Carbon & its Compounds
Ethanol

SOME IMPORTANT CARBON COMPOUNDS - ETHANOL AND ETHANOIC ACID

❖ ETHANOL

▶ PROPERTIES OF ETHANOL

(i)Ethanol is a liquid at room temperature.

(ii)Ethanol is commonly called alcohol and is the active ingredient of all alcoholic drinks.

(iii)Ethanol is also soluble in water in all proportions.

▶REACTIONS OF ETHANOL

(i) **Reaction with sodium:** Alcohols react with sodium leading to the evolution of hydrogen with ethanol and the by- product is sodium ethoxide.

$$2Na + 2CH_3CH_2OH \rightarrow 2CH_3CH_2O^-Na^+ + H_2$$

(Sodium ethoxide)

(ii) **Dehydration of Alcohol :** Heating ethanol at 443 K with excess of concentrated sulphuric acid results in the dehydration of ethanol to give ethene.

$$CH_3 - CH_2OH \xrightarrow[H_2SO_4]{\text{Hot conc.}} CH_2 = CH_2 + H_2O$$

The concentrated sulphuric acid can be regarded as a dehydrating agent which removes water from ethanol.

(iii) **Ester formation:** Under acid-catalyzed conditions, ethanol reacts with carboxylic acids to produce ethyl esters and water.

$$RCOOH + HOCH_2CH_3 \xrightarrow{H_3O^+} RCOOCH_2CH_3 + H_2O$$

(iv) **Oxidation :** Ethanol can be oxidized to acetaldehyde (also known as ethanal, is an organic chemical compound with the formula CH_3CHO, occurs naturally in ripe fruit, coffee, and fresh bread), and further oxidized to acetic acid. This oxidation is brought about by common oxidising agent used in organic chemistry like alkaline $KMnO_4$, acidified $K_2Cr_2O_7$, chromic acid etc.

$$CH_3CH_2OH \xrightarrow{\text{alk } KMnO_4} CH_3CHO \xrightarrow{\text{alk } KMnO_4} CH_3COOH$$

▶ MANUFACTURE OF ETHANOL: (INDUSTRIAL SCALE)

Ethanol preparation from fermentation of sugar

Fermentation is a process whereby an organic compound is broken into smaller molecules by enzymes such as yeast. Ethanol is prepared by fermentaion of molasses. Molasses, a by product of sugar industry, has traces of sugar, which gets broken down into ethanol. The fermentation is initiated by yeast, which secretes two enzymes called invertase and zymase. These enzymes act as catalyst for converting sugar into ethanol. The reaction is exothermic and carbon dioxide is released in the process.

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{\text{Inverase}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

$$\underset{\text{Glucose or fructose}}{C_6H_{12}O_6} \xrightarrow{\text{Zymase}} \underset{\text{Ethanol}}{2C_2H_5OH} + 2CO_2$$

Molasses is heated to about 20 to 30°C in an airtight container. Yeast is mixed in the molasses. The airtight container has outlets for removal of carbon dioxide released during the fermentation process. Ethanol and water vapours that are formed are collected and separated by fractional distillation.

▶ HOW DO ALCOHOLS AFFECT LIVING BEINGS?

(i) When large quantities of ethanol are consumed, it tends to slow metabolic processes and to depress the central nervous system. This results in lack

of coordination, mental confusion, drowsiness, lowering of the normal inhibitions, and finally stupor.

(ii) The individual may feel relaxed but does not realise that his sense of judgement, sense of timing, and muscular coordination have been seriously impaired.

(iii) Intake of methanol in very small quantities can cause death. Methanol is oxidised to methanal in the liver. Methanal reacts rapidly with the components of cells. It causes the protoplasm to get coagulated, in much the same way an egg is coagulated by cooking.

(iv) Methanol also affects the optic nerve, causing blindness. Ethanol is an important industrial solvent. To prevent the misuse of ethanol produced for industrial use, it is made unfit for drinking by adding poisonous substances like methanol dyes are also added to colour the alcohol blue so that it can be identified easily. This is called **denatured alcohol**.

(v) Consumption of small quantities of dilute ethanol causes drunkenness. Even though this practice is condemned, it is a socially widespread practice. However, intake of even a small quantity of pure ethanol (called absolute alcohol) can be lethal. Also, long-term consumption of alcohol leads to many health problems.

Ethanol is a good solvent. It is also used in medicines such as tincture of iodine, cough syrups, and many tonics.

▶ ALCOHOL AS A FUEL

Sugarcane plants are one of the most efficient convertors of sunlight into chemical energy. Sugarcane juice can be used to prepare molasses which is fermented to give alcohol (ethanol). Some countries now use alcohol as an additive in petrol.

It is a cleaner fuel which gives rise to only carbon dioxide and water on burning in sufficient air (oxygen). It is known as Power alcohol.

▶ USES OF ETHANOL:

(i) Ethanol is used for manufacturing of paints, dyes, varnishes.

(ii) Ethanol is used in medicines especially for disinfecting area on the skin before giving an injection. It is used for sterilization of syringes in hospitals.

(iii) Ethanol is used for preparation of compounds such as chloroform and ether.

(iv) Ethanol is used for making thermometer that is used for measuring low temperature.

(v) Ethanol is used in spirit lamps.

(vi) Ethanol blended fuel called rectified spirit is used as a substitute for fuels in vehicles that are environmental pollutant. They give off low emissions of carbon monoxide gas that is harmful to the environment. Ethanol is the main component of alcoholic beverages such as rum, whisky and beer.