



Republic of Iraq
Ministry of Higher Education
and Scientific Research
Al-Mustaqbal University College
Chemical Engineering and Petroleum Industries
Department

Subject: Fuel Technology
2nd Class
Lecture 9

GASOUS FUEL

Natural Gas

It is a mixture of paraffinic hydrocarbons, in which methane is the main constituent. It occurs:

- in the gas field (under the crust of earth) .
- in association with crude petroleum in oil fields.

After delivery from wells, natural gas is processed to remove the solids. It is then treated for recovery of gasoline and liquified natural gas (LNG).

- When natural gas contains very less recoverable condensate ($<15\text{gm/ m}^3$), it is known as dry natural gas.
- while it is termed as wet natural gas if recoverable condensate is more ($>50\text{gm/ m}^3$), it is known as dry natural gas.

This condensate is recovered and is known as (natural gasoline) which is used as a blending agent for motor fuel.

The condensate (natural gasoline) recovery from gas is done by compressing & cooling or adsorption on a porous solid.

Typical composition and properties of natural gas are given in Table.1.

Table (1). Composition and Properties of Natural' Gas

<i>Parameters</i>	<i>Dry and sweet</i>	<i>Wet and sweet gas</i>
<i>Composition (volume%)</i>		
<i>CH₄</i>	<i>96.91</i>	<i>77.22</i>
<i>C₂H₆</i>	<i>1.33</i>	<i>11.18</i>
<i>C₃H₈</i>	<i>0.19</i>	<i>5.83</i>
<i>C₄H₁₀</i>	<i>0.05</i>	<i>2.34</i>
<i>C₅H₁₂</i>	<i>0.02</i>	<i>1.18</i>
<i>CO₂</i>	<i>0.82</i>	<i>0.80</i>
<i>N₂</i>	<i>0.68</i>	<i>1.39</i>
<i>Gross C.V., kcal/Vm³(dry)</i>		<i>11200</i>
<i>Sp. gravity (Air = 1)</i>	<i>0.574</i>	<i>0.741</i>

Natural gas of some localities contains large quantity of N₂ and CO plus recoverable amount of helium. Sometimes H₂S are also present in the gas which is recovered as elemental sulphur. H₂S free gas is called a sweet gas.

Natural gas is used as a fuel for:

- cooking, domestic
- industrial heating,
- process furnace and boilers
- fertiliser production
- a source of carbon and hydrogen in chemical industries.

Producer Gas

It comprises mainly of CO & N₂ and is produced (in a furnace called 'producer') by blowing air or a mixture of air & steam through hot bed of solid fuels (coal/coke). In the simple gas producer, dry air is blown through a bed of coal/coke of sufficient depth and at a sufficiently high temperature. Gas obtained consists of CO and N₂ in the ratio of (1:2) by volume, with traces of CO₂ and H₂. Above method was modified by addition of steam to the blast to increase the thermal efficiency and moderate the temperature of the fuel bed by generating additional combustible gas by the reaction of steam with carbon, (e.g. $C + H_2O = CO + H_2$).

CO₂ (4 -6), CO (20 -30), H₂ (11 -20), CH₄ (0 -3), N₂ (46 -55)

Calorific value (CV) = 1250-1550 kcal/Nm³

Sp. Gravity (Air = 1) = 0.85-0.90

Combustion Air requirement = 1--1.3 Nm³/Nm³ of producer gas

Producer gas may also contain steam, tarry vapors, Sulphur compound, NH₃ in minor quantity.

Factors Affecting the Composition of Producer Gas

- Nature of fuel:

High volatile bituminous coal gives a rich gas, containing small proportion of methane.

- Operating temperature:

Low temperature favours high production of CO₂. High temperature favours high production of CO.

- Effect of Steam:

Water in the coal feed or steam in the air blast increases the proportion of H₂ and CO in the gas, thus raising its calorific value. If excess steam is added, the temperature of gasification is reduced; more CO₂ is formed and the calorific value of the gas is decreased. If steam is not added, there are chances of clinker formation.

Uses of Producer Gas:

- Gas for firing in glass melting and open hearth furnaces.
- Producer gas for use in internal combustion engines.