Crude Oil-Distillation

The process of distillation is the most common method adopted for separating the constituents of crude oil into compounds or groups of compounds having industrial uses.

Crude oil consists of a complex mixture of hydro-carbons widely differing in boiling points. Distillation is done to separate the crude oil into the basic fractions like motor gasoline kerosene, gas oil and fuel oil.

1. Atmospheric Distillation

Atmospheric distillation is considered the first essential step in the crude oil refining process. It is the process in which the components of crude oil are separated based on their different boiling points under normal atmospheric pressure. The goal of this process is to obtain light and heavy products used in various industries such as fuels, petrochemicals, heating, and more.

Principle of Operation:

Atmospheric distillation relies on heating crude oil to high temperatures, causing the lighter compounds to vaporize and rise to the top of the column, while the heavier compounds remain at the bottom. A distillation column equipped with trays or packing is used to allow contact between the liquid and vapor, improving the separation process.

Main Steps of Atmospheric Distillation:

1. **Desalting:**

Before entering the distillation column, salts and water are removed from the crude oil to protect the equipment from corrosion.

2. **Preheating:**

The crude oil passes through heat exchangers and is heated using the heat recovered from the products exiting the column, reaching a temperature of about 450°F

3. **Furnace Heating:**

After preheating, the crude enters the furnace to rise to about 650°F without exceeding this to avoid thermal cracking or carbon formation.

4. Distillation Column:

The hot crude enters the middle of the column:

- The light components vaporize and rise to the top.
- The heavy components remain and move downward.

Inside the column, there are trays that improve the separation by allowing contact between the rising vapor and the descending liquid.

5. Reflux:

A portion of the condensed liquid at the top of the column is returned to control the temperature and improve product purity.

6**. Product Withdrawal:**

Products are withdrawn from:

- The top (gases, light naphtha)

- Side draws (kerosene, diesel)

- The bottom (atmospheric residue)

Main Products:

• Gases

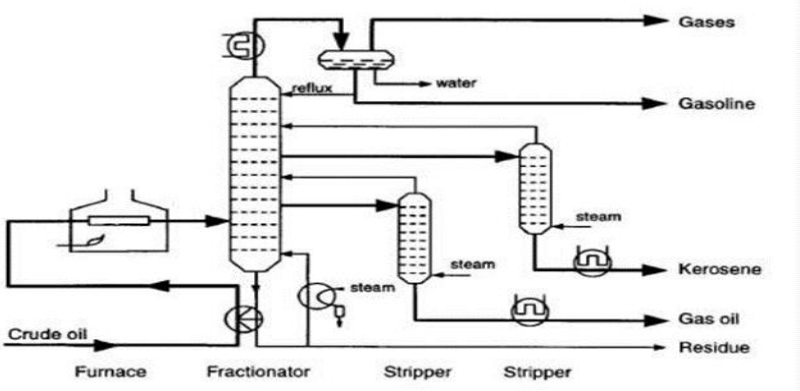
• Light and Heavy Naphtha

• Kerosene

• Diesel (Gas Oil)

• Atmospheric Residue

Figure 7.1: Atmospheric Distillation



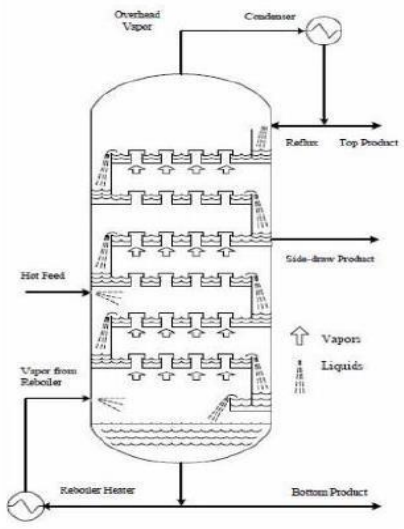


Figure 7.2: Distillation column with trays

Products from Crude distillation unit(CDU):

Figure 7.3 show various streams from atmospheric distillation column:

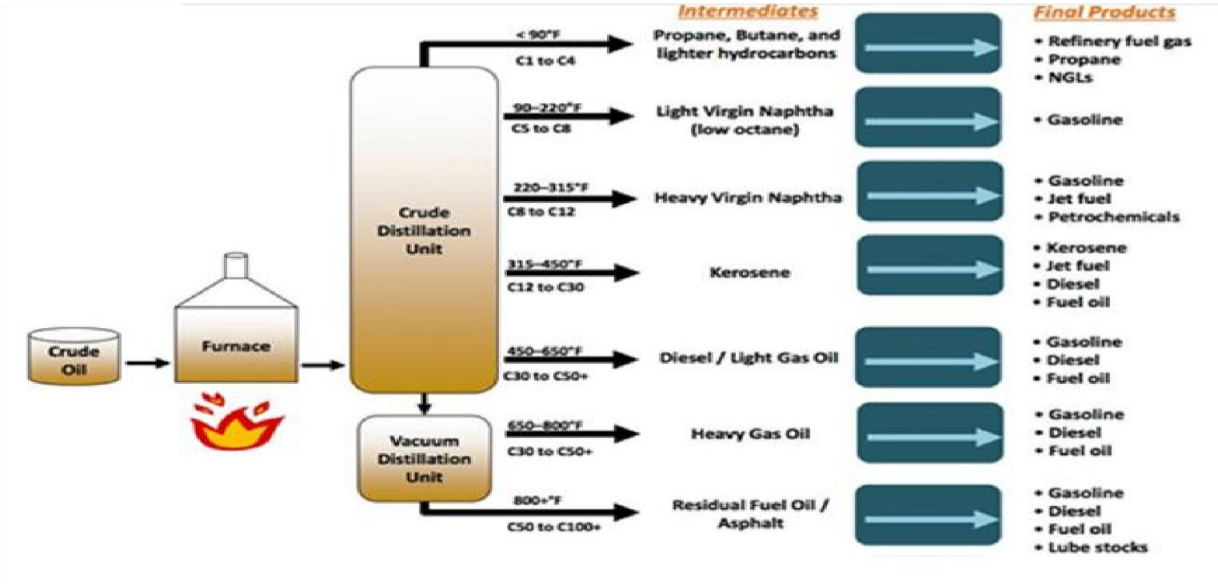


Figure 7.3 Products from Crude distillation unit.

2. Vacuum Distillation Column

The residue from an atmospheric distillation tower can be sent to a vacuum distillation tower, which recovers additional liquid.

Reduced crude oil is very heavy compared to crude oil distilling under pressure requires high temperature. Distillation under vacuum permits fractionation at lower temperature which avoid cracking of crude oil and coking of the furnace tube. These materials are therefore distilled under vacuum because the boiling temperature decreases with a lowering of the pressure.

Operating pressure of vacuum column:

- About 90-95 mm Hg at the top and
- About 135-140 mm Hg at the bottom

The main products from this unit are:

1- Heavy gas oil

2- Lubricant

3- Asphalt or vacuum residue (B.P > 1000F)