



**ELEMENTRAC**<sup>®</sup>

ELEMENTRAC CS-i  
ELEMENTRAC CS-d

**EXCELLENCE IN ELEMENTAL ANALYSIS**



| 1981

Foundation of  
ELTRA GmbH

| 1984

Launch of the  
C/S product line

| 1993

Development of  
the ON analyzer

| 1999

Launch of the  
ONH-2000 and  
CS-2000  
analyzers

| 2007

Development of  
the thermograv-  
imetric analyzer  
THERMOSTEP

| 2012

ELTRA becomes  
part of the Verder  
Group

| 2015

Launch of  
ELEMENTRAC  
ONH-p

| 2016

Launch of  
ELEMENTRAC  
CS-i

| 2018

Launch of  
ELEMENTRAC  
CS-d

| 2021

Launch of  
ELEMENTRAC  
ONH-p 2 with  
Autocleaner

## ELTRA – ELEMENTAL ANALYZERS

# EXCELLENCE IN ELEMENTAL ANALYSIS



Eltra GmbH in Haan, Germany

The history of ELTRA GmbH began in 1981 with the development of a carbon / sulfur analyzer for metals. Right from the start customer requirements were a priority, ensuring that ELTRA analyzers are easy to operate, have a long service life and provide reliable and precise measurement data even under harsh conditions, e.g. in a mine or near a blast furnace.

The best proof of our success are thousands of satisfied customers worldwide. They appreciate the reliability and flexibility of our analyzers, the good price-performance ratio of the instruments and consumables as well as the excellent after sales service. ELTRA analyzers are used in numerous industries, such as metal production and processing, aerospace, energy, medical technology, environment, but also in universities and research institutes.

ELTRA has been part of the Verder Group since 2012 and consistently invests in research and development. With the launch of the ELEMENTRAC series with powerful ELEMENTS software, ELTRA offers analyzers for fast and reliable O/N/H and C/S analysis that provide integrated solutions for special requirements in addition to modern design and convenient operation. The proprietary Dual Furnace Technology, for example, allows the analysis of organic and inorganic samples with one single instrument - a concept only offered by ELTRA.



## SOLUTIONS FOR C/S ANALYSIS

# ELTRA C/S ANALYZER ELEMENTRAC CS-i

For reliable carbon and sulfur analysis in a wide variety of samples such as metals, ceramics or fuels, ELTRA offers two powerful combustion analyzers with IR detection: the ELEMENTRAC CS-i and the ELEMENTRAC CS-d.



The ELEMENTRAC CS-i with a powerful induction furnace is ideally suited for robust analysis of carbon and sulfur in inorganic samples such as iron, steel, cast iron, alloys, glasses or ceramics.

## SOLUTIONS FOR C/S ANALYSIS

# ELTRA C/S ANALYZER ELEMENTRAC CS-i



The ELEMENTRAC CS-d enhances the ELEMENTRAC CS-i with a resistance furnace to additionally analyze organic samples such as wood, plastics, oils, soils for their C/S content.

Sample	Induction furnace	Resistance furnace
Metals: iron, cast, copper, titanium	✓	-
Soil	✗	✓
Cement	✓	✗
Lime	✓	✓
Ore	✓	✓
Coal, coke, wood, oil	-	✓
Plastics	-	✓
Waste	-	✓
Dust and ashes	✓	✗
Carbides (WC,SiC): Total C	✓	-
Free carbon in carbides	-	✓

✓ possible ✗ possible to a limited extent - impossible

## ELEMENTRAC CS-i

# C/S ANALYSIS IN INORGANIC MATERIALS VIA INDUCTION FURNACE



## BENEFITS ELEMENTRAC CS-I

- | Rapid C/S analysis (40 seconds)
- | Virtually no sample preparation
- | Wide measuring range from 1 ppm to 100 % for C and S
- | Analysis of pins, wires, powders, dust
- | Simple operation



## ELEMENTRAC CS-i

# OPERATION AND ANALYSIS PROCESS

The elemental analyzer ELEMENTRAC CS-i measures the carbon and sulfur concentration in predominantly inorganic samples through combustion in an induction furnace and the subsequent analysis of the gaseous combustion products carbon dioxide and sulfur dioxide.

The high temperature of more than 2000°C ensures complete decomposition of the sample and thus reliable and accurate elemental analysis over a wide concentration range.

The ELEMENTRAC CS-i meets and exceeds the requirements of all common standards for carbon and sulfur measurement, such as ASTM E1019, DIN EN ISO 9556.

### TYPICAL SAMPLE MATERIALS

I Steel, iron, cast iron, copper, alloys, ceramics, carbides, soil etc.

