ELTRA
ELEMENTAL ANALYZERS

the sample

ELTRA – Flexible Solutions for Elemental Analysis

Precise,
Reliable,
Flexible

ELTRA   ONH 2000
Oxygen Nitrogen Hydrogen
Determinator PC controlled

VERDER
scientific

Coal   Steel   Soil

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.

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. This flexibility can also be found in the **thermogravimetric analyzers** of which ELTRA offers a complete product family. 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

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.
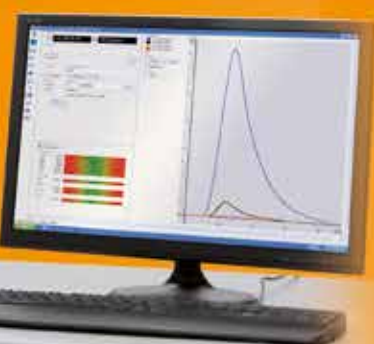
Variety of applications

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

	CS-800	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_2O 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 CS-800 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 (ELTRA ONH series); for CS analysis with an induction furnace, the ELTRA CS-800 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 CS-800 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 CS-800 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	ONH Series	TGA Thermostep & Thermochain
	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

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 in 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 which are equipped with either an induction or a resistance furnace. **The CHS-580 is a special analyzer which not only measures carbon and sulfur but also the hydrogen concentration.** As the analyzers accept high sample weights of up to 300 mg, it is even possible to reliably analyze inhomogeneous fuels such as waste or wood.

For applications with high sample throughput ELTRA offers autoloading systems with 36 or 130 positions which can be operated with both the induction furnace (CS-800) and the resistance furnace (CS-580A and CHS-580A).

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

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

ELTRA Dual Furnace Technology CS-2000

Analyzer	Element combination
CS-800, 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

The ELTRA concept:
Maximum flexibility for your analysis!

ELTRA provides unrivaled flexibility in the configuration of their analyzers, thus being able to respond to customer requirements in the best possible way. Customer-specific configurations include the measurement range as well as the elements to be analyzed.

Flexible selection of elements

The market mostly offers combined CS analyzers for simultaneous determination of carbon and sulfur. However, if the quality control process requires the determination of only one element, for example in casting or hardening plants, the purchase of a combined analyzer is not economical. ELTRA offers highly flexible solutions to analytical requirements, providing customized analyzers which can always be upgraded at a later point. The table on the right shows the possible element combinations in CHS analyzers.

Flexible measuring ranges

After the sample has been burnt in an oxygen stream the combustion gases are quantified in the infrared measuring cells. The "length" of the cuvette increases with its sensitivity. ELTRA offers cuvette lengths according to the customer's requirements. Thus, in combination with the element to be analyzed, an "individual" analyzer is created. 8 different cuvette lengths are available as standard. To extend the measuring range it is also possible to use cells of different lengths for one element.
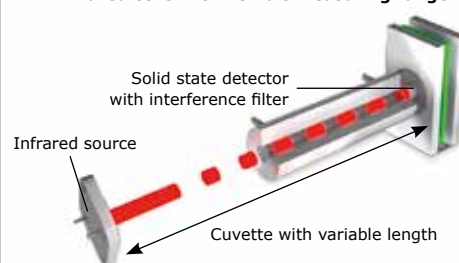
Flexible cells

When burning samples undesired byproducts may be produced, such as traces of gaseous acids or elemental halogens. These can have a damaging effect on the analyzer. ELTRA provides measurement technology which is highly suitable for analyzing such materials. All infrared cells which are in contact with the combustion gas for a longer period of time are available in a gold version. The inside of the gold cuvettes consists of a massive gold tube which is resistant to aggressive reaction gases. For the CS-580 and CS-2000 analyzers the gold version is standard but it is also available as an option for other analyzers (e. g. CS-800).

Infrared cells with flexible measuring range

Solid state detector with interference filter

Infrared source

Cuvette with variable length

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 CS-800

CS-800

The CS-800 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 CS-800 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 6 % / S: 0.0001 % to 12 %
Typical weight:	100 mg – 1,000 mg
Analysis time:	45 – 60 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 / cm²
Typical weights:	Gram range; surfaces up to 50 cm²
Analysis time:	2 – 8 min.

