Agri - Food

Chemicals

Geo - Environment

Energy

Application Note

CH analysis in hydrocarbons

Instrument: ECS 8020
Mode: CHN
Pretreatments: none

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NC TECHNOLOGIES
Innovative Elemental Analysis

Application Note – CH analysis in hydrocarbons

The hydrocarbons

Have you ever heard about hydrocarbons? This compound is frequently found in plastic materials and other industrial materials.
In general, hydrocarbons are also found in crude oil.

Hydrocarbons are organic compounds entirely made of two atoms: hydrogen and carbon. Typically, a hydrocarbon is colorless and almost odorless. It can form a simple to complex structure.

Generally, hydrocarbons can be categorized into four types: alkanes, alkenes or olefins, alkynes, and aromatic hydrocarbons. This compound has become one of the important components in industry.

For instance, propane and butane are used to produce LPG. Moreover, hydrocarbons can be found in plastics made of petroleum or natural gas.

The formulas of hydrocarbon compounds vary depending on their molecular structure. For example, the amount of hydrogen bound in alkenes and alkynes will decrease thanks to self-bonding (the ability of an element to form bonds with the same atom).

Hydrocarbons' ability to self-bond is called catenation. This compound can do catenation continuously to create a complex molecule, like cyclohexane, and aromatic hydrocarbons, like benzene (in some cases).

The size of these compounds also depends on their properties, such as boiling point and melting point. Therefore, some types of hydrocarbons are gaseous at room temperature, and some are solids or liquids.

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Functions of hydrocarbons

Hydrocarbons have many functions for industries, such as the energy and petrochemical industries. Because they form natural gas and petroleum, they are often used to fuel vehicles, kerosene, and diesel.

Hydrocarbons are also used to make cleaners and solvents. Most commonly, they are used to make synthetic materials, such as plastics and rubber. Furthermore, they are used to make medicines and dyes.

Our Earth provides various natural resources that we can leverage. One of them is petroleum, which is often used to produce fuels and synthetic materials.

Petroleum is a raw material of carbon and hydrogen formed naturally under the ground. To learn more about petroleum products, read the explanation below.

The crude oil is manufactured into various final products by many industries, one of which is the petrochemical industry. In general, petroleum is derived from an organic decomposition process that naturally occurs over millions of years.

Petroleum is processed and added with other substances to be the final product utilized by humans.

What are petroleum products?

- Gasoline
- Kerosene
- Liquefied Petroleum Gas (LPG)
- Jet Fuel
- Marine Fuel Oil
- Diesel
- Naphtha
- Asphalt

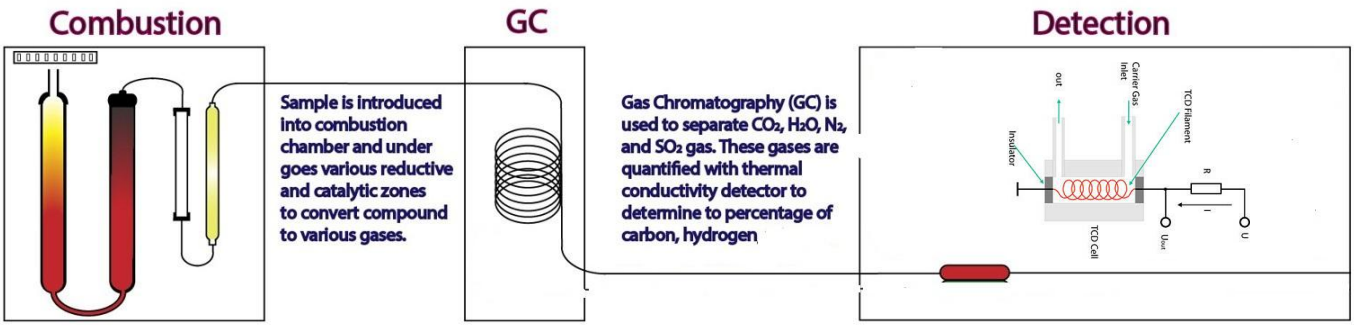
Application Note – CH analysis in hydrocarbons

Carbon and hydrogen analysis of hydrocarbons

As we saw, hydrocarbons are the base to produce petroleum products.

The elemental characterization of organic liquids is fundamental in organic chemistry and petrochemistry for research and quality control purposes. Laboratories need to determine percentage of carbon, and hydrogen accurately, with an automated solution delivering day to day reproducibility for high sample throughput.

Combustion analysis is a standard method of determining the hydrogen and carbon concentrations.
The samples are dropped automatically into the combustion reactor prior to the arrival of oxygen in the combustion reactor. The sample reacts with oxygen and combust at temperatures around 1100°C and the sample is broken down into its elemental components, CO2 and H2O. High performance copper wires absorb the excess oxygen not used to combust the sample. The gases flow through the gas chromatographic (GC) separation column which is kept at a constant temperature. As they pass through the GC column, the gases are separated and are detected sequentially by the TCD. The TCD generates a signal, which is proportional to the amount of element in the sample. The software compares the elemental peak to a known standard material (after calibration) and generates a report for each element on a weight basis.