Sample ID	Weight (mg)	Application
Sample 1	850	C/S steel
Sample 2	875	C/S steel
Sample 3	1001	C/S steel
Sample 4	987	C/S steel
Sample 5	1010	C/S steel
Sample 6	979	C/S steel
Sample 7	969	C/S steel
Sample 8	1007	C/S steel
Sample 9	968	C/S steel

### STEP 1: LOGGING THE SAMPLE INTO THE ELEMENTS SOFTWARE

The sample ID is logged into the software and the weight is automatically transferred (see step 2).



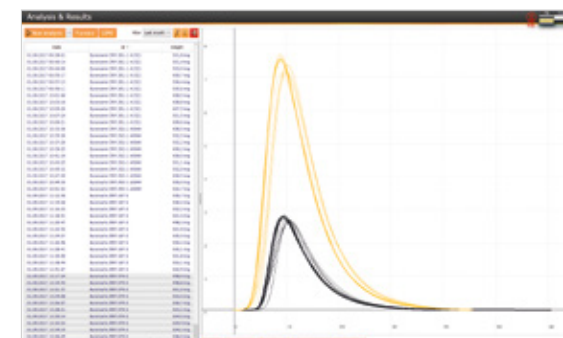
### STEP 2: WEIGHING AND ADDING OF ACCELERATORS

Sample volumes of 50 mg to 1000 mg are typical for C/S analysis. The sample is weighed in a ceramic crucible and accelerators like tungsten are added. The geometry of the sample (e. g. wire, powder, pin etc.) is not essential for a reliable analysis.



### STEP 3: ANALYSIS

The ceramic crucible is then placed on the pedestal and the analysis is started via the ELEMENTS software. The software controls all subsequent steps like combustion and evaluation.



### STEP 4: DATA OUTPUT AND EXPORT

45-60 seconds after the analysis has started, the measured carbon and sulfur concentrations are available for export as a report or via LIMS.

## BENEFITS ELEMENTRAC CS-d

- | Unique combination of induction & resistance furnace
- | IR path of massive gold
- | Wide C/S measuring range from 2 ppm to 100 %

### ELEMENTRAC CS-d

**C/S ANALYSIS IN INORGANIC  
MATERIALS VIA INDUCTION  
FURNACE & IN ORGANIC  
MATERIALS VIA RESISTANCE  
FURNACE**





## ELEMENTRAC CS-d

# OPERATION AND ANALYSIS PROCESS

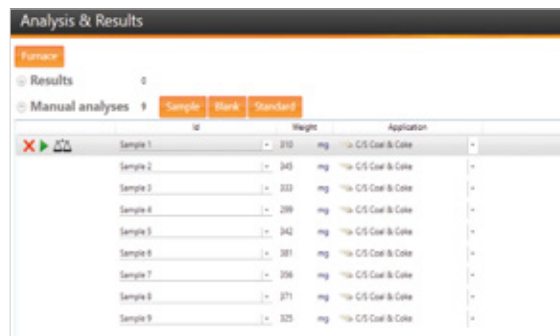
The ELEMENTRAC CS-d is equipped with a resistance furnace for the combustion of organic materials and an induction furnace for the combustion of inorganic materials.

For reliable carbon and sulfur analysis, the furnaces can be used independently without hardware adjustments. The shared detection unit detects the gaseous combustion products  $\text{CO}_2$  and  $\text{SO}_2$ . It consists of up to four infrared cells with an IR path made of solid gold which ensures a high resistance against aggressive combustion residues (e.g. halogens). The high temperatures of over 2000 °C in the induction furnace and 1550 °C in the resistance furnace guarantee a complete decomposition of the sample and thus a safe and precise C/S analysis over a wide concentration and sample range.

The ELEMENTRAC CS-d meets or exceeds the requirements of all common standards for carbon and sulfur measurement with combustion analyzers such as ASTM E1019, DIN EN ISO 9556. The use of the induction furnace is analogous to the ELEMENTRAC CS-i. The analysis process via resistance furnace is shown below.

### TYPICAL SAMPLE MATERIALS

- Induction furnace: steel, iron, cast, copper, titanium, ceramics
- Resistance furnace: coal, wood, soil, ore



id	Weight	Application
Sample 1	310 mg	C/S Coal & Coke
Sample 2	343 mg	C/S Coal & Coke
Sample 3	333 mg	C/S Coal & Coke
Sample 4	299 mg	C/S Coal & Coke
Sample 5	342 mg	C/S Coal & Coke
Sample 6	381 mg	C/S Coal & Coke
Sample 7	294 mg	C/S Coal & Coke
Sample 8	371 mg	C/S Coal & Coke
Sample 9	325 mg	C/S Coal & Coke

### STEP 1: LOGGING THE SAMPLE INTO THE ELEMENTS SOFTWARE

The sample ID is logged into the software and the weight is automatically transferred (see step 2).



### STEP 3: ANALYSIS

The sample is placed in front of the furnace and the measurement is started in the software. A green LED signals when the sample can be introduced to the furnace. During combustion the ELEMENTS software continuously records measurement values.



