Lecture 2

Petrochemicals Engineering

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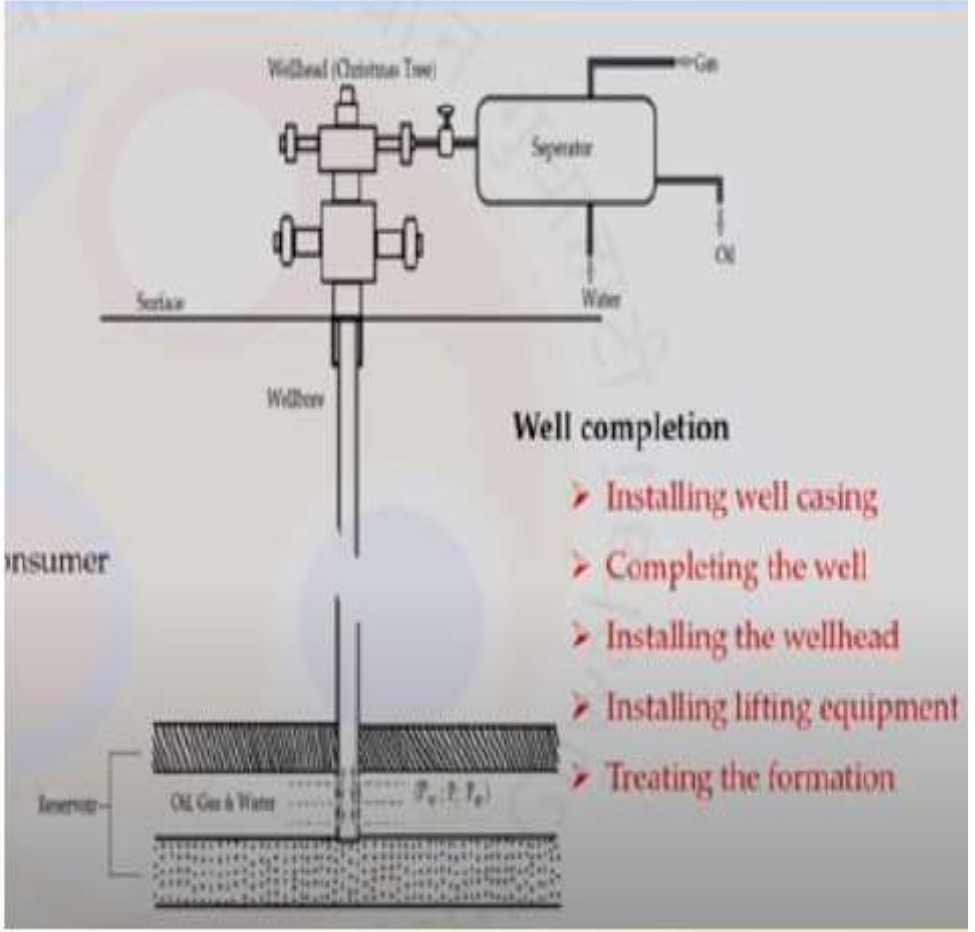
Terms used in the petroleum industry to describe natural gas reservoirs

- *Associated gas* is produced with the oil and separated at the casinghead or wellhead. Gas produced in this fashion is also referred to as ***casinghead gas***, ***oil well gas***, or ***dissolved gas***. (Gas dissolved in oil under natural conditions, free gas in contact with the crude oil)
- *Nonassociated gas* is sometimes referred to as ***gas-well gas*** or ***dry gas***. However, this dry gas can still contain significant amounts of NGL components.
- *Gas condensate reservoirs*, occurs where, because of the high pressures and temperatures, the material is present not as a liquid or a gas but as a very dense, high-pressure fluid, (gas with high content of liquid hydrocarbon).
- Natural gas is considered "dry" when it is almost pure methane, having had most of the other commonly associated hydrocarbons removed.
- the natural gas is "wet". The composition of natural gas varies depending on the field, formation, or reservoir from which it is extracted.

