PETROLEUM (CRUDE OIL)

The chief source of hydrocarbons is crude oil or petroleum. Petroleum, which means rock oil in Latin, occurs as a dark, sticky viscous liquid. It is found in huge underground deposits in many parts of the world. Natural gas is usually found together with it.

Petroleum is a mixture of gaseous, liquid and solid alkanes, alkenes, cycloalkanes, aromatic hydrocarbons, and others. Natural gas consists mainly of methane.

How Crude Oil is formed

Crude oil and natural gas are formed from the remains of marine algae and animals. When these tiny aquatic organisms died, their remains gradually settled on the seabeds. Over the years, the remains became covered by mud, silt, and other sediments. As the sediments

piled up, their mass exerted a great pressure on the lower layers, changing them to hard sedimentary rocks. During this process, bacteria activity, heat and pressure probably changed the plant and animal remains into crude oil and natural gas. The oil and gas so formed slowly moved to other areas through the tiny holes or pores in the porous rocks around them. Since oil and gas are not dense they tend to seep upwards until they meet a non-porous layer of rocks and are trapped under it, thus forming an oil trap.

Fractional Distillation of Petroleum

Crude oil is not a single compound but a complex mixture of hydrocarbons. It is so valuable that people call it 'black gold,' yet, as obtained from the ground, crude oil is just about useless. To justify its true worth crude oil must undergo fractional distillation first.

In this process, it is separated into different portions called *fractions*. Each fraction contains several compounds, all of which fall within a certain boiling point range. We can differentiate these fractions from one another by their different volatility, odour, colour, texture and their relative ease of ignition and burning. Then the less volatile fractions are subjected to further treatment called *cracking*.

Industrial Fractionation

The industrial distillation process is carried out in huge fractionating columns or towers, each standing some 40 to 50 metres high and 7 metres across. The crude oil is preheated to about 400^{o}C in an electric furnace where about 75% of the crude oil is vaporized; the mixture of hot vapour and liquid flows through pipes to the fractionating column.

The fractionating column is divided into several compartments by perforated plates called trays, each of which is maintained within a specific range of temperature. Each tray is a little cooler than the one below, so that towards the bottom of the column, the temperature is around 400^{o}C, while the temperature at the top part of the column is only 40^{o}C.

As the vapour containing a mixture of substances ascends the column, it cools, condenses and separates out into several fractions according to the volatility of the substances in the mixture. This means that substances with higher boiling points separate out in the trays on the lower part of the column, while those with lower boiling points separate out on the trays in the upper part of the column.

The different fractions are drawn off at different heights on the column, redistilled to improve purity and then further treated to obtain different liquid fuels and petrochemicals.

Fractions of Crude Oil

The following are the principal fractions obtained by the fractional distillation of crude oil: petroleum gases, petroleum ethers and ligroin, petrol, kerosene, gas oil and diesel oil, lubricating oils, bitumen and other residues.

1. Petroleum Gases: These gases are liberated at the top of the column at temperatures below 40^{o}C. They are mainly hydrocarbons consisting of one to four carbon atoms per molecule, e.g. methane, ethane, propane, butane and ethane. They are used mainly as fuels for homes and industries, and for the

manufacture of products like hydrogen, carbon (IV) sulphide, tetrachloromethane and ethyne.

2. Petroleum ethers and ligroin: This mixture of very volatile liquids consists of hydrocarbons with five or seven carbon atoms per molecule. The petroleum ether or light petroleum distils over between 2^{o}C to 60^{o}C, while the ligroin or light naphtha distils over between 60^{o}C to 100^{o}C. Both of the products are used as organic solvents.
3. Petrol: Petrol or gasoline is a mixture of hydrocarbons consisting of four to twelve carbon atoms per molecule. It is a volatile liquid which distils over in the temperature range of 40^{o}C to 200^{o}C. Petrol is used as a fuel for aeroplanes and motor-vehicles. It is also a good solvent for paints and grease.

4. Kerosene: Kerosene contains hydrocarbons with twelve to eighteen carbon atoms per molecule. It distils over in the temperature range of 200^{o}C to 250^{o}C. It is a fairly volatile liquid and is used as a fuel for lighting and heating and for driving tractors and some modern jet engines. It is also a good solvent for grease and paints.
5. Gas oil and diesel oil: These are mixtures of hydrocarbons with twelve to twenty-five carbon atoms per molecule. They distil over in the temperature range of 250^{o}C to 350^{o}C. They are used mainly as fuels for heating and diesel engines and as raw materials for the cracking process.
6. Lubricating oils: These are heavy oils. They consist of hydrocarbons with more than twenty carbon atoms per molecule, which distil over in the temperature range of 350^{o}C to 500^{o}C. They are viscous liquids

used for lubricating moving parts of engines and machines. Grease, which is semi-solid, also belongs to this group. Vaseline and paraffin wax are solid, long-chain hydrocarbons which are obtained on redistillation of these heavy oils. Vaselines is used in hair-care products while paraffin wax is used in making candles, waterproof materials, polish, ointments, and creams.

7. Bitumen and other residues: These are solid residues left behind at temperatures above 500^{o}C. Bitumen, or pitch, is used for surfacing roads and airfields while other residues may be used as fuel, in protective paints, as well as in pipe coating and water proofing roofs.