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Carbon Analyser
- RA 10 m -

**A thermal analyser for elemental and organic carbon
according to the german regulation § 40.2 BImSchG**

Indications

physical measuring method
analysis of 2 components
2 measuring ranges for each component

Collection of immission and emission samples with standard equipment.

Application

The fractionated analysis of carbon species is becoming more and more important since organic and elemental carbon are relevant for the air quality. Regarding the precatation, the diesel emission has been taken in the MAK-Werte-Liste, part III A 2. Due to the special cancerogenic potential of dry soot, there must be specific and precise distinction between dry soot, organic carbon and carbonates.

The carbon analyser RA 10 m can be used for the analysis of elemental carbon (dry soot) according to the regulation § 40.2 BImSchG and to monitor the limited soot concentration at work places (Technische Richtkonzentration, TRK-Wert). Filter samples of Suspended-Particulate-Sampler ("KleinfILTERgerät", High-Volume-Sampler, Aethalometer™) can be analysed. Moreover, it is possible to analyse the soot and hydrocarbon content of the particulate matter from various sources, such as diesel engine emissions, the ash of power stations, filter dusts also as biological materials and others.

Description

The department of air quality control of the Technical University Berlin has developed a thermographical measuring method which seperates the particulate carbon fraction into organic and elemental carbon and analysis both of these fractions in less than 10 minutes with high precision. This carbon analyser is schematically shown in the following figure.

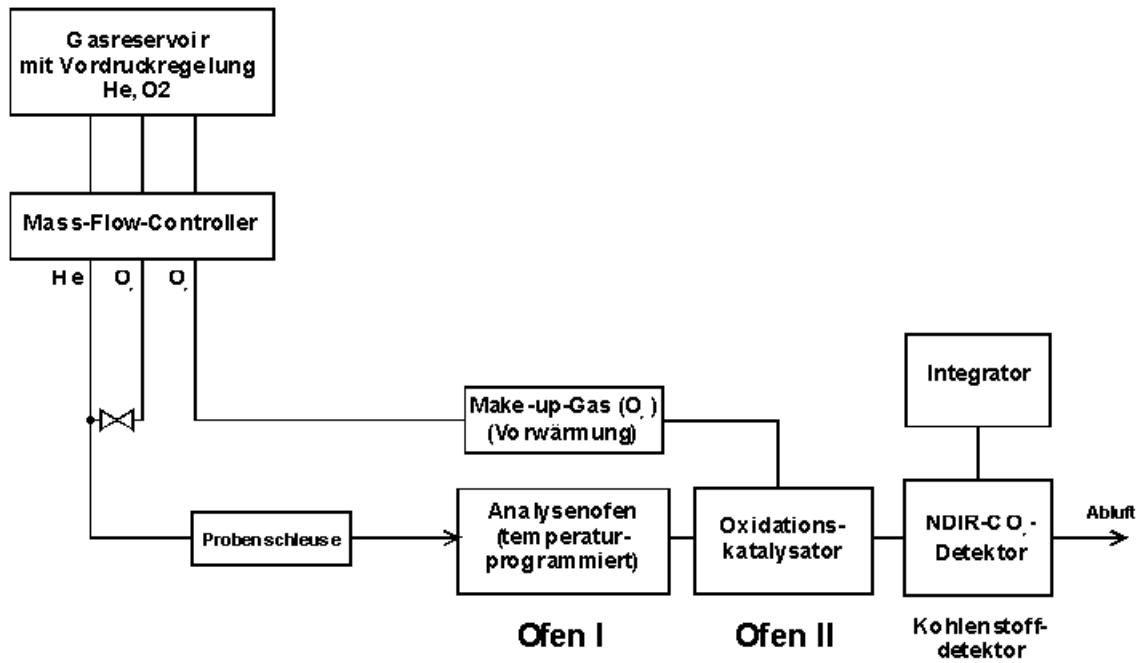


figure: carbon analyser RA 10 m

For the fractionated analysis of carbon, the chemical and thermal stability of elemental carbon (dry soot) in relation to organic carbon compounds is exploited. With the aid of a temperature program, the sample is first heated in an inert gas atmosphere (helium) to 620°C. Thus vaporizing and pyrolysing the volatile hydrocarbons completely. These hydrocarbons are passed over an oxidation catalyst and analysed subsequently as carbon dioxide. Afterwards, oxygen is passed through the sample at 600°C to burn and subsequently detect the elemental carbon.

for the thermal carbon analysis, the particles should be preferably collected either on binder free quartzfiber filters or on carbon free metal sheets. In general, a representative part of the filter sample suffices for the carbon analysis, so that enough material remains for further analysis of other constituents. The method has been validated and applied with extensive measurements on ambient suspended particulates and diesel engine emissions.

Compounds, range time

compounds	organic carbon (OC), elemental Carbon (EC, dry soot), carbonate, sulphate (optional, on request).
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Measuring range according to DIN 38 402 (Germany)

0.4 µg to 400 µg	organic carbon,
0.4 µg to 80 µg	elemental carbon,
0.03 µg to 3 µg	sulphate.

Analysis time about 10 minutes

Detection limit, precision

Measurements with the carbon analyser have shown a precision of better than 5% for the Parameters organic (OC), elemental (EC) and total carbon (TC).

By choosing the right sample volume for the sampling of dust with the "KleinfILTERgerät", it is possible to get detection limits much lower than 0.5 µg/m³ for elemental carbon.

Signal outputs, signal process

All the signal outputs are lead to a host computer. For signal processing a computer (CPU x486) with MS-DOS 6.2™ system is used. Other computer systems are configurable by option. The data reduction of the thermographic carbon analysis is performed by special software.

Power supply, gas supply

Gas supply	helium (gas cylinder), oxygen (gas cylinder), carbon dioxide (gas cylinder), compressed air 200 l/h (1 to 7 bar)
Cooling system	water 50 l/h (1 to 5 bar)
Alternating Voltage	230 V +10 % ... - 15 %, 48 ... 62 Hz
Power input	max. 16 A

Climatic stresses

Ambient temperature	+ 5°C to + 40°C
Transport and storage temperature	- 25°C to + 65°C
Relativ humidity	□ 75% annual average
Operation height	until 2200 m above NN

Construction, assembly

The carbon analyser consists of two oven, one carbon dioxide detector and one unit control.

Design	19"-casing, 20 HE with attachments (dimension: breath 1 m, depth 0.6 m, height 0.9 m)
Kind of protective casing	1/8" swagelok
Analogue and binary signals	sub-miniature
Main-switch	3-pole-plug

Development of the method

Technical University Berlin, Fachgebiet Luftreinhaltung
by order of the "Senatsverwaltung für Stadtentwicklung und Umweltschutz, Berlin" and the "Umweltbundesamt" Germany.

Users

Niedersächsisches Landesamt für Ökologie, Hannover
Technische Universität Berlin Fachgebiet Luftreinhaltung, Berlin
Sentasverwaltung für Stadtentwicklung und Umweltschutz, Berlin
EC/Joint Research Centre, Environment Institute, Ispra (Varese) Italy