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Method

For these tests, we used an ECS 8020 equipped with the LIA, the Liquid Injection Autosampler.

ECS 8020 elemental analyser with LIA

The LIA is a fully automatic autosampler for liquid samples.

Coupled with our ECS 8020 elemental analyser, it can allow you to reach an high throughput whenever you need to analyse liquid samples, like hydrocarbons.

The sample tray can host up to 15 vials of 2 ml.
Up to 6 positions for washing vials.
The LIA withdraws the sample directly from the vial and injects it into the furnace for a complete automatic analysis.
Fully automatic injection of organic liquids from < 1 to 100 µl, with different needle diameters.

The ***ECS 8020***

The ECS 8020 is the high-throughput elemental analyser for inhomogeneous samples. Thanks to the double oven configuration, which involves the use of one combustion tube and one reduction tube, the operability of the instrument increases significantly; this translates into greater autonomy of the instrument.

	ECS 8020
Elements	C, H
LIA Autosampler	Up to 15 positions
Max sample weight	300 mg**
Max C content	20 mg
Max H content	5 mg
Operating mode	CHN in 1 run
Type of samples	Liquids (possible to upgrade for solids autosampler)

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Standard test method

The tests were carried out in accordance with the ASTM D5291:

Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants

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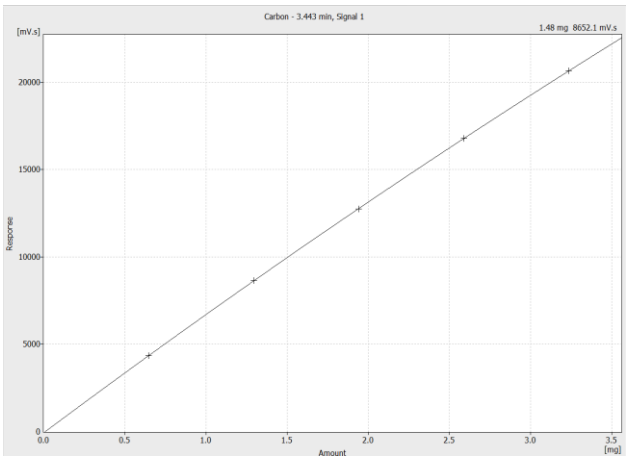
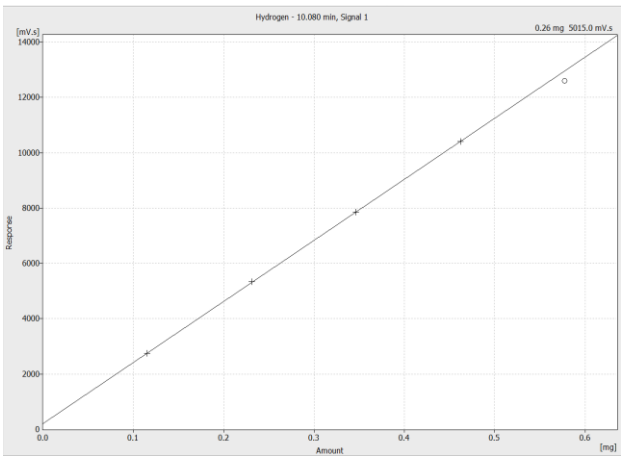
Test samples

The calibration was performed by analyzing a certified crude oil standard sample: ASTM D5307, in CHN operative mode.





Instrument set up	
Instrument	ECS 8020
Operative mode	CHN
Left furnace	Cr2O3+Co3O4 ; 18 mm diam; T = 950°C
Right furnace	650°C
GC column	T = 100°C; 3 m long.
TCD gain	L3
Carrier flow	100 ml/min
Oxygen amount	10 ml

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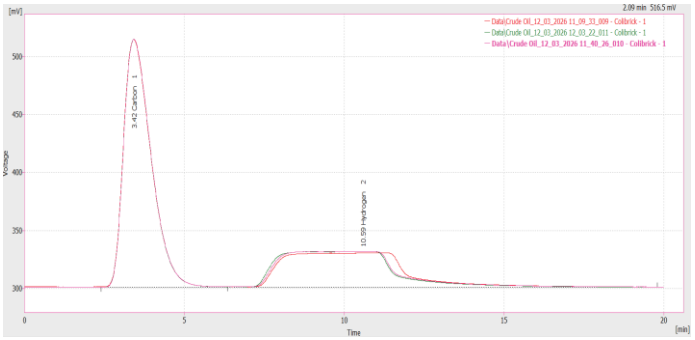
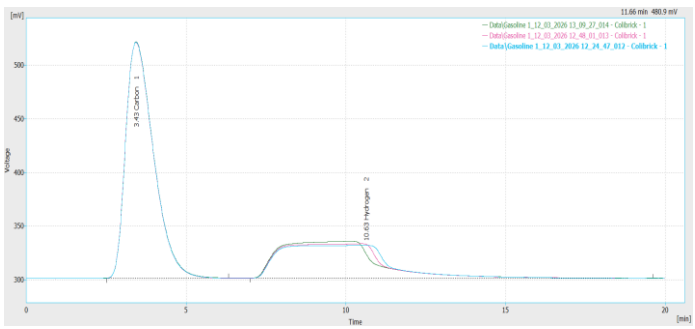
Sample analysis – Crude oil

