

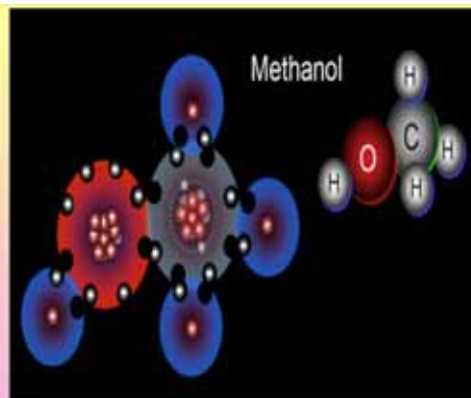
Organic Compounds- A General Introduction



Learning Outcomes:

Students will be able to:

1. define organic chemistry.
2. enlist the general characteristics of organic compounds.
3. explain the diversity and magnitude of organic compounds.
4. know the sources of organic compounds.
5. enlist the uses of organic compounds.



Introduction:

The Swedish chemist Torbern Bergman in 1770 was the first to express this difference between "*organic*" and "*inorganic*" substances, and the term organic chemistry soon came to mean the chemistry of compounds found in living organisms.

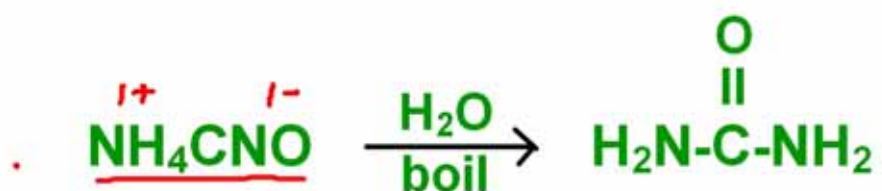
To many chemists of that time, the only explanation for the differences in behaviour between organic and inorganic compounds was that organic compounds must contain a peculiar "*vital force*" as a result of their origin in living sources.

Drawback of vital force theory:

The most profound drawback of the *vital force theory* was that the chemists of that time believed that these substances were impossible to be synthesized in the laboratories.

- Synthesis of urea:

The *vital force theory* was rejected in 1828 by a German chemist Friedrick Wohler, when he synthesized urea, a waste product excreted by animals through urine. Wohler prepared urea in the laboratory from inorganic material, ammonium cyanate by boiling it with water.



· Preparation of urea confirmed the belief that no special force was needed for the synthesis of organic compounds. Thereafter numerous organic compounds were synthesized in laboratories and by 1860 the vital force theory stood completely rejected.

· Following the revolutionary discovery of Wohler, it was found out by analytical methods that organic compounds always contain the element carbon and most of them

Methane $\overset{\cdot}{\text{C}}\text{H}_4$

Benzene C_6H_6



also contain hydrogen and oxygen. While some of them also contain nitrogen, sulphur and halogens as well. Therefore, organic chemistry was redefined as *the chemistry of the compounds of carbon.*

Modern definition:

For historical and conventional reasons a few of the carbon compounds such as carbon monoxide, carbondioxide, carbonates, bicarbonates etc. are studied as inorganic compounds. Therefore, the modern definition of organic chemistry has been developed as

~ "The chemistry of hydrocarbons and their derivatives."

General Characteristics of Organic Compounds:

Following are some of the main characteristics of organic compounds.

Covalent Nature:

They show characteristics of covalent compounds.

- ✓ (i) They are volatile in nature.
- ✓ (ii) They have low melting and boiling points.
- ✓ (iii) They are generally insoluble in water but soluble in organic solvents.
- ✓ (iv) They are bad conductors of electricity.
- ✓ (v) They do not furnish ions. They show molecular reactions.

Action of heat:

Organic compounds are unstable towards heat. They decompose on heating at high temperature. Some of them decompose on heating leaving a black residue.

→ Combustion:

Organic compounds readily burn in air. They burn with a smoky or non-smoky flame. One of the products of combustion is always carbon dioxide.

In general, the reactions of organic compounds are slow. They never proceed to completion and their yields are generally of low order.

Homologous series:

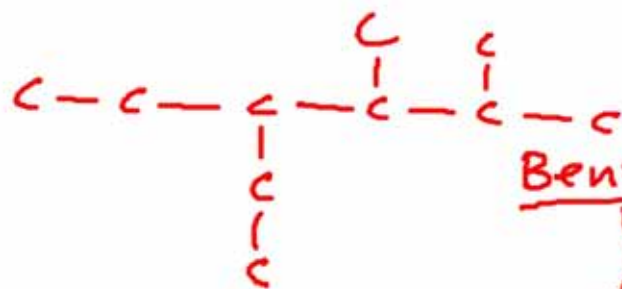
Organic compounds have been classified into many classes each having the same functional group. The classes are known as homologous series. The compounds belonging to the same class show similar chemical properties.

