elementar

vario EL CUBE

elementar
vario EL CUBE

The roots of success

100 years ago, in the center of Germany, near Frankfurt, the advanced technology company Heraeus developed and manufactured the world's first elemental analyzer for organic substances.

From that foundation, a continuous progression of technology in elemental analysis products lead to the establishment of Elementar. Still at the same location today, Elementar is the world's leading producer of instruments for the analysis of C, H, N, S and O.

In the mid 90s a ground breaking technology in elemental analysis combining the two worlds of micro and macro elemental analysis – the now famous vario EL – was born. The worlds most successful instrument of its class now has a worthy successor.

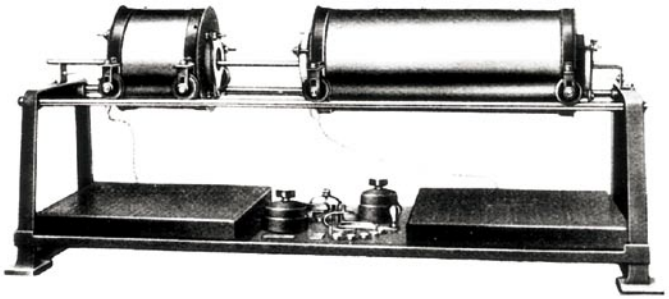
Given Elementar's century long expertise, it is not surprising that our newest development is particularly special.

- Wide variety of elements measured from nearly all types of samples.
- Highest precision and accuracy of the analytical results.
- Unsurpassed reliability and long time stability.
- High ease of use with a very innovative design.
- Lowest operation costs and set up requirements.

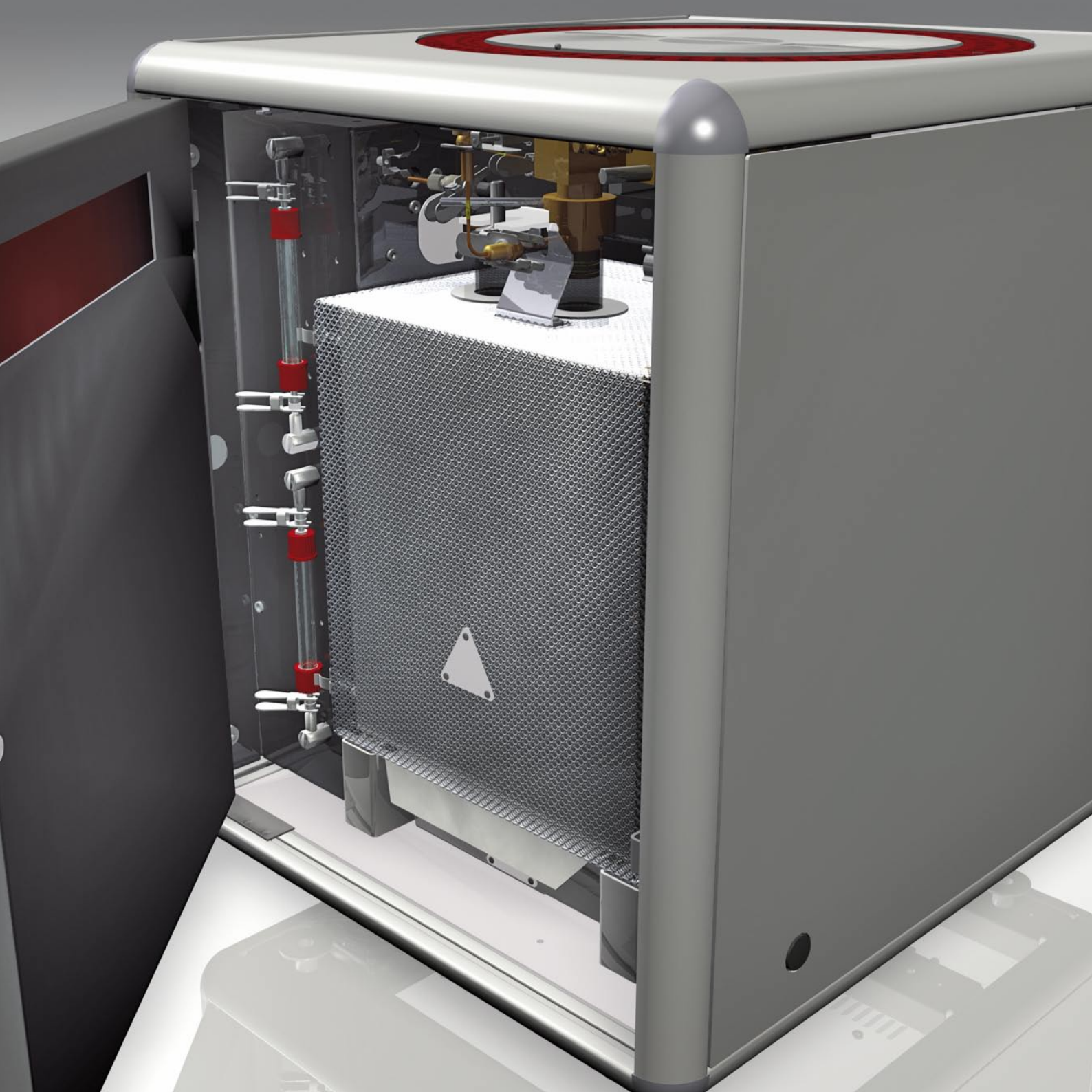
Elementar has coupled the latest developments in micro electronics and mechanics with the vast experience in elemental analysis. Newly developed separation and detection methods have been utilized.

