CHNS Analyzer

CHNSO

Techniques & Applications

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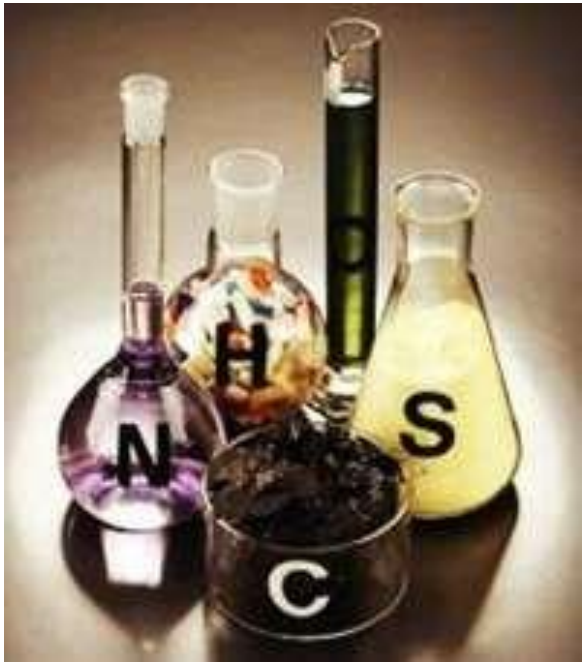


BASIC THEORY

CHNS Analyzer

- **Organic Elemental Analyzer "OEA" is a simultaneous technique to determination of :**

  Carbon,

  Hydrogen,

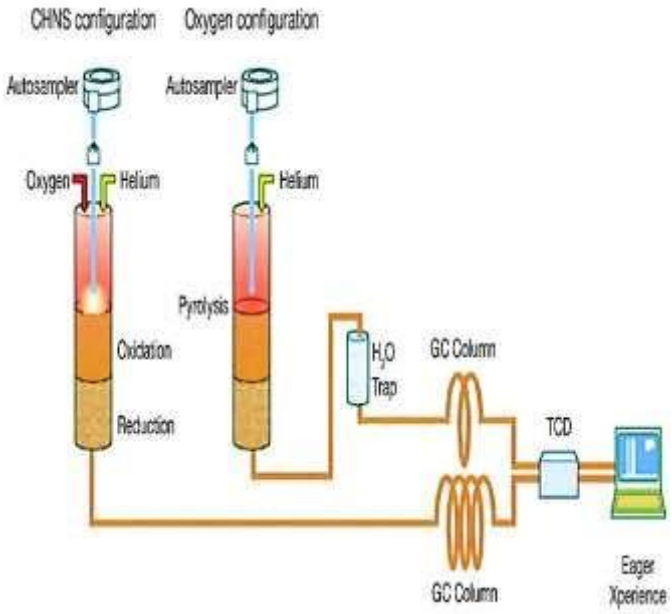
  Nitrogen,

  Sulfur.

  contained in organic and inorganic materials in solid, liquid, and gas forms.

CHNS Combustion sequence

1. Organic or inorganic, solid or liquid are weighed in a tin capsule.
2. Introduced into the combustion reactor by an AS.
3. Inserted in the special furnace heated at 1020°C.
4. A small volume of pure Oxygen is added to the system and helps to burn the sample.
5. Reduction “Using copper” converting the sample into elemental gases.
6. A separation column and TCD detector allows the user to determine elements.

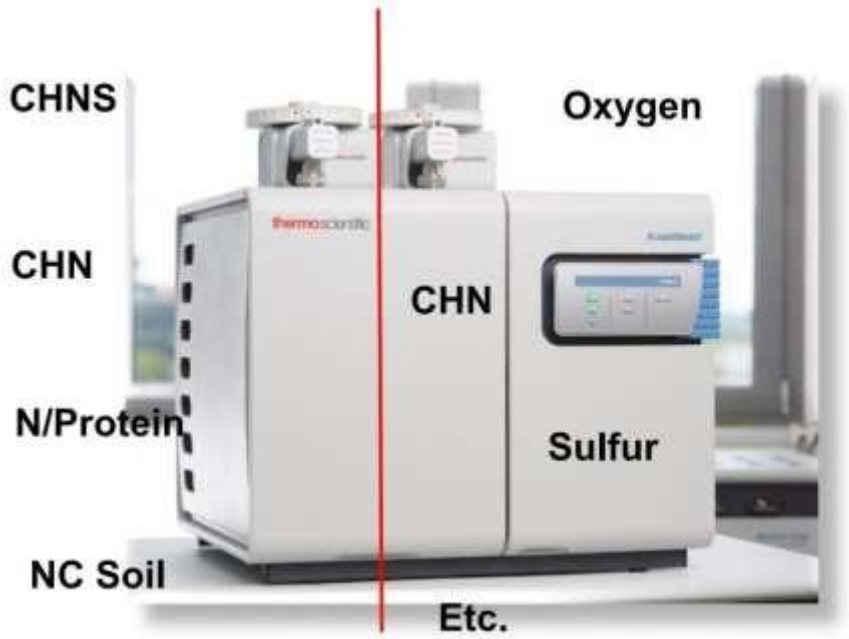


HARDWARE

Instruments configuration

The molecular design of the FLASH 2000 Series means that laboratories can easily change the configuration to any other, according to their needs and application fields.

- **CHN**
- **CHNS**
- **NC ORG**
- **NCS**
- **NC soil**
- **N lube**
- **N org**
- **N protein**
- **Oxygen**
- **Sulphur**



Hardware configurations

The instrument, in its different configurations, consists

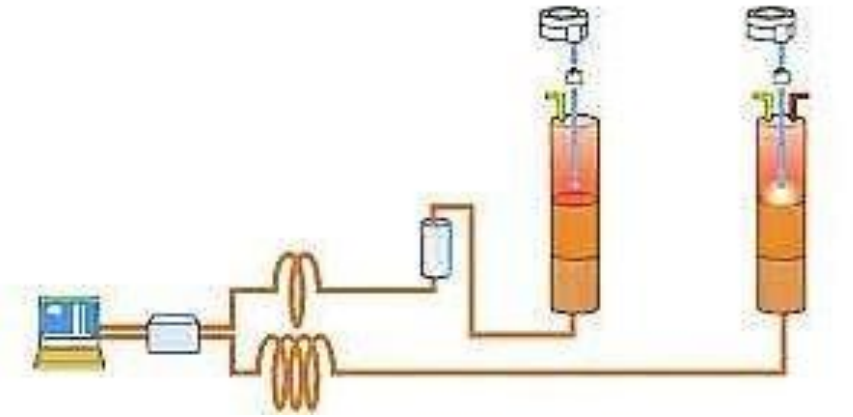
in a single structure subdivided into two sections:

I. **Analytical Section**

II. **Control Section**

I. Analytical Section

1. **Autosampler**
2. **Reactors**
3. **Adsorption Filters**
4. **Furnaces**
5. **Chromatographic Columns**
6. **Thermal Conductivity Detector (TCD)**



1. Autosampler

- It performs the automatic injection into the reactor of samples.

