Technical Data

analytikjena
An Endress+Hauser Company

multi EA 4000
Macro Elemental Analyzer

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General

The multi EA 4000 is a macro elemental analyzer for the determination of carbon, sulfur and chlorine in solid and pasty samples. It enables the fully automated determination of the parameters total carbon, total sulfur, total chlorine as well as TIC, TOC, EC/BOC.

The multi EA 4000 is suitable for most diverse analytical tasks, in addition, the system can easily be extended and modified at any later time.

Feature

- **HTC technology** – permits the analysis of more aggressive and corrosive samples in a nearly wear less ceramic combustion tube (C/S determination) at very high digestion temperatures
- Sample feeding via a **maintenance-free gas lock**, no mechanical wearing parts
- **Modular design** – system extension by accessory modules (detection, digestion, sample supply) possible at any later time
- Optional TIC solids module "automatic" – fully automatic combined **TIC / TOC determination** out of the same sample aliquot in a single analysis run - saves valuable analysis time
- **Pyrolysis function** (optional) allows determination of active carbon, elemental carbon (**EC**) and the biodegradable organic carbon (**BOC**)
- Integration of an **analytical balance** - automatic determination and transfer of sample weights to operation software
- **Flame sensor** (optional) for the safe analysis of chlorine by controlled digestion of reactive samples (e.g., waste, polymers etc.)
- **Self Check System (SCS)** – continuous system monitoring ensures instrument safety and high quality of the analysis results
- **Wide-range detectors** for widest dynamic operation range
- **Chlorine option** - patented 3-in-1 combi electrode based on robust ceramic technology, extremely low-maintenance & fast operational readiness
- Intuitive user guidance with **multiWin** software
- Integrated **method library** with preconfigured standard methods assures easy operation

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User Benefits

- Unique **application variety** and upgrade possibilities
- High productivity, **low operating costs**
- **Optimal system safety**, trouble-free analysis
- Maximum operating time, **high sample throughput**
- **Minimal maintenance effort** - extremely robust hardware components
- Easy to use - **minimum operating effort**, intuitive user guidance

Efficient Digestion of Samples

The catalyst-free high temperature digestion in an oxygen stream at up to a combustion temperature of 1,500 °C (1,800 °C, with additives for short term use) allows the digestion of thermally very stable sample components, e.g., carbonates or sulfates.

- **Required gases**- Oxygen 99.5% (2.5) for C and S determinations, additionally argon 99.996% (4.6) for chlorine analysis or pyrolysis (EC/BOC, active carbon determination).
- **HTC technology** - The application of high-temperature ceramic technology (HTC) allows the analysis of more aggressive and corrosive samples in nearly wear-free ceramic combustion tubes with high digestion temperatures.
- **Sample weighing** - The multi EA 4000 is a true macro elemental analyzer. It allows sample weights of up to 3 g, thus ensuring reliable analysis even with very inhomogeneous sample material. Due to the high dynamic weighing range, the analysis can be adapted to the widest range of element concentrations.

Pyrolysis Function

The optional pyrolysis function allows the determination of active carbon (AC), elemental carbon (EC) and biodegradable organic carbon (BOC).

The pyrolysis of the sample is performed at, e.g., 850 °C in an inert gas atmosphere (argon). The BOC fraction is therefore removed from the sample. In a second step, the remaining sample is oxidized in an oxygen atmosphere, whereby the RC (residual carbon – corresponding with the EC) can be directly measured. BOC can then be calculated from the difference between TOC and RC.

Using the pyrolysis function, the concentration of active carbon – an important parameter in the foundry industry – can reliably be analyzed too.

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Detection

Carbon and sulfur determination:

Special wide-range NDIR detectors enable the simultaneous analysis of carbon and sulfur in a dynamic measurement range of ppm to percentage with high linearity. Effective NDIR signal evaluation with the assistance of well-known VITA method ensures precise and matrix-independent measurement results.

