Tikrit University

The College of Petroleum Processes Engineering

Petroleum Systems Control Engineering

Department

Properties of Petroleum & Natural Gas

Third Class

Lecture 3

By

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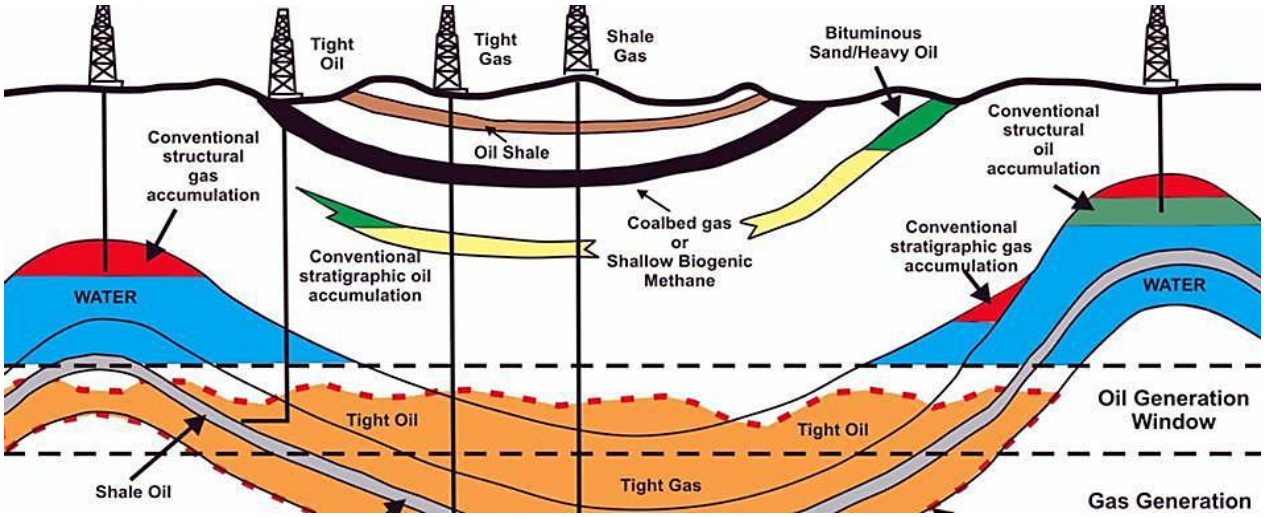
Drilling the well

• Once an oil or gas prospect has been identified, a hole is drilled to assess the potential. The oil potential of a deposit depends on the **pressure and temperature** of the formation, the **surface tension**, the **density** and **viscosity** of the oil, the **porosity and permeability of the rock**.

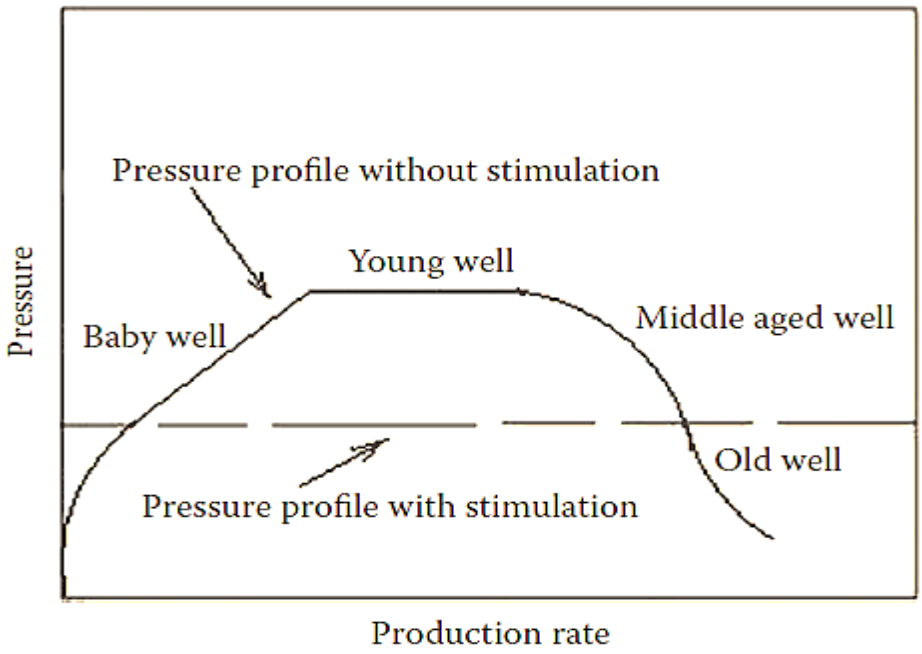
• The cost of drilling is very great, on an offshore rig, it may cost $10,000 for each meter drilled.