Even the form and color of the new instrument line offer improved clarity of the basic concept and special demands of elemental analysis.

The progress in the analytical performance of the vario EL cube is particularly evident in the fact that apart from the characteristic ability of sample measurements up to the macro range, also the micro analysis of samples < 1 mg is possible with the same sensitivity and precision like the vario MICRO cube, the dedicated instrument for micro analysis



Heraeus Micro Analyzer 1930



The instrument concept - simply sophisticated

The measuring principle is impressively simple as shown in the functional diagram.

The samples are weighed in tin or silver vessels and loaded in the integrated carousel for 80 samples. In a fully automatic process, the transfer of the sample through the ball valve into the combustion tube is performed.

Each sample is individually flushed with carrier gas (Heraeus patent) to remove atmospheric nitrogen, resulting in a zero blank sampling process.

The catalytic combustion is carried out at a permanent temperature of up to 1200 °C. Unique is the furnace warranty of 10 years!

For special applications, even 1400 °C can be selected.

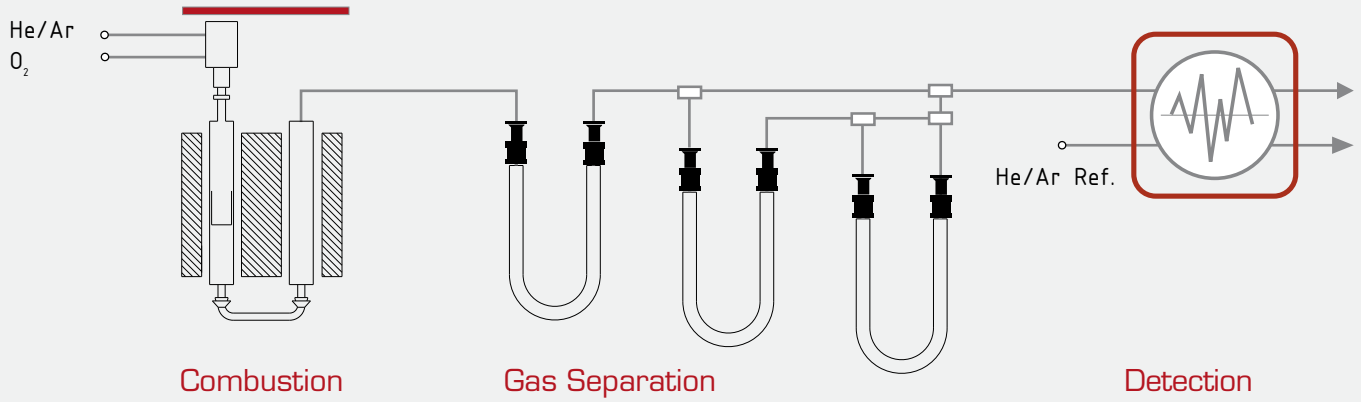
Subsequently, the reduction of the combustion gases on hot copper is carried out in a second furnace. The formed analysis gases, N_2, CO_2, H_2O and SO_2 remain in the He carrier gas stream.