Polymerism:

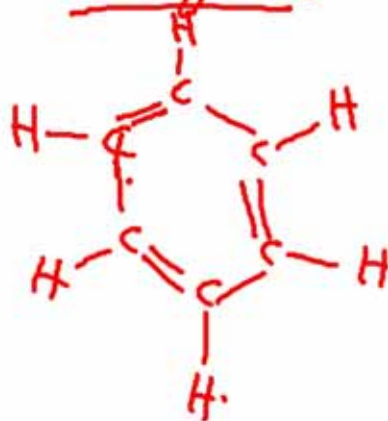
Quite a number of organic compounds exhibit polymerism (when a molecular formula of an organic compound is a simple multiple of the other). For example, benzene (C_6H_6) is a polymer of acetylene (C_2H_2).

Isomerism:

Organic compounds show the phenomenon of isomerism.



Benzene.



Diversity and Magnitude of Organic Compounds:

There are millions of organic compounds known at present. Although the earth's crust contains only 0.027% carbon, but the millions of organic compounds are possible because of the unique property of carbon atoms which is called *catenation*

" Catenation is the ability of element to bond itself with its own atoms."

Moreover, the enormous number of organic compounds is due to the ability of carbon atoms to show tetravalency and to form:

- (i) Strong, stable covalent bonds with other carbon atoms giving rings and chains of different sizes.
- (ii) Strong and stable bonds with hydrogen, oxygen, nitrogen and other atoms.

Sources of Organic Compounds:

The main sources of organic compounds are Petroleum, Coal and Natural Gas.

Natural gas:

Natural gas is one of the important sources of simple organic compounds and is a mixture of light weight alkanes. A typical sample of natural gas when it is collected at its source contains

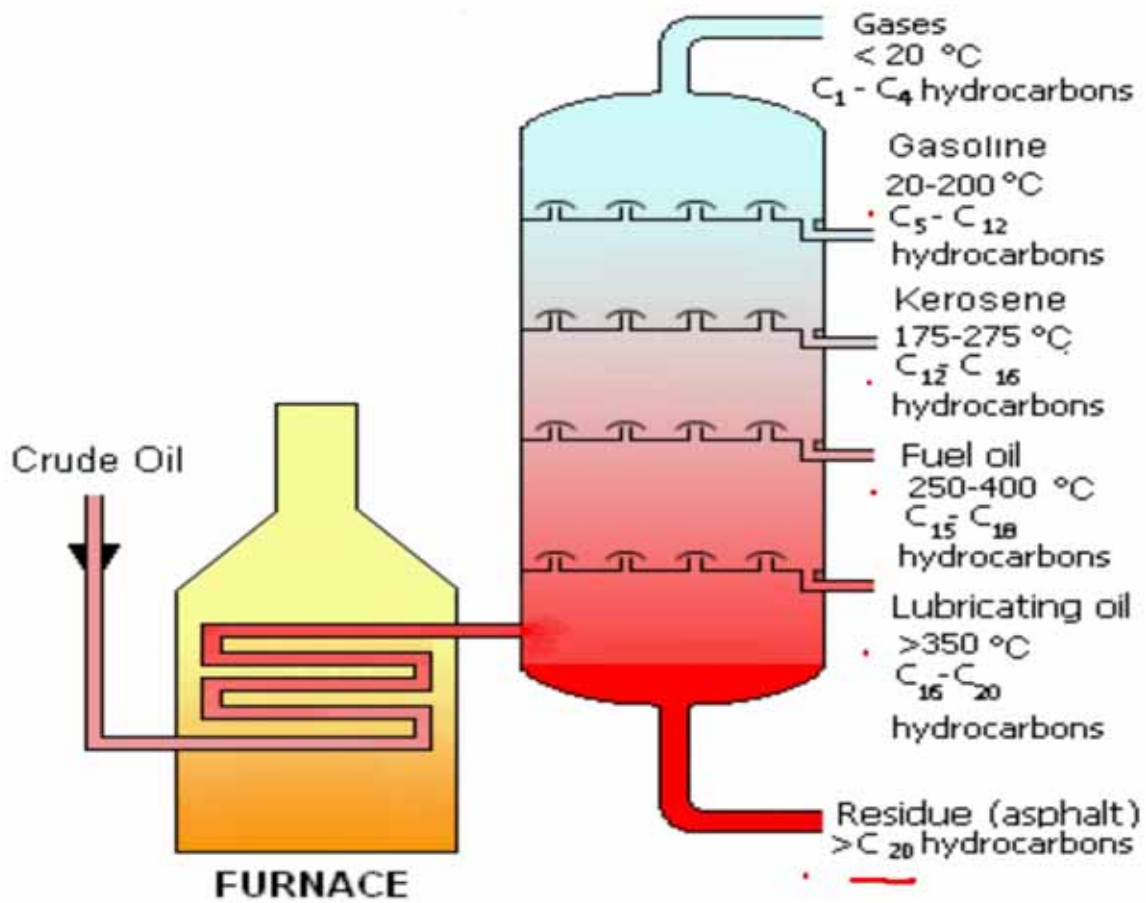
- methane (CH_4)
- ✓ ● ethane (C_2H_6)
- propane (C_3H_8)
- n-butane and isobutane (C_4H_{10})
- ● and pentanes (C_5H_{12}).

