— University of Mosul —
College of Petroleum & Mining Engineering

Technology of natural gas

Lecture 1

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1.1 Natural Gas

Natural gas is defined as gas obtained from a natural underground reservoir. It generally contains a large quantity of methane along with heavier hydrocarbons such as ethane, propane, isobutane, normal butane, etc. Also, in the raw state it often contains a considerable amount of non-hydrocarbons, such as nitrogen, hydrogen sulphide and carbon dioxide. There are some traces of such compounds as helium, carbonyl sulphide and various mercaptans. It is also generally saturated with water. Table 1.1 below outlines the typical make up of natural gas before it is refined.

Table 1.1: Typical Raw Gas Composition

Name	Formula	Volume (%)
Methane	CH_4	<85
Ethane	C_2H_6	3-8
Propane	C_3H_8	1-2
Butane	C_4H_{IO}	<1
Pentane	C_5H_{12}	<1
Carbon dioxide	CO_2	1-2
Hydrogen sulfide	H_2S	<1
Nitrogen	N_2	1-5
Helium	H_e	<0.5

1.2 Origin & World Reserves

was Natural gas is generally considered a *nonrenewable fossil fuel*. Natural gas is called a fossil fuel because most scientists believe that natural gas was formed from the remains of tiny sea animals and plants that died 200-400 million years ago.

Briefly, Natural gas exists in nature under pressure in rock reservoirs in the Earth's crust, either in conjunction with and dissolved in heavier hydrocarbons and water or by itself. It is produced from the reservoir similarly to or in conjunction with crude oil. Natural gas has been formed by the degradation of organic matter accumulated in the past millions of years. Two main mechanisms (biogenic and thermogenic) are responsible for this degradation.

1.3 Chemical Composition of Natural Gas

Natural gas is a complex mixture of hydrocarbon and nonhydrocarbon constituents and exists as a gas under atmospheric conditions. Virtually hundreds of different compounds may be present in natural gas in varying amounts. Even two wells producing from the same reservoir may produce gases of different composition as the reservoir is depleted.

The components of natural gas are either aliphatic (chain) or cyclic (ring) hydrocarbons. Their structures are as follows:

Aliphatic or Chain Hydrocarbons:

Aliphatic hydrocarbons occur in two forms: paraffin hydrocarbons and olefin hydrocarbons. The most common are saturated hydrocarbons.

CH_4 - Methane (predominant).

C_2H_6 – Ethane

C_3H_8-Propane

C_4H_{10}-Butane

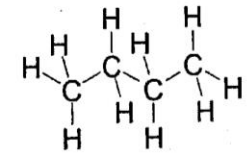
C_5H_{12}-Pentane

C_6H_{14}-Hexane

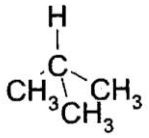
C_7H_{16}-Heptane

Isomer

Isomers are compounds having the same composition and molecular weight but different properties due to a different structural arrangement. The structural formulae for butane isomers are as follows:



Normal butane



Isobutane

Olefin hydrocarbons

Olefin hydrocarbons have the general formula of CnH_2n and are classed as unsaturated hydrocarbons. They usually occur only in traces.

C_2H_4-Ethene

C_3H_6-Propene

C_4H_8-Butene

The structural formula for butene is.