- **Wide-range NDIR detectors** - High linear working range allows flexible adjustment of the sample weighing from a few milligrams up to a maximum of 3 g. Thanks to the use of resistant materials, a special optical arrangement and the effective gas cleaning the C/S detectors require extremely low maintenance and are stable over a long period of time.
- **Fully-automated assignment of the optimal evaluation functions** - Several calibration functions can be used (multi range calibration) – the selection of the optimal function is performed fully automatically.
- **Auto zero function** - Automatic zero compensation is performed prior to every measurement.
- **Integrated VITA method** - high reproducibility of the results, significant matrix-independence, high long-term stability of the calibration, reduction of calibration effort, electronic flow control of the system

Chlorine determination:

A wide-range coulometer in combination with a variable gas channeling permits chlorine analysis in the lowest ppm to the lower mass percent range. The coulometric detection system works with a patented combination electrode based on state-of-the-art ceramic technology. The integrated cooling of the titration cell and a high-capacity electrolyte ensure outstanding long-term stability, even with high chlorine contents and large sample series.

TOC/TIC determination:

The TOC (Total Organic Carbon) and TIC (Total Inorganic Carbon) parameters can be determined with the multi EA 4000 from only one sample aliquot in a single analysis step.

This is the only fully automated direct determination of TOC and TIC in a single analysis step. The solids sampler in combination with the TIC solids module “automatic” allow fully automated digestion and detection of inorganic carbon materials. Finally, the TIC-free sample is automatically transferred to the furnace for TOC determination. The fully automated determination of TOC by differential method is possible with this combination, too.

For the manual processing of small sample numbers, a separate TIC solids module is available for the determination of TOC (TOC=TC-TIC) by the differential method.

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Measurement Time:

C/S determination (simultaneous or separate): at least 3 minutes, depending on the sample quantity, concentration and application

Cl determination: 3 - 10 minutes, depending on the sample quantity, concentration and application

Self Check System (SCS)

Easy to use – each multi EA 4000 comes equipped with Self Check System, this ensures optimal measurement safety with minimum operating effort. The system autonomously checks all relevant parameters, therefore ensuring trouble-free, fully automatic operation.

The Self Check System includes:

- Electronic flow monitoring for optimal detector signal evaluation
- Electronic control of the wide-range NDIR detectors
- Electronic control of the wide-range coulometer
- Software control of the combustion temperature - prevents incomplete sample digestion
- Automatic gas shut-off at the end of a sample sequence, the carrier gas stream is automatically shut off, thus saving operating costs
- Standby and wake-up functions - save operating costs due to lower furnace temperatures and assure fast operating readiness
- Automatic reminder function for routine maintenance, e.g., cleaning of the dust trap

Sample Introduction

The open gas lock makes a cumbersome opening and closing during sample feeding unnecessary. The gas lock is fully maintenance-free, contamination and wear are excluded. Automation of the sample feed is therefore easy.

During manual operation, the manual boat drive allows optimal positioning of the sample boat in the furnace – no risk of material loss during the feeding process.

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Higher sample throughput – highest productivity

The multi EA 4000 achieves high productivity due to its state-of-the-art automation technology. **FPG 48** – a fully-automated solids sampler with integrated boat drive with high capacity, ensures the transfer of the sample boats into the combustion furnace, thus enabling automatic C, S and Cl analysis with an extraordinarily high sample throughput.

- Solids sampler with 48 positions assures high sample throughput for C, S and Cl analysis.
- Programming of the sample feed with different waiting positions and feeding speeds allows sample analysis using a **temperature program** or **temperature ramp**.
- Several methods can be applied within one sequence, sample boats can be repeatedly loaded at any time (infinite loop).
- Equipped with a flame sensor (optional for chlorine determination) the safe analysis of very reactive and sensitive samples (e.g., solid derived fuels, waste) can easily be ensured.
- The optional boat deposition station enables the fully automatic disposal of used sample boats.