### STEP 2: WEIGHING THE SAMPLE

Sample volumes of 50 mg to 500 mg are typical for C/S analysis in a resistance furnace, depending on the material. The sample is directly applied to a boat. Accelerators are usually not required.



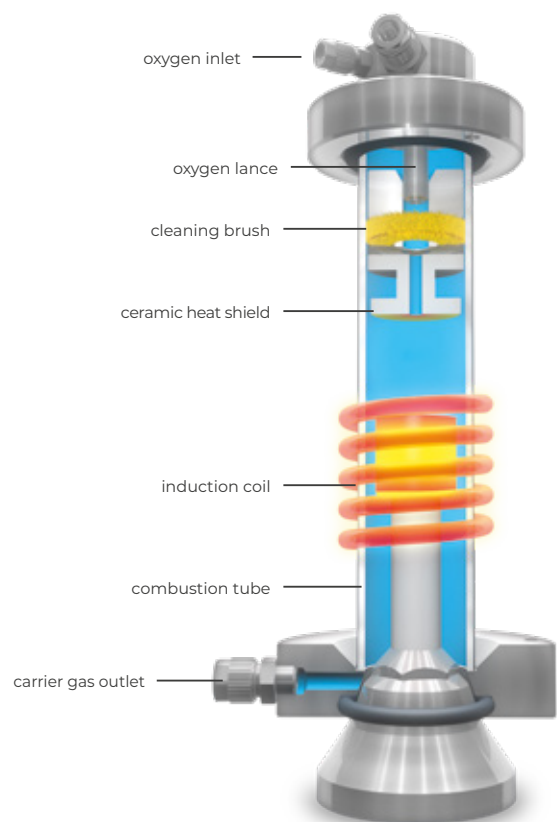
### STEP 4: DATA OUTPUT AND EXPORT

60 to 240 seconds after the analysis has started, the measured carbon and sulfur concentrations are available for export as a report or via LIMS.

## SOLUTIONS IN DETAIL

# OPTIMUM COMBUSTION IN THE INDUCTION AND RESISTANCE FURNACE

The ELEMENTRAC CS-i and CS-d offers intelligent solutions as standard features to provide accurate and reliable measurement of the carbon and sulfur concentrations also in complex sample:



### INTELLIGENT LANCE MANAGEMENT IN THE INDUCTION FURNACE

Due to the high temperatures in the induction furnace of  $>2000^{\circ}\text{C}$  and the high oxygen flow of 180 L/hour, solid samples of all types are completely decomposed, allowing for determination of the C/S content with the aid of infrared measuring cells. Here, thorough combustion ensures reliable measurement results.

Since powder samples might splash out of the crucible, which could lead to results below the actual value, the CS-i and CS-d

features an intelligent lance and combustion management system to ensure complete combustion without sample loss.

For this purpose, the oxygen flow to be dosed can be applied via a lance or the chamber to prevent blowing of the sample and allowing for controlled combustion. The ramping function of the induction furnace enables a gentle combustion process by gradual power increase.

### SAMPLE PORT IN THE RESISTANCE FURNACE (BLANK VALUE REDUCTION)

The ELEMENTRAC CS-d provides accurate and reliable analysis of samples with a low carbon content in the resistance furnace. Thanks to the optimized sample port geometry with reduced diameter and oxygen flushing at the sample entrance, the  $\text{CO}_2$  blank value of the atmosphere is drastically reduced when the sample is introduced which allows for reliable results in the low measuring range.



## SOLUTIONS IN DETAIL

# OPTIONS

In addition to the integrated features of the ELEMENTRAC CS-d and ELEMENTRAC CS-i, further options are available to increase the efficiency of the carbon / sulfur measurement.



### TIC MODUL

Carbon can be determined as total carbon (TC) or in fractions, i. e. total organic carbon (TOC) or total inorganic carbon (TIC). When combined with the ELEMENTRAC CS-d or CS-i, ELTRA's TIC module measures the TIC content by acidification in products like soil or construction materials.



### AUTOLOADER

The induction furnace of the ELEMENTRAC CS-i/CS-d can be equipped with an optional automatic sample loader. The standard module offers 36 crucible positions, the XL model even features 130 positions. It is the largest Autoloader available in the market for this type of application.



