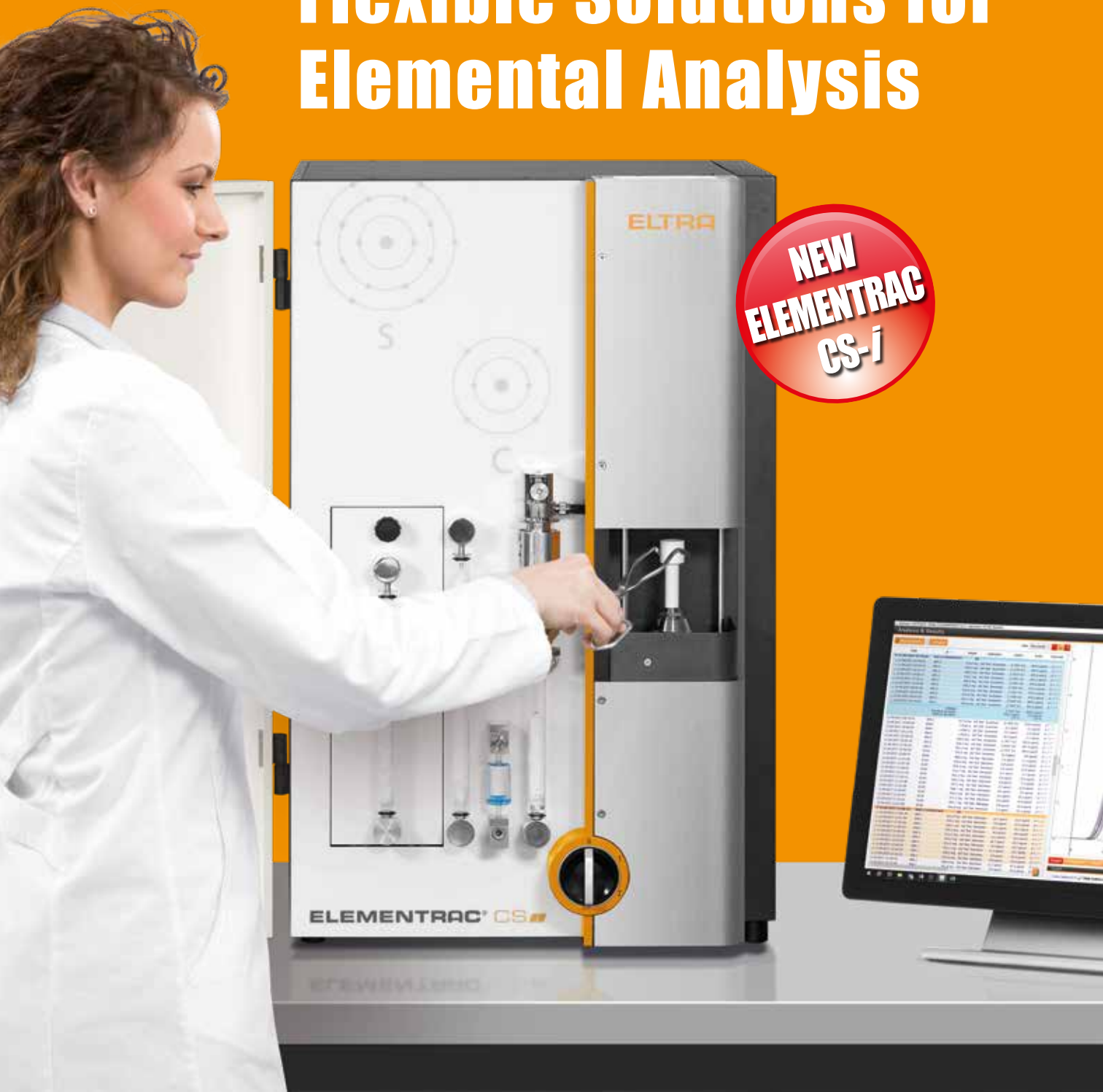
ELTRA
ELEMENTAL ANALYZERS

the sample

VERDER SCIENTIFIC Customer Magazine | Issue 40

part of VERDER scientific

ELTRA – Flexible Solutions for Elemental Analysis



Dear readers, customers and business partners,

In this special issue of the VERDER SCIENTIFIC customer magazine "the sample" we present to you ELTRA's elemental analyzers and give you an overview of the methods and application areas.

The concentrations of elements such as carbon and sulfur in metals and fuels are important parameters in many industry sectors which influence not only the product properties (carbon content in steel) but also the process control (flue gas desulfurization). In the field of high performance materials elements such as oxygen and hydrogen need to be measured in the lower ppm range. It is not possible to use atomic-spectroscopic methods for these tasks, only elemental analysis can close this gap.

ELTRA's strength is the great flexibility of their analyzers which allows them to adapt the measuring ranges to the user's requirements. The ELTRA concept is complemented by extensive counseling and test analyses of customer samples in the in-house application laboratory. Thanks to their close cooperation with customers, ELTRA is able to develop individual, customized solutions.

If you would like to optimize your elemental analysis – talk to us!

