Analyzing Total Organic Carbon in Sea Water

Application Note

Abstract

The analysis of Total Organic Carbon (TOC) in seawater can be both challenging and expensive. The concentration of organic carbon in seawater is of considerable interest. The effect this matrix can have on TOC analyzers can lead to rapid consumable turnover, costly maintenance and repairs. Laboratories are continually looking to increase sample throughput, decrease overall cost of analysis, and improve ease of use while maintaining reproducibility. This poster will demonstrate the ability to maximize throughput of seawater samples using a high temperature combustion analyzer for TOC analysis.

Introduction

Organic contamination in oceans and bodies of salt water is of particular interest due to the ability to detect environmental pollution. Measuring the potential of oxygen demanding load of organic material in seawater by high temperature combustion Total Organic Carbon (TOC) analyzers provide the most efficient way to measure organic carbon in these waters.

Analyzing seawater can be challenging and expensive. Over time, dissolved salts crystallize on the quartz combustion tube. This can impair the ability to fully oxidize the organic carbon and increase maintenance and downtime of the instrument.

The new Lotix TOC Combustion analyzer is designed to accurately measure carbon content in sea water matrices with minimal down time. It uses proven high temperature combustion, oxidation of carbon material into carbon dioxide, and detection using a new Non-Dispersive Infrared (NDIR) Detector.

This study evaluates the Lotix and a newly employed combustion tube configuration to increase the longevity of analyzing seawater samples while decreasing maintenance. This study focused on durability while still meeting the requirements of Standard Method 5310B by removing all inorganic carbon with the addition of 21% phosphoric acid and sparging of inorganic carbon; thus, leaving only the Non-Purgeable Organic Carbon (NPOC) fraction in seawater samples[1].

Experimental Instrument Conditions

The standard combustion tube is packed with ¼ gram (g) of quartz wool on the bottom, followed by 17 g of catalyst, and topped with 3g of quartz beads. Seawater can be a difficult matrix to analyze for TOC by high temperature combustion due to salt crystallization on the quartz combustion tube and catalyst. Due to this phenomenon, a new combustion tube setup was employed to increase the longevity of the sample throughput. This combustion tube was packed with a ¼ g of quartz wool on the bottom, followed by the 17 g of catalyst, and a platinum screen and quartz retainer ring in lieu of the quartz beads on top of the catalyst.

A 1000 ppmC organic carbon stock solution was prepared according to Standard Method 5310B by dissolving 2.1254 g of potassium hydrogen phthalate (KHP) in 1 liter (L) of deionized (DI) water. This stock standard was then diluted to create a working calibration curve from 1 ppmC to100 ppmC. Seven points were chosen at final concentrations of 0.0, 1.0, 5.0, 10.0, 25.0, 50.0, and 100.0 ppmC. These standards were then poured into 40 milliliter (mL) vials and placed on the autosampler for analysis.

In order to ensure complete oxidation, the carrier gas delay (CGD) time was increased from the method default of 60 seconds to 120 seconds. The updated method parameters used to generate the data in this application note are presented in Table I.