## SOLUTIONS IN DETAIL

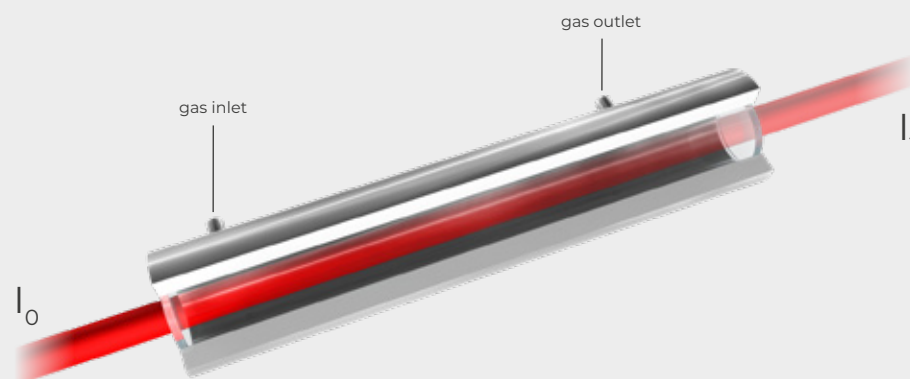
# SPECIAL CONFIGURATIONS OF THE ELEMENTRAC CS SERIES

With a broad customer base, ELTRA also has experience in the configuration of analyzers for special applications, such as sulfur analysis of sulfidic ores with very high sulfur content, or C/S analysis of halogen-containing salts.

### VERSIONS WITH HALOGEN TRAP OR CEMENT CONFIGURATION

Some samples release more water during inductive combustion; in case of higher sample volumes this may lead to lower results for sulfur determination, since  $\text{SO}_2$  is absorbed by the water vapor. An enlarged anhydron trap instead of a metal filter therefore offers greater reliability for sulfur measurements in building materials and ores, since larger amounts of water vapor can be filtered out.

Carbon and sulfur analysis in samples containing halogens such as  $\text{KBr}$ ,  $\text{K}_2\text{TaF}_7$ , can lead to massive corrosion in the analyzer. An optional halogen trap (image on the left) absorbs the corrosive halogens released during combustion, thus extending the maintenance intervals of the ELEMENTRAC CS-i or CS-d.



## SOLUTIONS FOR AN EXTENDED MEASURING RANGE

Products with a high sulfur content, such as  $\text{ZnS}$  or copper concentrates, can often only be measured with a reduced sample weight, as otherwise the measuring cells would be saturated due to the high sulfur content.

For these special applications, the analyzers of the ELEMENTRAC series can be equipped with more robust infrared measuring cells for carbon and / or sulfur analysis to extend the measuring range and thus improve the reproducibility of the results.

## ELEMENTRAC CS-i AND CS-d

# STANDARD-COMPLIANT OPERATION

Regardless of the ELEMENTRAC CS-i or CS-d version, both analyzers meet the requirements of the relevant standards such as ASTM and/or DINENISO.

The following standards are supported (among others):



No.	Name
15349-2	Unalloyed steel – determination of low carbon content
7526	Nickel, ferronickel and nickel alloys – determination of carbon content
4935	Steel and iron – determination of sulfur content
13902	Steel and iron – determination of high sulfur content
4689-3	Iron ores – determination of sulfur content



No.	Name
E-1019	Standard test method for determination of carbon and sulfur (...) in steel, iron, nickel and cobalt alloys
E-1587	Standard test methods for chemical analysis of refined nickel
E-1941	Standard test method for determination of carbon in refractory and reactive metals
E-1915	Standard test methods for analysis of metal bearing ores and related materials for carbon, sulfur



No.	Name
15936	Sludge, treated biowaste, soil and waste, determination of total organic carbon by dry combustion
1744-1	Tests for chemical properties of aggregates (sulfur measurement)
15350	Steel and iron – determination of total carbon and sulfur content
10694	Soil quality – determination of organic and total carbon after dry combustion
9556	Steel and iron determination of total carbon content



## ELTRA'S APPLICATION LABORATORY

For many common samples, such as copper and ceramics, no standards for carbon and/or sulfur analysis by combustion analysis and IR detection are published. To guarantee a safe and reliable measurement, the ELTRA laboratory in Haan is available for application consulting and free sample measurement with all ELTRA analyzers.

Participation in round robin tests (e.g. ASTM Powder Metallurgy) and participation in the certification of reference materials (e.g.: ECRM 268-1; ECRM 049-1) ensure a constantly high analysis quality.



## ELEMENTRAC CS-i AND CS-d

# THE ELEMENTS SOFTWARE

The C/S analyzers of the ELEMENTRAC series are controlled by the innovative ELEMENTS software. All essential functions are located in the main window (analyses and results), while less important functions such as application settings or instrument status can be used in other windows. Control and switching of windows is done by PC mouse or function keys.



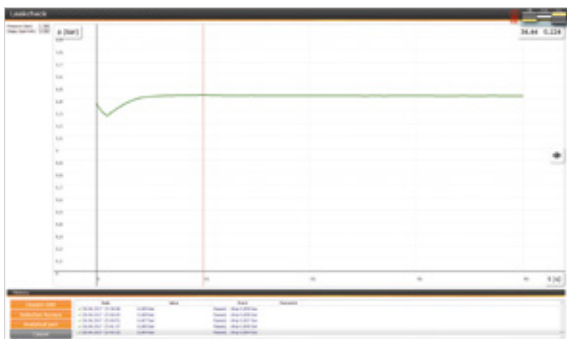
Clear display of measured samples and samples to be analyzed, analysis graphs and calibration functions in one window



