SHIMADZU
Excellence in Science

Total Organic Carbon Analyzer TOC-L

Application News

TOC Analysis for Evaluation of Plastics and Other Organic Materials in Contact with Drinking Water

Markus Janssen
Shimadzu Europa GmbH

User Benefits

- TOC analysis helps ensure compliance with EU regulations for materials in contact with drinking water, protecting public health and maintaining high water quality standards.
- TOC-L supports a comprehensive analysis capable of testing a wide range of components, thus helping to obtain conformity certification for the hygienic suitability of products in contact with drinking water.

■ Introduction

Ensuring the purity of drinking water during production and distribution is a critical requirement. Quality standards are defined by the European Union in the Drinking Water Directive (EU) 2020/2184, where Article 11 specifically addresses materials that come into contact with water (Table 1) . These materials must not adversely affect human health, alter the taste, color or odor of the water, contribute to microbial growth or release significant quantities of contaminants. In essence, no extractable substances from these materials should contaminate drinking water. Therefore, the technical and hygienic suitability of products in contact with drinking water must be verified by laboratory tests.

Article 11 (EU) of 2020/2184 is essentially based on the "4 Member States Initiative" (4MSI) common approach for organic materials. One guideline that has dealt with this topic to date is the KTW guideline (German for Plastics - Drinking Water) from the German Federal Environment Agency. It was used for the hygienic assessment of organic materials in contact with drinking water and describes the requirements that plastics must meet in this context. As guidelines tend to be of a recommendatory nature, the EU has obliged its member states to specifically regulate the requirements for materials in contact with drinking water. Accordingly, the Federal Environment Agency published the KTW-BWGL (Plastics Drinking Water Assessment Guideline) in March 2019. It officially replaced the previous recommendations of the KTW guideline.

■ Sample preparation

To test the suitability of plastics or other organic materials for use in the drinking water sector, migration waters are produced that result from aqueous elution tests of the materials. These are carried out in accordance with the specifications of EN 12873-1 and EN 12873-2. A specific water/product (area) ratio is set and then analyzed for the parameters TOC (EN 1484), odour / flavour (EN 1622), turbidity (ISO 7027) and coloration (ISO 7887). The aim of these tests is a "certificate of conformity regarding the hygienic suitability of products for drinking water", which is issued by a certification body. Certification bodies are accredited bodies in accordance with ISO/IEC 17065.

Table 1 Excerpt from DWD (EU) 2020/2184
Article 11 testing related to material type

Criteria	Organic materials	Metallic materials	Cementitious materials	Enamels and ceramic materials
Organoleptic tests				
Odour and flavour	X		X	
Color and turbidity	X		X	
General hygiene assessments				
Leaching of total organic carbon (TOC)	X		X	
Surface residues (metals)		X		
Migration testing				
DWD relevant parameters	X	X	X	X
MTC_{tap} of positive list substances	X		X*1	
Unexpected substances (GCMS)	X		X*1	
Compliance with composition lists		X		X
Enhancement of microbial growth	X		X*1	

*1 Depending on the existence of organic substances in the material

■ Example: Drinking water hoses

To produce migration waters, the test specimens are brought into contact with water for at least three consecutive periods. A migration period is defined in the standard as follows:

- 72 hours at a temperature of 23 °C (cold water application) or
- 24 hours at a specified temperature between 60 °C and 85 °C for products or materials that come into contact with hot water.

Prior to the start of the migration period, each specimen is pre-treated by rinsing, stagnation and pre-washing. The hoses are rinsed for 60 minutes (Figure 1). The specimens are then filled with water, which is left to stagnate for approximately 24 hours. The samples are then rinsed again for 60 minutes.

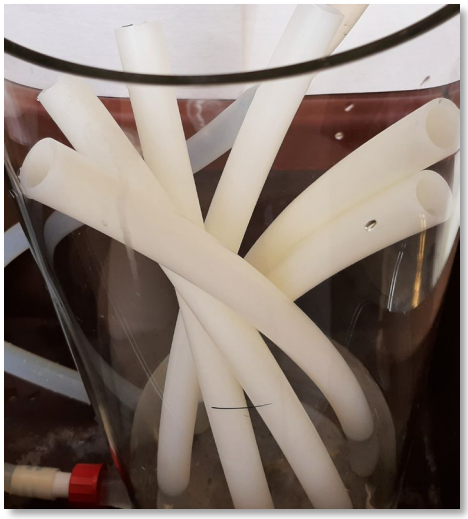

Figure 1 Hoses being rinsed for 60 minutes

At this point, the hoses are filled, and the water is left in the hoses for the time/condition (T) of a migration period (Figure 2). At the end of the migration period, the migration water is removed for analysis and the hose is refilled to await the next migration period. It is important that the migration periods are run consecutively without interruption.

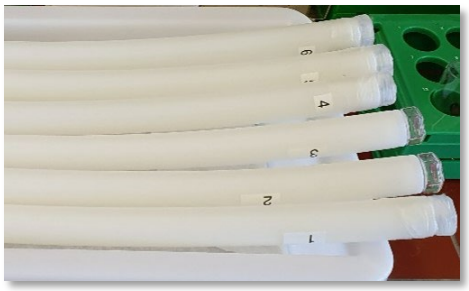

Figure 2 Hoses during 72h migration period

The KTW-BWGL (Plastics Drinking Water Assessment Guideline) is not only used for plastics, but also for organic coatings and lubricants. This applies not only to pipes or hoses, but also to a wide range of products or components such as gaskets, fittings, meters, supply lines, diaphragms for expansion vessels and much more.

■ TOC determination

The direct method (TOC as NPOC) is recommended for TOC determination in this application note. Sample preparation (acidification and degassing) is carried out automatically by the TOC-L system.

Table 2	**Measurement conditions**
Analyzer	: TOC-L CPH
Catalyst	: High Sensitivity
Meas. Parameter	: Direct method (TOC=NPOC)
Calibration curve	: Multi-point calibration using automatic dilution function in the range of 0,25 - 5 mg/l

■ Results

Table 3 shows the results of the TOC measurements of the migration water from a hose.

Table 3 Results of a hose examinations after 3 migration periods

Sample	NPOC [mg/L]
Hose A (1st migration period, 3d)	0,72
Hose A (2nd migration period, 6d)	< 0,5
Hose A (3rd migration period, 9d)	< 0,5

■ Recommended analyzer configuration

TOC-L CPH

ASI-L

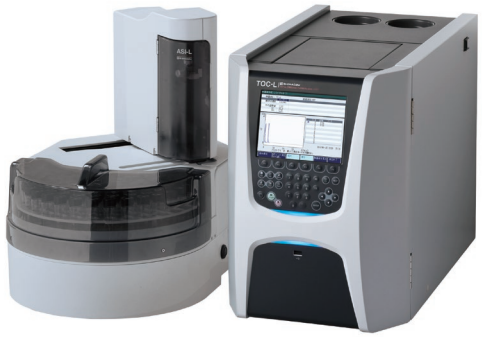

Figure 3 TOC-L with ASI-L

05-SCA-130-406-EN First Edition: Nov. 2024

SHIMADZU

Shimadzu Corporation
www.shimadzu.com/an/

SHIMADZU Europa GmbH,
www.shimadzu.eu

› Please fill out the survey

Related Products Some products may be updated to newer models.

› TOC-L Series
Total Organic Carbon Analyzer

› ASI-L
Autosampler for TOC-L Series

Related Solutions

› Food and Beverages

› Food Contact Materials (FCM)

› Environment

› Water

› Price Inquiry

› Product Inquiry

› Technical Service / Support Inquiry

› Other Inquiry