

## Elementar varioMACRO cube (CHNS) Methodology

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### **Instrumentation**

varioMACRO cube

### **Sample Analysis**

Following the running of blanks and standards for daily corrections, typically ~ 20 to 200 mg of sample material is weighed into a tin foil, dependent on the program and type of sample (weights up to 1500mg are possible). Additives may be used depending on the sample. The weight is recorded and the appropriate calibration program is selected. The tin foil is pressed/folded and placed in the loading assembly for analysis. The sample is combusted at 1150 °C, the resulting gases analysed and the results checked by staff before release.

### **Theory of Operation:**

After atmospheric gases have been flushed from the instrument system and the sample has dropped into the combustion crucible, oxygen dosing begins and C, H, N and S burn to form gaseous reaction products: CO<sub>2</sub>, H<sub>2</sub>O, N<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub> and SO<sub>3</sub>. Halogens react to form volatile halogen compounds. The combustion temperature for the system is 1150 °C. The gases pass through the combustion tube which prevents the formation of non-volatile sulphates and binds alkali and earth alkali elements, before passing through the reduction tube, where SO<sub>3</sub> is reduced, NO<sub>x</sub> is completely reduced and volatile halogen compounds are bound. The gas components are absorbed by a column and individual gases to be measured are then separated, with the exception of N<sub>2</sub>, which is not absorbed and analysed first. The individual gases are transported by a carrier gas to be measured by a thermal conductivity detector (TCD) (EA, 2017: 47-50).

The TCD "consists of two chambers through which the analysis gas mixture (measuring cell) and the pure carriage gas (reference cell) simultaneously flow through during the analysis. The chambers form a measuring bridge. The thermal conductivity of the carrier gas reacts sensitively on the addition of small amounts of foreign gases such as the measuring components N<sub>2</sub>, CO<sub>2</sub>, H<sub>2</sub>O and SO<sub>2</sub>. If one of these measuring components exists in the analysis gas mixture, this leads to a disturbance of the measuring bridge that is registered in the form of an electrical signal. The TCD measuring signal is digitized, integrated and output by the instrument to the PC, where it is registered in the form of a measuring peak dependent on time, and the integral is correlated with the absolute quantity of the respective measuring component by calibration functions." (EA, 2017: 45)

### **Reference**

Elementar Analysensysteme GmbH (EA), 2017, *Operating instructions vario MACRO cube CHNOS Elemental Analyzer*. Langensfeld, Germany: Elementar Analysensysteme GmbH.