The gas mixture is separated in its components via three columns by the well proven purge & trap chromatography and is subsequently fed into a thermal conductivity detector (TCD).

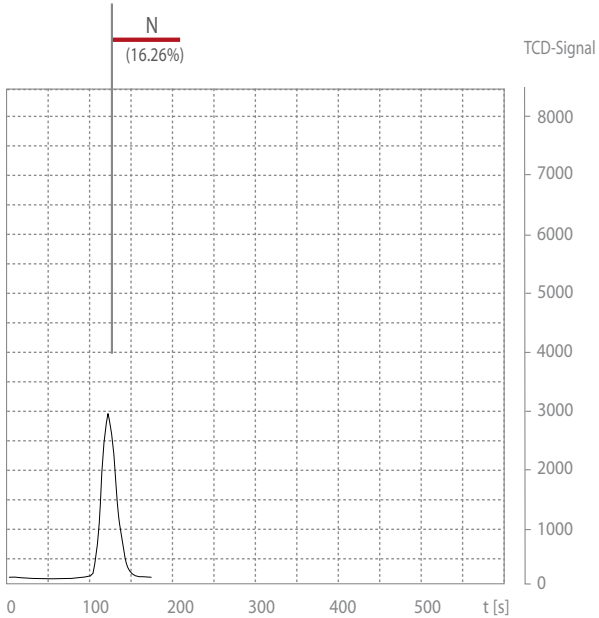
The TCD is based on thermistor technology, is impervious to damage from oxygen intrusion, and stands out for particularly high stability and measuring dynamics.

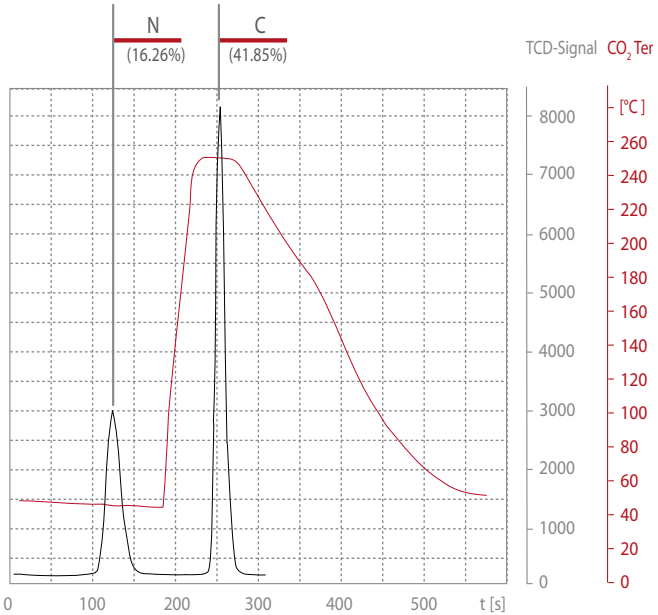
Right before the detector an electronic gas flow controller ensures absolutely stable pressure and flow conditions. This results in a stable instrument calibration over months or even years.

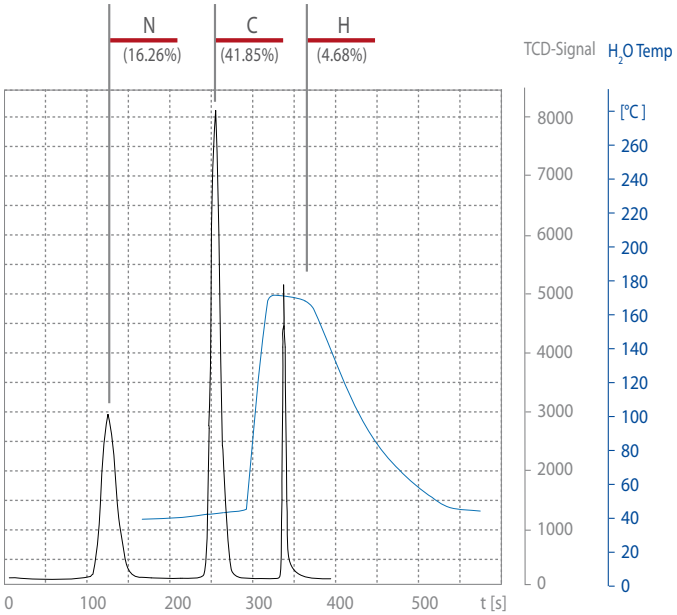
A connected PC computes the element concentration from the detector signal, and the sample weight on the basis of stored calibration curves.