Petroleum or Crude oil:

*Petra = rock
oleum = oil*

Mineral Crude oil is called petroleum and is a complex mixture of various organic compounds. When extracted from rocks it appears like a viscous liquid of dark brownish colour-a crude oil. The first step in refining crude oil involves separating the oil into different fractions by distillation.

A typical set of petroleum fractions is given in the picture. Since there are a number of factors that influence the boiling point of a hydrocarbon, these petroleum fractions are complex mixtures. More than 500 different hydrocarbons have been identified in the gasoline fraction.



Coal:

In nature coal was found from the remains of the trees buried inside the earth crust some 500 millions years ago. Due to the bacterial and chemical action, wood passes through several stages to be converted into hardest form of the coal called anthracite.

WOOD → PEAT → LIGNITE →
BITUMINOUS COAL → ANTHRACITE

Coal is an important fuel and a source of organic compounds when subjected to destructive distillation. When coal is heated in absence of air; it is converted into coke, coal gas and coaltar. Coaltar

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contains a large number of organic compounds, which separate out on fractional distillation.

Animation

Uses of Organic Compounds:

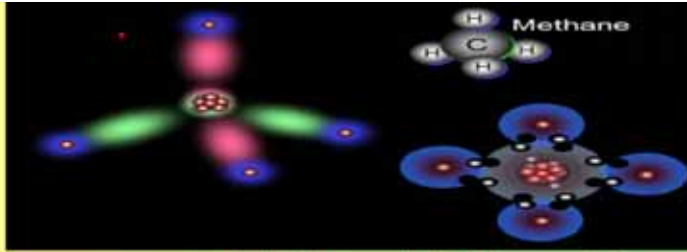
The knowledge of organic chemistry is applicable in all fields of life. Thus, we are being surrounded by a variety of organic compounds. The important uses of organic chemistry in every day life and industry are as under.

We are being surrounded by variety of organic compounds.

- ✓ - **Foods** Starch, Fats, Proteins, Vitamins etc.
- ✓ - **Clothes** Cotton, Wool, Nylon, Dacron, Terylene etc.

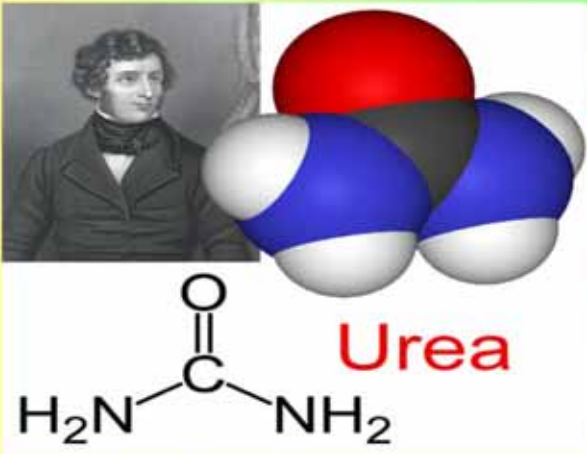
- **Feuls** Kerosene oil, Diesel, Petrol etc.
- **Rubber and Plastics** Polyethylene, Polystyrene etc.
- **Medicines** Pencillin, Streptomycin, Cartison, Antibiotics etc.
- **Inseticides** DDT etc.
- **Stationery** Paper, Pencil, Writing inks etc.

Organic compounds can also be used in dyes, drugs, paints, varnishes, cosmetics, refrigerants etc.



Multiple Choice

Questions



1. Which of the following element is the essential constituent of all organic compounds?

- ↵ A. Carbon
- ↵ B. Nitrogen
- ↵ C. Oxygen
- ↵ D. Phosphorous

2. Which of the following property is generally a characteristic of an organic compound?

- A. High melting point
- B. Low melting point
- C. Soluble in polar solvents
- D. Insoluble in nonpolar solvents

3. Carbon has the ability to form variety of organic compounds, due to its property of

- A. allotropy.
- B. isotropy.
- C. catenation.
- D. trivalency.