Petroleum

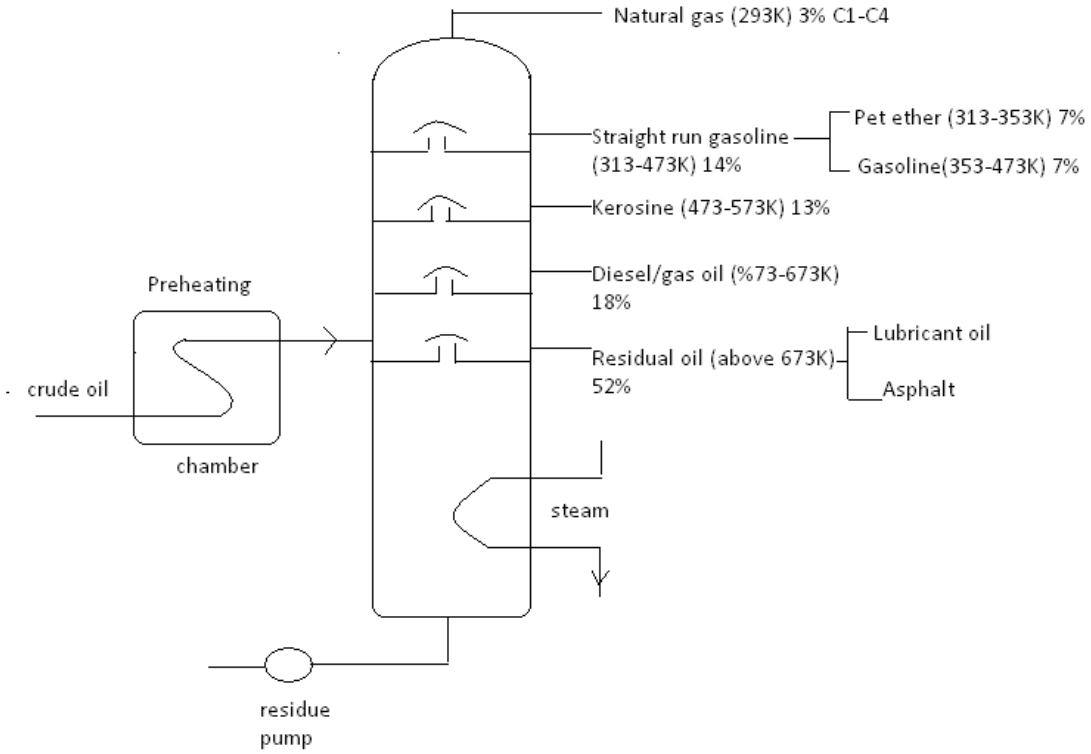
The dark coloured viscous, oily mixture of hydrocarbons found in the impervious rock deep below the earth's crust from which the various petrochemicals are obtained directly ot indirectly is called Petroleum. The gas in the atmosphere of petroleum is called natural gas.

Origin of petroleum: Different theories:

1. Carbide theory: petroleum is originated from inorganic source. Molten mwetals react with coal deposits to form carbides which on further reactions such as hydrogenation, isomerisation, polymerization alkylation etc form different hydrocarbons.
   $Ca + 2C \rightarrow CaC_2$ $\quad CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$
   $4Al + 3C \rightarrow Al_4C_3$ $\quad Al_4C_3 + 12\ H_2O \rightarrow 4Al(OH)_3 + 3CH_4$
   $Mg + 2C \rightarrow Mg\ C_2$ $\quad Mg\ C_2 + 2H2O \rightarrow Mg(OH)_2 + C_2H_2$
   $C_2H_2 + H_2 \longrightarrow C_2H_4$
   $C_2H_4 + H_2 \longrightarrow C_2H_6$
   $2\ C_2H_4 \longrightarrow CH_3\text{-}CH{=}CH\text{-}CH_3 \longrightarrow CH_3\text{-}CH_2\text{-}CH{=}CH_2$
   $3\ C_2H_4 \longrightarrow C_6H_{12}$
   Moissan supported this theory by producing petroleum like liquid by reacting Uranium carbide with water at high temp and pressure. However, this theory does not explain the presence of N, S compounds and chlorophyll and haemin etc in petroleum.
2. Organic Or Engler's theory: Sea animals killed due to volcanic eruption were buried under the earth by earthquake, which were decayed and decomposed to form petroleum. Engler obtained petroleum like liquid by decomposition of fish il and animal fat at high temp and pressure. This theory explains the presence of N and S, sea water and fossils in petroleum but not the presence of chlorophyll, high resin content and coal deposits in the petroleum. Field.
3. Modern theory: petroleum is formed by decay and decomposition of biological material from both plants and animals by radioactive elements or bacteria. This theory explains the presence of material like brine, coal, resins and optically active substances of plant and animal origin in the petroleum.

Constitution and refining:

Crude oil is stabilized by heating to remove natural gas. Then it is washed with acid and alkali to remove basic and acidic impurities. Then it is subjected to fractional distillation into five components as follows:



Cracking: conversion of high boiling fractions like kerosene, gasoil, residual oil to gasoline is called cracking.

Cracking is carried out in two ways:

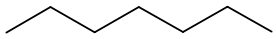
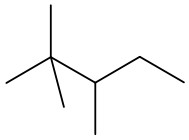
1. Thermal cracking: straight chain alkanes are passed over the heated coil under pressure.
2. Catalytic cracking: In presence of a catalyst like silica/ alumina or 1% MnO_2.

Hydroforming or catalytic reforming: process of changing open chain hydrocarbons to aromatic hydrocarbons in presence of a catalyst like Pt/ MoO_2/Al_2O_3 is called hydroforming or catalytic reforming.

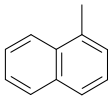
Knocking: The sharp metallic rattling sound produced during working internal combustion engine is called knocking. This causes loss of power, wear in enging, fuel wastage, and leads to pollution.

Knocking tendency order is as follows:
Linear hydrocarbons> branched hydrocarbons> olefins> naphthenes> arenes
Knocking is minimized by adding antiknocking agents like TEL (tetra ethyl lead) or BTX (benzene, toluene, xylene mixture) to gasoline. TEL decomposes to fine particles of lead and alkyl radical in the combustion chamber which reduces knocking.

Octane number: Octane number is a scale which is used to determine the knocking property of the fuel. Edger selected two pure hydrocarbons n-heptane with high knocking property and isooctane (2,2,4-trimethyl pentane) with lowest knocking property as standards.
% of isooctane present in the mixture of isooctane and n-heptane having the same knocking performance with the test fuel is called octane number.
Eg. 70 octane number indicates that the fuel is having same knocking performance with the mixture of 70% isooctane and 30% n-heptane. Higher the octane number , better is the fuel quality.

	n-heptane highest knocking	Octane number 0
	Isooctane (2,2,4-trimethyl pentane)	Octane number 100

Cetane number: quality of diesel is expressed in terms of cetane number. Hexadecane ($C_{16}H_{34}$) or cetane which ignites rapidly and 1-methyl naphathalene which ignites slowly are taken as standard and the igniting property of the fuel under study is compared with that of the mixture of the two to find its cetane number.

	Hexadecane or cetane Rapid ignition	Cetane number 100
	1-methyl naphathlene Slow ignition	Cetane number 0