Yours

Dr. Jürgen Pankratz
CEO VERDER SCIENTIFIC

ELTRA

Elemental analyzers are also frequently called combustion analyzers because the combustion of the sample is an essential step of the analysis process. ELTRA analyzers utilize various types of furnaces with different temperatures for combustion. The maximum temperatures range from 1,000 °C in a resistance-heated quartz tube furnace up to more than 3,000 °C in an impulse furnace for the analysis of the elements O, N, H in metals. The choice of the best suited analyzer depends on the sample to be analyzed and its matrix. There are organic sample matrices with a high carbon content, such as coal, oil, food, and inorganic sample matrices, such as metals, ceramics or carbides. For sample materials such as cement or soil various analyzers are suitable for measuring the element concentrations.

The new Eltra ELEMENTRAC series: precise, reliable and flexible


Experts in Combustion Analysis

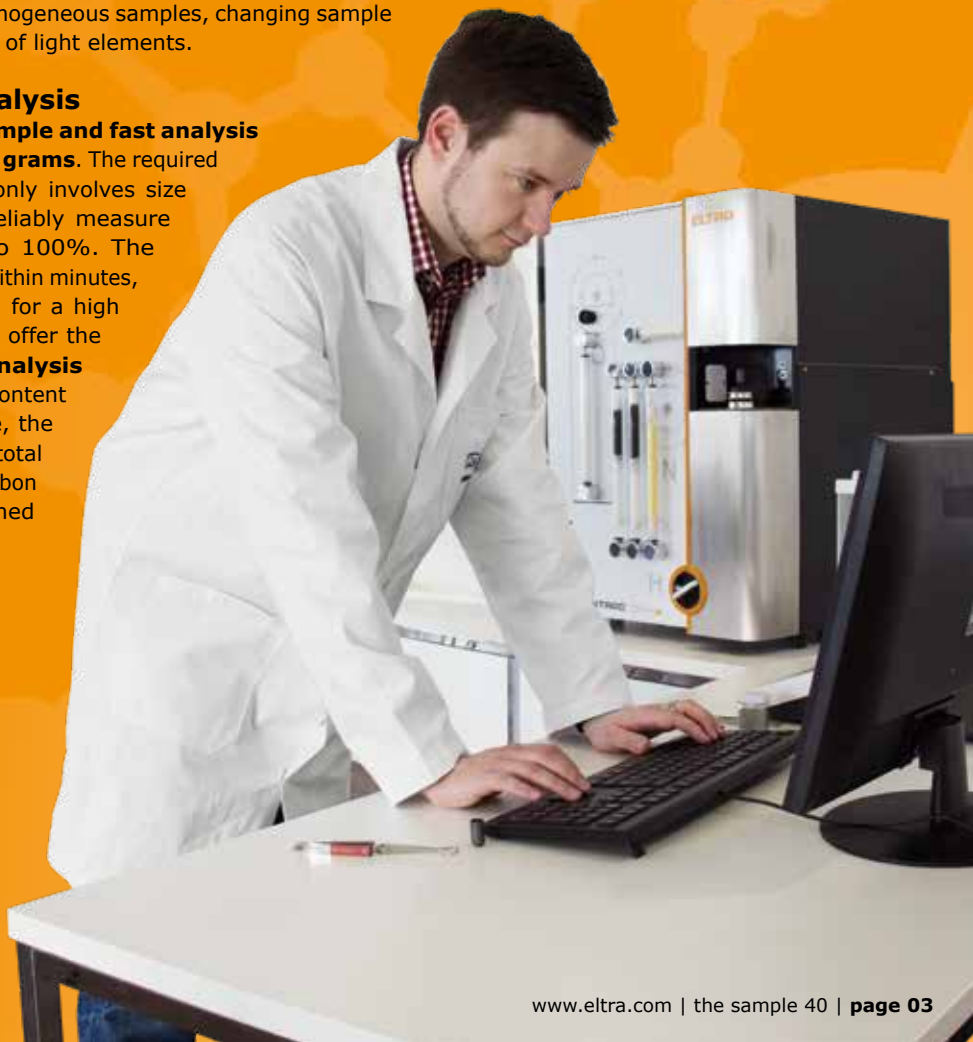
For more than 30 years ELTRA has been among the leading manufacturers of elemental analyzers. The line of instruments covers a measuring range from a few ppm to 100 % and reliably and accurately analyzes organic as well as inorganic materials.

Spectrometric methods

For the determination of C, H, N, S, O concentrations in solids, different methods are applied in laboratories and production. **Wet chemical methods** such as AAS or ICP OES are not only **time-consuming and cost-intensive**, they are also not suitable for analyzing gaseous sample components (N, O, H). For direct analysis of solid materials methods such as x-ray fluorescence, spark spectrometry or glow discharge are well established. However, these spectrometric procedures have some disadvantages. Whereas elemental analyzers are suitable for metallic and non-metallic materials, regardless of the sample geometry (e.g. wires, powders, liquids), spectrometric methods require a plane, defined surface and are **often limited to the analyses of metallic materials**. Other limiting factors of spectrometric methods are inhomogeneous samples, changing sample matrices and the excitation and detection of light elements.

Advantages of combustion analysis

Elemental analyzers offer the benefit of **simple and fast analysis with high sample weights up to several grams**. The required sample preparation is rudimentary and only involves size reduction. ELTRA elemental analyzers reliably measure concentrations from a few ppm up to 100%. The measurement results are usually available within minutes, depending on the method used, allowing for a high sample throughput. ELTRA analyzers also offer the possibility of carrying out **fractional analysis** which not only provides the total element content but also the chemical origin. For example, the carbon content of a soil sample consists of total organic carbon (TOC) and total inorganic carbon (TIC). Both parameters can be determined with ELTRA analyzers.