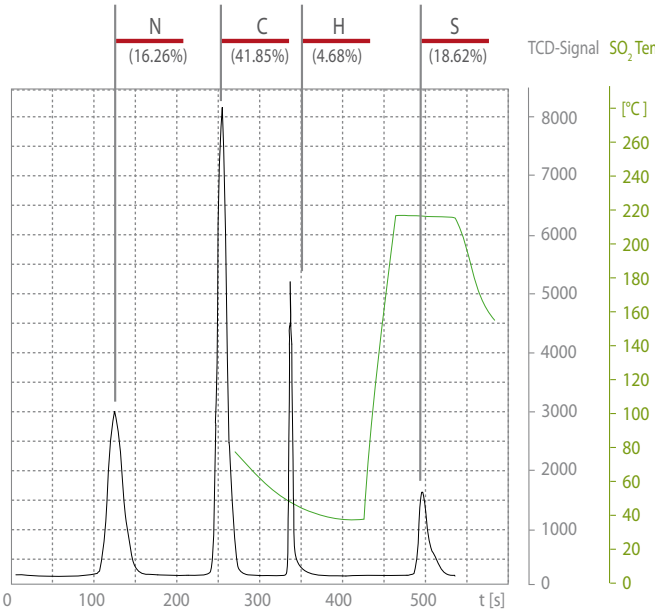


Peak graphic - Sulfanilamide









The perfect gas separation

Controlled desorption on three columns allows a very wide dynamic range.

The CHNS elemental analysis is based on the high temperature combustion and subsequent analysis of the combustion gases. The quantitative separation of the analyte gases N_2, CO_2, H_2O and SO_2 in the He carrier gas prior to the detection is crucial for the performance of the complete instrument.

With vario EL cube Elementar uses a well proven way for the highest demands. The adsorption of the measuring gases on three separation columns and their controlled desorption allow a very wide dynamic range.

CO_2, H_2O and SO_2 are specifically adsorbed while passing through the adsorption columns whereas N_2 gets to the detector. After the detection of the N_2 peak, the CO_2 column is quickly heated up. CO_2 is released and detected. The temperature increase of the second column desorbs H_2O, the third column is specifically meant for SO_2.

Each heating step takes place only after completion of previous peak detection on the TCD. Thus, a complete peak separation is secured - independent from the concentration ratio, even if large differences in contents e.g. of C and N are existent.