- Production rate is inversely proportional to the viscosity of oil and directly to the pressure of the reservoir.



There are four stages of production with ages.

Stage 1 is the baby well, in which production is gradually rising and reaches its maximum. **Stage 2 is the young well**, which produces the oil at the maximum rate. **Stage 3 is the middle-aged well** when production starts decreasing, and finally **stage 4 is the old well.**

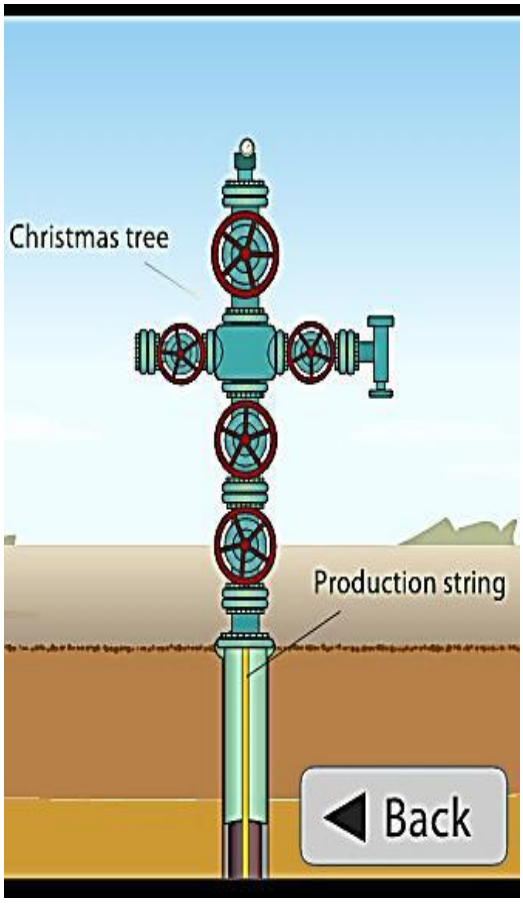


Well Logging

Well logging is a continuous recording process of the activities during drilling.

Oil Production

Wellhead pressure is provided by gas and water in the subsurface. Post-extraction treatment removes water and separates gas from oil. Secondary treatment involves pumping of water or gas into wells that force oil into the extraction wells.