Variety of applications

ELTRA analyzers are used in production, quality control, and research and development. There is a very wide array of sample matrices that can be analyzed for their C, H, N, S, O concentrations and thermogravimetric parameters with ELTRA analyzers.

Fuels

In order to control the heating value in fuels such as coal, coke, waste, wood, or oil, analysis of the carbon content is necessary. In addition, efficient management of the desulfurization plant requires the control of the sulfur content. Both parameters (and optionally the hydrogen content) can be determined reliably with ELTRA's CHS-580 series.

Building materials

Cement plants face the challenge to examine the carbon and sulfur content of both the fuels used as well as of the cement. The sulfur content significantly influences the "aging" of the cement due to acidification. In order to analyze both matrices reliably, the CS-2000 is the ideal instrument with its unique combination of resistance and induction furnace (ELTRA Dual Furnace Technology).

Product Overview ELTRA Analyzers

	ELEMENTRAC CS-*i*	CHS-580	CS-2000	CW-800 Series	
Max. temperatures:	2,500 °C	1,550 °C	Resistance furnace 1,550 °C Induction furnace 2,500 °C	1,000 °C	
Type of furnace:	Induction furnace	Resistance furnace (ceramic)	Combination: Resistance & Induction furnace	Resistance furnace (quartz glass)	
Elements:	C, S from ppm range to 100 %	C, H, S from ppm range to 100 %	C, S from ppm range to 100 %	C, H_20 from ppm range to 100 %	
Typical sample material:	metals, soil, ceramics	fuels, oil	metals, fuels, soil, cement	cement, soil, waste	

Ceramic materials

As a result of its thermal characteristics, silicon carbide forms the basis of many mixtures in refractory linings in industrial furnaces. The proportion of SiC can be reliably and accurately determined in the ELEMENTRAC CS-*i* indirectly via the carbon content.

Plastics

By means of the thermogravimetric analysis, moisture or filler contents of plastics can be determined in one analysis run. In the context of quality control, the thermal decomposition behavior provides valuable information about errors in the mixing ratio and in processing. The TGA Thermostep is ideally suited for this application.

Metals

The content of C, H, N, S and O influences properties such as ductility, corrosion tendency, or brittleness of almost any metal (e.g. steel, iron, copper, titanium, nickel). An effective ONH analysis is possible by means of an electrode furnace (ELEMENTRAC ONH-*p* series); for CS analysis with an induction furnace, the ELTRA ELEMENTRAC CS-*i* is used.

Soils

In this matrix, the carbon is present in different bonding forms. Total organic carbon (TOC) and total inorganic carbon (TIC) are suitable standard parameters for the characterization of soils. ELTRA offers different analyzers for this application: The CW-800 series can apply different temperatures and carrier gases for the determination of TOC and TIC (temperature method). Alternatively, acid-treated samples can be analyzed with the ELEMENTRAC CS-*i* or CS-580.

Glass

The amount of SO_3 in the glass melt influences the extent of bubble formation in the glass production. In order to control this glass fining process, the ELEMENTRAC CS-*i* is the ideal analyzer for the determination of the sulfur content.

Food

The quality of some foods, such as flour, is among other factors influenced by the ash content. 100 g flour of type 550 contains 550 mg of ash which indicates the mineral content in the flour. These values can be conveniently determined with the ELTRA TGA Thermostep.

	SurfaceC-800	ELEMENTRAC ONH-*p*	TGA Thermostep
	1,000 °C	>3,000 °C	1,000 °C
	Resistance furnace (quartz glass)	Impulse furnace	Resistance furnace (ceramic)
	C from ppm range to 100 %	O, N, H from ppm range to 30 % (or more)	Mass loss
	metal surfaces	steel, copper, titanium, ceramics	fuels, food, plastics, chemicals

Analyzers for C | H | S determination

HIGHLIGHTS

- Wide product range
- Individual customization
- Autoloader available
- Optional hydrogen analysis
- High sample weights
- Durable detectors made of gold

ELTRA offers a comprehensive product range of high-performance analyzers for the determination of C, H, S. The unique CS-2000 is the only analyzer on the market which features both a resistance furnace and an induction furnace. The CS-2000 provides full flexibility for carbon and sulfur analysis. The induction furnace is suitable for analyzing inorganic sample materials, such as iron, copper, steel, titanium or cement, while the resistance furnace is used for coal, coke and oil. **This economic combination of two furnaces in one instrument covers the full range of C and S analysis from ppm level up to 100 %.**

The product range also includes analyzers that are equipped with either an induction or with a resistance furnace. **Here, the CHS-580 analyzer is distinct, as it not only measures the carbon and sulfur content of sample materials but also their hydrogen concentration.** The analyzers can be loaded with high sample weights of up to 300 mg, thus allowing for reliable analysis of inhomogeneous fuels such as waste or wood.

ELTRA offers autoloading systems with 36 or 130 samples positions for applications with a high sample throughput. These can be operated with both the induction furnace (ELEMENTRAC CS-*i*) and the resistance furnace (CS-580A and CHS-580A).