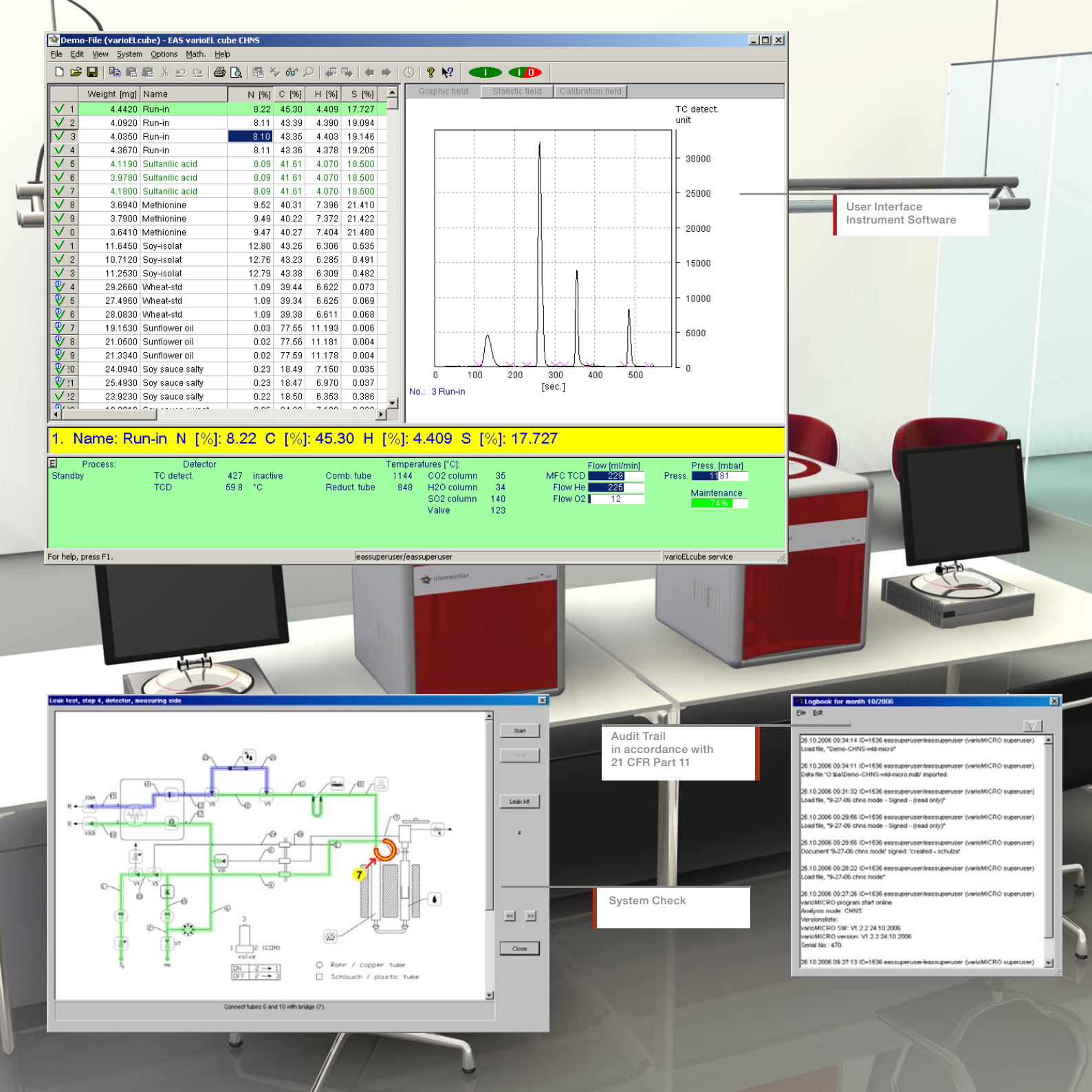
The purge & trap chromatography has the advantage that large amounts of organic material of up to 40 mg carbon content as well as large concentration differences of the elements can be analyzed. Thus it is unsurpassed without any cutbacks in the analysis of micro samples.

Problems of peak overlapping and drift known from gas chromatographic separation do not occur.

The thermally controlled ad- and desorption causes a peak sharpening and at the same time an enhancement of the detection sensitivity.

The ability to time control the adsorption behavior over a large range makes it also possible to determine the isotope ratios (IRMS) of CNS or even CHNS in one analysis run – even for low S or N concentrations.

Helium is used as carrier gas for the standard mode. For special applications argon can be used as an alternative to helium. It shall be observed that by changing the physical characteristics changes in the performance parameters may occur.


Demo-File (varioELcube) - EAS varioEL cube CHNS
File Edit View System Options Math. Help
Graphic field
Statistic field
Calibration field
TC detect. unit
[sec.]
No.: 3 Run-in
1. Name: Run-in N [%]: 8.22 C [%]: 45.30 H [%]: 4.409 S [%]: 17.727
Process:
Standby
Detector
TC detect. 427 inactive
TCD 59.8 °C
Temperatures [°C]:
Comb. tube 1144
Reduct. tube 848
CO2 column 35
H2O column 34
SO2 column 140
Valve 123
Flow [ml/min]
MFC TCD 229
Flow He 225
Flow O2 12
Press. [mbar]
Press. 1181
Maintenance
74%
For help, press F1.
eassuperuser/eassuperuser
varioELcube service
User Interface
Instrument Software
Leak test, step 4, detector, measuring side
Start
Leak kit
Close
Rohr / copper tube
Schlauch / plastic tube
Connect tubes 6 and 10 with bridge (7).
System Check
Logbook for month 10/2006
File Edit
Audit Trail
in accordance with
21 CFR Part 11

Digitalization in the user‘s interest

In our time an analytical instrument can only be as good as its micro electronics and software.

