuring range	6ppm~ 100%C02
Sample injection volume	20 μ L ~ 10mL
Sample injection method	Manual injection using gaslight syringe (Septum for gas chromatograph is employed as an injection inlet.)
Measuring accuracy	Within C.V.2.0% when peak height is 10% or more of full scale on the peak display screen
Calibration method	Known concentration of standard gas (normally carbon dioxide) conforming to the measuring aims is drawn into the gaslight syringe, measured, and a calibration curve created

Note: These specifications only describe items related to gas sample measuring.

See the TOC-5000A catalogue for details regarding specifications for water sample measuring.

## Application in Other Fields

By adding optional accessories to the TOC-5000A, carbon concentrations can be measured in gas phases, liquid phases and solid phases. The TOC analyzer is helpful in the pursuit of knowledge about carbon cycles in the following types of microorganism tests (example: biodegradability test, micro organism propagation speed, and methane fermentation).

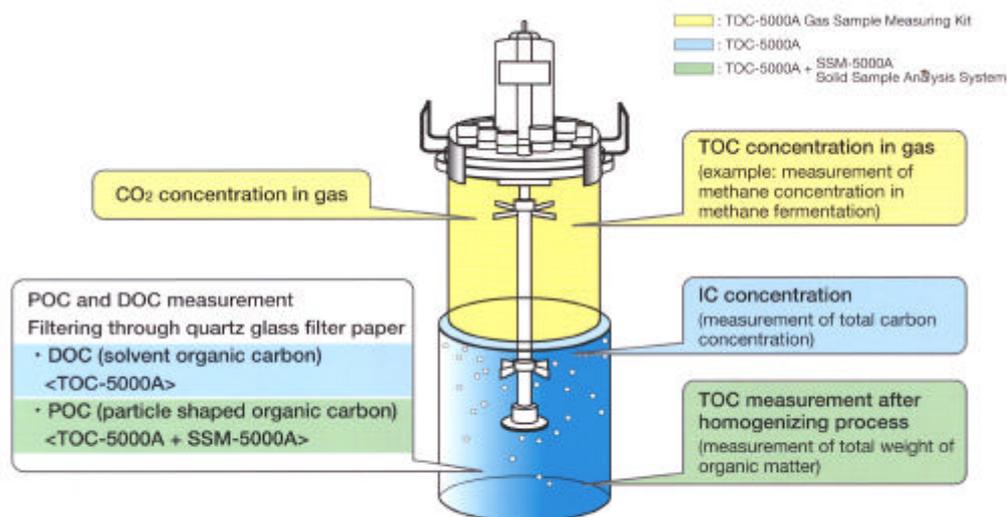


Fig: TOC-5000A application example to a micro organism fermenter