— University of Mosul —
College of Petroleum & Mining Engineering

Technology of natural gas

Lecture 2

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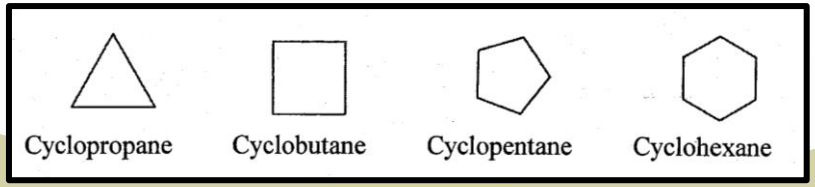
Cyclic or Ring Hydrocarbons

Cyclic hydrocarbons also occur in traces most of the time. They are of two kinds: naphthenic, and aromatic hydrocarbons. For simplicity, only the ring structures will be shown.

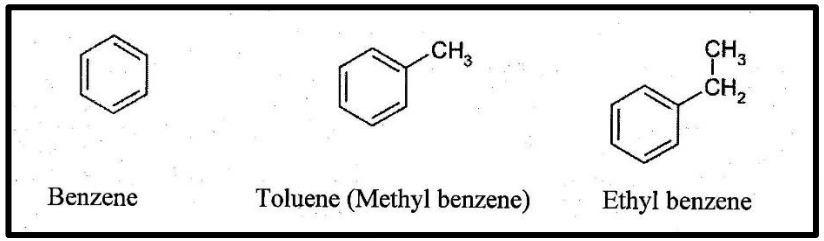
Naphthenic hydrocarbons

Naphthenic hydrocarbons are saturated cyclic hydrocarbons with the general formula of C_nH_{2n}.

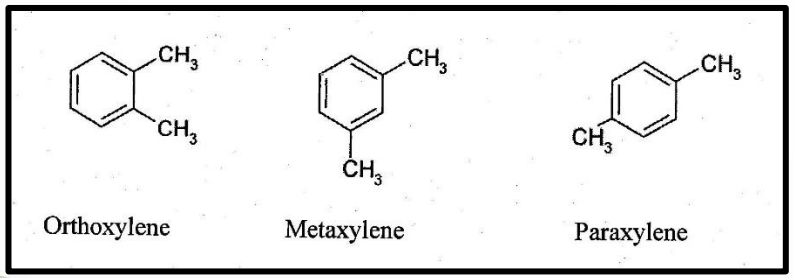


Aromatic hydrocarbons

Aromatic hydrocarbons are unsaturated cyclic hydrocarbons classified by the number of six-carbon rings in the molecule. The structures of benzene, toluene, and ethyl benzene are as follows:



Structures of more complex aromatics such as xylenes in which two or more methyl groups or side chains are attached to the benzene ring are shown below:



Nonhydrocarbon Components

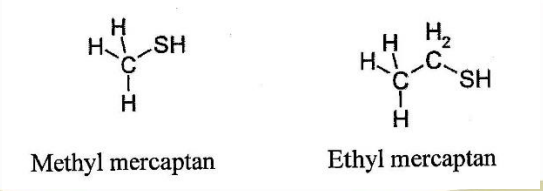
Some non-hydrocarbon components of natural gas are as follows:

Nitrogen	N_2
Carbon dioxide	CO_2
Hydrogen sulfide	H_2S
Helium	He
Water vapor	H_2O
Carbonyl sulfide	COS
Carbon disulfide	CS_2
Sulfur	S
Mercaptans	*RSH

Note: R represents an alkyl group

Methyl Mercaptan and Ethyl Mercaptan

Methyl mercaptan and ethyl mercaptan are the two mercaptan compounds most commonly found in natural gas. Their structures are as follows:



Nitrogen (N_2)

This compound is quite inert and does not contribute to the gas in any way. It should be noted that gases with high N_2 content often have high helium content.

Hydrogen Sulphide (H_2S)

This compound is the cause of the sourness in natural gas. It is one of the most dangerous of industrial gases. For example, if a person is exposed to a concentration of 0.06% in air for two minutes, it will probably result in his death. Therefor, H_2S has to be removed from the raw gas. This is done, primarily by the process of sweetening. The H_2S content of gas is reduced to less than either 0.25 (4 ppm) or 1 grain (16 ppm) per 100 CF of gas, depending on the pipeline the gas is being sold to. Thus, 1 grain pipeline gas contains less than 0.0016% H_2S. The actual metric specifications are 6 mg/in or 23 mg/m^3.

***Carbon Dioxide* (*CO_2*)**

This compound is an acid gas like H_2S, but it is not nearly so undesirable. It does not support combustion and thus does not contribute to the gas. The normal maximum acceptable concentration in pipeline gas is 2%... Often gases of higher contents are accepted from small fields as it does not pay to remove the CO_2 if only it is present. The sweetening process also is used for the removal of CO_2.

Carbonyl Sulphide (COS)
This is a compound that often appears in raw gases with high concentration of H_2S in them. It is generally reported in grains per 100 CF (or in ppm or mg/m^3). It has the undesirable property of forming nonregenerable compounds with one of the most commonly used sweetening agents, monoethanol amine. This causes increased chemical consumption of this agent. Other sweetening agents such as "diethanol amine", "sulphinol", etc., can be used to absorb it. The COS is generally broken down in the regeneration step with these agents.

It also contains varying amounts of:

Water: water vapor and liquid water.

Liquid hydrocarbons: perhaps some natural gas condensate (also referred to as ***casing-head gasoline or natural gasoline*)** and/or crude oil.

Mercury: very small amounts of mercury primarily in elementary form, but chlorides and other species are possibly present.