The cube instruments of Elementar set new standards as the first elemental analyzers in which all instrument functions are digitally controlled and monitored. This results in completely new possibilities for automatic operation, optimization as well as remote control and diagnosis over the internet.

The basis for this is the use of the new micro processor generation with 24 bit signal processing and electronic sensors for all gas flows and pressures.

The vario EL cube‘s firmware (internal software of the analyzer) is stored on flash memories, which can be easily updated via PC or the internet. The critically important fast signal communication between components in the analyzer (such as the detector signal) is handled by the fail-safe CAN bus technology.

A commercial PC or laptop serves as the user interface for control and evaluation. Our software runs under the Windows® operating system and offers features and capabilities too numerous for a complete listing here. It equals in all points the state of the art in electronics.

Almost unlimited storage capacity of analytical data incl. graphics, statistics, automatic optimization of the operation conditions and monitoring of the maintenance intervals or service messages are a matter of course like the implementation into existing networks and data transfer into LIMS. Data transfer to table calculation programs like Excel® is easily possible. Self-explanatory user navigation and content sensitive on screen help make printed manuals almost obsolete. Graphical leak checking with pictorial guides for each step are a new favorite feature of users.

The system is designed for intuitive operation, but content sensitive help is just a click away. User friendliness is the best definition of the basic software concept. Without special skills of the operator the software serves for the best adoption of the instrument setting on the analytical tasks.

A software of this class is of course in accordance with the strict requirements on data safety of 21 CFR Part 11.

The software of Elementar instruments is developed at our own premises by our own personnel, also in the best interest of our users.

	Carbon *		Hydrogen *		Nitrogen *		Sulfur *	
N-F-dibenzolsulfonimide	45.46	± 0.05	3.39	± 0.02	4.45	± 0.11	20.38	± 0.05
Measurements: 4 Weight: 5 mg								
Sulfanilic Acid	41.68	± 0.017	4.04	± 0.02	8.05	± 0.015	18.47	± 0.05
Measurements: 5 Weight: 5 mg								
Starch	39.66	± 0.01	7.078	± 0.012	0.042	± 0.003	0.014	± 0.0038
Measurements: 4 Weight: 35 mg								
Wheat	40.70	± 0.02	7.149	± 0.018	1.86	± 0.01	0.101	± 0.002
Measurements: 6 Weight: 35 mg								
Soil	0.634	± 0.017	0.208	± 0.018	0.019	± 0.006	0.004	± 0.0004
Measurements: 4 Weight: 100 mg								
Coal	59.02	± 0.03	3.73	± 0.01	1.13	± 0.02	1.42	± 0.01
Measurements: 4 Weight: 10 mg							(S mit IR Detektor)	
Soy Sauce	24.80	± 0.09	6.21	± 0.03	0.354	± 0.001	–	–
Measurements: 3 Weight: 25 mg								
Oil	86.506	± 0.046	10.531	± 0.024	0.671	± 0.041	1.634	0.030
Measurements: 6 Weight: 20 mg							**Oxygen ***	
Kerosine (O with IR)	–	–	–	–	–	–	0.351	0.007
Measurements: 8 Weight: 15 mg							**Chlorine ***	
PVC (Chlorine)	–	–	–	–	–	–	44.336	0.888
Measurements: 6 Weight: 25 mg								

* Element concentration in [%], Standard deviation in [%]

The most flexible CHNS analyzer

vario EL cube is the most flexible instrument for the universal elemental analysis of CHNS, as well as optional O and Cl.

The applications cover all organic and the majority of inorganic samples of solid or liquid material. Its special strength lies in its flexibility. Sample weights in the lower milligram range or in the semi-macro range are analyzed in one work step. Regarding detection limit, concentration dynamics and the possibility to also analyze difficult samples e.g. those with a high fluorine or chlorine content vario EL cube is without any alternative.

A key characteristic is the ability to analyze organic samples up to a weight of 40 mg in the CHNS mode, as well as 1 gram of soil samples.

This is possible due to the quantitative combustion at a continuous furnace temperature of up to 1200 °C. Another key to the complete combustion of even samples with large gas generation is the oxygen „jet injection“ via a ceramic lance directly at the place of combustion. Combustion gases which could otherwise insulate further combustion are blown away by the high velocity oxygen jet.