  - Liquid autosampler
  - Solid autosampler

Auto Injector AI 3000

Sample loading

Sample capacity:	8 Vials
Max. vial capacity:	2 ml
Injections/vial:	0-99

Syringes

Standard sampling:	10µl
Micro volume sampling:	5µl

Injection parameters

Max volume:	5µl
Min. Volume :	0.1µl
Increments:	0.1µl steps
Viscosity Delay:	Yes/No

Auto Sampler AS 3000

Sample loading

Sample capacity:	105 Vials
Max. vial capacity:	2 ml
Injections/vial:	0-99

Syringes

Standard sampling:	10µl
Micro volume sampling:	5µl

Injection parameters

Max volume:	5µl
Min. Volume :	0.1µl
Increments:	0.1µl steps
Viscosity Delay:	Yes/No

MAS 200 R Autosampler for Solid Samples

- It is mounted directly on the connecting fitting of the concerned reaction tube.

It consists of:

- Anodized aluminum block provided on the left with fittings for carrier gas and purge gas lines connection.
- 32-position sample-holding tray.
- Up to 4 optional trays are available to accommodate 125 samples.

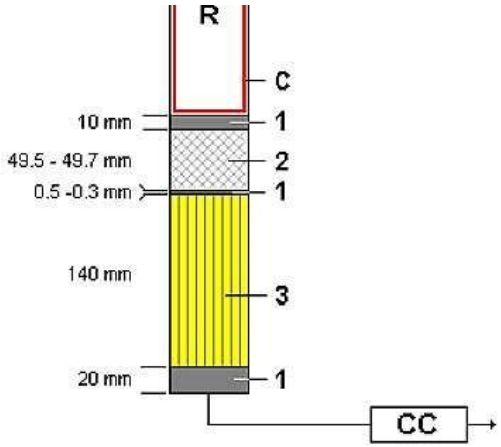
2. Reactors

- The reactors can be quartz tubes or special steel tubes.
- The quartz and special steel tubes have a conical bottom end.
- The special steel reactors have their top end provided with two through-holes.
- The filling materials used vary according to the analytical determination required.

CHNS Analyzer

CHNS Reactors

- If the sample to be analyzed presents particular characteristics (high presence of inorganic material) we suggest to insert the quartz crucible into the oxidation/ reduction reactor.
- In this case it is necessary to reduce the Quartz Wool between Copper Oxide and Electrolytic Copper up to obtain a thin layer and to reduce the Copper Oxide proportionally as shown in the figure above.



1. Quartz Wool
2. Copper Oxide
3. Electrolytic Copper

Reactor Cleaning

- After 200-300 samples have been measured (depending on application and sample size) the reactor should be replaced.
- After approximately 50 samples have been measured (depending on material and sample amount) the quartz crucible should be cleaned and the ash of the samples be removed.

Refill Reactor

- Starting from the reactor bottom (conical end), introduce a sufficient amount of quartz wool.
- Plug with your finger the mouth of the reactor conical end. Gently press the quartz wool using the rod provided.
- Pour sequentially the required filling materials into the reactor ensuring that each layer has the indicated size.
- Put the other components and at each step gently press the quartz wool using the rod provided.

3. Adsorption Filters

According to the analytical configuration required,

the following adsorption filters can be used:

- **Large filter (Plexiglas)**
- **Small filter (Glass).**

Refill the Adsorption Filters

- The filling materials used vary according to the analytical determination required.
- The filling of reactors requires the use of quartz wool.
- Before handling quartz wool, we recommend to wear gloves and face protection.
- The filling procedure should be carried out on a wide and clean workbench.

Steps

- Introduce into either of the tube ends a sufficient amount of quartz wool to form the required layer.
- While plugging the tube mouth with your hand, press gently the quartz wool using the rod provided.
- Screw the nut complete with its seal onto the threaded mouth
- Pour sequentially the required filling materials into the adsorption filter, ensuring that each layer has the indicated size.
- At each step gently press the quartz wool using the rod provided
- Do the last layer using a sufficient quantity of quartz wool to form the required layer.
- Complete the procedure by screwing on the second nut complete with its seal

4. Furnaces

- Each furnace consists of a candle surrounded by an electrical resistor.
- The candle is plunged in a refractory material housed in a metal compartment.
- Furnace Temperature is monitored by a thermocouple appropriately located in the furnace.
- Furnace Cooling time varies according to the operating temperature setting.
- The analyzer can be equipped with one or two furnaces according to the instrument configuration.

- Do not open the furnace compartment during the operation.
- Left furnace maximum temp. 1450 °C .
- Right furnace maximum temp. 1100 °C .
- Left Furnace Present in all configurations.
- Right Furnace Present only when required by the instrument configuration.

Notes

- As the life time of the furnace heater is limited, do not heat it to higher temperatures than necessary.
- If you do not want to perform any analysis for about one day (e.g. over night), cool down the furnace to 400 °C .
- If you do not want to perform any analysis for more than one week, cool down both furnace and column to ambient temperature.

5. Column

- The chromatographic column performs the chromatographic separation of the reaction products generated during the combustion or pyrolysis process.
- The column can be kept at room temperature, or it can be placed in the thermostatic chamber of the TCD detector according to the instrument configuration.
- The CHNS-O and CHN-O instrument versions use two analytical columns placed inside the thermostatic chamber.

Columns Application

Columns	Material	Length (cm)	OD (mm)	ID (mm)	CHNS	CHN	NCS	S (TCD)	S (FPD)	O	N	N/Protein	N-Brew	NC	NC-Soil	NC-Sediments	NC-Filters	IRMS (NC)	HT (NC)	HT (O/H)
	Steel	100	6	5						✔										✔
		200	6	5										✔	✔	✔	✔			
		300	6	5														✔	✔	
	PTFE	15	6	4					✔											
		50	8	6							✔	✔								
		80	6	4				✔												
		100	8	6									✔							
		200	6	5	✔	✔	✔													

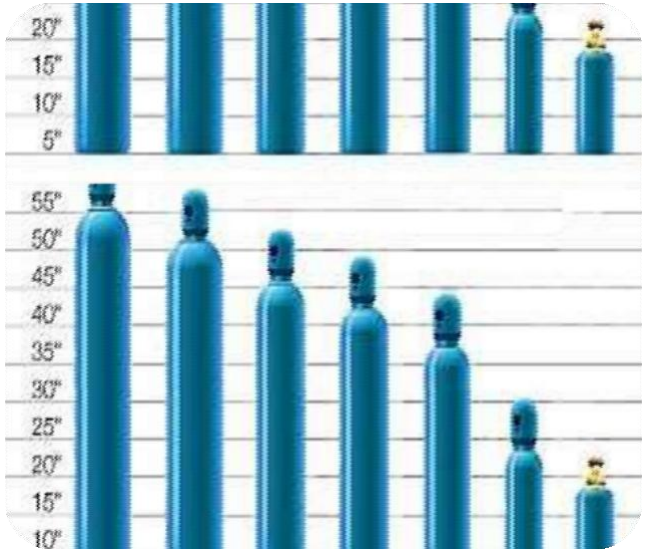
Characteristics

Analytical Determination

Gases

Helium : GC grade,

- He flow: 120 - 140 ml/min (measurement channel) and 100 ml/min (reference channel)



