

Application News

No. 063

Total Organic Carbon Analysis

TOC and TN Measurements of Seawater

For pollution control of the ocean and in the research of the ocean environment, the measurement of total organic carbon (TOC) is regarded as an important index of organic contaminants contained in seawater. At the same time, the measurement of total nitrogen (TN), which is known to cause eutrophication, is also attracting attention for environmental pollution control and in ecological research.

Seawater has an NaCl content of approx. 3.5 %. Shimadzu's TOC-L combustion method total organic carbon analyzer allows accurate measurements of TOC directly from samples containing a high concentration of inorganic salts without any pretreatment such as dilution. In addition, by installing the TNM-L total nitrogen unit, TN measurement is also enabled. This makes possible simultaneous measurements of TOC and TN.

This article introduces an example of simultaneous TOC/TN measurements of seawater, using Shimadzu TOC-L_{CPH} combustion method total organic carbon analyzer and TNM-L total nitrogen unit.

M. Tanaka

■ Analysis Method

We collected seawater from the Sea of Japan and prepared samples ① to ⑤ by adding potassium hydrogen phthalate as a TOC substance and potassium nitrate as a TN substance to have both at a concentration of 25 mg/L, 50 mg/L, 100 mg/L and 150 mg/L, respectively. We measured the TOC and TN of these samples directly without any pretreatment such as dilution using TOC-L_{CPH} + TNM-L.

Table 1 Measurement Sample

Sample	Added TOC concentration (mgC/L) (potassium hydrogen phthalate)	Added TN concentration (mgN/L) (potassium nitrate)
Sample ①	0	0
Sample ②	25	25
Sample ③	50	50
Sample ④	100	100
Sample ⑤	150	150

Table 2 Measurement Conditions

Analyzer	: TOC-L _{CPH} + TNM-L total nitrogen unit
Catalyst	: TOC/TN catalyst
Measurement item	: Simultaneous measurement of TOC (= TOC using acidification and sparging) and TN
Calibration curves	: TOC : Single point calibration curve using 150 mgC/L aqueous solution of potassium hydrogen phthalate TN : Single point calibration curve using 150 mgN/L aqueous solution of potassium nitrate
Sample	: Seawater collected from the Sea of Japan (on the coast of Fukui prefecture)
Substance added as TOC	: Potassium hydrogen phthalate (Wako Pure Chemical, special grade)
Substance added as TN	: Potassium nitrate (Wako Pure Chemical, special grade)



■ Measurement Results

The measurement results of the seawater sample and the spiked seawater samples are shown in Table 3, Fig. 1 and Fig. 2. The measurement data is shown in Fig. 3.

Since the samples are seawater, they contain approx. 3.5 % NaCl; however, we can see that the TOC and TN are accurately measured without being affected by coexisting substances including salts.

Table 3 Measurement Results

Sample	TOC measurement (mgC/L)	TN measurement (mgN/L)
Sample ① (seawater only)	1.05	0.21
Sample ② (seawater + 25 mg/L)	25.8	24.7
Sample ③ (seawater + 50 mg/L)	51.7	49.1
Sample ④ (seawater + 100 mg/L)	102.1	101.2
Sample ⑤ (seawater + 150 mg/L)	151.4	152.8

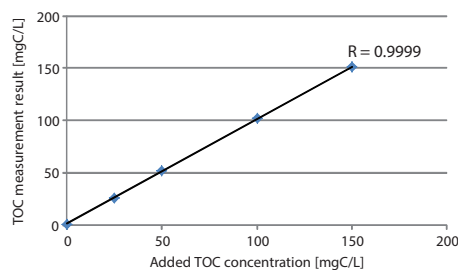


Fig. 1 TOC Measurement Result

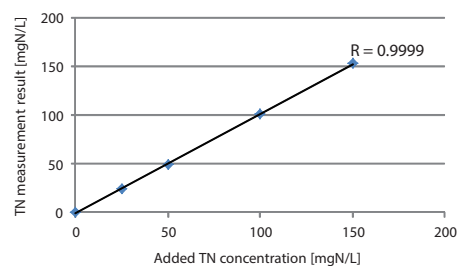
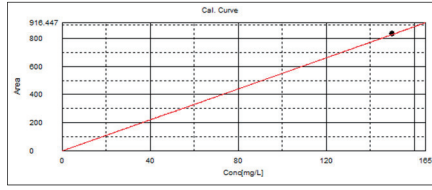
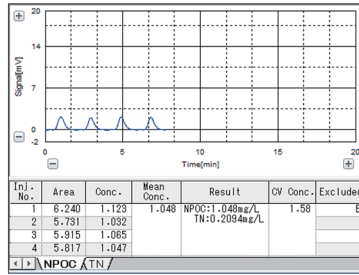


