Application News

Sum parameter – Total Organic Carbon

TOC –Determination in drinking water

No. SCA-130-101

Drinking water is one of the main important and life-sustaining food stuffs and is essential to the survival of all known organism. It is a crucial component for metabolic processes and serves as solvent for many bodily solutes. Water for human consumption must be free from pathogens, pleasant to drink and pure. Continuous monitoring is carried out according to European Drinking Water Regulation to ensure the greatest possible security

■ European Drinking Water Directive

The Directive is intended to protect human health by laying down healthiness and purity requirements which must be met by drinking water within the European Union (EU).

The directive applies to all water intended for human consumption apart from natural mineral waters and water which are medicinal products.

The European drinking water directive includes the category of indicator parameter value specifications. These are not directly linked to health problems but have an indicator function.

This list of indicator parameters also includes the TOC value (total organic carbon), which has not been assigned a limiting value or criterion but can be considered as a cautionary warning for action under unusual circumstances. Another indicator parameter included in the list is oxidizability. This is a measure for the sum of all chemically oxidizable organically bound compounds present in water.

With reference to drinking water limiting values, this parameter is no cause for direct health concern but can lead to regermination or undesirable disinfection byproducts. Oxidizability is proportional to the sum of organically bound carbons that are determined as DOC (dissolved organic carbon) or TOC. Oxidizability can therefore be replaced by the TOC parameter. The frequency of determination of the parameter indicators depends on the volume of water that is produced or released in a water supply area.

■ TOC determination in drinking water

When examining carbon compounds in drinking water, it is apparent that the amount of inorganic carbons, such as carbonates and hydrogen carbonates, is much higher than the organic fraction.

The organic fraction is only 1% of the total carbons. A TOC determination via the difference method (TOC = TC - IC) will not be appropriate in this case, as the calculated TOC value is prone to large statistical errors.

Example:

TC = 100 mg/l (RSD = 2%) ± 2 mg/l
       (98 – 102 mg/l)

IC = 98 mg/l (RSD = 2%) ± 1,96 mg/l
       (96,04 – 99,96mg/l)

Based on error propagation the total error is ± 3,96 mg/l

TOC (calc.) = 2 mg/l ± 3,96mg/l
                       (- 1,96 - 5,96 mg/l)

The total error is bigger than the TOC-result, negative results are possible.

According to European Standardization EN 1484 (instructions for the determination of total organic carbon and dissolved organic carbon), the difference method can only be applied when the TIC value (total inorganic carbon) is smaller than the TOC value.

For drinking water analysis the NPOC method (non purgeable organic carbon) is therefore used. The drinking water sample is first acidified to a pH value of 2. This way the carbonates and hydrogen carbonates are transformed into carbon dioxide. The CO_2 is then removed via sparging with carrier gas. The amount of volatile and therefore purgeable organic carbon can be disregarded in drinking water. What remains is a solution of non-volatile organic carbon compounds. These can be oxidized to CO_2 and detected via NDIR.

■ **TOC-L Series**

The sample preparation for the NPOC method (acidification and sparging) is automatically done in the TOC-L analyzer. The removing of the TIC can be performed either in the syringe of the ISP-Module or in the autosampler with the external spare kit.

The ISP (integrated sample preparation) module consists of an 8-port valve and a syringe with sparging gas connection. In addition to acidification and sparging in the syringe, the ISP also enables automatic dilution. This feature facilitates an extended measuring range, dilution of highly contaminated samples and the preparation of a series of calibration samples from a stock solution. The ISP module can therefore considerably reduce time-consuming sample handling steps.

■ **Example of drinking water analysis:**

NPOC-Method
Acidification: 1,5%
Sparge time: 5 minutes
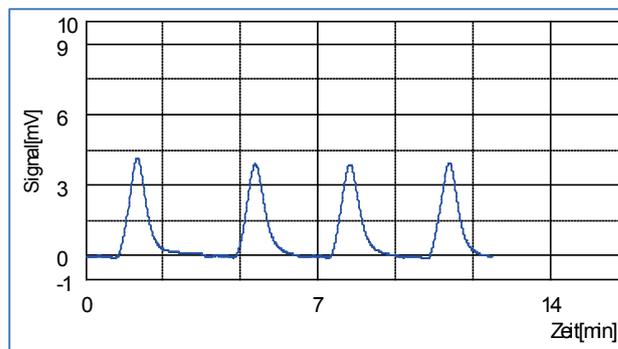
■ **Recommended analyzer / Configuration**

TOC-L CPH
ASI-L (40ml), External Sparge-Kit.

TOC-V WP with ASI-V (40ml)

⊕ SHIMADZU

Shimadzu Europa GmbH

www.shimadzu.eu