Gas production

- Exploration
- Drilling
- Well completion
- Production
- Gas processing/refinery
- Transmission/ pipeline
- distribution to ultimate consumer



Conventional natural gas production

- Exploration techniques: Geologist And Geophysicist
- Geologic survey
- Seismic survey (2D-3D, now 4D)
- Magnetometer
- Logging
- Advanced techniques, computer modelling

- Until the late 1970s, successful drilling was a hit and miss operation.
- A rate of 10% one good well and nine dry holes for every ten drilled) was consideration attractive.

Exploration : Potential of reservoir, decision where to drill wells.

Extraction : Focuses on the drilling process, underground reservoirs to the surface.

Production : including the processing of natural gas once it is brought out from underground.

Transport : from the wellhead and processing plant, using the extensive network of pipelines.

Storage: how it is accomplished, and why it is necessary.

Distribution delivery of natural gas from the major pipelines to the end users.

Marketing the gas from the wellhead to the end user.

Three steps to producing natural gas

- 1- remove the impurities
- 2- cool it down
- 3- separate into gas and liquid.

- Impurities :
- CO_2 (carbon dioxide)
- H_2S (hydrogen sulphide)
- H_2O water

- Why do remove CO_2

  it will form ice and damage the equipment used to process the natural gas. (Amine treating)
- Why do remove H_2S
- is toxic
- it has a rotten egg smell
- when mixed with water it destroys our equipment.

- Why do we remove the water? (mol sieve dehydration, silica absorb the water)
  - water form to ice
  - which plug the pipes.
  - corrosion

- Cool down the gas
  - use an equipment called (turbo expander) cool down the gas to about -150 F
  - National weather service weather forecast office -27 F has been the lowest temperature in Tulsa (reference)
  - Antarica -12 F

- separate into gas and liquid.

Which used separation equipment to let the gas let from the top and the liquid from the bottom for further analysis or for user.

Effect of Impurities Found in Natural Gas

- Field processing operations of natural gas, which is classified as a part of gas engineering, generally include the following:
  1. *Removal of water vapor, dehydration*
  2. *Removal of acidic gases (H2S and CO2)*
  3. *Separation of heavy hydrocarbons*

The effect of each of these impurities has on the gas industry, as end user, is briefly outlined in table 3:

Table 3: Effect of Impurities on Gas Industry

Water vapor	H_2S and CO_2	Liquid hydrocarbons
It is a common impurity. It is not objectionable as such. (a) Liquid water accelerates corrosion in the presence of H_2S gas. (b) Solid hydrates, made up of water and hydrocarbons, plug valves, fittings in pipelines, and so forth.	Both gases are harmful, especially H_2S, which is toxic if burned; it gives SO_2 and SO_3 which are nuisance to consumers. • Both gases are corrosive in the presence of water. • CO_2 contributes a lower heating value to the gas.	Their presence is undesirable in the gas used as a fuel. • The liquid form is objectionable for burners designed for gas fuels. • For pipelines, it is a serious problem to handle two-phase flow: liquid and gas.

Classification of Gaseous Fuels

- The following is a list of the types of gaseous fuel:

(A) **Fuels naturally found in nature:**

- Natural gas
- Methane from coal mines

(B) **Fuel gases made from solid fuel**

- Gases derived from Coal
- Gases derived from waste and Biomass
- From other industrial processes (Blast furnace gas)

(C) **Gases made from petroleum**

- Liquefied Petroleum gas (LPG)
- Refinery gases
- Gases from oil gasification

(D) **Gases from some fermentation processes.**

The Importance of Gaseous Fuels

- Generally very clean burning. Little soot. Operate with low XSA.
- Easy to burn - No grinding or atomization. Excellent mixing
- No problems with erosion or corrosion
- No ash
- The gas is easy to clean. E.g. if sulfur is present, it may be easily removed prior to combustion.
- Simplest combustion plant of all { Burners, Control system, No ash problems, Heat exchangers, Can be started up and shut down very easily and quickly.

Disadvantages of gaseous fuels

- Problems with distribution and storage
- Explosion risk - very volatile.
- Relatively costly. Offset by cheaper and more efficient plant.

Thank you