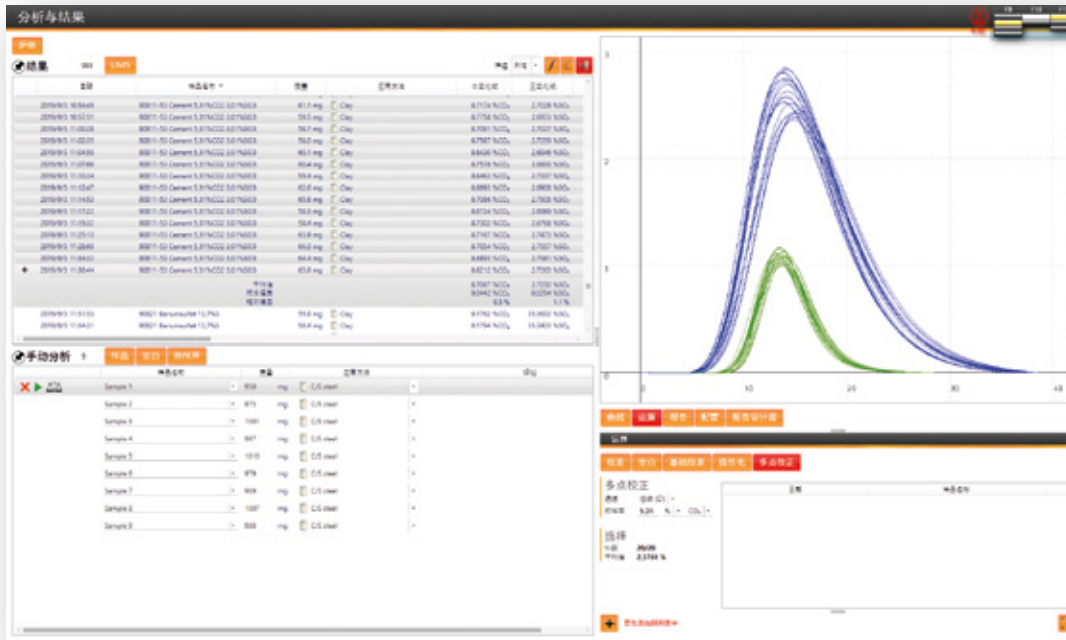
Comprehensive diagnosis screen for monitoring all relevant technical parameters



Clear representation of regression line and the measurement data used



Leakage test for monitoring the correct operation of the analyzer. Segmented evaluation is supported



## ELEMENTS SOFTWARE

# SELECTED FUNCTIONS

The ELEMETS software is characterized by quick usability, a clear structure and high security. Special strengths include reporting options and adaptation to different languages.

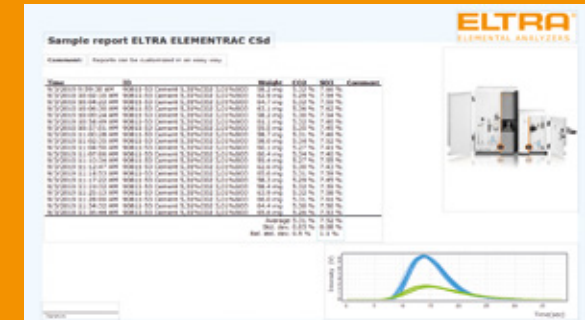
### THE ELEMETS SOLUTION FOR DIFFERENT LANGUAGES

Operating a software in a foreign language can lead to errors, especially under hectic conditions. The ELEMETS software delivery scope includes different languages, but can also be adapted to the local language any time via an external text file.

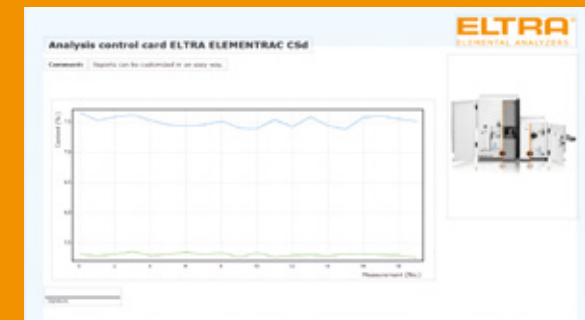
## ELEMENTS REPORT DESIGNER



The Report Designer interface allows convenient editing of tables, as well as adding images and diagrams.



Measured values can also be given as  $\text{CO}_2$ ,  $\text{SO}_2$  or  $\text{SO}_x$  values, as well as with and without statistics. All elements can be freely arranged on the surface.



The Report Designer can also be used to create control charts to help identify drift and outliers.

## APPLICATIONS

## ELEMENTRAC CS-i/CS-d

For the ELEMENTRAC C/S series, ELTRA offers a comprehensive collection of application instructions, which provides the specific analysis steps, instrument settings and measurement data for each sample to be analyzed.