ELTRA's range of combustion analyzers is completed by instruments for fractional analysis. The CW-800 series determines the carbon and hydrogen fractions by the application of different temperatures and carrier gases. To determine the surface carbon content, ELTRA has developed the **SurfaceC-800**. It features a particularly broad furnace which can also accept large sheets of metal for a safe and reliable analysis.

CHS-580A, CHS-580, CS-2000 analyzers

NEW ELEMENTRAC CS-*i*

Precise carbon/sulfur analysis by inductive combustion!

The ELEMENTRAC CS-*i* is the latest addition to the ELEMENTRAC series. It was developed for accurate and safe measurement of carbon and sulfur, typically in inorganic samples, combining modern design and state of the art technology with the proven principles of elementary analysis.

HIGHLIGHTS

- Induction furnace with power control
- Heated dust trap for improved sulfur determination
- Optimized catalyst for more precise carbon determination
- New dust extraction for higher measurement precision and stability

Superiority in detail: The new ELEMENTRAC CS-*i*

To meet even the most demanding requirements, the ELEMENTRAC CS-*i* can be equipped with IR-cuvettes of different sensitivities. By using an induction furnace, the analyzer is able to apply **temperatures of up to 2500 °C**. The predominantly inorganic samples include, e.g., steel, iron, cast iron, brass, ores, ceramics and glass.

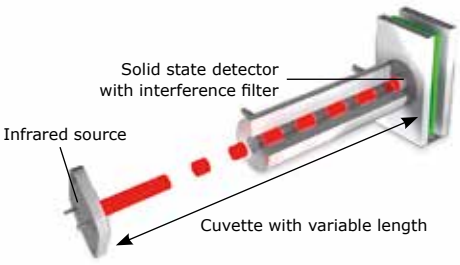
In addition to the variety of configurations and the robust design, the CS-*i* also offers some powerful features as part of the standard equipment. The tempered dust trap, in combination with the heated Pt/Si catalyst, ensures **reproducible results even for very low concentrations**. The adjustable induction power is ideal for samples with low-melting matrices, such as copper or magnesium. ELTRA has developed the Intelligent Lance Management (ILM) for the measurement of very fine samples. Depending on the type of sample, this regulates the oxygen flow into the crucible and thus prevents the sample from being stirred up.

The analyzer is operated with the new ELEMENTS software. This provides extensive statistics, grouping, report and diagnostic functions. Via the main analysis window, the user can choose subordinate tasks, like calling up parameter settings. This clear structure permits easy operation of multiple tasks.

Analyzer	Element combination
ELEMENTRAC CS-*i*, CS-2000	C, S, CS
CHS-580, CHS-580A	C, S, H, CS, CHS, CH, HS
CW-800	C, H, CH

C = carbon, S = sulfur, H = hydrogen

Infrared cells with flexible measuring range



Cuvette length	Measuring range	Application
Long:	C, S in ppm range	steel, pure iron
Medium:	C, S in % range	soils, cement
Short:	C, S up to 100 %	coal, fuels, chemicals, pyrite, pure
The cuvettes are available in gold or aluminum.		

Options for CHS Analyzers
Autoloader with 36 or 130 positions
Gas purification for measurements in the low ppm range
Pre-heating furnace for reduction of blank values in crucibles for measurements in the low ppm range
Module for the determination of total inorganic carbon (TIC)
Voltage stabilizer

Carbon | Sulfur Analyzer ELEMENTRAC® CS-i

ELEMENTRAC CS-*i*

The ELEMENTRAC CS-*i* determines the carbon and sulfur content in inorganic sample materials. Thanks to high temperatures of up to 2,500 °C in the induction furnace, metals, ceramics, cement and soils are reliably analyzed. The ELEMENTRAC CS-*i* can be equipped with up to 4 independent infrared cells with individual measuring ranges.

Elements:	Carbon, sulfur
Sample materials:	Steel, metal, glass, ceramics, soil
Sample preparation:	Cutting
Carrier gas:	Oxygen
Temperature:	up to 2,500 °C
Measuring range*:	C: 0,0001% to 12% / S: 0,0001% to 9%
Typical weight:	100 mg – 1,000 mg
Analysis time:	45 sec.
Options:	Autoloader, gas purification

*Extension to 100 % possible by adjusting the cuvette length

Carbon | Sulfur Analyzer CS-2000

CS-2000

The CS-2000 is the only analyzer in the market featuring both a resistance furnace with ceramic tube and an induction furnace. Thus, the full range of carbon and sulfur analysis can be realized with only one analyzer (ELTRA Dual Furnace Technology). The 4 infrared cells cover a measuring range from a few ppm to 100 %.

Elements:	Carbon, sulfur
Sample materials:	Resistance furnace: coal, coke Induction furnce: steel, metals
Sample preparation:	Grinding (200 µm), cutting
Carrier gas:	Oxygen
Temperature:	up to 1,550 °C (resistance furnace) up to 2,500 °C (Induction furnace)
Measuring range*:	C: 0.0002 % to 40 % / S: 0.0002 % to 8 %
Typical weight:	100 mg – 1,000 mg
Analysis time:	1 – 3 Min.
Options:	Autoloader, TIC module

*Extension to 100 % possible by adjusting the cuvette length

Carbon | Hydrogen | Sulfur Analyzers CS-580 & CHS-580

CS-580 | CHS-580

ELTRA's CS-580 is ideally suited for simultaneous determination of carbon and sulfur in organic sample materials, accepting sample weights of 500 mg and more. The resistance furnace with ceramic tube can be heated in steps of 1 °C up to 1,550 °C. It is possible to equip the analyzer with up to 4 independent infrared cells. The CHS-580 model also allows for measuring the hydrogen content, in addition to carbon and sulfur.