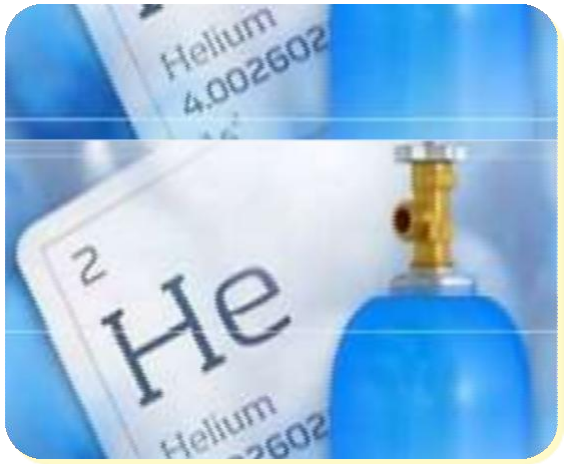
Oxygen : 99.995 % purity,

- Volume and flow are proportional to the sample weight and the sample nature.
- Average consumption: 200 – 300 ml / analysis
- In Stand-By condition the Helium flow decreases to 10 ml/min while the Oxygen flow is cut off.

The carrier gas

An inert gas, which is used to sweep a mixture to be separated through a gas chromatograph , (helium).

- **Push the sample through the chromatograph column**
- **Clean out the chromatograph column after sample analysis**



Carrier gas

- Ultra-pure and research-grade gases of up to 99.9999% (Grade 6.0) purity.
- the carrier gas system often contains a molecular sieve to remove water or other impurities.
- Linear Velocity (u) Is the speed at which the carrier gas or mobile phase travels through the column.
- The linear velocity is generally expressed in cm/s
- The linear velocity is independent of the column diameter while the flow rate is dependent on the column diameter.

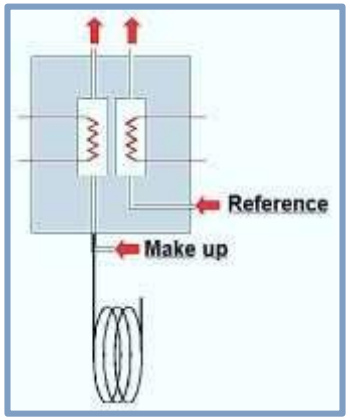
6. Thermal Conductivity Detector

- Located in a thermostatic chamber, This chamber also accommodates the analytical column.
- The detector essentially consists of a stainless steel block provided with two pairs of filaments (generally of tungsten/rhenium) having the same electrical resistance.
- The detector is housed in a thermally insulated metal block (detector oven) and maintained at constant temperature.
- The two pairs of filaments are electrically connected according to a Wheatstone bridge circuit powered at constant voltage.

TCD

Mechanism:

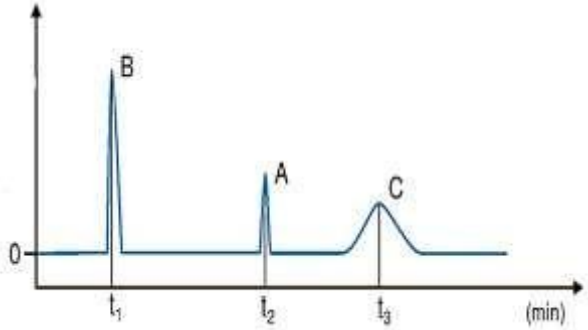
- **A detector cell contains a heated filament with an applied current. As carrier gas containing solutes passes through the cell, a change in the filament current occurs. The current change is compared against the current in a reference cell.**
- **The difference is measured and a signal is generated.**



Selectivity:	**All compounds except for the carrier gas**
Sensitivity:	**5-20 ng**
Linear range:	**10^5 - 10^6**
Gases:	**Makeup - same as the carrier gas**
Temperature:	**150-250°C**

Good Detector

1. High sensitivity for sample.
2. Rapidly respond to concentration changes.
3. Large linear range.
4. Stable with respect to noise and drift.
5. Low sensitivity to variation in flow, pressure and temperature.
6. Possible selectivity.
7. Produces an easily handled signal.



II. Control Section

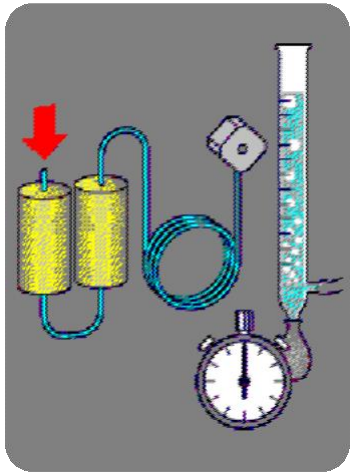
The control section consists of two major components:

- Pneumatic Compartment
- Electronic Compartment

Pneumatic circuits

All pneumatic circuits have the following common components:

- The EFC Electronic Flow Controller for gases.
- Inlet gases pressure regulators and relevant gauges.
- The TCD Thermal Conductivity Detector.



According to each analytical configuration,

- One or two reactors.
- One or two gas chromatographic columns.
- One or two adsorption filters or none.

The filling of reactors and absorbent filters, and the type of analytical columns vary according to the instrument configuration.

Pneumatic Compartment

It consists of:

- **Two pressure reducers,**
- **Two pressure gauges and ,**
- **Several lines fitted with an thermo regulator electronic flow controller (EFCt), which ensures the switching between helium and oxygen, and controls the flow values.**

Electronic Compartment

It comprises the electronic boards for the instrument

- power supply and control.
- Low voltage section
- Mains voltage section
- EFC electronic flow controller for gas regulation

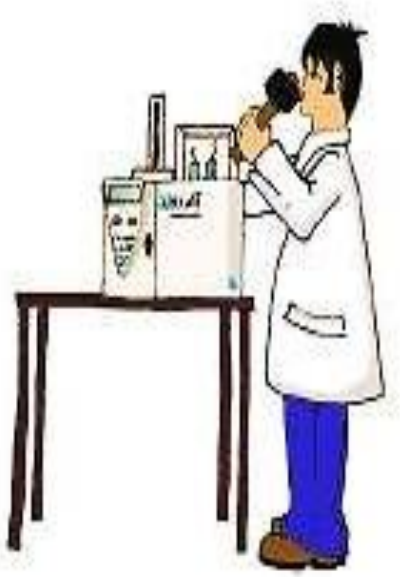
Transformers Compartment

- Located in the right bottom part of the instrument, it is accessible from the rear panel by removing the relevant cover.
- It contains the electrical devices to power the furnaces and control their temperature.

