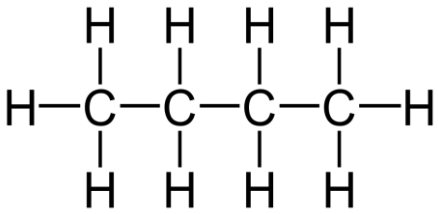
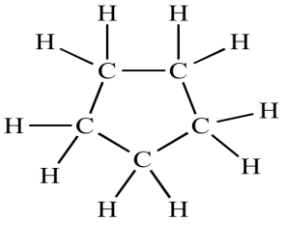
Oil Pollution of Water Bodies

Oil is a complex (hydrocarbon), naturally occurring mixture of organic compounds (hydrocarbon), that is produced by the incomplete decomposition of biomass over a geological long period.

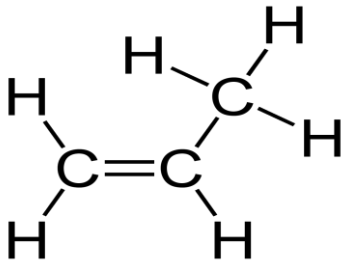
Chemical nature: The oils are chiefly hydrocarbons either saturated or unsaturated in nature. They either be of long chain fatty acid or hexane derivatives. Structures assumed by Hydrogen (H) and Carbon (C) molecules in four common hydrocarbon compounds. They may of,



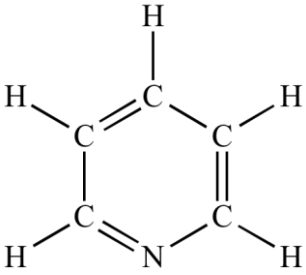
Butane (Paraffin)



Cyclopentane (Naphthene)



Propylene (Olefin)

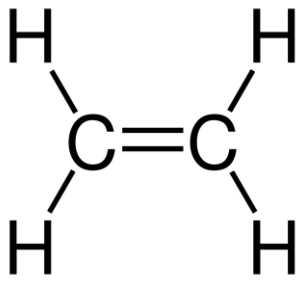


Benzene (Aromatic)

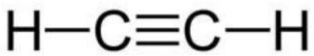
Classification / Chief constituents:- The hydrocarbon may be classified into 3 broad categories and each with various subclasses (Clark and Brown, 1977; Kornburg,1981)

1) Aliphatic hydrocarbon:- This are open chain compounds and are saturated, if there is single bond among all adjacent carbon atom, this may be branched or unbranched and saturated or unsaturated.

In case of unsaturated molecule have at least one double or triple bond like as in ethene and acetylene.

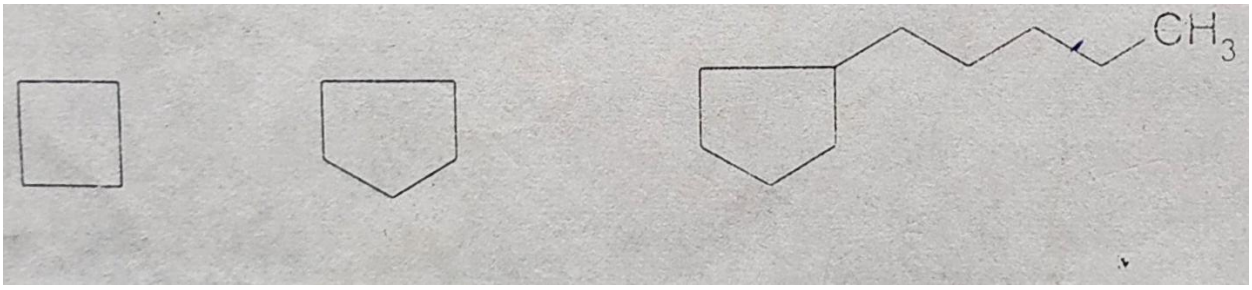


Ethene

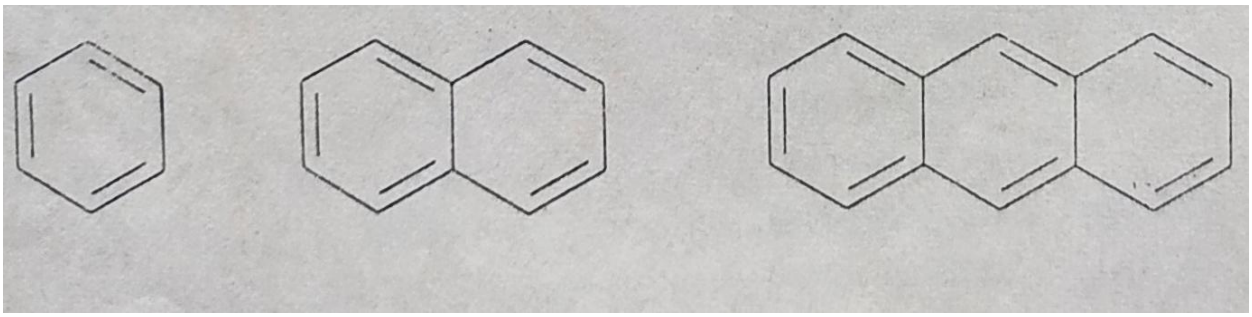


Acetylene

2) Alicytic hydrocarbon:- This have a four/five carbon ring at the part of their structure or total carbon atoms arranged in such way including 4/5 carbon ring structure and usually they may be saturated or unsaturated.