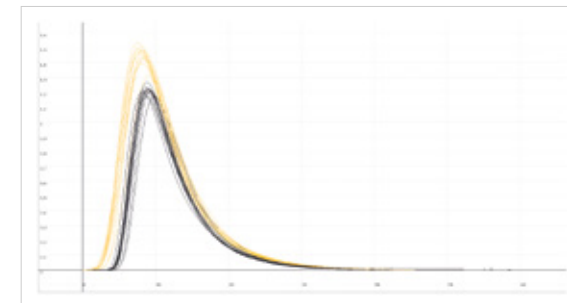


## C/S ANALYSIS IN STEEL

<b>Accelerator</b>	1.7 g Tungsten
<b>Sample weight</b>	500 – 1000 mg
<b>Analysis time</b>	30 – 50 seconds
<b>ELTRA application instruction</b>	1030

Weight (mg)	Carbon (%)	Sulfur (%)
500.2	0.2038	0.0297
502.2	0.2044	0.0298
501.5	0.2045	0.0297
498.3	0.2029	0.0302
501.9	0.2015	0.0303
505.5	0.2035	0.0300
505.2	0.2035	0.0302
502.1	0.2031	0.0304
501.8	0.2038	0.0302
502.9	0.2050	0.0302

<b>Mean value</b>	0.2036	0.0301
<b>Deviation</b>	0.0010	0.0003
<b>Rel. deviation</b>	0.5%	0.9%



<b>Sample</b>	ECRM 187-2	<b>Sulfur</b>	Yellow Peak	<b>X-axis</b>	Analysis time (sec)
		<b>Carbon</b>	Black Peak	<b>Y-axis</b>	Intensity (V)

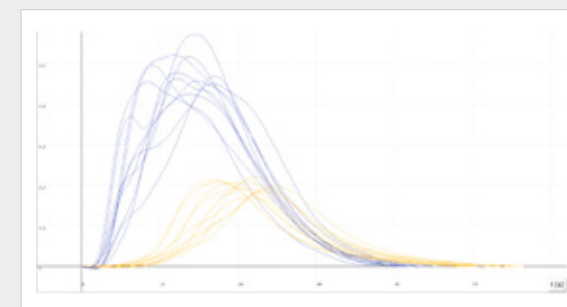


## C/S ANALYSIS IN COPPER

<b>Accelerator</b>	1 g copper
<b>Sample weight</b>	500 – 2000 mg
<b>Analysis time</b>	40 – 50 seconds
<b>ELTRA application instruction</b>	1037

Weight (mg)	Carbon (ppm)	Sulfur (ppm)
1071.1	18.71	30.35
1112.7	19.48	30.69
1124.3	15.64	28.77
1082.7	16.62	31.02
991.8	18.11	29.01
1133.2	13.74	28.93
1011.5	18.59	28.53
1086.7	20.06	29.37
1083.7	15.00	29.55
1071.8	16.19	28.32

<b>Mean value</b>	17.21	29.45
<b>Deviation</b>	2.08	0.94
<b>Rel. deviation</b>	12.09 %	3.18 %



<b>Sample</b>	IARM 158 B	<b>Sulfur</b>	Yellow Peak	<b>X-axis</b>	Analysis time (sec)
		<b>Carbon</b>	Blue Peak	<b>Y-axis</b>	Intensity (V)



## APPLICATIONS

## ELEMENTRAC CS-i/CS-d

For the ELEMENTRAC C/S series, ELTRA offers a comprehensive collection of application instructions, which provides the specific analysis steps, instrument settings and measurement data for each sample to be analyzed.

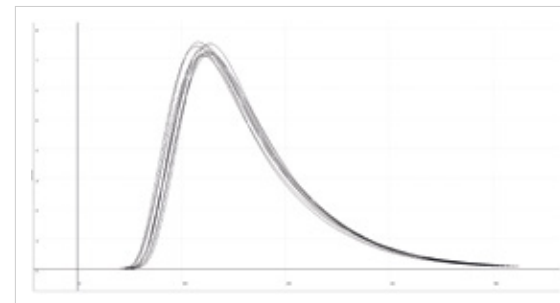


## C ANALYSIS IN TUNGSTEN CARBIDE

<b>Accelerator</b>	1 g copper, 1 g iron
<b>Sample weight</b>	50 – 300 mg
<b>Analysis time</b>	40 – 50 seconds
<b>ELTRA application instruction</b>	1033

Weight (mg)	Carbon (%)
257.7	6.1299
258.7	6.1206
264.7	6.1292
254.9	6.1270
261.8	6.1319
255.1	6.1288
261.8	6.1258
265.2	6.1378
256.2	6.1375
250.3	6.1310

<b>Mean value</b>	6.1300
<b>Deviation</b>	0.0051
<b>Rel. deviation</b>	0.1 %



<b>Sample</b>	<b>Carbon</b>	<b>X-axis</b>
ELTRA 90816-3001 (914C)	Black Peak	Analysis time (sec)
		<b>Y-axis</b>
		Intensity (V)