*Extension to 100 % possible by adjusting the cuvette length

The perfect analyzer for each sample

ONH-2000 Analyzer

Determination of the O | N | H content

Highlights

- Flexible configurations and measuring ranges for O, N, H

- Optional measurement of diffusible hydrogen

- Powerful 8 kW furnaces

- Ramping included

- Extra wide furnace for larger samples

ELTRA's ONH analyzers are highly efficient, flexible and robust. They use **inert gas fusion** in an impulse furnace and apply **temperatures of up to 3,000 °C**. Whereas oxygen is detected as carbon dioxide in the infrared cells, nitrogen and hydrogen are determined in a thermal conductivity cell. 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.

The ONH models with integrated resistance furnace are ideally suited for a complete hydrogen analysis. They allow for analyzing the total hydrogen content with the impulse furnace and the residual hydrogen with the resistance furnace.

The analyzers are operated with a powerful software which allows for evaluation of different fractions (peaks) during ramping.

Analyzer	Element combination
OH-900*:	O, H, OH
ON-900:	O, N, ON
ONH-2000*:	ONH

*with optional resistance furnace for the determination of residual hydrogen

O = oxygen, N = nitrogen, H = hydrogen

Options for ONH analyzers

Furnace width
In addition to the standard furnace, an extra wide furnace is available for the ONH series which accepts larger samples.

	Standard	Wide version
Sample size:	8 x 12 mm	12 x 20 mm
Crucible volume:	1.5 ml	3.1 ml

Water or air cooling
Efficient cooling is required due to the high temperatures inside the furnace. It is provided by an internal and external cooling cycle to prevent mutual contamination. For the external cooling cycle both water and air cooling are available.

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.

Voltage stabilizer

Resistance furnace for analyzing H_2

H-500 Analyzers

Oxygen | Nitrogen | Hydrogen Analyzer

ONH-2000

The ONH-2000 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
Temperature:	>3,000 °C
Measuring range*:	N: 0.00001 % to 2 % O: 0.00001 % to 2 % H: 0.000001 % to 0.1 % (Extension by reduction of sample weight)
Typical weight:	100 mg – 1,000 mg
Analysis time:	2 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.

Elements:	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

TGA analyzers are an ideal alternative to standard laboratory ovens or muffle furnaces for thermogravimetric analysis. They measure the mass loss of different samples under defined conditions of temperature, time and surrounding atmosphere. The TGA Thermostep offers the possibility of varying the measurement configuration during analysis. Thus, a number of parameters can be determined with only one sample weight.

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
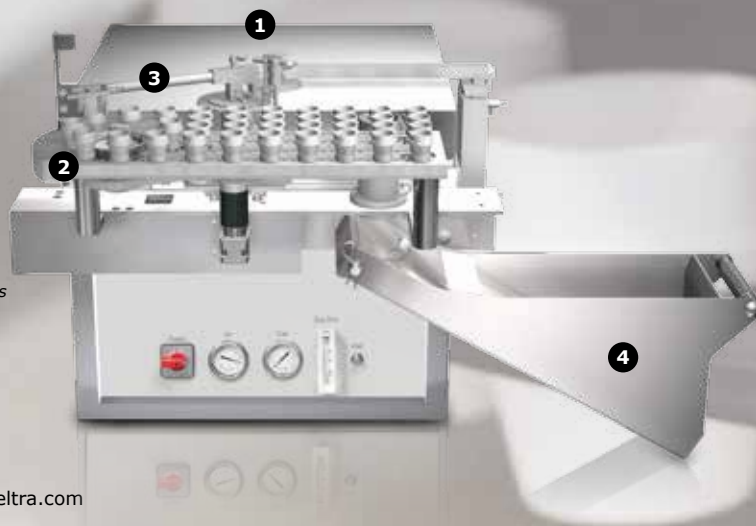- Integrated Autoloader with 36 positions

Thanks to a programmable furnace that is connected to an integrated balance, heating and weighing are combined in the Thermostep. This saves time-consuming manual work and allows for high sample throughput. In addition, typical parameters such as moisture, ash and volatiles can be determined in one analysis run.

ELTRA thermogravimetric analyzers are available in various configurations to serve the different requirements of laboratory and production applications. All ELTRA TGA models are controlled via PC and use a heated furnace chamber which is connected to an integrated balance. Similarly, all TGA analyzers are supplied with 15 ml ceramic crucibles.

- The sample feeding for **TGA Thermostep** is done manually. After selecting the SOP in the software the pre-defined temperatures and gases are applied to the sample to determine the various thermogravimetric parameters.