3) Aromatic hydrocarbon:- These are the hydrocarbons that contain at least one 6 carbon ring in this molecular structure. The basic ring is C_6H_6 and Known as Benzene ring and may be either saturated or unsaturated.



Petroleum crude oils are complex mixtures of hydrocarbons, chemical compounds composed only of carbon (C) and hydrogen (H). Crude oils from different location greatly varying in their hydrocarbon composition. The 3 most important groups of hydrocarbons in petroleum are:-

1) Long chin hydrocarbon, paraffin molecule, their hydrocarbon ranging from single carbon to more than 17 carbons.

2) Saturated and unsaturated and 5 carbon ring with/without branch hydrocarbons chain (alicyclic derivatives) and within it on average about 1% by weight of aromatic hydrocarbons (one 6 carbon ring structure) are found.

3) The aromatic hydrocarbons with more than one or two benzene rings generally called polycyclic or polynuclear aromatic Hydrocarbons (PAH) and their great varieties eg. Benzoanthracene, naphthane etc.

Saturated molecules

The simplest form of the hydrocarbon molecules is methane (CH_4) which has one carbon atom and four hydrogen atoms per molecule. The next simplest, ethane (C_2H_6) has two carbon atoms and six hydrogen atoms. A whole class of hydrocarbons can be defined by expanding upon the relationship hetween methane and ethane. Known as the paraffins, this is a family of chainlike molecules with the chemical formula C_nH_{2n+2}. These molecules are also referred to as saturated. Since each of the four valence electrons on a carbon atom that are available for bonding is taken up by a single hydrogen or carbon atom. Because these "single" bonds leave no valence electron available for sharing with another atom. Paraffin molecules tend to be chemically stable.

Paraffin can be arranged either in straight chains (nommal paraffins, such as butane: see figure) or branched chains (isoparaffins). Most of the paraffin compounds in naturally occurring crude oils are normal paraffins, while isoparaffin are frequently produced in refinery process. The normal paraffin are uniquely poor as motor fuels, while isoparaffins have good engine combustion characteristics. Longer chain paraffins are major constituents of waxes.

Once a hydrocarbon molecule contains more than four carbon atoms, the carbon atoms may form not a branched or straight chain but a closed-ring structure known as a cyclo-compound. Saturated cyclo-compounds are called naphthenes. Naphthenic crudes tend to be poor raw materials for lubricant manufacture, but they are more easily converted into high-quality gasoline than are the paraffin compounds.

Unsaturated molecules

Two other chemical families that are important in petroleum refining are composed of unsaturated molecules. In unsaturated molecules, not all the valence electrons on a carbon atom are bonded to separate carbon or hydrogen atoms: instead, two or three elections may be taken up by one neighbuoring carbon atom, thus forming a "double" or "triple" carbon-carbon bond like saturated compound. Unsaturated compounds can form either chain or ring molecules. Unsaturated chain molecules are known as olefins. Only small amounts of olefins are found in crude oils. But large volumes are produced in refining processes. Olefins are relatively reactive as chemicals and can be readily combined to form other longer-chain compounds.

The other family of unsaturated compounds is made up of ring molecules called aromatics. The simplest aromatic compound, benzene (C_6H_6), has double bonds linking every other carbon molecules (see figure). The double bonds in the benzene ring are very unstable and chemically reactive. For this reason benzene is a popular building block in the petrochemical industry.

Unsaturated hydrocarbons generally have good combustion characteristics, but their reactivity can lead to instability in storage and sometimes to environmental emission problems.

Types of crude oil

The above description of hydrocarbons refers in simpler members of each family, but crude oils are actually complex mixtures of very long-chain compounds, some of which have not yet been identified. Because such complex mixtures cannot be readily identified by chemical composition, refiners customarily characterize crude oils by the type of hydrocarbon compound that is most prevalent in them paraffins, naphthenes and aromatics. Some crude oils such as those in the original pensylvanian oil

fields, consist mainly of paraffins. Others, such as the heavy Mexican and Venezuelan crudes, are predominantly naphthenic and are rich in bitumen (a high-boiling semi solid material frequently made into asphalt for road surfaces).