Elements:	Carbon, sulfur, hydrogen
Sample materials:	Coal, coke, oil, chemicals, soil
Sample preparation:	Grinding (200 µm)
Carrier gas:	Oxygen
Temperature:	up to 1,550 °C
Measuring range*:	C: 0.005 % to 100 % / S: 0.005 % to 20 % / H: 0.01 % to 15 %
Typical weight:	100 mg – 1,000 mg
Analysis time:	1 – 3 min.
Options:	TIC module

*Extension to 100 % possible by adjusting the cuvette length

Carbon | Hydrogen | Sulfur Analyzer CS-580A & CHS-580A

CS-580A | CHS-580A

The analyzers of the CS-580A series are available in configurations for the determination of C and S (CS-580A) as well as C, H and S (CHS-580A). They can be equipped with an optional autoloader accepting 36 or 130 samples. For smooth sample loading, the CS-580A series features a vertical resistance furnace with ceramic tube. Temperature regulation and infrared cells offer the same flexibility as in the CS-580 series.

Elements:	Carbon, sulfur, hydrogen
Sample materials:	Coal, coke, oil, chemicals, soil
Sample preparation:	Grinding (200 µm)
Carrier gas:	Oxygen
Temperature:	up to 1,550 °C
Measuring range*:	C: 0.005 % to 100 % / S: 0.005 % to 20 % / H: 0.01 % to 15 %
Typical weights:	100 mg – 1,000 mg
Analysis time:	1 – 3 min.
Options:	Autoloader, TIC module

*Extension to 100 % possible by adjusting the cuvette length

Carbon | Water Analyzer CW-800

CW-800 | CW-800M

The CW-800 series is used for fractional analysis of carbon and water in organic and inorganic sample materials. The analyzers are equipped with a resistance furnace with quartz tube which can be heated in steps of 1 °C up to 1,000 °C. It is possible to modify the temperature and carrier gas (nitrogen or oxygen) during analysis. The CW-800 series features up to 2 independent infrared cells.

Elements:	Carbon (organic, inorganic, elemental), water
Sample materials:	Gypsum, soil, waste
Sample preparation:	Grinding
Carrier gas:	Nitrogen, oxygen
Temperature:	up to 1,000 °C
Measuring range*:	CO_2: 0.01 % to 70 % / H_2O: 0.01 % to 20 %
Typical weights:	200 mg – 1,000 mg
Analysis time:	2 – 3 min.

*Extension to 100 % possible by adjusting the cuvette length

Surface Carbon Analyzer SurfaceC-800

SurfaceC-800

Properties of metal are not only influenced by bound carbon but also by the surface carbon content. It has an effect on, for example, the formation of rust or the suitability for painting. Thanks to the use of an extra broad furnace with quartz tube and 2 independent infrared cells for carbon, the SurfaceC-800 covers a very wide measuring range.

Elements:	Carbon (surface)
Sample materials:	sheets of metal
Sample preparation:	None
Carrier gas:	Nitrogen, oxygen
Temperature:	up to 1,000 °C
Measuring range*:	0.1 –1,000 µg carbon / cm^2
Typical weights:	Gram range; surfaces up to 50 cm^2
Analysis time:	2 – 8 min.

