

Comparison of Online High Temperature Combustion for TOC Analysis: Catalytic vs. Non-Catalytic

APPLICATION NOTE

Introduction

Process monitoring of industrial utility water and wastewater must provide high uptime and low maintenance in order to deliver trustworthy data to make profitable process decisions. TOC technology using high temperature combustion provides the robustness needed to handle many sample types, but among combustion oxidation technologies there are differences between catalytic and non-catalytic combustion. These differences impact uptime, maintenance needs, and cost of ownership, among other factors.

This document outlines key differences between online catalytic vs non-catalytic high temperature combustion TOC. For brevity, these technologies will be referred to herein as High Temperature Catalytic Combustion (HTCC) or “catalytic”; and High Temperature Non-Catalytic Combustion (HTNCC) or “non-catalytic”. This comparison applies to online technologies and high temperature combustion TOC technologies only.

Comparison of Catalytic vs Non-Catalytic Combustion

	Catalytic	Non-Catalytic
TOC technology description	High Temperature Catalytic Combustion (HTCC)	High Temperature Non-Catalytic Combustion (HTNCC)
Measurement parameters	NPOC [†] , TOC, TN _b [†] , TC [†] , IC [†] , BOD/COD [†] conversion, VOC/POC [†] by subtraction	NPOC, TOC, TN _b , TC, IC, BOD/COD conversion, VOC/POC by subtraction, VOC/POC direct
Temperature of combustion	680 - 1,100 °C for carbon detection, 720 - 950 °C for nitrogen detection	1,200 °C for both carbon and nitrogen detection
Carbon detection method	Non-dispersive Infrared (NDIR) detector	Non-dispersive Infrared (NDIR) detector
TOC measurement range	0.25 - 20,000 ppm	0.10 - 50,000 ppm
Nitrogen detection method	Chemiluminescence or electrochemical	Chemiluminescence or electrochemical

[†] NPOC = Non-purgeable Organic Carbon, TN_b = Total Nitrogen Bound, TC = Total Carbon, IC = Inorganic Carbon, BOD/COD = Biochemical Oxygen Demand/Chemical Oxygen Demand, VOC/POC = Volatile Organic Carbon/Purgeable Organic Carbon

Maintenance	Frequent: Samples containing large amounts of salts, high molecular weight and difficult-to-oxidize organics can shorten the lifetime of the catalyst and cause more downtime for repairs.	Minimal: Non-catalytic high temperature combustion ensures complete oxidation of organics without the need to replace a catalyst. In addition, this technology is more robust against salt than catalytic technologies.
Measurement time	3-5 minutes (varies, application dependent)	3-5 minutes (varies, application dependent)
Cost of ownership	High: Frequent replacement of catalyst and combustion tube with variable samples.	Low: Minimal consumables and no catalyst.

Want to know more?

- Combustion TOC methods are primarily selected for samples that contain high molecular weight and difficult-to-oxidize organic compounds often found in wastewater, process water and industrial effluent samples.
- Catalytic combustion involves heating a sample in a furnace tube with oxidation support using a platinum catalyst. The purpose for adding the catalyst is to ensure complete oxidation of all organic carbon in a sample because the furnace temperature in catalytic combustion methods is not high enough to do so with temperature alone.
- Non-catalytic high temperature combustion heats a sample to higher temperatures in a furnace tube to ensure complete oxidation without the use of a catalyst, resulting in less interference.
- Salt content for both HTNCC and HTCC must be thoroughly evaluated to prevent frequent maintenance issues. HTCC has a lower temperature of combustion than HTNCC which means the uncombusted salts could “poison” the catalyst and even more importantly, the combustion tube. While alternative combustion tubes and catalysts can help catalytic combustion units operate in salt environments, these conditions may limit range and performance capabilities while still increasing maintenance. With HTNCC, salts are fully combusted and the lack of a catalyst means less maintenance for the user.
- The biggest differences between catalytic and non-catalytic combustion are maintenance requirements, uptime, and cost of ownership.

Sievers* TOC-R3 Non-Catalytic Online TOC Analyzer

The Sievers TOC-R3 uses non-catalytic high temperature combustion that offers simple maintenance and low cost of ownership resulting in high instrument uptime. With direct VOC monitoring using a photoionization detector (PID) or TN monitoring using an electrochemical detector (ECD), the Sievers TOC-R3 provides flexibility to meet any application need. Its automated dilution, rinsing, and check standard capabilities allow for high uptime even in challenging sample matrices. The Sievers TOC-R3 is built with a robust, modular design and provides rapid responsiveness to a change in sample matrix. Additionally, it offers reliability through predictive diagnostics.

Conclusion

Compared to catalytic combustion, non-catalytic combustion requires fewer consumables and less maintenance, which means a low cost of ownership for the user and greater uptime. With more uptime and trustworthy data comes a better ability to make profitable process decisions. The Sievers TOC-R3 uses non-catalytic high temperature combustion that is robust and flexible enough to meet various application needs.