— University of Mosul —
College of Petroleum & Mining Engineering

Petroleum Chemistry

Lecture 1

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The chemical composition of crude oil

1- Introduction:

Petroleum has been defined as Gaseous, liquid and solid mixture of hydrocarbon and non hydrocarbon components which are derivatives that occur naturally in the earth.

Petroleum (from Creek: *petra*: "rock" + *oleum*: "oil" or crude oil is a naturally occurring liquid found in formations in the Earth consisting of a complex mixture of hydrocarbons (mostly alkanes) of various lengths. The approximate length range is C_5H_{12} to $C_{18}H_{38}$. Any shorter hydrocarbons are considered natural gas or natural gas liquids, while long-chain hydrocarbons are more viscous, and the longest chains are paraffin wax . In its naturally occurring form, it may contain other nonmetallic element such as sulfur, oxygen, and nitrogen. It is usually black or dark brown (although it may be yellowish or even greenish) but varies greatly in appearance, depending on its composition. Crude oil may also be found in semi-solid form mixed with sand, as in the Athabasca oil sands in Canada, where it may be referred to as crude bitumen .

Petroleum is used mostly for producing fuel oil and gasoline (petrol), both important "primary energy" sources. 84% by volume of the hydrocarbons present in petroleum is converted into energy-rich fuels (petroleum-based fuels), including gasoline, diesel, jet, heating, and other fuel oils, and liquefied petroleum gas. Due to its:

. high energy density

. easy transport ability

relative abundance .

Gaseous hydrocarbon is composed of lighter fractions, of which the common is methane(CH_4) that refer to as natural gas. Liquid petroleum consists of the liquid hydrocarbon but also contain varying proportion OF dissolved gases and bituminous materials , it is most commonly called crude oil. Solid and semisolid petroleum is consists of heavier fraction from hydrocarbon and bituminous materials and had been refer to as bituminous or asphalt.

2- Definition of Petroleum :

It Is a mixture of hydrocarbon compounds and relatively small quantities of other materials such as oxygen, nitrogen, sulphur, salt, water, dissolved gases such as hydrogen sulphide (H_2S) and trace amounts of metals such as iron, nickel, copper and vanadium.

3- Origin of Petroleum:

Tow assumptions are explaining the formation of petroleum as follows:

A- Inorganic hypothesis:

This hypothesis assume the oil hydrocarbon reaction hot water vapor with carbides which will form under high pressure and temperature as follows:

$Al_4C_3 + l2H_2O \rightarrow 4Al(OH)_3 + 3CH_4$

$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$

$C_2H_2 \rightarrow$ petroleum

B- Organic hypothesis:

This hypothesis assume that the petroleum is formed from the decomposition of the animals and plants dead which converted to liquids and gases hydrocarbon by effect the high temperature, Pressure and catalyst (as a small microscopic beings). Some sources suggest this hypothesis to explain the formation of the Arabian Gulfs Petroleum.

4- Importance of Petroleum:

a- It represent the major sources for energy in the world (45% crude oil and 15% natural gases).

b- Electrical power generation.

c- Fuel for cars, ships and airliners.

d- Fuel for heating and cooking.

e- It is used in petrochemicals industrials to produce various materials useful such as cloths, plastic , drugs , ….etc.

f- It used for lubrication engines of different types.

5- Chemical analysis of crude oil:

The proportion of hydrocarbons in the mixture is highly variable and ranges from as much as 97% by weight in the lighter oils to as little as 50% in the heavier oils and bitumen.

The exact molecular composition varies widely from formation to formation but the proportion of chemical elements vary over fairly narrow limits as follows:

Element	Wt%
C (Carbon)	83 – 88
H_2 (Hydrogen)	11 – 14
S (Sulphur)	0.05 – 8
N_2 (Nitrogen)	1 – 2
O_2 (Oxygen)	0.05 – 1.5
Metals (Fe , Ni , Cu , V , ...)	< 0.03