

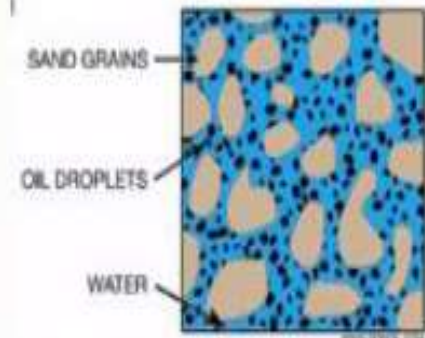
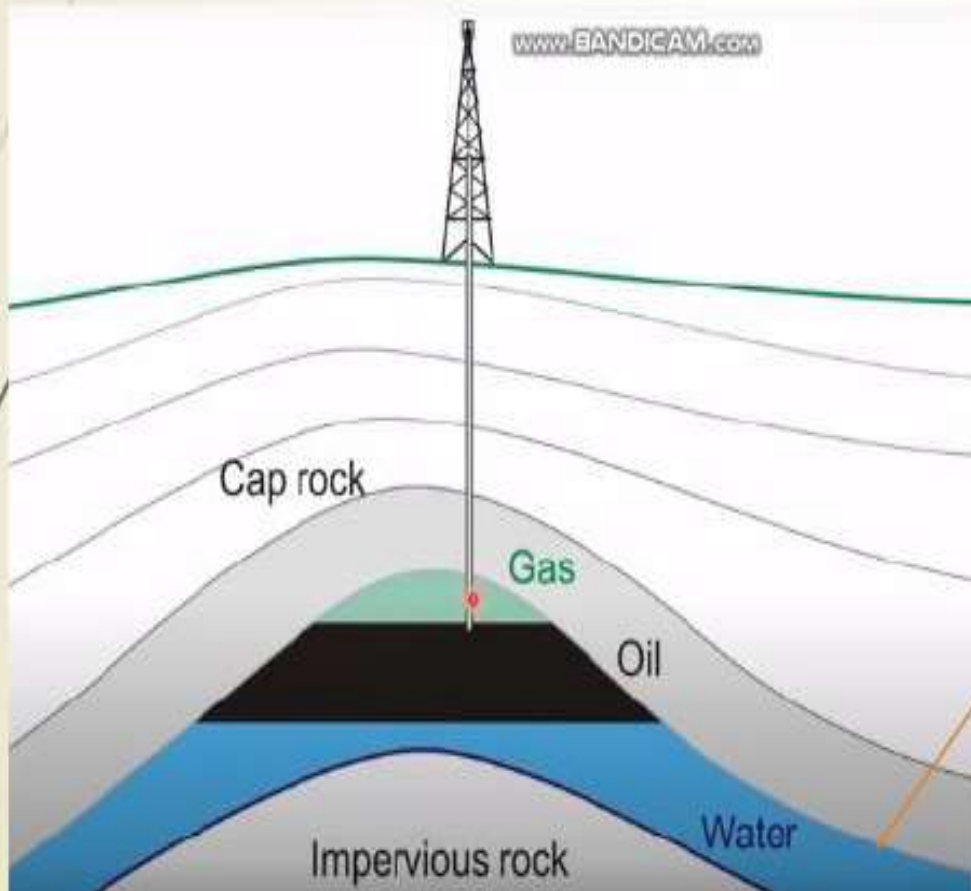
# Petrochemicals Engineering

hydrate prediction and prevention

- ▶ To prepare natural gas for sale, its undesirable compounds ( water, H<sub>2</sub>S and CO<sub>2</sub>) must be removed.

H<sub>2</sub>O

- ▶ Free water
- ▶ Water vapor mixed with the hydrocarbon.



❖ **Water vapor** is the most common undesirable impurity in gas stream.

H<sub>2</sub>O

Corrosion

Slugging in the pipeline, cased the pipeline quality.

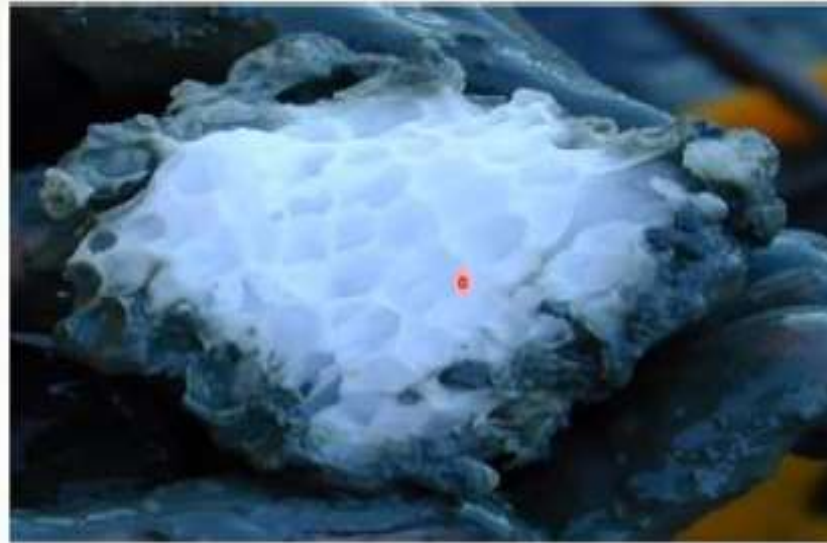
Reduced the calorific value

Hydrate for the NG

❖ **Hydrate** : is a substance looks like an ice. Hydrate formed at low temperature and high pressure, hydrate is formed usually in gas exporting pipelines due to the intersection between light hydrocarbon molecules such as methane ethane and propane with free water to form hydrate. is the crystal lattice is produced as a results of bond formation between the NG molecules and water molecules.