Sample ID	Sample injected	% C	% H
Crude oil	3 µl	84,96	15,15
Crude oil	3 µl	85,18	15,35
Crude oil	3 µl	84,7	15,28
Average		84,95	15,26
Std Dev		0,24	0,10
RSD %		0,28	0,67



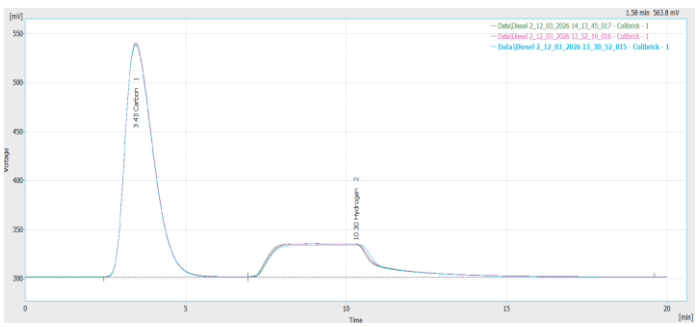
Sample analysis – Gasoline 1

Sample ID	Sample injected	% C	% H
Gasoline 1	3 µl	85,75	13,88
Gasoline 1	3 µl	85,64	13,75
Gasoline 1	3 µl	85,4	13,78
Average		85,60	13,80
Std Dev		0,18	0,07
RSD %		0,21	0,49



Sample analysis – Diesel 2

Sample ID	Sample injected	% C	% H
Diesel 2	3 µl	85,5	13,00
Diesel 2	3 µl	85,9	13,31
Diesel 2	3 µl	85,98	12,96
Average		85,79	13,09
Std Dev		0,26	0,19
RSD %		0,30	1,46



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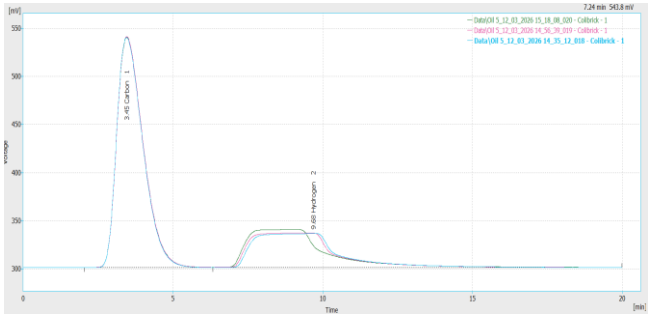
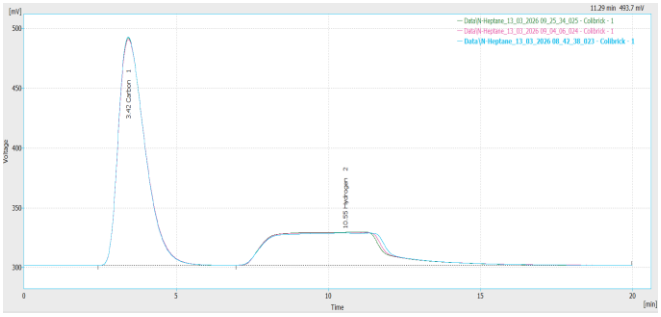
Sample analysis – Oil 5

Sample ID	Sample injected	% C	% H
Oil 5	3 µl	84,93	11,95
Oil 5	3 µl	85,55	12,07
Oil 5	3 µl	85,58	12,13
Average		85,35	12,05
Std Dev		0,37	0,09
RSD %		0,43	0,76



Sample analysis – N-Heptane

Sample ID	Sample injected	% C	% H
N-Heptane	3 µl	85,19	16,03
N-Heptane	3 µl	85,18	16,03
N-Heptane	3 µl	85,31	16,08
Average		85,23	16,05
Std Dev		0,07	0,03
RSD %		0,08	0,18



Conclusions

The ECS 8020 Elemental Analyzer is the optimal solution for the analysis of CH in liquid hydrocarbons samples, in terms of accuracy, repeatability, automation and cost per analysis.
The software controls the analytical conditions of the ECS 8020 Elemental Analyzer and the LIA Liquid Autosampler conditions as the volume injected, the washing of the syringe and the timing of injection to get the proper combustion of the sample.
No memory effect was observed changing the sample matrix, indicating complete combustion and detection of all elements.

To send your samples: sales@nctechnologies.it
For analytical and technical questions: customerservice@nctechnologies.it

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