Intuitive User Guidance by Operating System multiWin

The self-explanatory multiWin software accompanies the user, beginning with the system start till turning off the analysis system at the end of a workday, with guidance through all the relevant menu points. multiWin monitors and regulates all important system parameters. The software immediately communicates any system configuration errors and recommends suitable parameter settings so that unusable results can be prevented in advance. multiWin checks the system performance and the analytic quality and delivers a clear presentation of the measurement results in individual analysis reports, and much more besides. multiWin is classified as GAMP5 category 3.

The uniquely versatile and easy-to-use software offers free editing of the sample data, automatic selection of the optimal evaluation function, fully automatic generation of calibration curves for the different measurement ranges (multi range calibration) and the possibility for individual re-calculation of the measurement data.

- Intuitive software navigation
- Integrated method library - preconfigured standard methods assure easy operation
- Extensive user-oriented functions, among others: multi-point calibration, blank correction, re-calculation of results, freely selectable dimension for results reporting, statistics etc.
- Comfortable management and storage of the measurement data and parameters, automatic and manual data export (LIMS, Excel)

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Maintenance and Care

multi EA 4000 requires a minimum of maintenance and operating effort.

Features:

- Unparalleled easy access to all relevant components
- Easy exchange of components thanks to modular design
- Easy exchange of the combustion tube
- Robust system due to the use of resistant materials
- Electronic parameter monitoring and automatic error indication
- Easy-to-understand software explanations and troubleshooting assistance
- Automatic monitoring and information for maintenance intervals

Standard Compliance

The multi EA 4000 complies with the requirements of several relevant standards, such as:

- DIN EN 13137 (TOC determination in waste, sludge, sediments)
- DIN EN 15936 (TOC determination in soil, sludge, bio-waste)
- DIN ISO 10694 (TOC/TC determination in soils)
- DIN ISO 15178 (determination of sulfur in soil)
- ASTM D4239, method C (determination of sulfur in coal and coke)
- ASTM D1552 (determination of sulfur in petroleum products)
- ASTM D1619 (determination of sulfur in soot)
- ASTM D5016 (determination of sulfur in coal and coke combustion residues)
- ISO 19579 (determination of sulfur in solid mineral fuels)
- and many more ...

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	Carbon Determination	Sulfur Determination	Chlorine Determination
Detection	NDIR	NDIR	Coulometry
Measurement Range*/**	0 – 100 % C at 0.5 g sample or 500 mg C absolute	0 – 20 % S at 75 mg sample or 15 mg S absolute	0 – 10 % Cl at 100 mg sample or 10 mg Cl absolute
Detection Limit**	3 ppm at 3 g sample weight or 10 µg C abs.	3 ppm at 3 g sample weight or 10 µg S abs.	0.3 ppm at 3 g sample weight or 1 µg Cl abs.
Precision (reproducibility)**	< 2% RSD at 12% C	< 2% RSD at 2% S	< 2% RSD at 3.5% Cl
Sample weight***	Up to 3,000 mg		
Analysis time**/***	2 – 3 min	3 – 5 min	3 – 10 min
Furnace temperature	up to 1,500° C	up to 1,500° C	up to 1,000 °C
Gas supply	Oxygen 99.5% (2.5) 4 – 6 bar, approx. 2.5 L/min For pyrolysis additional: Argon 99.996% (4.6) 2 – 4 bar, approx. 1.5 L/min	Oxygen 99.5% (2.5) 2 – 4 bar, approx. 2.5 L/min	Oxygen 99.5% (2.5) 2 – 4 bar, approx. 1 L/min Argon 99.996% (4.6) 2 – 4 bar, approx. 2.5 L/min
Power supply	230 VAC; 50/60 Hz; max. 16 A		
Dimensions (WxHxD):****			
Basic unit incl. 1 detector	810 mm x 460 mm x 550 mm		
Accessory module	300 mm x 460 mm x 550 mm		
Autosampler	500 mm x 460 mm x 550 mm		
Weight:****			
Basic unit incl. 1 detector	approx. 37 kg		
Accessory module	approx. 8 kg		
Autosampler	approx. 15 kg		

* other specifications upon request
** depends on the sample matrix and system configuration
*** depends on the concentration of elements
**** without PC, keyboard, monitor and printer

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