- The sample feeding for **TGA Thermochain***, however, is done via an external autoloader at constant furnace temperature. The samples are ejected after the measurement, for example, after a successful ashing process. This allows for a high throughput at a fixed temperature. It is also possible to transfer a sample from one TGA Thermochain analyzer to another which operates at a different temperature

- The **TGA Automation*** is the basic model of a thermogravimetric analyzer which can be used in an automated process.

TGA Thermochain

1. *Resistance furnace*
2. *Autoloader with 36 positions*
3. *Crucible gripper*
4. *Collecting vessel*

NEW: Encapsulated Weighing Cell

TGA Thermostep & TGA Thermochain: Applications

Typical thermogravimetric parameters such as moisture, ash, volatiles or also the loss on ignition (LOI) can be reliably analyzed with the ELTRA TGA series. 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 |
| Automatic sample loader, transfer stations (TGA Thermochain) |

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.

Cement Production

Raw materials (lime, clay)

⬇

Grinding in a raw mill

⬇

Raw meal is burnt in the rotary kiln

⬇

Ball mill mixes raw meal with additives

⬇

End product cement

CS-800: analysis of carbon and sulfur in raw and intermediate products

TGA Thermostep: Determination of moisture

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

CS-800: analysis of carbon and sulfur in cement

CW-800: TOC/TIC determination in 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*
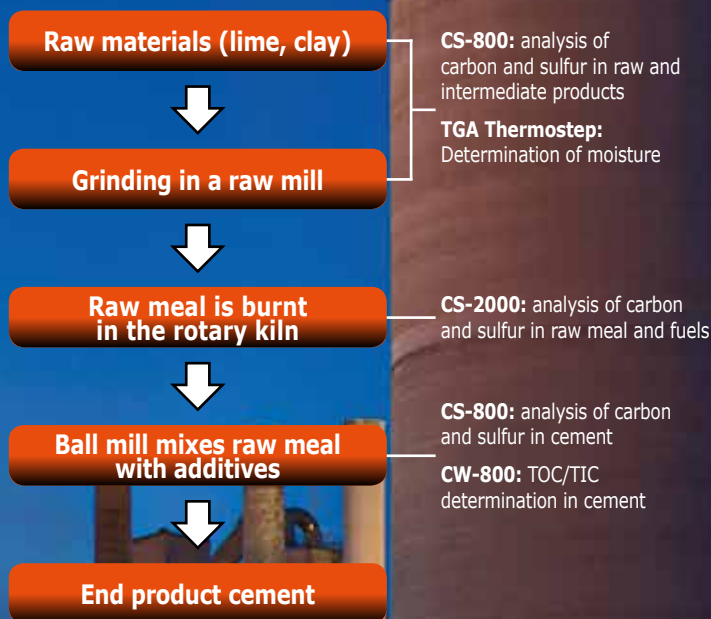
Determination of carbonate and water in cement

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.

Legend: — H_2O — CO_2
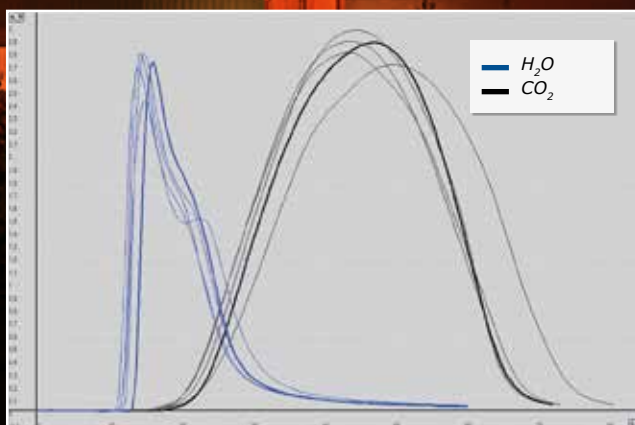
Elemental analysis of steel

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.

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 ELTRA's ONH-2000

Elements and steel properties

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

	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, CS-800, CHS-580**	**ONH-2000, CS-800**	**ONH-2000, H-500, CS-800**

ELTRA PRODUCT RANGE

Analysis of Carbon and Sulfur

CS-800

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

ON-900

OH-900

ONH-2000

H-500

Analyzers for special applications

CW-800

CW-800M "Multiphase"

SurfaceC-800

Thermogravimetric Analyzers

TGA Thermostep

VERDER scientific

CARBOLITE 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.