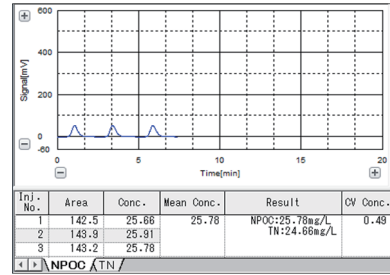
Fig. 2 TN Measurement Result



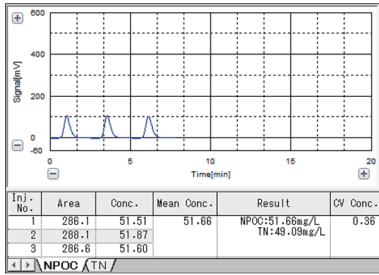
TOC calibration curve



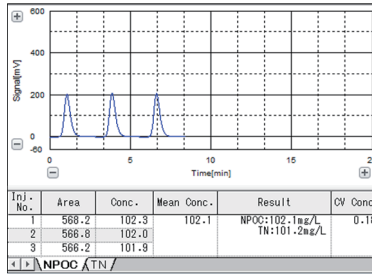
Sample ① seawater only:
TOC measurement



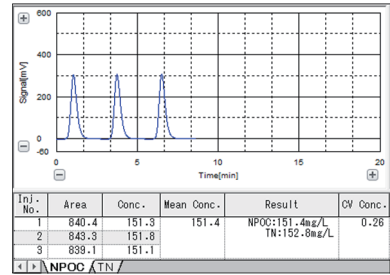
Sample ② seawater + 25 mg/L:
TOC measurement



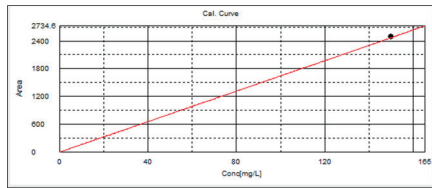
Sample ③ seawater + 50 mg/L:
TOC measurement



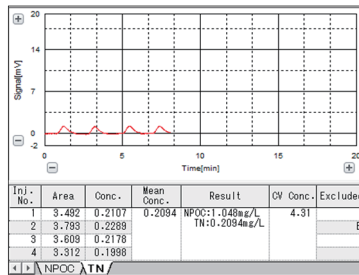
Sample ④ seawater + 100 mg/L:
TOC measurement



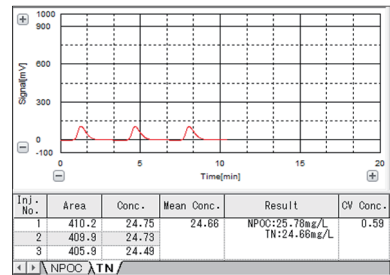
Sample ⑤ seawater + 150 mg/L:
TOC measurement



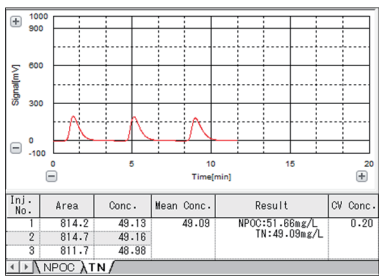
TN calibration curve



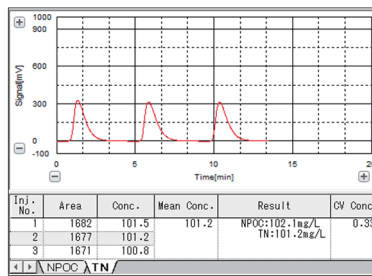
Sample ① seawater only:
TN measurement



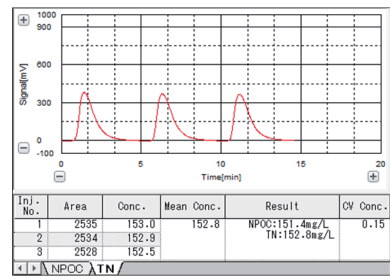
Sample ② seawater + 25 mg/L:
TN measurement



Sample ③ seawater + 50 mg/L:
TN measurement



Sample ④ seawater + 100 mg/L:
TN measurement



Sample ⑤ seawater + 150 mg/L:
TN measurement

Fig. 3 Measurement Data



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