- ▶ It is a results of the hydrogen bond that water can form hydrates. The hydrogen bond causes the water molecules to align in regular orientation.



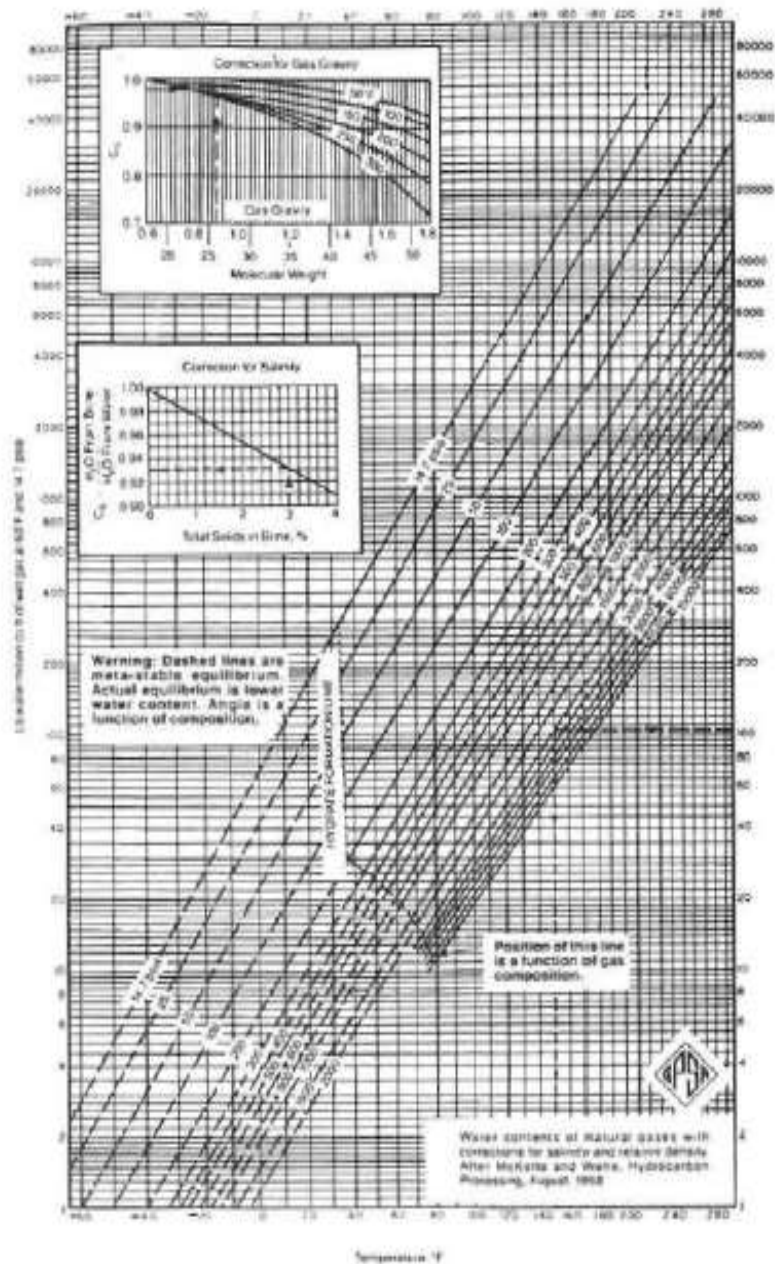
- ▶ **To processing of natural gas to the pipeline specifications usually involves four main processes:**
  - oil and condensate removal
  - water removal
  - separation of natural gas liquids.
  - sulfure and carbon dioxide removal.



**Natural-gas hydrates** are ice-like solids that form when free water and **natural gas** combine at high pressure and low temperature. This can occur in **gas** and **gas/condensate** wells, as well as in oil wells. Location and intensity of **hydrate** accumulations in a well vary and depend on: Operating regime

- Gas hydrates accumulate at restrictions in flow lines, chokes, valves and instrumentation and accumulates into liquid collection section of vessels.

### Water Content of Hydrocarbon Gas



- ❖ Water percentage in NG is predicted using Michetta-wehe graph.
- ❖ Hydrate point is the temperature that the hydrate crystal is produced.

Figure B-1. Michetta-Wehe pressure-temperature correlation. (From Gas Processors Suppliers Association, *Engineering Data Book*, 10th Edition.)

## ► How do we prevent or control hydrates?

- Adding heat
- Chemical injection
- Design process to melt hydrate.

## ► Hydrate inhibitors?

- A- Ethanol
- B- Glycol
  - ethylene
  - Di-ethylene
  - Tri-ethylene
  - Tetra-ethylene




- ▶ **A- ethanol**

- ▶ **Features:**

- **non-continuous injection**
- **non- re-generation**

- ▶ **B- Glycol:** are extremely stable to thermal and chemical decomposition, readily available at moderate cost, useful for continuous operation and are easy to regenerate.

- ▶ **Features:**

- **continuous injection**
  - **re-generation**
- 





Thank you