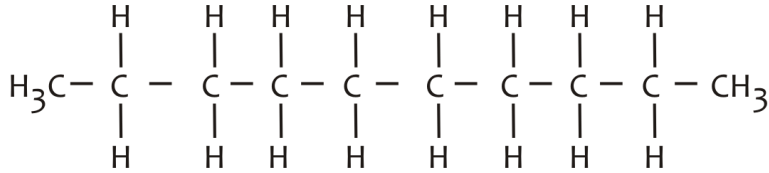
CRACKING AND PETROCHEMICALS

The hydrocarbons obtained from the fractional distillation of crude oil range from those with one carbon atom like methane to those with more than sixty carbon atoms. It is only the low molecular mass and low boiling fractions (which make up 49% of the fractions) that are useful as fuels and raw materials in the chemical industry. It is economical to convert some of the higher boiling hydrocarbon fractions to lower boiling ones. This can be achieved by the process of cracking, i.e. the breaking of bigger hydrocarbons into smaller hydrocarbons. In other words, cracking means the breaking down or decomposition of a compound by the action of heat alone. This process involves splitting larger molecules into smaller molecules by subjecting

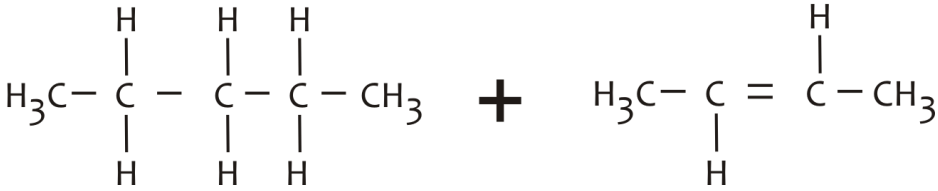
them to high temperatures and pressures, usually in the presence of a catalyst.

Thermal Cracking: In thermal cracking of petroleum, the less volatile crude oil fractions are simply passed through a chamber heated to a very high temperature (above 1000^{o}C). Long chain alkanes are converted into smaller chain alkanes, alkenes, and hydrogen, with ethane, C_2H_4, being the predominant alkene present. Depending on the reaction conditions, cracking can take place at any point along the main carbon skeleton of the alkane to give shorter chain alkanes or alkenes. The cracking of decane is shown below:



Decane $C_{10}H_{22}$





Pentane C_5H_{12} But-2-ene C_4H_8

Note that the products given are only some of the many possible products formed during the cracking of decane.

Thermal cracking is not particularly efficient because there is poor control over the cracking pattern

to yield alkanes of desirable chain length. This is due to the fact that the carbon-carbon bonds of the alkanes in the heavy oil fractions are about the same strength.

Catalytic Cracking: Nowadays, catalytic cracking is the method used for cracking of petroleum in the presence of a catalyst. Higher boiling-point fractions, particularly, gas oil, are brought into contact with a finely divided silica-aluminium catalyst at a temperature of 450^{o}C to 550^{o}C and under a slight pressure. Catalyst cracking is better because firstly, the process is more controllable, i.e. the conditions can be adjusted such that desirable products of certain chain lengths are obtained. This process thus yields a source of alkenes which serve as raw materials for a great variety of organic chemicals. Secondly, the process not only yields petrol but also gives petrol of high quality. In fact, this

petrol is a higher grade petrol than the one obtained directly from the petrol fraction during the distillation of crude oil.

Petrochemicals

Petrochemicals are processed products from petroleum. These petrochemicals are often known as value-added products because after processing, the market value of petrochemicals can go up to thirteen times that of the original crude petroleum.

Common petrochemicals include pesticides, nylon, synthetic rubber, plastics, detergents, paints, etc.

Synthesis gas is a mixture of gases like hydrogen, carbon (IV) oxide, carbon (II) oxide and impurities like dihydrogen sulphide. It can be used as a source of carbon (IV) oxide, hydrogen sulphur and

tetraoxosulphate (VI) acid. From synthesis gas, we can obtain ammonia, methanol, gasoline, fertilizers, refrigerants, explosives, urea, polymers, and petrol additives.

Alkenes. These are obtained from the cracking of crude oils. Alkenes such as ethane and propene can be made into poly(ethene), poly(chloroethane), poly(phenylethene), nylon, ethanol, propanone and alkanes. Products like cosmetics, dynamite, synthetic rubber can be made from these petrochemicals.

Aromatic Compounds: From petroleum, we get aromatic compounds like benzene, toluene and xylene. The processed products are synthetic fibres such as nylon, plastic, insecticide, detergents, and solvents.