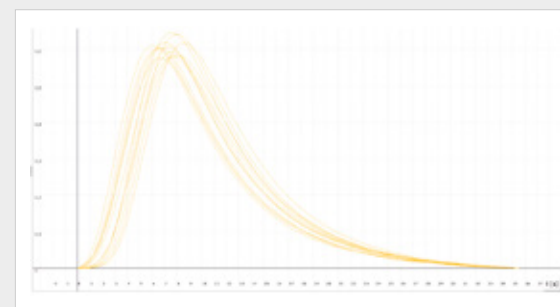


## S ANALYSIS IN SODA GLASS

<b>Accelerator</b>	0.7 g iron, 1.7 g tungsten carbide
<b>Sample weight</b>	100 – 150 mg
<b>Analysis time</b>	30 – 50 seconds
<b>ELTRA application instruction</b>	1039

Weight (mg)	SO <sub>3</sub> (%)
103.5	0.176
103.6	0.175
103.6	0.173
104.3	0.170
102.5	0.166
99.3	0.169
98.3	0.170
102.8	0.166
100.1	0.164
100.8	0.166

<b>Mean value</b>	0.170
<b>Deviation</b>	0.004
<b>Rel. deviation</b>	2.3 %



<b>Sample</b>	<b>Sulfur</b>	<b>X-axis</b>
NCS DC 61103	Yellow Peak	Analysis time (sec)
		<b>Y-axis</b>
		Intensity (V)

## APPLICATIONS

## ELEMENTRAC CS-d

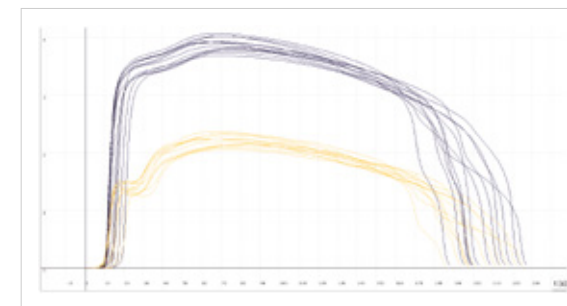
In addition to the induction furnace, the ELEMENTRAC CS-d also uses a resistance furnace which is more suitable for the analysis of organic products. In contrast to the induction furnace, no additives (such as tungsten) are required for measurements in the resistance furnace.



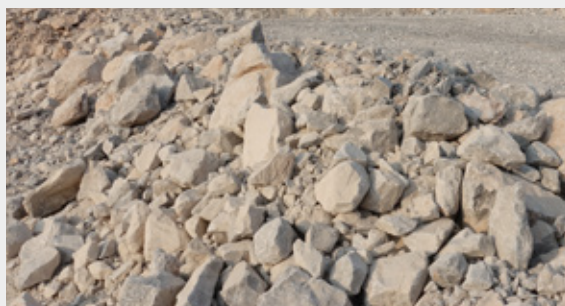
## C/S ANALYSIS IN COAL

<b>Furnace</b>	Resistance, 1350 °C
<b>Sample weight</b>	150 – 350 mg
<b>Analysis time</b>	120 – 240 seconds
<b>ELTRA application instruction</b>	1059

Weight (mg)	Carbon (%)	Sulfur (%)
351.6	61.24	6.18
350.0	61.48	5.93
349.2	60.68	6.14
360.0	60.69	6.16
355.8	61.42	6.21
360.1	59.95	6.19
342.1	59.78	6.22
372.0	60.10	6.22
348.2	60.7	6.26
365.2	60.45	6.24
<b>Mean value</b>	60.65	6.18
<b>Deviation</b>	0.59	0.09
<b>Rel. deviation</b>	1.0 %	1.5 %



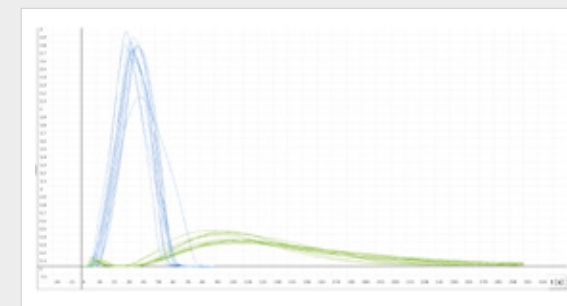
<b>Sample</b>	ELTRA 92511-3030(705114)	<b>Sulfur</b>	Yellow Peak	<b>X-axis</b>	Analysis time (sec)
		<b>Carbon</b>	Black Peak	<b>Y-axis</b>	Intensity (V)



## C/S ANALYSIS IN LIME

<b>Furnace</b>	Resistance, 1450 °C
<b>Sample weight</b>	150 – 300 mg
<b>Analysis time</b>	200 – 300 seconds
<b>ELTRA application instruction</b>	1061