Simple Checks

The areas and items to check include:

1. Gases - pressures, carrier gas average linear velocity, and flow .
2. Temperatures - column, AS, detector .
3. System parameters - purge activation times, detector attenuation and range.
4. Gas lines and traps - cleanliness, leaks, expiration.
5. Sample integrity - concentration, degradation, solvent, storage.
6. Data system - settings and connections.



CHNS Analyzer

SAMPLE PREPARATION

Homogenizing the Sample

Before the analysis the sample must be properly homogenized.

- **Soils, Sediments and Minerals**

  A homogenizing sample amounts of a few hundreds of grams is followed by finer homogenizing on a few dozens of grams, until optimum granulometry (100-200 µm) is reached.

  The resulting sample is dried in an oven

- **Carbons**

  The technique of carbons is the same as that used for the preparation of soils, but the sample drying in an oven for one hour at 105°C, left in the air for the same time to let them acquire again their natural moisture and then stored in airtight containers. Finally they are put into driers.

Vegetal

- To prepare samples of vegetal products, two types of mills are normally used:

  Blade mills to homogenize cereals, leaves, forage and wood. In these mills, devices with 1 mm mesh sieves are used for N/Protein determination.

- Ball mills to homogenize samples of fruit and vegetables after lyophilization.
- These mills use devices for finer granulometry.
- The sample amount to be analyzed depends on the type of determination and on the homogenizing degree.
- **Metals, Plastic, and liquid** are mostly homogenous.

Liquid Sample

- Liquid samples are prepared according to a procedure that depends on the sample volatility.
- Liquid samples with limited volatility are weighed in traditional tin containers.
- However, to avoid sample losses, we suggest to use two containers for each sample.
- If the sample is characterized by high viscosity, it should be properly mixed before being drawn for injection.
- Samples injectable by micro syringes can be introduced manually using the optional manual injection device, or automatically using the autosampler for liquids.

Important Notes

- In soils, sulfur is often present as ion sulfate, and therefore it is necessary to add5-10 mg of vanadium pentoxide (V_2O_5) every 10-20 mg of soil to ensure complete conversion of inorganic sulfur into sulfur dioxide.
- Plants are rich in Nitrogen, Carbon and Hydrogen, but relatively poor in Sulfur. Therefore, after the first analysis, check that the peak of sulfur dioxide is correctly integrated.
- In soils and sediments The Nitrogen content in such samples is generally very low (0.1%). Set a very high sensitivity of integration and use Oxygen of maximum purity grade.
- Generally *: For samples rich in sulfur, samples of 2-5 mg are prepared. For* samples with sulfur traces, samples of 10-20 mg are prepared.

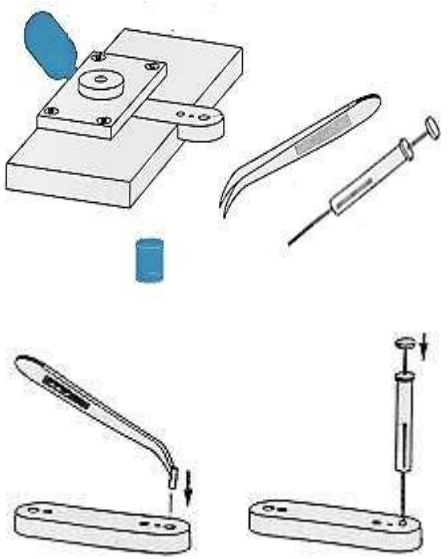
Weighing Technique

- For Large Quantities of Solid Samples The following procedure contains the instructions to weigh large quantities .

- Balance
- Tin disks
- Spring tweezers
- Sealing device and cylindrical tool
- Spatula
- Brush

Weighing Technique

- The following operating procedure contains the instructions to properly weigh liquid samples.



- Electronic micro balance.
- Tin container for liquid samples.
- Spring tweezers.
- Sealing device.
- Spatula.
- 10 or 100 µl syringe according to the instrument configuration.

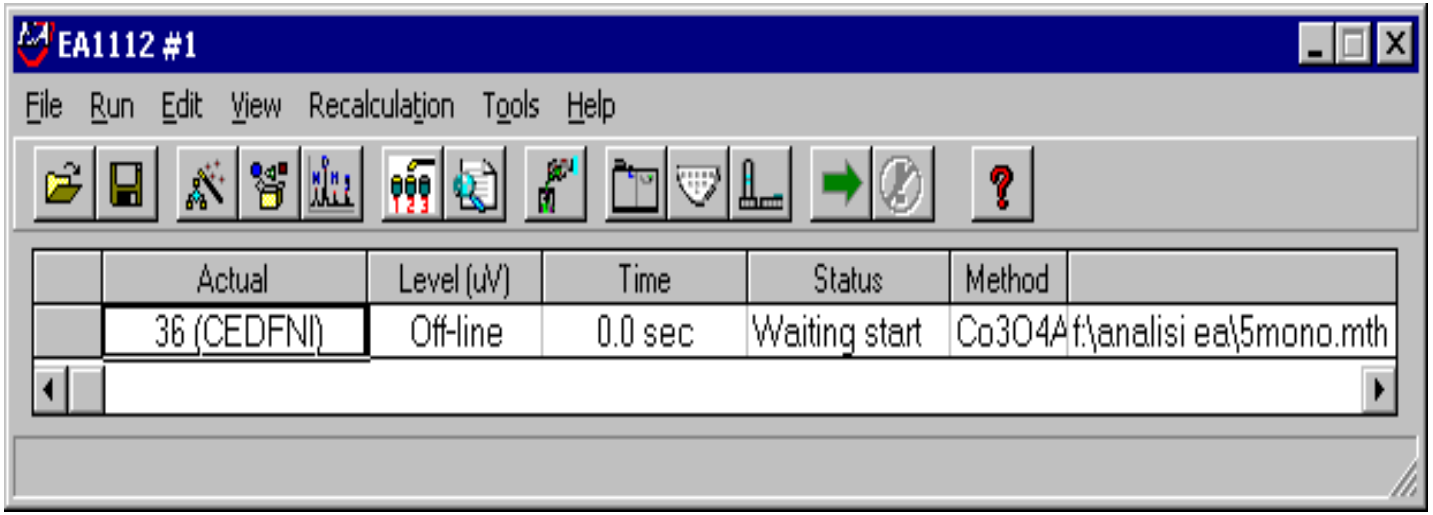
SOFTWARE

Eager Xperience software

- The most comprehensive software dedicated to OEA.
- The dedicated software controls the operation, data acquisition and data evaluation capabilities of the FLASH 2000 Series enabling quick reference to method parameters and instrument status readout.
- Users can configure this flexible platform to gain access to either all available features or alternatively to a customized and simplified user interface incorporating pre-set methods.
- Eager Xperience is the most advanced, complete and flexible dedicated software for OEA applications.