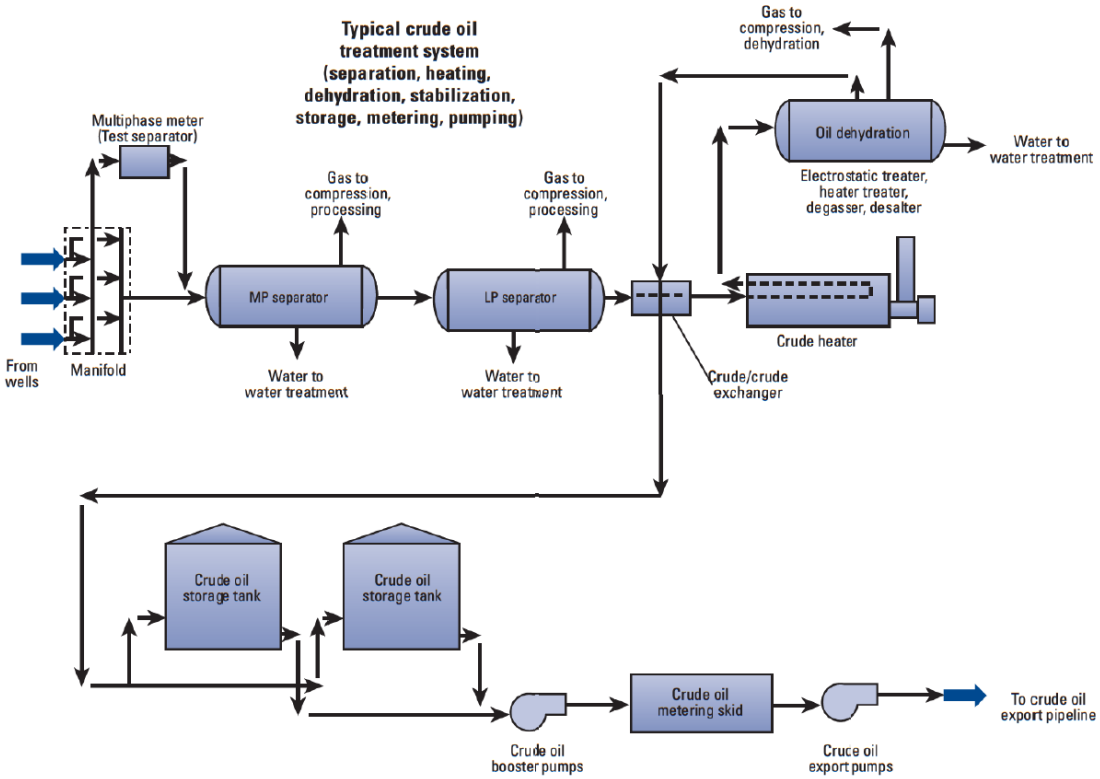


Crude Conditioning and Storage

Raw crude oil collected from the wells also contains sand, mud, and water as impurities which may vary from 20% to 30% by volume. Hence, raw crude is collected in a battery of treatment tanks where both storage and treatment of crude oil are carried out. Treatment steps involve:

- **gravity settling**
- **removal of sand and water**
- **chemical treatment to remove emulsified water**
- **crude conditioning unit**

Proper mixing and repeated heating above room temperature (usually 45°C–50°C at low pressure and up to 90°C at a pressure of 2–3 atm) followed by cooling to storage temperature can increase the dissolution of gases and homogenise the layers of light and heavy liquid hydrocarbons.



Why conditioning?

• Hydrocarbon gases and light and heavy hydrocarbon liquids are all present in a single homogeneous phase under pressure in the formation before it is drilled.

• After released from the formation, components of crude oil separate into layers of light and heavy hydrocarbons making heterogeneous mixture.

• Reduces segregation of wax by making it uniformly distributed in the bulk and thus it can be stored transported at lower temperature above the *pour point.*

Transportation and Metering of Crude Oil

- Treated crude oil is received in large storage tanks usually under pressure to avoid loss of hydrocarbon vapours and is despatched by tankers (ships), trailers (large tank cars), and most conveniently through pipelines. Pipelines as long as 1000 m or more from the oil field tanks to the refineries or to the shipping ports are most common in any oil-producing country.
- Booster pumping stations are placed at the required positions to maintain delivery pressure to the receiving ends. High pressure centrifugal or screw pumps are employed for pumping through pipelines. The horse power of such pumps may vary from 500 to 2,000 hp with a capacity to transport 500–1,000 m3/h with a discharge pressure of 100 atm or more. Power consumption depends on the pressure loss a rate of delivery, which is ultimately determined by the viscosity of the oil, the roughness of the surface, and the diameter and length of the pipe, flow rate, etc.
- Injection of methane in the pipeline may be useful for boosting pressure and this is separated from crude only at the refinery. However, this is not suggested for loading in a tanker or while crude contains water, which may form abrasive methane hydrate crystals at low temperature.
- Quantity loaded in the vessels of the tanker or trailer or to refinery tankages are measured directly by physical dipping using calibrated dip rods or tapes as required.
- Flow rate through a pipeline is measured by low-pressure drop flow meters to reduce power loss. Ultrasonic, electromagnetic, or tracer type flow meters with signal-generating devices are suggested as these do not come in contact with the oil and hence no pressure loss occurs.
- Pressure sensing gauges are also installed at vital distances of the pipeline to monitor any failure of pumps or oil leakage in the line.
- Electrical signals from the flow and pressure sensors are transmitted continuously to control rooms at the originating and booster pumping stations.

- Nowadays, verbal and digital communication and recording between these stations are maintained by computers. Private microwave towers are also built for this purpose. Since pipeline routes are on the surface, underground, or under river or sea bed, it may be necessary to have proper vehicles to check the pipelines for maintenance. Helicopters are commonly employed to access remote places.
- Pipeline washing is carried out using a leather or polymer ball (known as pig) pushed by pump pressure at one end and collected at the pig-trapping-pit end before reaching the suction of the booster pump.
- Pressure safety valves are located at places to release oil or gas to prevent damage to the pipeline during excessive pressure rise owing to blockage of the line for any reason.