Weight (mg)	Carbon (%)	Sulfur (%)
258.6	11.6	0.44
252.6	11.6	0.43
271.6	11.6	0.43
269.5	11.9	0.41
280.6	11.6	0.42
251.7	11.6	0.40
269.7	11.6	0.40
275.7	11.7	0.40
273.2	11.7	0.40
289.7	11.7	0.40
<b>Mean value</b>	11.70	0.41
<b>Deviation</b>	0.09	0.01
<b>Rel. deviation</b>	0.8 %	3.4 %



<b>Sample</b>	ELTRA 90812-3002(101602)	<b>Sulfur</b>	Green Peak	<b>X-axis</b>	Analysis time (sec)
		<b>Carbon</b>	Blue Peak	<b>Y-axis</b>	Intensity (V)

## APPLICATIONS

## ELEMENTRAC CS-d

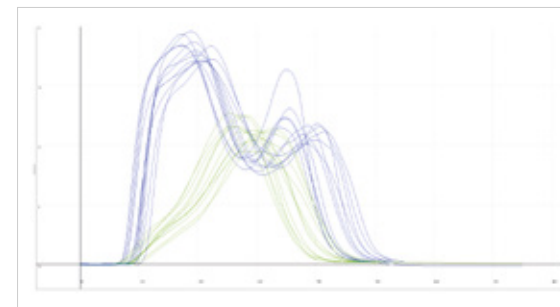
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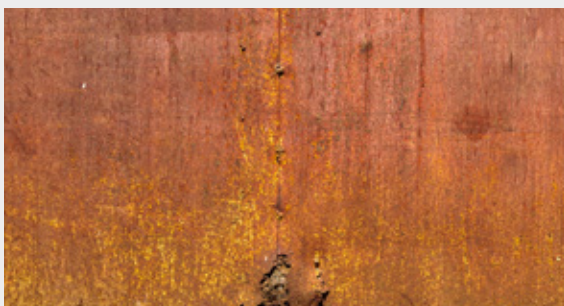
## C/S ANALYSIS IN SOIL

<b>Furnace</b>	Resistance, 1350° C
<b>Sample weight</b>	60 – 300 mg
<b>Analysis time</b>	60 – 300 seconds
<b>ELTRA application instruction</b>	1063

Weight (mg)	Carbon (%)	Sulfur (%)
256.1	0.48	0.43
253.2	0.48	0.42
250.7	0.51	0.44
259.6	0.50	0.44
260.0	0.50	0.43
258.1	0.50	0.44
263.3	0.49	0.43
260.4	0.49	0.43
263.7	0.50	0.45
257.1	0.51	0.45
<b>Mean value</b>	0.50	0.44
<b>Deviation</b>	0.008	0.009
<b>Rel. deviation</b>	1.7 %	2.2 %



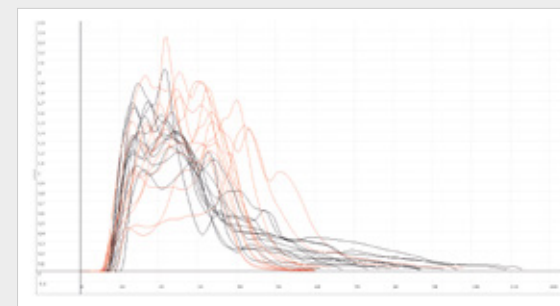
<b>Sample</b>	AR 4017 (313b)	<b>Sulfur</b>	Green Peak	<b>X-axis</b>	Analysis time (sec)
		<b>Carbon</b>	Blue Peak	<b>Y-axis</b>	Intensity (V)



## C/S ANALYSIS IN ORES

<b>Furnace</b>	Resistance, 1450° C
<b>Sample weight</b>	60 – 500 mg
<b>Analysis time</b>	60 – 300 seconds
<b>ELTRA application instruction</b>	1062

Weight (mg)	Carbon (%)	Sulfur (%)
353.5	3.80	3.84
356.3	3.81	3.77
381.3	3.80	3.76
373.0	3.73	3.82
366.7	3.75	3.81
356.2	3.64	3.82
352.8	3.73	3.86
369.8	3.75	3.85
357.1	3.74	3.85
363.9	3.70	3.79
<b>Mean value</b>	3.75	3.82
<b>Deviation</b>	0.05	0.05
<b>Rel. deviation</b>	1.4 %	0.9 %



<b>Sample</b>	ELTRA 91900-1002(615D)	<b>Sulfur</b>	Red Peak	<b>X-axis</b>	Analysis time (sec)
		<b>Carbon</b>	Black Peak	<b>Y-axis</b>	Intensity (V)

## Eltra GmbH

Retsch-Allee 1-5  
42781 Haan  
Germany

Phone: +49 2104 2333-400  
Fax: +49 2104 2333-499

info@eltra.com www.eltra.com



## VERDER scientific

### VERDER SCIENTIFIC

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