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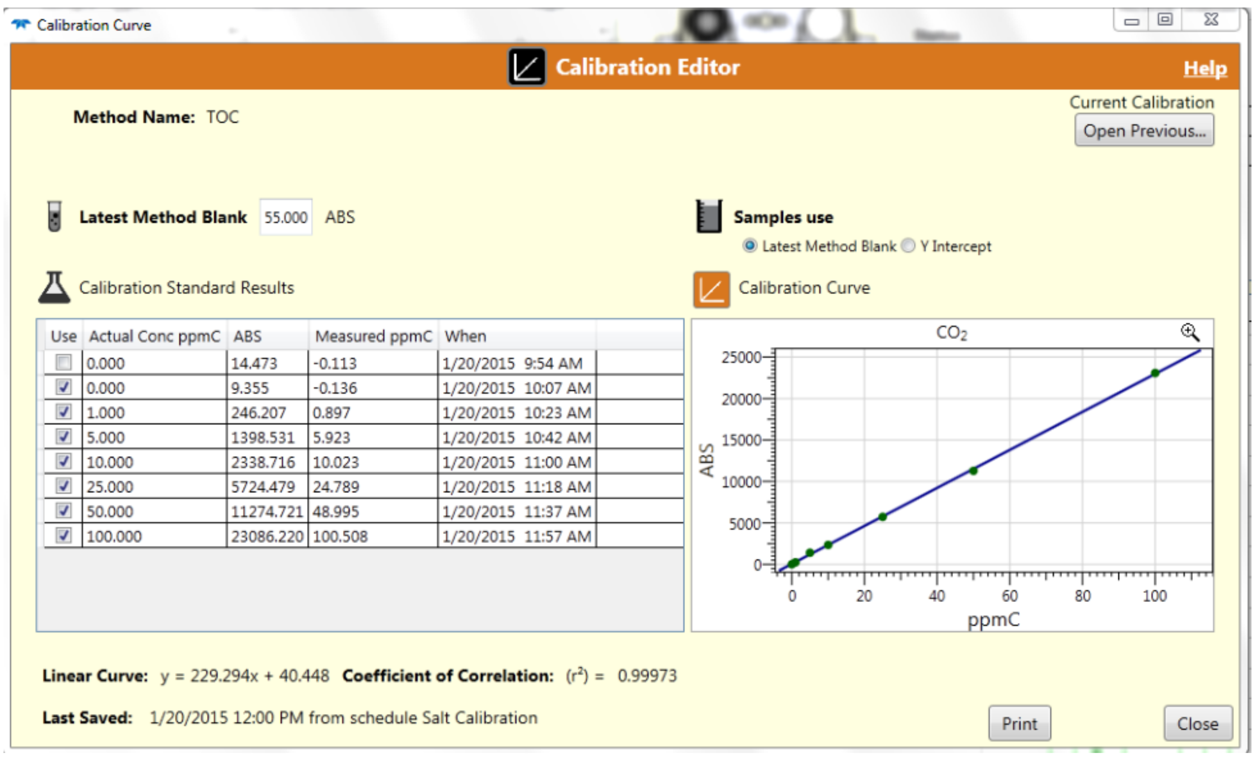
Table I	TOC Method Parameters
Parameter	**Value**
Acid Volume	0.2 mL
Carrier Gas Delay Time	120 seconds
Furnace Temperature	680°C
IC Sparge Time	60 seconds

Each calibration level was run in triplicate with the percent relative standard deviation (%RSD), linear curve and coefficient of correlation (r^2) presented in Figure 1.



Seawater, comprised of various ions, has a total salinity averaging 3.5%. Sodium is the most dominant cation present in seawater, while chloride makes up the majority of the anion portion. Other ions that are abundant in seawater include magnesium, sulfate, and calcium[3]. To accurately represent this complex composition, a Seawater Ocean mixture was purchased.

Seawater samples were created by adding 35 g of anhydrous Seawater Ocean mixture to a 1 L volumetric flask of DI water spiked with 25ppmC of KHP. This mixture created a sample with the salinity and ions similar to seawater while also containing a known about of organic carbon.

As Standard Method 5310B dictates, a check standard must be analyzed after every 10 samples. A 25ppmC check standard was prepared from KHP and analyzed after every 10 seawater samples[2].

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The Lotix handled both the check standards and salt samples accurately and precisely. The Lotix was able to analyze over 200 samples in triplicates, or 600 injections, could be analyzed before maintenance was required. The low %RSD on both the salt samples and the KHP check standards show that the instrument can accurately analyze easy and difficult matrices while using the same method and injection volume. A summary of results is in Table II.

Table II Sample Summary		
Sample ID	**Mean TOC Value (ppmC)**	**Mean %RSD**
Seawater	26.74	3.8
25ppmC Check Standard	26.61	3.4

Conclusion

The Teledyne Tekmar Lotix TOC analyzer is an instrument aimed at increasing sample throughput, while maintaining reproducibility. The Lotix is ideal for accurately analyzing seawater, ground water or wastewater samples with a variety of matrices. Teledyne Tekmar's new flow-through Non-Dispersive Infrared Detector (NDIR) is highly sensitive and can reproducibly quantitate into the low ppb range with a single 0.5 mL injection volume. The Lotix is the ideal instrument for any laboratory that needs to analyze samples quickly, accurately, and with ease of use.

References

1. American Public Health Association (APHA) 2005. Standard Methods of Water and Wastewater. 21st ed. American Public Health Association, American Water Works Association, Water Environment Federation publication. APHA, Washington D.C.
2. American Society For Testing and Materials, 1994. Standard Test Method for Total Organic Carbon in Water by High Temperature Oxidation
3. Girard, James. *Principles of Environmental Chemistry*. 2nd ed. Sudbury: Jones and Bartlett, 2010. 185-190. Print.

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