

Application News

No. SCA-130-401

Sum parameter – Total Organic Carbon

TOC-determination in algal biomass – suspension method



The excessive global CO₂ emissions from the burning of fossil fuels (for instance in power plants) causes the search for climate-friendly uses of carbon dioxide.

One of the approaches for environmentally sound recycling is to convert the emitted CO₂ into biomass using photobioreactors.

The CO₂ gas is introduced into the photobioreactor in order to be used for the growth of algae. The biomass, or algae, can be used in many different application areas: in the cosmetics industry, the construction industry, and the food segment, in agriculture as fertilizer or for energy utilization.

■ Test methods for implementation

The efficiency of the photobioreactors and the yield of growth are continuously monitored. To this end, various methods are available, including the determination of dry mass (gravimetric) or the photometric determination of chlorophyll (by absorption). These methods either require a high expenditure in terms of time and personnel, or they are nonspecific and inaccurate.

■ Innovative methods

To determine the biomass in the photobioreactor, a TOC analyzer was used. The carbon content of the 'algal soup' is directly proportional to the biomass.



■ TOC Measurement method

Depending on the type of algae used in the reactor, either the difference method or the direct method (NPOC) is suitable. In both cases, one should test which method will most accurately detect each particular type of algae. This can be compared with the results of the reference method.

Information on the analysis:

- calibration of the TC/NPOC and the IC parameters via the automated dilution function
- sample is generally measured undiluted
- injection volume: 90 µL
- at least 3 to 5 injections for statistical confidence
- rinse several times, depending on the sample

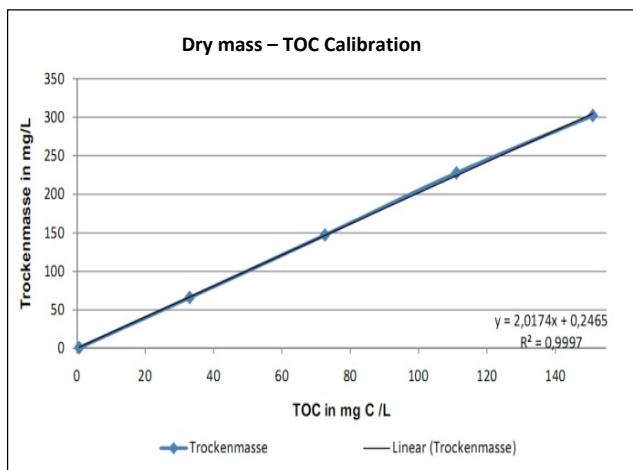
■ Sample preparation

The 4 – 10 μm large micro-algae of the *Chlorella vulgaris* species can be measured directly after sampling from the reactor without any further sample preparation. The difference method was used for the biomass determination. The method is suitable for all other single-cell algae that exhibit a stable carbon content under different growth conditions.

Using the difference method, the TC and TIC were determined and the TOC was subsequently calculated from these values. Calibration using the resulting dry mass of the algae makes it possible to draw conclusions on the dry biomass content in the sample from the TOC.

■ Correlation

The TOC correlation (algae biomass/TOC) must be determined for each type of algae specifically. It can also be calibrated against the determined dry mass.



First, the algae sample is measured and the TOC is determined. Subsequently, the sample is filtered through a 0.2 μm syringe filter and measured again in the TOC analyzer to be able to distinguish between the TOC content originating from the algae and the carbon content possibly originating from

the extracellular substances produced by the algae or released into the culture medium after the algae have died off. The TOC determined this way is the carbon content of the investigated algae. To draw conclusions on the dry mass yield, the percentage carbon content in the algae must be determined.

Several direct and indirect methods are available. The most simple and, at the same time, highly reliable method is to combust the washed and dried algae in a solid-matter TOC analyzer. A second method is to filter the algae, dry them and then determine their mass. In combination with TOC and photometry measurements, a correlation between the TOC value and the algal dry mass can be determined, which provides information on the carbon content of the algae. From the carbon mass fraction and the TOC value, the dry mass of the algae solution can be very accurately calculated.



■ Recommended analyzer / Configuration

TOC-L CPH
ASI-L (40ml) with stirrer option and external Sparge-Kit

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