

The Sievers InnovOx TOC Analyzer: Compliance with ISO-CEN EN 1485 Cellulose Performance Criteria

In order to use a Total Organic Carbon (TOC) analyzer for regulatory testing within the European Community, a laboratory must prove that the analyzer meets the compliance criteria for performance and validation established by the European Committee for Standardization (CEN). Regardless of method, manufacturer, or unique sample type, the CEN expects every TOC analyzer reporting mandatory testing data to be fully compliant.

The CEN was founded in 1961 to centralize the regulatory community. Today, this community includes the European Union and the European Economic Area. The CEN provides a comprehensive range of European Standards for implementing and recognizing good conformity assessment practices. The methods are performance based and highly regarded within the scientific community.

The CEN has approved several official methods for measuring Total Organic Carbon (TOC). This application note addresses the method, *ISO-CEN EN 1485; Water Analysis Guidelines for the Determination of TOC*. This method sets forth a performance criterion that ensures carbon content measurement within a sample.

ISO-CEN EN 1485 Methodology

When measuring TOC under *ISO-CEN EN 1485 Annex C*, the carbon source can be a mixture of dissolved and undissolved organic matter in the water. Although this method is applicable for any contributing source of organic substances, the protocol uses a cellulose solution. The purpose of this precision and bias



procedure is to ensure that the determination of TOC is accurately represented in samples containing particles.

This European Standard does not consider the instrument-dependent aspects used to achieve the performance criterion. The method clearly states that systems based on oxidation using UV are not suitable for microcellulose determination. However, it is worth noting the instrument aspects offered by the Sievers* InnovOx Laboratory TOC Analyzer, which achieves unprecedented oxidation efficiency.

InnovOx Methodology

The Sievers InnovOx's principle of operation is based on the wet chemical oxidation technique, which adds an acid and oxidizer to the sample of interest. The inorganic carbon is removed by purging, and the sample is then oxidized with persulfate at elevated temperatures. The resultant carbon dioxide is measured by a nondispersive infrared spectrometer.



The Sievers InnovOx elevates the temperature of the sample and reagent mixture to ensure efficient oxidation and to convert the liquid water sample into supercritical water. Once in this phase, a phenomena called Supercritical Water Oxidation (SCWO) occurs. This innovation achieves greater than 99% efficient oxidation resulting in better accuracy and precision.

Another SCWO benefit is that it can remove problematic sample matrix contamination at the end of every analysis. As a result, no cellulose or oxidation by-product builds up in the reactor, tubing, or valves.

CEN's Precision and Bias Statement vs. the Sievers InnovOx

To demonstrate compliance, the Sievers InnovOx was calibrated using different concentrations of potassium hydrogen phthalate (KHP). The samples were made from readily available commercial grade cellulose. The reported purity was 99.9% and the average particle size was 90 microns. Two cellulose samples were prepared at different concentrations. The first solution was made to a 5 ppm concentration and the second was made to a 100 ppm concentration. Based on the CEN method, the solutions were placed in volumetric flasks and mixed with a magnetic stirrer before use to ensure a homogenous suspension. Each sample was run in nine consecutive replicates.

The CEN requires subsequent measurements to yield a mean value within 10% of the expected value and not to exceed a 10% variation coefficient (RSD). The InnovOx data reported in **Table 1** demonstrates that the SCWO oxidation efficiency offers unprecedented recovery and compliance with *ISO-CEN EN 1485*. When comparing published data demonstrating the combustion technique's performance, the Sievers InnovOx clearly shows the capability of handling samples with larger sized particles with superior recovery.

Table 1. Data for Cellulose Solutions

InnovOx Data for 90um cellulose solutions		
Replicate Analysis	5ppm	100ppm
1	5.27	103.4
2	5.17	95.4
3	5.08	97.5
4	5.16	108.1
5	5.17	97.4
6	5.03	100
7	4.99	101.8
8	5.18	99.5
9	5.06	100.4
Mean	5.1	100.4
Standard Deviation	0.1	3.8
Relative Standard Deviation	1.75%	3.74%

Typical Combustion Data	
100ppm 20-75um cellulose solution	
Mean	90.8
Standard Deviation	4.9
Relative Standard Deviation	5.44%

Conclusion

The CEN is very specific when describing a TOC Analyzer's analytical performance. The criteria discussed and reported in this application note show the InnovOx's ability to exceed CEN's expectations. The exceptional performance in oxidizing the difficult cellulose matrix is largely due to the innovative oxidation offered by the SCWO technique. The InnovOx clearly fulfills method *ISO-CEN EN 1485* expectations and is deemed compliant for TOC testing.

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