In addition to aqueous samples, TOC determination can also be performed on soil, sludge, sedimentation, and other solid samples. By swabbing, the carbon in attached residues can be measured for cleaning validation.

In some regulations (e.g., regulations for the acceptance of waste at landfills pursuant) a limit value for TOC is mentioned.

The modular design of Shimadzu’s TOC series supports straightforward combination with a solid sample module. In this way, the instruments can also be employed for the analysis of solids. The SSM-5000A module can be used in combination with TOC-L or TOC-V wet-chemical.

The solid module allows the separate determination of TC (Total carbon) and the IC (inorganic carbon). It has two different sampling parts. The module is fully integrated into the TOC software (standalone and TOC-Control software) which automatically calculates the TOC-content.

**■ TC – Determination**

For the TC determination, a subsample of the dried solids is weighed into a ceramic boat and combusted at 900 °C in a stream of oxygen. To ensure complete conversion to CO₂, the generated gases are passed over a mixed catalyst (cobalt/platinum) for catalytic post-combustion. The CO₂ produced is subsequently transferred to the detector in the main unit.

The SSM-5000A solid sample module does not have its own detector, but is coupled to the NDIR detector of the main instrument (TOC-V or TOC-L).

The NDIR detector of the main unit contains a tandem cell consisting of a long cell and a short cell. The long cell is used for water analysis and the short cell for solid sample analysis. This configuration assures that the system can be employed for measurements of solids, while retaining its complete flexibility and switching functionality between water and solid sample analysis without any additional conversion.

**■ IC – Determination**

The determination of the inorganic carbon is carried out in a separate furnace of the module. Phosphoric acid is added to the sample and the resulting CO₂ is purged at 200 °C and measured.
Calibration

The SSM calibration can be carried out in different manners. A solid (with known C-content) is weighed in a ceramic boat or a standard solution is added to a sample boat filled with ceramic wool.

In case of solid calibration, different weights in of one compound (for example glucose) are used. Based on the carbon content of the compound (Glucose contains 40% carbon) the absolute carbon content in the boat is calculated (in µg) and used for the calibration graph (x-axis).

Example of a real solid sample (Bauxit)

TC determination

Result: 1.30 ± 0.001% (CV: 0.11%)

IC determination

Result: 0.94 ± 0.009% (CV: 0.95%)

TOC-Result: 0.36%

Recommended analyzer / Configuration

TOC-L or TOC-V wet chemical
SSM-5000A

Example of Application

108 TOC determination in solids
203 TOC determination in cleaning validation – SWAB method