Liquid Fuel/ Petroleum

Petroleum Assay

Petroleum

Petroleum (or rock oil) is a naturally occurring brown to black oil comprising **mainly of hydrocarbons found under the crust of the earth**. It is obtained, from the ground either by natural or by drilling wells to various depths. Either petroleum oil flows out itself due to underground gas pressure or these are mechanically pumped out.

Modern Theory (Organic Theory)

According to modern views, petroleum is believed to be formed by the decay and decomposition of:

- **Marine animals .**

- **Vegetable organism of the pre-historic forests, i.e. it is of animal as well as of plant origin.**

When these microscopic plants, and sea animals died, they sank to the bottom of the sea. Over millions of years, layer after layer of sediment, pressure, temperature, bacteria, and other reactions caused these dead organisms to change into oil and gas. The rocks where oil and gas were formed are known as the source rock.

Difference between Origins of Petroleum Oil and Coal

- Petroleum oil was formed mainly from sea plants and animals decaying under strongly reducing conditions while the coal was formed mainly from land plants decaying under mildly reducing conditions.

- Coal seams remained static where formed/deposited while oil can migrate under the effects of pressure and temperature so that the location of the existing deposits may not be the location of the initial accumulation of oil forming debris. The source rock is sedimentary and mainly or entirely of marine origin.

Composition of Petroleum

Atypical composition (by weight %) of petroleum is given below

Carbon = 84-87%	Hydrogen = 11-15%	Sulphur = 0.1-3%
Nitrogen = 0.1-1.5%	Oxygen = 0.3-1.8%	

The principal components of petroleum are hydrocarbons, small amounts of sulphur, nitrogen & oxygen compounds as impurities and some inorganic compounds & metals.

Inorganic compounds present in petroleum are **salt, clay and sand** etc.

Accumulation and Production of Petroleum

The formation of a petroleum reservoir involves first the accumulation of the remains of land and sea life and their burial in the mud and sedimentary materials of ancient seas. This is followed by the decomposition of these remains under conditions that recombine the hydrogen and carbon to form the petroleum mixtures. Finally, the formed petroleum is either trapped within the porous **source rock** when a cap rock ,sedimentary rocks to trap oil and gas, exists or it migrates from the source rock to another capped (sealed) structure under the effects of pressure and gravity.

Reservoir Rocks are the rocks that have ability to store fluids inside its pores, so that the fluids (water, oil and gas) can be accumulated. And **cap rock** is a rock that prevents the flow of a given fluid at a certain temperature and pressure and geochemical conditions.

Gas, oil, and water segregate within the trap rocks, because of the differences in density. **Gas, when existing, occupied the upper part of the trap and water occupied the bottom part of the trap, with the oil between the gas and water.**

When the oil well contains both oil and gas it is called (wet well) and if it contains only gas then it is called a (dry well).

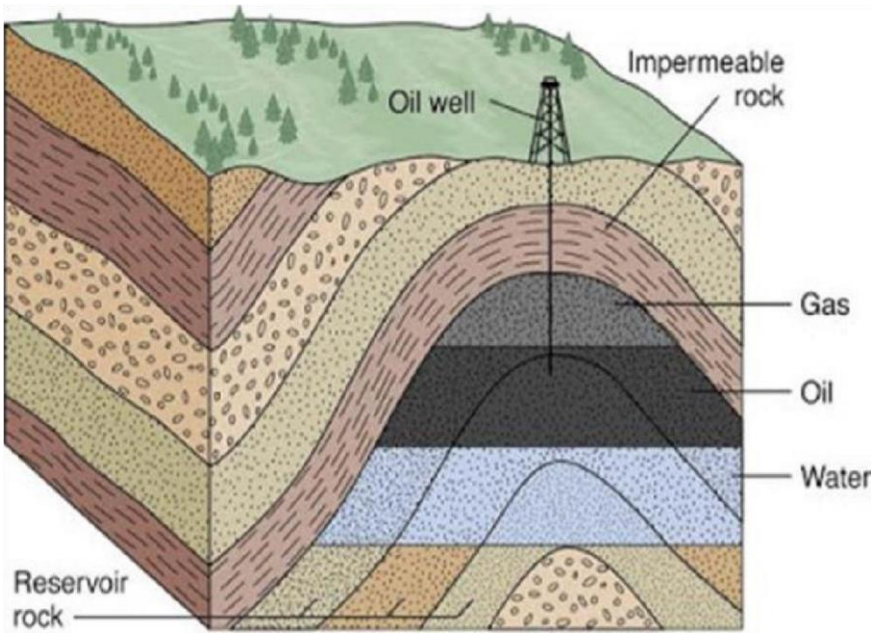

Figure 5.1. Petroleum reservoir

Pre-Treatment of Oil at Oil Field before Refining

Oil and gas when they come out of oil field are separated. The natural gas is compressed to liquify it which is used for heating of domestic and industrial ovens. Petroleum oil is made free of:

- Water,
- Sediments and
- Salts present in it.

It is then made free of some dissolved gases (hydrogen sulfide H_2S) into it by the process called 'stabilization'. It is then sent to oil refinery _ for separation into various petroleum products by distillation mainly and auxiliary operations.

Crude oil as it comes out of well may contain up to 25% water, salts ($MgCl_2$,-$CaCl_2$, NaCl, etc.) up to 2000-5000 (mg/liter) and sediments up to 1 - 1.5%. For refining crude oil, the salt content in it should be < 50 mg/liter and Water < 0.3%.

Salt in crude oil causes:

- scaling
- corrosion
- reduces heat transfer co-efficient during its processing.

Sediments present in crude causes:

- erosion
- scaling.