Main Menu

- **The main menu of Eager 300, is the starting point to enter all menus and relevant functions. Menus and icons of the main menu are described in the following.**



Description Of Menu

Menu	Description	Submenus and Options
File	This menu is used during the analyzer installation procedure. It contains functions concerning the instrument operation.	Color set - Instrument configuration System administration Installation qualification Load method - Load system defined method Save method - Copy method from... Printer setup - Print method - Exit Eager 300
Run	Use this menu to choose the type of start command to be sent to the analyzer, and also to stop the analytical cycle or abort the current analysis. - Start sequence of samples Stop running sequence - Start single sample data acquisition - Stop data acquisition - Abort data acquisition	Start sequence of samples Stop running sequence Start single sample data acquisition Stop data acquisition Abort data acquisition - Run macro
Edit	This menu provides functions related to the instrument setup and analytical parameters	Method - Component table - Sample table Wizard method development Edit Elemental Analyzer parameters
View	Use this menu to monitor the analysis in real time, read the result of the last sample run, check the calibration curve, compare and overlay chromatograms, check the instrument status and maintenance.	View sample being acquired - Last sample calculated results - View Calibration curve View Chromatograms - Overlay Chromatograms Operate on Chromatograms - Compare Chromatograms - View Elemental Analyzer Status View Maintenance

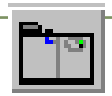
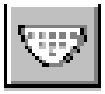
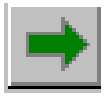
Description Of menu

Menu	Description	Submenus and Options
Recalculation	Use this menu to cancel the calibration curve and the results of previous analyses. You can recalculate previous results individually or sequentially. It also provides the summary of results.	Reset calibration factor Recalculation Summarize results
Tools	Use this menu when the ashes removal and/or reactor replacement is required as maintenance	Ashes removal Reactor replacement
help	Use this menu to enter the Eager 300 help program. It is subdivided into different modules, each one designed to cover specific issues of the module currently in use.	Help Consumable About Eager 300

Description Of Icons

Icon	Function	Description
	Load method from disk	Use this icon to load a previously saved analytical method.
	Save method to disk	Use this icon to store new operating methods.
	Wizard method development	Use this icon to develop new operating methods
	Edit method sections	This icon gives access to the integration and calculation parameters, and to the parameters for printing analytical reports.
	Edit the components table	This table contains the stored retention times, which allow to identify N,C, H, S and O.
	Edith the Sample Table	This table contains all functions related to sample records, and the function allowing communication with the balance.
	View Maintenance	This icon allows to program current maintenance by recording the number of analyses run by each reactor of the analytical circuit.

Description Of Icons

Icon	Function	Description
	Summarize results	This feature contains analytical results, print options and chromatograms.
	Edit elemental analyzer method	Use this icon to have access to the three pages containing the commands for the setting of temperatures, flows, times, detector and the analyzer control functions.
 	Elemental analyzer status	This function comprises four pages displaying the analyzer conditions. It contains special functions to check the system pneumatic tightness (Leak Test), to check the baseline level, and to program automatically the "Autoready" function. It also contains functions to check the autosampler operation, the status of the reduction reactor or oxygen purity. These functions can be activated only after temporarily disabling some functions on the analyzer.
 	Start sequence	Use this icon to start a series of analyses having different current and timed requirements. At the end of the analytical cycle, the instrument can either be put in Stand-by or the furnace and detectors be switched off, or the gas flows turned off.
	Stop sequence	Use this function to stop in any moment the sequence of analyses only completing the current run.

Synoptic Panel

Icon	Function	Description
	Power On	When lit, the instrument is powered
	Ready	When lit, the instrument is ready to run analyses.
	Run	When lit, an analysis is in progress
	Stand By	When lit, the instrument is in stand-by condition. During this condition, gas flows are decreased to 10 mL/min, and the furnaces temperature is reduced to 50% of the set value.
	Wake Up	When lit, the instrument has been programmed for a timed automatic startup (Ready Condition).
	Furnace On	Two LEDs are provided, one for each furnace. When one is lit, the relevant furnace is powered.
	Oven On	When lit, the detector oven is powered.
	TCD	When lit, the detector filaments are powered.
	Safety Cut Off	It lights up when an alarm condition occurs.

CALIBRATION

Calibration

- The Eager 300 software offers three calibration methods:
  - K-Factor
  - Linear
  - Non Linear
- All tests are performed with the K-Factor method that is generally used by most users.
- This method consists in obtaining a constant of calculation by means of the following formula:

$$K = \%Th*(I-b)/p$$

where:

Th = Theoretical % of the standard

p = Weight in milligrams

I = Area integral

b = Blank area integral

Linear and non- linear

- **The Linear method is generally used when samples very different from each other are analyzed in the same analytical sequence.**
- **In this way the errors due to the detector response linearity are minimized.**
- **Three-four substances different in percentage from each other are used for calibration.**

- **The Non-Linear method is used when the analyzer is connected to another detector having a response of exponential type.**
- **To select the calibration method or view the calibration curves of a memorized method, do what described in the following operating sequence.**

Standard

Standard	N%	C%	H%	S%	O%
Acetanilide	10.36	71.09	6.71		11.84
Aspartic Acid	10.52	36.09	5.30		48.08
Atropine	4.84	70.56	8.01		16.59
BBOT	6.51	72.53	6.09	7.44	7.43
Benzoic Acid		68.85	4.95		26.20
Cyclohexanone 2-4 DNPH	20.14	51.79	5.07		23.00
dl-Methionine	9.39	40.25	7.43	21.49	21.45
Imidazole	41.15	52.93	5.92		
L-Cystine	11.66	29.99	5.03	26.69	26.63
Nicotinamide	22.94	59.01	4.95		13.10
Sulphanilamide	16.27	41.84	4.68	18.62	18.58
Urea	46.65	20.00	6.71		26.64

Validation Kit

- Validation is a process to evaluate and certify the performances of the instrument.
- One (or more) validation kit according to the configuration which must be validated.
- The kits are constituted of consumables, standard, filter and column and it includes
- Every component necessary for the validation of the FlashEA configuration selected.
- FlashEA 1112 equipment and the relative Eager 300 software is validated for the installation
- (Installation Qualifications IQ), operation (Operation Qualification OQ) and performance (Performance Qualification PQ) For the FlashEA validation are requested :

OEA COOKBOOK

Cookbook

- The OEA Cookbook is a compendium of sample analyses, with information on operating conditions, instrument configuration and tips on sample preparation, to be used as a reference for your samples.
- Indications and guidelines on instrument settings are all included to help you optimize and enhance your analyzer's results.
- Included type of standard, sample weighing range, number of runs performed, and results in percentage ppm, as well as the Relative Standard Deviation (RSD %),