*Extension to 100 % possible by adjusting the cuvette length

ELEMENTRAC ONH-p

ELEMENTRAC® ONH-*p* series
Precise O | N | H Determination

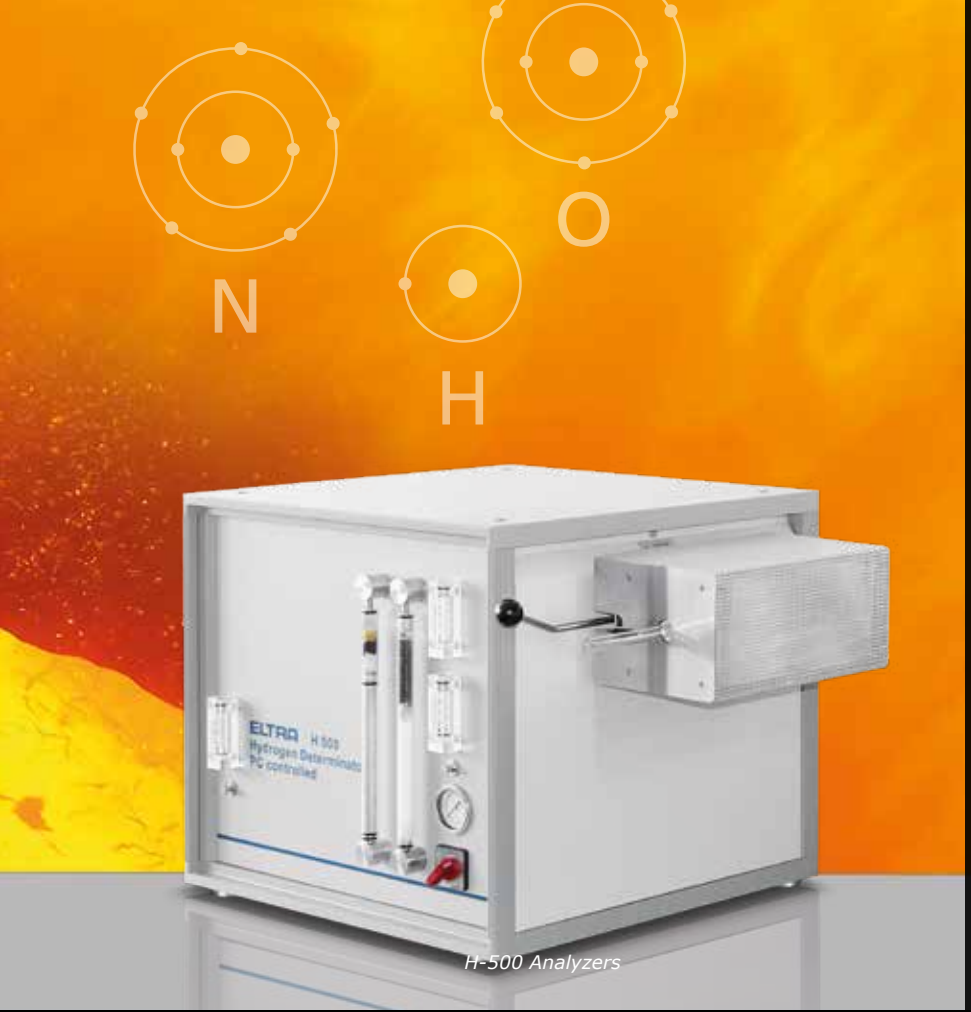
Highlights

- Closed gas management and optimized gas circulation for sensitive ONH determination
- Use of cost efficient argon as carrier gas possible
- Powerful catalyst furnace for precise oxygen measurement
- User-friendly software with segmented leakage test

ELTRA's new ELEMENTRAC ONH-*p* series ensures precise analysis of both high and low element concentrations and allows usage of argon as carrier gas. The analyzers use **inert gas fusion in an impulse furnace** and apply **temperatures in excess of 3,000 °C**. Thus oxygen is detected as carbon dioxide in the infrared cells, and nitrogen and hydrogen are determined in the thermal conductivity cell over a wide measuring range. This method is suitable for analyzing metals such as iron, copper, and titanium but also ceramics and other inorganic sample materials.

The ONH analyzers are available in various versions allowing for both the determination of a single element as well as any combination of elements. New features of the ELEMENTRAC generation – beside the optimized closed gas management for reduced consumption – are the catalyst furnace for even more sensitive measurements and new powerful software with advanced functionalities.

For comprehensive hydrogen analysis ELTRA also offers the H-500 analyzer which is equipped with a resistance furnace and uses the heat extraction technique to determine the residual hydrogen content.



H-500 Analyzers

Analyzer	Element combination
OH-*p*:	O, H, OH
ON-*p*:	O, N, ON
ONH-*p*:	ONH

O = oxygen, N = nitrogen, H = hydrogen

Options for ONH analyzers

Water or air cooling
Efficient cooling is required due to the high temperatures inside the furnace. Depending on the options on site, the type of cooling can be adapted to individual requirements. These options are available:
- Tap water
- External heat exchanger
- External chiller

Carrier gas purification
The optional carrier gas purification is used to remove even the smallest impurities from the carrier gas to ensure reliable analysis in the low ppm range. The reduction of the blank values increases the sensitivity and reproducibility when measuring low element concentrations.

Gas calibration
Calibration can be carried out either with solids or with gas (e. g. CO_2). Gas calibration is available as an option; a defined volume can be set by the manufacturer.

Oxygen | Nitrogen | Hydrogen Analyzer

ELEMENTRAC ONH-*p*

The ELEMENTRAC ONH-*p* uses inert gas fusion and an impulse furnace with >3,000 °C to analyze oxygen, nitrogen and hydrogen in inorganic materials. Thermal conductivity cells and infrared measuring cells detect the released gases. The analysis of oxygen, nitrogen and hydrogen can be combined in any possible way according to the user's requirements.

Elements:	Nitrogen, oxygen, hydrogen
Sample materials:	metals, slag, ceramics
Sample preparation:	Cutting
Carrier gas:	Nitrogen, helium, argon
Temperature:	>3,000 °C
Measuring range:	N: 0.1 ppm to 2 % O: 0.1 ppm to 2 % H: 0.01 ppm to 0.1 %
Typical weight:	100 mg – 1,000 mg
Analysis time:	2.5 min.

Hydrogen Analyzer H-500

H-500

The H-500 is equipped with a resistance furnace with quartz tube and precisely and reliably analyzes the residual hydrogen content of metallic samples by hot extraction with a maximum temperature of 1,000 °C. Therefore, it complements the ONH series which serves for the determination of total hydrogen.

Element:	Hydrogen
Sample materials:	Metals
Sample preparation:	special sampling devices
Carrier gas:	Nitrogen
Temperature:	up to 1,000 °C
Measuring range:	H: 0.000001 % to 0.1 %
Typical weight:	5 g
Analysis time:	3 – 10 min.