Element concentrations of well below 100 ppm to 100 % are detectable with the standard detector (TCD).

For even lower detection limits, special detectors can be employed. As one example an IR photometer allows the detection of sulfur down to 2 ppm.

The basis for the special detection strength is the high amplifying dynamic of the detector signals, the short gas pathways, and the high stability of the gas flow by means of a digital mass flow controller directly before the detector.

Therefore the entire range of applications from organic chemistry, pharmaceuticals, petrochemical and other industrial products, to fossil fuels, environmental samples or bio material can be handled.

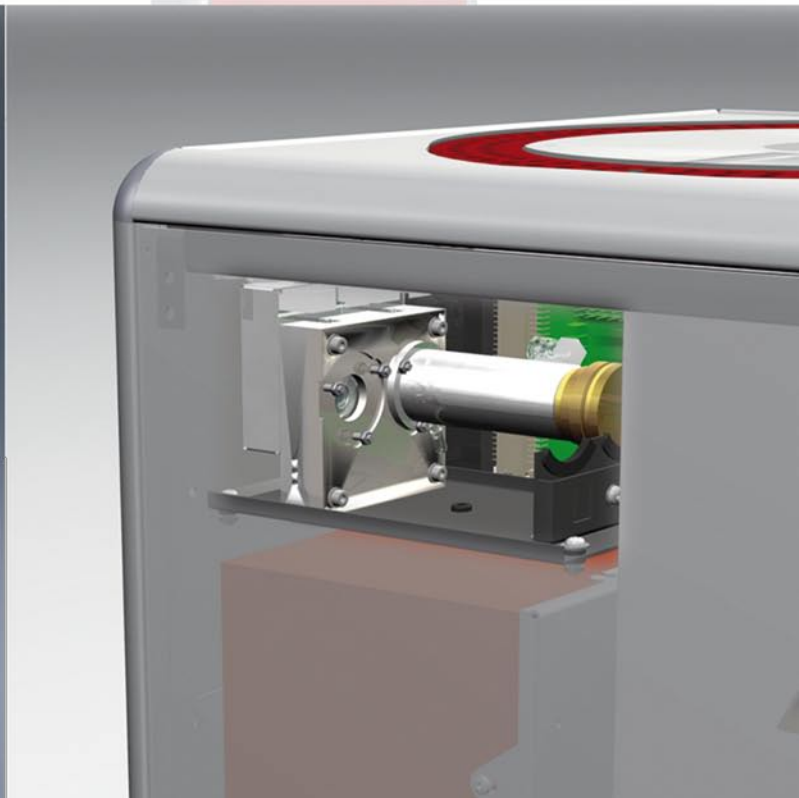
For particularly inhomogeneous samples which are difficult to grind or homogenize, large samples weights are required. In these cases alternative instruments of the vario family such as the vario MACRO or vario MAX are available.

Long lifetime requires sustainability

The lifetime of an elemental analyzer is very long – we can guarantee it. However, the requirements for an elemental analyzer change over the course of time just like the requirements in the laboratory may change. Due to a modular construction, the intelligent design and the various options vario EL cube is ready for the use in your laboratory – no matter what the future may offer.

Isoprime
elementar

elementar



Adding value systematically

In addition to the standard CHNS determination, easy add-on options provide the broadest application range for the elemental analysis:

Upgrade kits for oxygen determination

using high temperature pyrolysis. Conversion to CO in the presence of carbon, and measurement of CO with standard TCD, or for special requirements with IR detection. High pyrolysis temperature of max. 1400 °C for special IRMS applications.

Sulfur measurement with IR detection

for the improvement of the detection limit for S to approx. 2 ppm simultaneously to CHN determination. Recommended also for samples with a high fluorine content.

Accessory for chlorine analysis

with absolutely new IR detection of HCl in the combustion gas. This results in a large dynamic concentration range of < 0.1 to 100% (patent pending).

Measurement of liquid samples

- capsule technique
- manual injection
- automatic liquid sampler

for the analysis of liquids for absolutely gas tight sealing of liquids in capsules. Also applicable for the analysis of air sensitive samples under inert gas.