Example No. 1 from Cookbook

Analytical conditions for CHNS

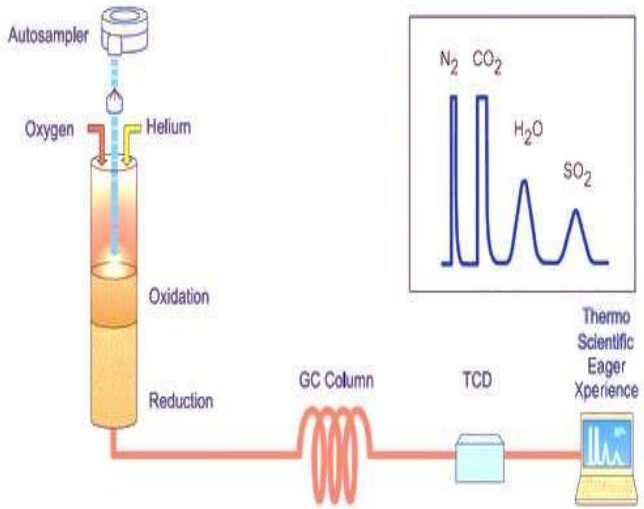
Pressure (kPa)

- **He** **250**
- **Oxygen Flow (mL/min)** **300**
- **He meas.** **140**
- **He ref.** **100**
- **Oxygen** **250**

Temperature (°C)

- **Left** **950**
- **Right** **0**
- **Oven** **65**

- **Cycle (Run Time)** **720 s**
- **Oxygen Injection time** **5 s**
- **Sample delay time** **12 s**



Sample for CHNS

CHNS determination Tires as an example

Sample	N %	RSD %	C %	RSD %	H %	RSD %	S %	RSD %
A	0.454 0.462	1.235	79.597 79.676	0.0701	6.945 6.937	0.0815	1.435 1.454	0.930
B	0.436 0.427	1.475	82.672 82.781	0.0932	7.137 7.137	0	1.666 0.668	0.0848

Standard weight: **2 - 3 mg**

Sample weight: **2 – 3 mg**

BBOT: **2,5-Bis (5-tert-butyl-benzoxazol-2-yl) thiophene**

Notes: Standard and samples were analyzed with the addition of about 10 mg of Vanadium Pentoxide

Samples were cut into small pieces.

Example No. 2 from Cookbook

Analytical conditions for CHN

Pressure (kPa)

- **He** 250
- **Oxygen** 300

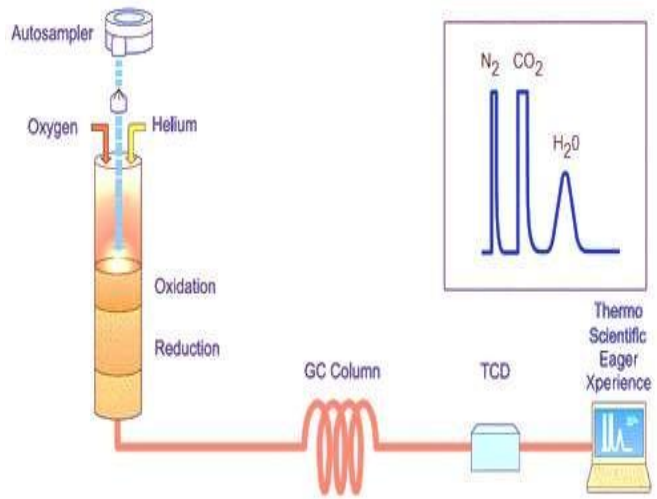
Flow (mL/min)

- **He meas.** 140
- **He ref.** 100
- **Oxygen** 250

Temperature (°C)

- **Left** 950
- **Right** 0
- **Oven** 65

- **Cycle (Run Time)** 480 s
- **Oxygen Injection time** 5 s
- **Sample delay time** 12 s



Sample conditions for CHN

CHN determination SUGARS as an example

Sample	N %	C %	H %
A	14.384	2.903	16.051
	14.357	2.977	15.982
B	9.503	1.976	17.647
	9.591	1.661	17.726
C	5.087	31.601	4.445
	5.065	31.512	4.163
D	5.386	36.962	6.392
	5.268	36.856	6.608

Standard: **BBOT*** **6.51 %N, 72.53 %C, 6.09 %H**

Standard weight: **2 - 3 mg**

Sample weight: **1 - 1.5 mg**

BBOT: **2,5-Bis (5-tert-butyl-benzoxazol-2-yl) thiophene**

For more information

For more information, to provide your valuable feedback, or for copies of Application Notes, please contact:

oeacookbook@thermofisher.com

ANALYSIS

Environmental Conditions

- Internal use.
- Altitude up to 2000 meters.
- Temperature from 15 to 35 °C.
- Maximum relative humidity between 30% and 85%.
- Voltage variations not exceeding of the nominal value.
- Transients according to installation categories II.
- Degree of pollution according to IEC 664 (3.7.3) 2.

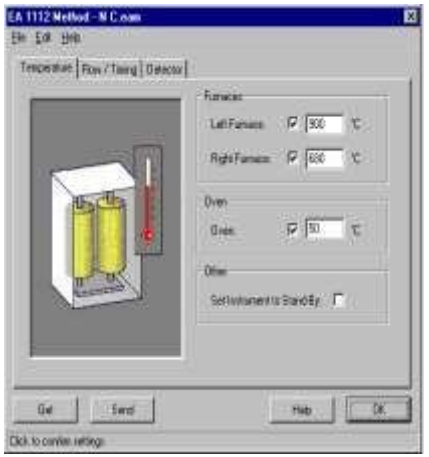
Pre – Analysis Steps

- Before starting the operating sequences, make sure that instrument, reactors, adsorption filters, autosampler (or manual injection device for liquids) and any complementary units are properly installed.

- Open the gases cylinders and adjust the gauges.
- Switch on the instrument
- Switch on the computer and any complementary units.
- Click twice the icon Eager 300 for EA1112.
- Click twice on the icon of the instrument selected.

Cont.

- In the main menu, select File and then the option Load System Defined Method.
- In the main menu select Edit and then the option Edit Elemental Analyzer Parameters.
- Press SEND to transfer the operating parameters to the instrument.
- After about 50 minutes the instrument furnaces reach the temperature settings and the LED Ready
- However, before starting an analytical cycle, a leak test must be carried out to check that reactors, filters, if any, and gas chromatographic columns have been properly installed.
- The instrument is now ready to run analyses.