TGA analyzers

for the measurement of thermogravimetric parameters

ELTRA's TGA Thermostep is the ideal alternative to standard laboratory ovens or muffle furnaces for thermogravimetric analysis. It measures the mass loss of a variety of sample materials under defined conditions of temperature, time, and atmosphere. The TGA Thermostep permits the modification of settings during analysis, thus allowing for determination of different parameters, like moisture or ash content, fully automatically in one analysis cycle.

Highlights

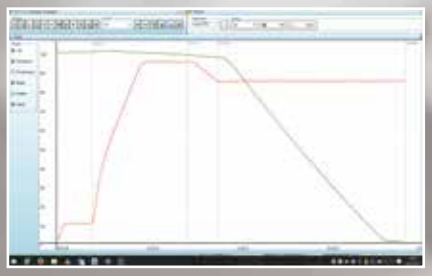
- Measurement of up to 19 samples in one analysis run
- Sample weights up to 5 g
- Fast heating rates, accurate temperature control
- High-performance, precise weighing cell
- Automatic placing and lifting of the crucible covers
- Robust design allows for use in laboratories and production
- Fully automated analysis

Thanks to a programmable furnace that is connected to an integrated balance, heating and weighing of up to 19 samples are combined in the Thermostep. This combination saves time-consuming manual work and automates the analysis process. In contrast to lab ovens, the Thermostep makes waiting for reaching a defined constant mass obsolete, as the software maintains a constant temperature in the furnace until the constant mass is achieved.

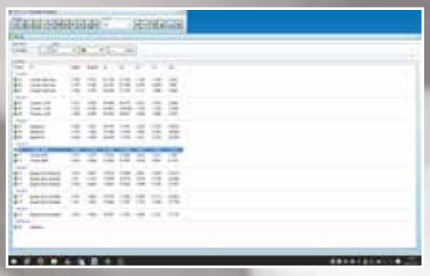
Typical sample materials include fuels like coal and coke but also plastics and food.

ELTRA's TGA Thermostep provides temperatures up to 1,000 °C which can be set with a tolerance of +-2 °C, and can be used with oxygen or nitrogen as carrier gas. The software may be customized according to customer requirements for optimum presentation of analysis results.

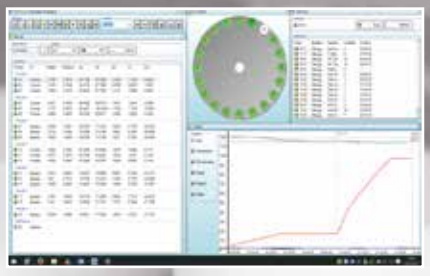
Clearly structured and convenient



Simultaneous display of temperature (red) and loss in weight (green)



Display of analysis results in groups



Simultaneous display of result, graph and current measurement position

NEW: Encapsulated Weighing Cell

TGA Thermostep: Applications

Typical thermogravimetric parameters such as moisture, ash, volatiles or also the loss on ignition (LOI) can be reliably analyzed with the ELTRA TGA Thermostep. Parameters like temperature, heating rates or purge gases, such as nitrogen or oxygen, can be easily programmed and adapted to the sample matrix. Typical sample goods are amongst others: fuels, plastics, chemicals, paper, cement and food.

Analysis results TGA Thermostep

Element	Coal	Paper	Flour 405
Moisture	0.37 ±0.08	4.9 ±0.1	13.5 ±0.05
Ash	6.6 ±0.5	23.3 ±0.07	0.41 ±0.02
Volatiles	9.1 ±0.3	–	–

Determination of mass loss	
Samples:	soils, fuels (coal, coke, substitute fuels), plastics, food, chemicals
Sample preparation:	none
Carrier gas:	nitrogen, air, oxygen
Temperature:	up to 1,000 °C
Resolution balance	0.1 mg
Typical sample weights:	400 mg to 2,000 mg
Analysis time:	1 to 6 hours (depending on the application)

Options TGA analyzers
External weighing
Carousel with ceramic crucibles

ELTRA analyzers in the cement industry

Elemental analysis with combustion technology is an important part of quality control in the cement industry. Cement production involves the quarrying and size reduction of the raw materials (lime, clay, sand), drying and grinding in raw mills, burning in the rotary kiln and the final grinding of the cement.

Typical measurements in a cement plant		
10 measurements of cement	% CO_2	6.01 ±0.04
	% SO_3	2.61 ±0.04
10 measurements of wood	% C	49.86 ±0.18
	% S	0.02 ±0.001
10 measurements of coal	% C	64.42 ±0.07
	% S	0.56 ±0.002

Analysis of the CS content in cement, wood and coal with the CS-2000

Cement Production

Raw materials (lime, clay)

ELEMENTRAC CS-*i*: analysis of carbon and sulfur in raw and intermediate products