Accessories for special applications

like steel tubes for the combustion of aggressive samples (CN mode), reaction tubes with a diameter of 14.5 mm for a particularly small dead volume (e.g. for very small sample weights), special means for large sample amounts, accessories and consumables for high fluorine contents, interface for mass spectrometer coupling, ceramic equipment for 1400 °C high temperature pyrolysis.

Isotope ratio analysis (IRMS) analysis

The coupling with an Isoprime IRMS (or instruments of other manufacturers) offer special features in stable isotope ratio analysis. A major advantage is the simultaneous multielement analysis of CNS or even CHNS isotopes in one automatic analysis run (patented). Additionally, H and O can be determined pyrolytically (up to 1400 °C). Aside from the analysis of very small sample amounts of below 1 mg, also the isotope analysis of up to 40 mg organic substance or 1 g soil is possible. This is particularly advantageous for inhomogeneous samples or for low N and S contents.

Software for quality assurance

e.g. the safety of electronic data (21 CFR Part 11), analytical quality assurance (AQS) and instrument validation (IQ, OQ) are available.

Specifications vario EL cube

Analysis method:	High temperature combustion or pyrolysis of the sample and conversion of the elements into gaseous products. Separation of the analysis gases by purge & trap chromatography at up to 3 specific columns and detection at TCD (IR optional).
Operating modes:	CHNS, CHN, CNS, CN, N, S as standard with TCD, S with IR detection optional, O with TCD or IR detection optional, Cl with photometric detection optional.
Digestion temperatures:	adjustable up to 1200°C, for special applications also selectable up to 1400°C (by combustion of the tin vessels a temperature of approx. 1800°C is temporarily reached).
in accordance with the safety standards:	CE-label, EN 61010–1, EMV low voltage directives 73/23/EEC
Detection range*:	C: 0-40 mg (or 100%) N: 0-15 mg (or 100%) H: 0-3 mg (or 100%) S: 0-6 mg (or 100%) O: 0-6 mg Cl: 0-2 mg
Detection limit*:	< 40 ppm with TCD 2 ppm with IR detection for S
Standard deviation*:	< 0.1% abs. (1-2 mg sulfanic acid)

* depending on sample kind, analysis mode and options

Specifications vario EL cube

Calibration:	Multi point calibration, regression linear to the 4th order, stable over months.
Sample weight*:	0.02 - 50 mg organic substance or up to 1 g soil sample.
Analysis time*:	self-optimizing depending on element content and sample weight

e. g.	CHNS	10 min
	CHN	8 min
	CN	6 min
	N	3 min

Autosampler:	80 positions in a magazine as standard reloadable any time during operation 120 or 60 positions depending on sample size optional direct injection of liquid or gaseous samples optional

Gases:	He:	99.995% purity	3 l/analysis
	O_2:	99.995% purity	0.05 l/analysis
	Ar:	alternative carrier gas (deviating analytical specification)	

Instrument control:	Operation and control via PC under Windows®; All instrument functions are digitally controllable, the comprehensive operation software includes e.g. automatic leak test, extensive error diagnosis, monitoring of the maintenance cycles, sleep-/wake up function, statistical evaluation and almost unlimited memory capacity for analysis data incl. graphics. Integration in data networks like LIMS and the possibility of remote control and diagnosis via the internet. In full compliance with 21 CFR Part 11 (option).
Electrical connections:	100/110/200/230 V, 50/60 Hz, 1,8 kW
Dimensions:	42 × 55 × 55 cm (W × D × H)
Weight:	approx. 65 kg

* depending on sample kind, analysis mode and options

vario EL cube is the most flexible instrument for the micro or semi-macro elemental analysis of C, H, N, S and O and Cl. Number, combination and occurance of the analyzed elements as well as precision of their determination by using most modern technologies represent the most advanced state of instrumental analysis for application areas like:

Chemistry and Pharmaceutics

Fine chemicals, pharmaceuticals, catalysts, polymers, oil products, etc.

Industrial quality control

Rubber, fertilizers, building materials, dyestuffs, cosmetics, etc.

Agriculture and Environment

Plants, soil, food, compost, sewage sludge, waste, etc.

Fossile fuels and power generation

Coal, coke, fuel oil, biomass and other alternative fossile fuels

Special applications

Sulfur trace analysis, chlorine determination, isotope ratio analysis

19.00-5204