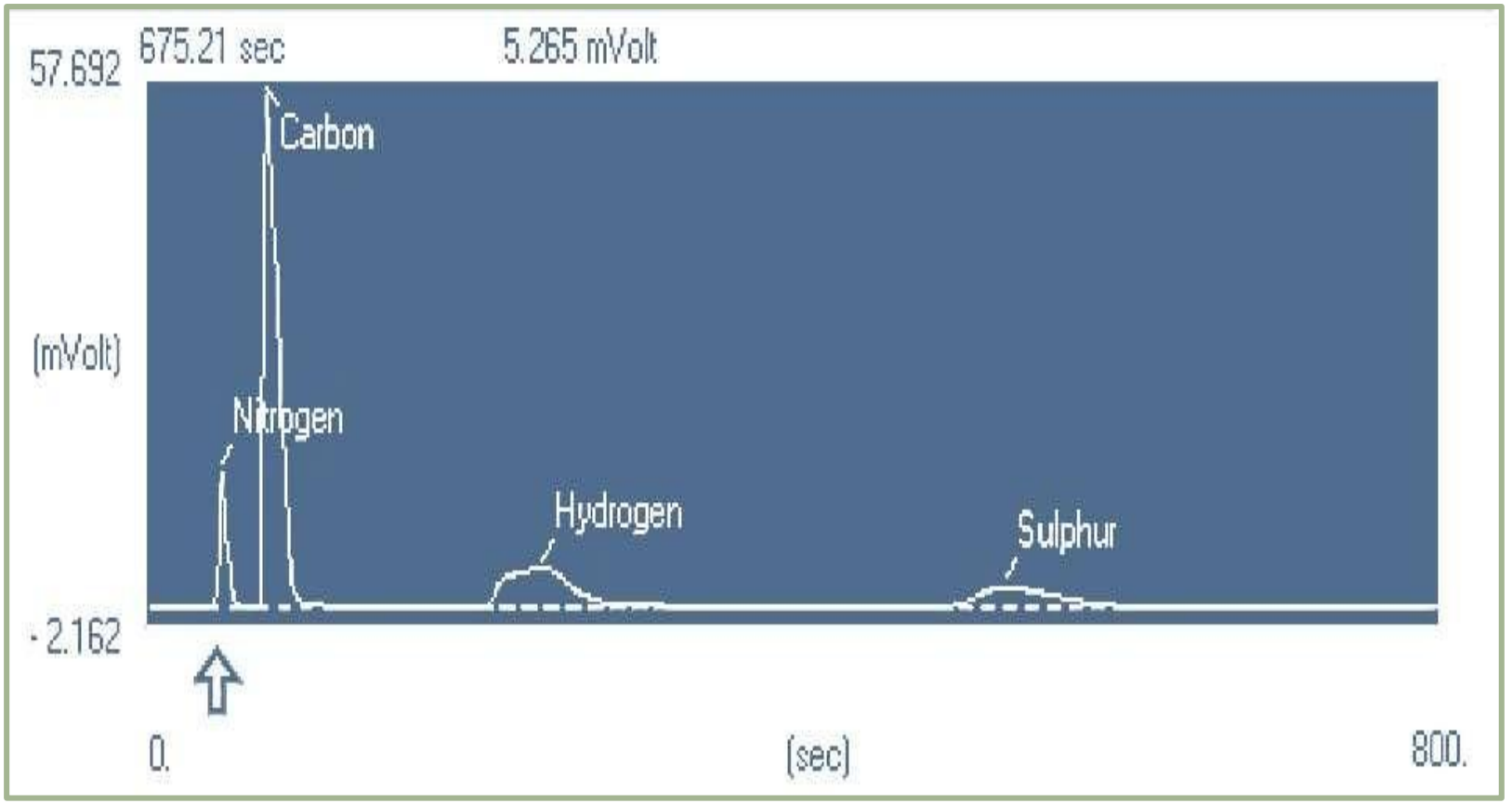
Sequence of analysis

- During pre-analysis, the solenoid valve EV1 shuts off the Oxygen flow, where as the solenoid valve EV2 allows Helium to flow in the circuit.
- When Start Analysis is pressed, the valve EV1 opens, whereas the valve EV2 switches to allow Oxygen to flow in as far as the combustion reactor R1 for a preset time.
- After a few seconds the sample in a tin container which placed in the autosampler, is dropped into the combustion reactor.
- Tin, coming in contact with an extremely oxidizing environment, triggers a strong exothermic reaction temp. rises approx. 1800 °C .

Cont.

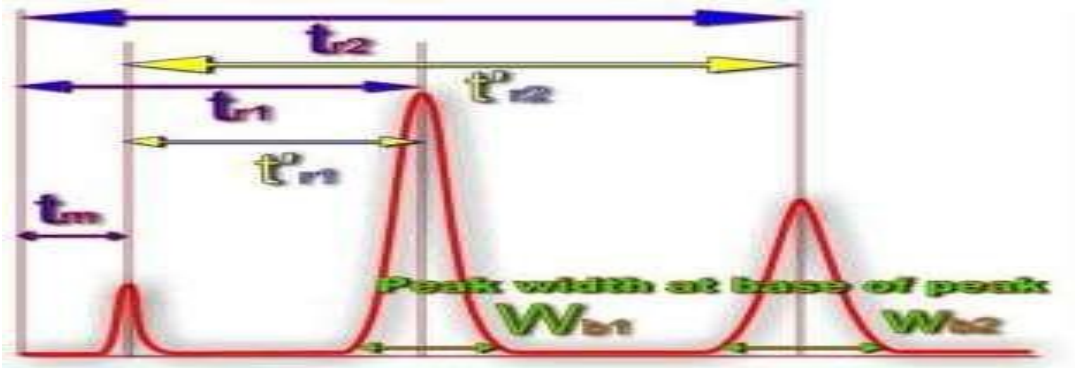
- At the end of the time set for Oxygen introduction, the valves EV1 and EV2 return to their original position restoring the Helium flow.
- The combustion products are conveyed across the reactor R1 where oxidation is completed.
- Nitrogen oxides and sulfur trioxide, possibly formed, are reduced to elemental nitrogen and sulfur dioxide, and the Oxygen excess is retained.
- Then the gas mixture (N2, CO2, H2O e SO2) flows into the chromatographic column CC1 where separation takes place.
- The eluted gases are sent to the thermal conductivity detector TCD that generates electrical signals, which, properly processed by the Eager 300 software, provide the percentages of Nitrogen, Carbon, Hydrogen and Sulfur contained in the sample.