The proportions of products that may be obtained by distillation of five typical crude oils, ranging from heavy Venezuelan Boscan to the light Bass Strait oil produced in Australia, are shown in the figure. Given the pattern of modern demand (which tends to be highest for transportation fuels such as gasoline), the market price of a crude oil generally rises with increasing yields of light products. It is possible to process heavier crudes more intensely in order to improve their yields of light products, but the caqpital and operating costs required to support such high conversion processes are much greater than those required to process lighter crudes into the same yields of products.

Sources of oil pollution:-

Water as well as soil is polluted by the oil by means of different sources like -

1) Oil spill from wrecked super tanker.
2) Oil spills from offshore drilling ridges.
3) Experimental oiling of salt-marsh vegetations.

By the above 3 main way the water and soil is polluted by oil, and create the hazardous conditions.

1) Oil spills from wrecked super tanker:

a) Wrecked tanker transportation- the world production of crude oil is about 3 million ton per one year. And half of it is transported by the sea through tanker (Clark, 1989). During the unloading of the Cargo a certain amount of oil remain clinging to the wall of the compartment and this may amount to as much as 800 ton in a two lakes ton tanker capacity.

b) Dried docking- All ships including oil tanker required periodic dried docking for servicing, repairing etc, then it is essential that all oil to be the removed from the cargo compartment in the mean time the oil are licked out and polluted the environment.

c) Marie terminals- Accident through human error and pipeline failure are an inevitable accompaniment to loading oil to tanker and discharging it in oil terminals.

d) Tanker accidents- The tanker accident the major sources by which large amount oil is drainage into sea or if accident occurs closed to the sore, coastal pollution is immediately results. And oil spills from offshore drill platforms is one of the notable sources and cause of oil pollution.

2) Miscellaneous sources :

a) Atmospheres- The incomplete combustion of the petrol diesel vehicles results in pollution of hydrocarbons being released result into the atmosphere, these are precipitate and swept out by rain either direct by into the sea or indirectly by contribution into the river runoff.

b) Municipal and industrial wastes- Domestic waste and sewage contents considerable quantity of oil, greases, petroleum hydrocarbons. In the coastal areas this wastes are often discharged into the sea or it is drained into the river is a municipal drained disposed into sea through the river runoff.

c) The coastal oil refineries- In the refineries required a large amount of water and total discharge of such water are not negligible after the used in refineries this water contains considerable amount of this hydrocarbon and this is continuously discharged into sea by either directly or indirectly in a river runoff.

1) Licensed dumping at sea:- Shipping channel is estuarine and spiels need regular dragging. The dragging spiel, which is usually dumped at the sea, is contaminated in the soil.

2) Oil spills from offshore drilling ridges:- In the offshore area from where through mining and pumping out the oil during this process the process the considerable amount of oil are continuously contaminated with the sea water as is happens in the Gulf Region.

3) Experimental oiling of the salt marsh vegetation:- Using as an insecticide and to eradication of the insect the experimental oiling is done in the different region, particularly in the salt- marsh vegetation which is a direct source of oil pollution of sea water.

Environmental impact of oil spill:- The crud oil in environment caused various types of harmful effect, the cumulative effect of the many minute spills that hand occurred both land and sea may be at least as serious.

The harmful effect of oil on living organisms may be divided into two

Effects of oil pollution:-

a) Decreases of light penetrability: Oil is generally lighter and float on the surface of the water at as a layer, the thick layer of such film of spilled oil reduced the rate of light penetration which is very much necessary for the production of photosynthesis. Therefore the primary production of decreases which in turn affects on the lighter forms.

b) Decrease of oxygen up take by water: Due to hydrophobic and impermeable nature of the oil, the film of the oil-spill inhibited the interchange of oxygen at the water air surface. Therefore the dissolved oxygen in that area became depleted which in turn affect on the higher form of the tropic level population density of planktonic form simply decreased and this becoming less production area.

c) Destruction of neuston: The plankton and specially neuston (the organism which restricted on the surtace of the water) are subjected to damage caused by the higherconcentration of following oil due to hypoxic condition and skin burning.

d) Destruction of Birds (sea birds): By the oil coating caused a lot of destruction in the community of sea birds by matting the feathers, the oil destroyed there insiulation capacity reduced buoyancy in water and prevent flight, so that this animal may die drawing and an excessive heat loss leads to hypothermia situation, inactive and dead.

e) Prohibited the water turbulence: By the thick layer of the on sea surface eased the probation of water turbulence therefore the film of the spill oil remain at an area and caused much destruction of inside inhabitant plankton, fishes, etc. Therefore the nutrition status is depleted.

f) Changing the biological habitat: The most of the marine as well as terrestrial species end avoid the oil-coating and its harmful effect except same oil eating bacteria.