TGA Thermostep: Determination of moisture

Grinding in a raw mill

Raw meal is burnt in the rotary kiln

CS-2000: analysis of carbon and sulfur in raw meal and fuels

Ball mill mixes raw meal with additives

ELEMENTRAC CS-*i*: analysis of carbon and sulfur in cement

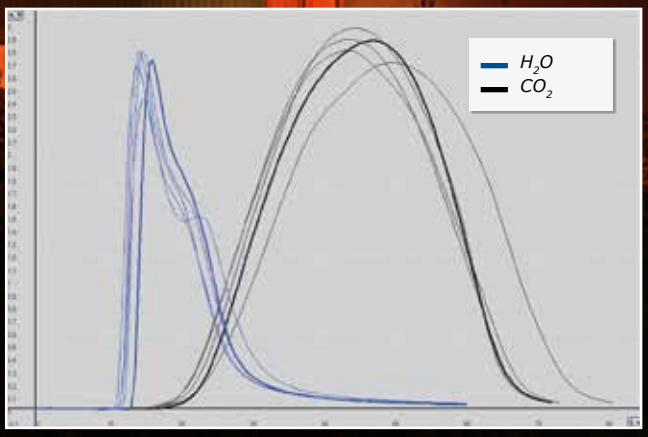
CW-800: TOC/TIC determination in cement

End product cement

Determination of carbonate and water in cement

The quality of cement is characterized by its content of water and carbonate-bound carbon. In the example below the cement sample was measured in the CW-800 at 1,000 °C under nitrogen atmosphere to analyze the water and carbonate content.

Measurement results		
Five 250 mg samples **Analysis time 70 seconds**		
Parameter	**Mean value (%)**	**Standard deviation**
CO_2-content	7.1	0.03
H_2O-content	1.1	0.01



Exemplary measurement:
The blue curve represents the released water; the black curve shows the released carbonate. The area below the curves represents the water resp. the carbonate content of the sample.

Elemental analysis of steel

The essential stations of steel production are the blast furnace, converter and finishing. After each step the determination of the C, H, N, S, O content is required for quality control. In the blast furnace pig iron is produced from iron ore, coke and lime, along with the by-product slag. The burning of coke generates temperatures of up to 1,400 °C inside the blast furnace, which is 30 to 50 meters high. At this temperature, iron ore liquefies and is at the same time chemically reduced through the carbon monoxide coming from the coke. At the end of this process the pig iron still has a very high carbon content of up to 7 % which is reduced in the converter where scrap metal and, if required, more lime are added. Oxygen is introduced which substantially reduces the existing carbon content by forming gaseous CO_2. After this oxidizing process the iron melt can be alloyed with other metals (e. g. chrome, nickel, vanadium, cobalt). Finally, this melt is used to produce the end product.

	Blast furnace	Converter	Finishing
Product to be analyzed	iron ore, lime, coke, slag	pig iron, scrap metal, lime	alloyed metals, steel
Intermediate product	**pig iron** C: 4 – 7 % S: 0.1 – 0.3 %	**semi-finished products** C: 10 ppm – 1 % S: 10 ppm – 0.4 % N: 10 ppm – 0.6 % O: 5 – 1,000 ppm	**steel/stainless steel** C: 10 ppm – 1 % S: 10 ppm – 0.4 % N: 10 ppm – 0.6 % O: 5 – 1,000 ppm H: 0.2 – 10 ppm
Analyzers	**CS-2000, ELEMENTRAC CS-*i*, CHS-580**	**ELEMENTRAC ONH-*p*, ELEMENTRAC CS-*i***	**ELEMENTRAC ONH-*p*, H-500, ELEMENTRAC CS-*i***

Measurement results steel			
Elements	**Steel (1)**	**Steel (2)**	**Steel (3)**
Nitrogen (ppm)	530 ±9	27 ±2	118 ±3
Oxygen (ppm)	45 ±3	12 ±2	244 ±5
Hydrogen (ppm)	3.4 ±0.3	1.9 ±0.2	5.1 ±0.4
Typical weight	1,000 mg	1,000 mg	1,000 mg

Analyzed with ELEMENTRAC ONH-p

Elements and steel properties

- **Carbon** → Hardness, Forgeability
- **Sulfur** → Ductility
- **Nitrogen** → Ductility
- **Oxygen** → Corrosion tendency
- **Hydrogen** → Brittleness

ELTRA PRODUCT RANGE

Analysis of Carbon and Sulfur

ELEMENTRAC CS-*i*

CS-2000

ELTRA is synonymous for high quality, customer-oriented solutions and efficient products. Thousands of satisfied customers worldwide are proof of the reliability of ELTRA analyzers.

Analysis of Carbon and Sulfur

CS-580

CS-580A "Helios"

Analysis of Carbon, Hydrogen and Sulfur

CHS-580

CHS-580A "Helios"

Analysis of Oxygen, Nitrogen and Hydrogen

ELEMENTRAC ON-*p*

ELEMENTRAC ONH-*p*

ELEMENTRAC OH-*p*

H-500

Analyzers for special applications

CW-800

CW-800M "Multiphase"

SurfaceC-800

Thermogravimetric Analyzers

TGA Thermostep

VERDER scientific

Qness CARBOLITE GERO ELTRA Retsch Retsch TECHNOLOGY

As part of the VERDER Group, the business division VERDER SCIENTIFIC sets standards in the development, manufacture and sales of laboratory and analytical equipment. The instruments are used in the areas of quality control, research and development for sample preparation and analysis of solids.

ELTRA GmbH | Retsch-Allee 1-5 | 42781 Haan | Germany | Phone: +49(0)2104/2333-400 | Fax: +49(0)2104/2333-499 | info@eltra.com | www.eltra.com