CHNS Chromatogram



CHNS Analyzer

Chromatogram

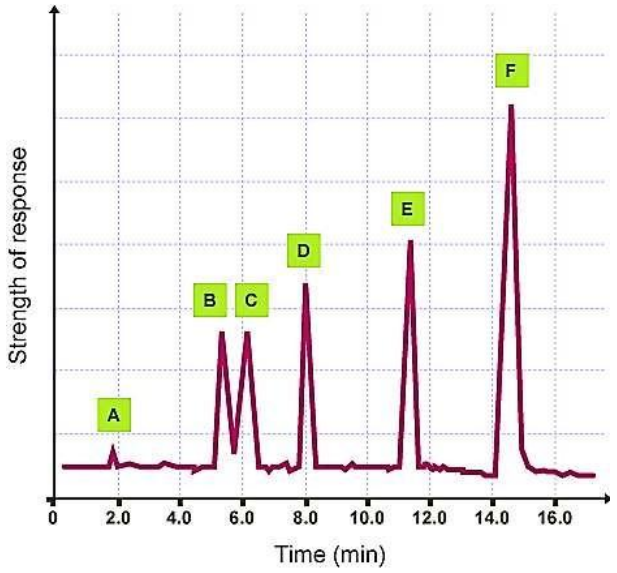


1. **The data recorder plots the signal from the detector over time.**
2. **The retention time, is qualitatively indicative of the type of compound.**
3. **The area under the peaks or the height of the peak is indicative of the amount of each component.**

Retention Time (RT)

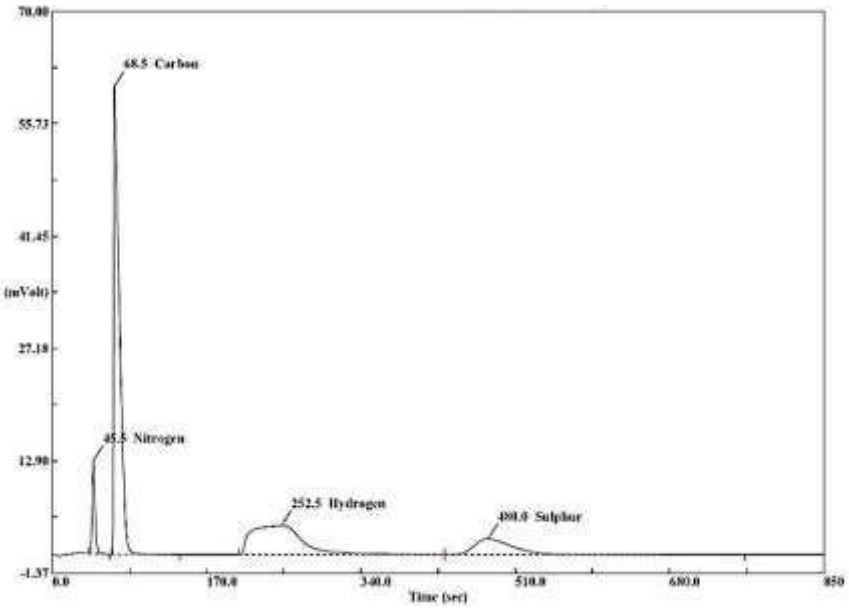
The retention time RT,

- **Is the time it takes for a compound to travel from the injection port to the detector**
- **Thousands of chemicals may have the same retention time, peak shape, and detector response.**
- **For example, under certain conditions, DDT has the same retention time as PCBs (polychlorinated biphenyls).**



Retention Time Shifts

1. Different column temperature.
2. Different carrier gas flow rate or linear velocity.
3. Leak in the injector, especially the septum.
4. Contaminated column.



ACCESSORIES

Balance

MX5

- **Capacity: 5,1 g**
- **Resolution: 1 µg**
- **Repeatability: 0.9 µg / 0.8 µg (0 …2g)**
- **Linearity: 4 µg / 2 µg (0 … 2g)**
- **Stabilization time: 8 … 12 sec**

CONSUMABLES & SPARE PARTS

Consumables & S. Parts for CHNS

No.	Items	Quant.
1	Bottom O-Ring for 18 mm OD Quartz Reactor (Set of 5)	1
2	Top O-Ring for 18 mm OD Quartz Reactor (Set of 5)	1
3	Quartz Wool	5 g
4	Copper Oxide	50 g
5	Electrolytic Copper	70 g
6	Vanadium Pentoxide	1 g
7	Empty Quartz Reactor Tube 18 mm OD (Set of 2)	1
8	Prepacked Quartz Reactor for CHNS/NCS/S	1

Consumables & S. Parts for CHNS

No.	Items	Quant.
9	Packed Column CHNS/NCS (PTFE; 2 m; 6x5 mm)	1
10	Tin Containers	100
11	Forceps	1
12	Spatula	1
13	BBOT STD	2 g
14	Sulphanilamide STD	2 g
15	L- Cystine STD	2 g
16	Quartz Crucible	2 g

APPLICATIONS


DiSC

Applications

- Organic/Inorganic Chemistry & Pharmaceuticals
- Material Characterization
- Environmental Analysis
- Agronomy & Marine Science
- Petro chemistry & Energy
- Human & Animal Samples
- Isotope Analysis

Organic/Inorganic Chemistry & Pharma

- Pharmaceuticals Products
- Organo-metallic compounds
- Polymers
- Plastic
- Synthetic rubbers
- Fibers
- Explosives
- Catalysts
- Textiles
- Pesticides
- Detergents
- Fluorine-compounds

MATERIAL CHARACTERIZATION

- Glue/Resins
- Papers
- Rubbers
- Cement
- Ceramics
- Carbon/Glass Fibers
- Tires
- Pigments & Dyes
- Refractory materials
- Building materials
- Inorganic materials
- Metals
- Textile fibers
- Wood powders

ENVIRONMENTAL ANALYSIS

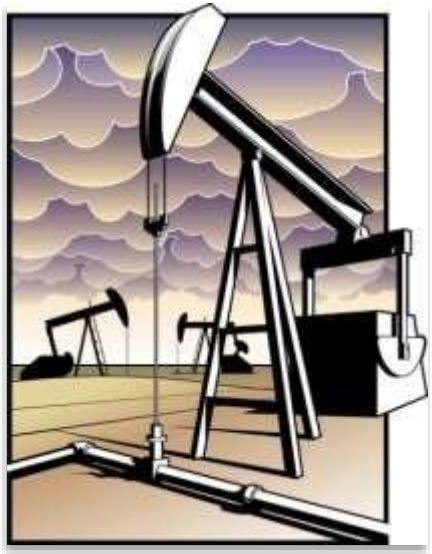
- Soils, sediments, and rocks
- Composts
- Wastes
- Sewage/sludge
- Pesticides
- Water solution
- Waste Water
- Particulates in Air by Filters
- Particulates in Water by Filters

AGRONOMY

- Soil
- Plants (leaves, roots, fruit)
- Sediments
- Humus
- Algae
- Plankton
- Particulate matter in water by filters
- Water
- Fertilizer

PETROCHEMISTRY & ENERGY

- Coals
- Cokes
- Crude oils
- Gasoline/Diesel
- Alternative fuels
- Petroleum derivates
- Lubricants
- Oil additives
- Graphite



HUMAN & ANIMAL SAMPLES

- **Blood**
- **Hairs**
- **Nails**
- **Serum**
- **Urine**

Thanks

To everyone who has helped us with support, new books, hard / software and over the internet

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