CHAPTER IV

PROCESSING OF CRUDE OIL

Introduction

The first phase in the oil refining industry is the processing of crude oil. The main input to the oil refineries is the crude oil which is processed and fractionated to get different distillates and residues. These different fractions of distillates are further processed by petro-chemical and fertiliser industries to obtain a large group of products that serve as raw materials for a number of industries.

Productivity in the oil refining industry is mainly attributed to the technological innovations and applied research. Technology can be defined as the method of transformation of a set of inputs into desired outputs. Inputs include manpower of various skill levels, capital, raw materials and infrastructural facilities etc. The output are the end products either for further processing or for final consumption. The technology may be of local origin, transferred internationally or a mixture of both. In the case of processing the crude petroleum, the processing methods and equipments employed depend on the composition and properties of the petroleum to be processed and on the products to be obtained.
Crude oil consists of a mixture of alkanes boiling between a wide range, say $0^\circ$C to $400^\circ$C, and as such unsuitable for technical purposes. So the oil is subjected to fractional distillation. The process of dividing crude oil into fractions with different boiling ranges and free from undesirable impurities, is termed 'refining'. The main processing steps are as follows:

1. **Distillation**

The primary separation process which is used in almost every stage of petroleum processing is fractional distribution. This involves the separation of a mixture of liquids into its components or fractions, each with a limited range of molecular mass, by virtue of their different boiling points. The crude oil is passed through the heaters and heated to a specified temperature before the partially vapourised mixture of vapours and liquid is fractionated in a fractioning tower, where the products are separated. Feed material is first pumped through heat exchangers and then through a tubular oil-fired furnace to the column. The column usually contains a large number of trays each filled with bubble caps, the temperature on each tray decreases up the column and hence the liquid on each tray has a different composition. As hot vapours pass up the column, the heavier components
with higher boiling points condense out and return as liquid to a lower tray. The latent heat released vapour rises lighter components which rise as vapour up the column. Each tray therefore serves to continuously condense and partially re-evaporate the liquid. Outlets are provided in the side of the column at suitable height to withdraw the fractions. The actual number of fractions and their boiling point ranges depending on the source of the petroleum and the trade demand.

The general flow scheme for the primary distillation of crude petroleum is given in Fig. 14. The overheads from the distillation contain hydrocarbon gases, kerosene and gasoline, which are condensed out. The light gases - methane and ethane, are used as a feedstock for the production of petrochemicals and as a fuel, and the heavier gases - butane and propane are liquified by compression and sold as liquified petroleum gases. The lighter distillates such as gas and naptha come out from the top of the tower. The middle distillates such as kerosene, gas oil range are obtained from the middle of the column, and are further subjected to a series of treatments to get the specified products.
2. **Catalytic Refining**

In order to secure a higher yield of petrol or gasoline, the higher boiling straight run Gas Oil (Diesel) or Residual Oil are cracked and simultaneously distilled. The heavier petroleum fractions are decomposed either by thermal cracking or catalytic reforming for producing lighter hydrocarbons. The entire residue or definite fractions of the petroleum are fed to the reforming unit where the high molecular hydrocarbons of heavy fractions are decomposed. The decomposition can either be achieved at high temperature and pressure (thermal cracking) or at relatively lower temperature by accelerating the cracking reactions with a catalyst. However, in character, catalytic cracking is slightly different from thermal cracking as a proportion of unsaturated hydrocarbons obtained reduces by 2% to 3% in the catalytic refining as compared to the thermal cracking. In catalytic cracking the process is much cheaper, modern and efficient. Thus kerosene could be changed to gasoline.

3. **Conversion of the residue**

The residue obtained from the bottom of the column may be further subjected to treatment in any of the following processes depending upon the type of final products required.
1) Visbraker, (ii) Cohar, (iii) F.C.O., (iv) Hydrocracking

By Polymerisation process the residues are converted into very light distillates and gases into high octane petrol and it also produces by-products from which detergents, plastics, synthetic fibres and synthetic rubber are manufactured.

All the refineries are not similar technologically. They differ from one another according to the process, type of crude oil and the nature of products manufactured.
References


