Short Application of the Sum Parameter Analysis – TOC
Determining TOC in Power Plant Waters

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Waters within power plants, and particularly boiler feed waters are subject to strict analytical control. Organic impurities in the boiler feed water can easily be oxidised under high pressure and high temperatures, and may lead to the formation of corrosive organic acids and carbonic acid. Salts are often added as oxygen scavengers.

TOC monitoring in the boiler feed water is crucial for controlling this process. This is a matter of trace contamination in the range below 1 ppm TOC.

Wet chemical UV digestion is particularly suited for the TOC determination within this concentration range and this matrix, not least due to its large volume of sample injection (up to 20 ml) and its high measurement sensitivity.

Experimental

A similar matrix as generally found in power plant waters was synthesised and defined TOC contents were added.

The following concentrations and substances were used for the synthetic matrix:

- 7 g/l boric acid
- 1 mg/l sodium
- 7 mg/l potassium
- 2 mg/l lithium
- 7 mg/l ammonium

A 300 µg/l and a 1000 µg/l TOC-standard (potassium hydrogen phthalate) were then added to this synthetic solution.

The synthetic samples were adjusted to pH 2 with 2N sulphuric acid.

The following method parameters were set at the instrument system.

Measurement parameters	NPOC
Digestion technology	Wet chemical UV digestion (185nm and 254nm)
Number of repeated measurements	3 of 4
Purging time	300 seconds
Injection volume	5000 µl
Additional reagents (oxidising agent)	No

A TIC control measurement ensured that the inorganic carbon and dissolved carbon dioxide had been eliminated.

An autosampler with parallel purging and analysis function was used for feeding the sample. This reduces analysis times and allows a high sample throughput.

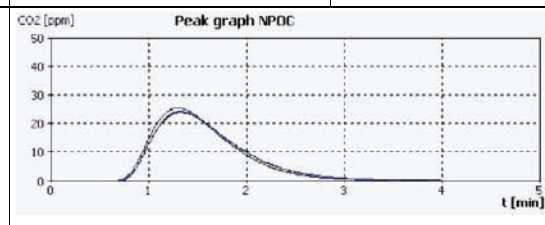
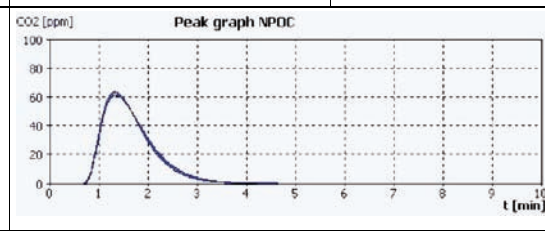
The non-purgeable organic carbon (NPOC) proportion was oxidised to CO_2 in the UV reactor without additional use of an oxidising agent and determined by means of an NDIR detector.

Calibration

The software of the analyser allows the combination of one measuring method with several calibration ranges. The most suitable calibration curve for calculating the results is automatically selected by the analyser based on the surface integrals. This ensures that the optimal calibration range is always selected. This is particularly user-friendly and guarantees highest accuracy and precision of the measured values. A single-point calibration with 1000 ppb TOC was prepared from potassium hydrogen phthalate for the synthetic samples for the field of power plants.

Results

The following table shows the mean values of the NPOC measurements as well as the relative standard deviation.

	multi N/C®	
Sample ID	**Average NPOC [µg/l]**	**RSD NPOC [%]**
	The blank value of the preparation water (with matrix) of 113.9 AU/ml was determined immediately before the measurement, and then automatically deducted from the standard	
300 ppb KHP + matrix	**326.2 µg/l**	**1.25%**
Measurement curves		
1000 ppb KHP + matrix	**1060 µg/l**	**0.89%**
Measurement curves		

Summary

The results show that there is no need to add an oxidising agent charged with a TOC blank value such as sodium peroxodisulphate for the complete oxidation of waters in the field of power plants. The UV radiation and the dissolved oxygen in the sample are sufficient to convert all organic compounds into CO_2. The results are extremely reliable TOC measurements in the boiler feed water, other ultrapure waters and even in drinking water analyses.