**ETHERS**

Saturated aliphatic ethers form a homologous series and correspond to a general molecular formula (CnH2n+1)2O where n is equal to or greater than 1. They are characterized by the structural feature of an oxygen atom linking two hydrocarbon groups.

R-O-R’

Where R and R’ may be similar or different. They may be aromatic or aliphatic and the names of the ethers correspond to the hydrocarbon groups present.

Examples

CH3OCH3 Methoxymethane CH3CH2OCH2CH3 Ethoxyethane

(CH3CH2CH2CH2)2O Butoxymethane CH3CH2 OCH3 Methoxyethane

CH3CH2CH2OCH2CH3 Ethoxypropane

**NOMENCLATURE**

Ethers may be designated by the IUPAC system as hydrocarbon derivations. They are regarded as alkoxy derivatives of alkanes.

CH3CH2OCH2CH(CH3)CH2CH3 2-Methylethoxybutane

CH3CH2O(CH2)4CH3 Ethoxypentane

**General properties**

1. Physical states

At room temperature, ethers are colourless, neutral liquids with pleasant odours. The lower aliphatic rthers are highly flammable gases or volatile liquids.

1. Solubility

Ethers are less soluble in water than are the corresponding alcohols. Lower molecular weight ethers such as methoxymethane and methoxyethane are fairly soluble in water since the molecule are able to form hydrogen bonds with the water molecules but as the hydrocarbon content of the molecules increases, there is a rapid decline in solubility. They are miscible with most organic solvents.

1. Density

Most of the simple ethers are less dense than water, although the density increases with increasing relative molecular mass and some of the aromatic ethers are in fact denser than water

1. Boiling point

Low molecular mss ethers have a lower boiling point than the corresponding alcohols but those ethers containing alkyl radicals larger than four carbon atoms, the reverse is true. The boiling point of ethers tend to approximate those of hydrocarbons of same relative molecular mass from which it can be concluded that the molecules are not associated in the liquid phase as there are no suitably available hydrogen for association through hydrogen bonds,

1. Reactivity

Ethers are inert at moderate temperature. Their inertness at moderate temperatures leads to their wide use as reaction media

Simple ethers are not found commonly in nature but the ether linkage is present in such natural products as sugars, starches and cellulose

**MANUFACTURE AND PREPARATION OF ETHERS**

1. Partial dehydration of alcohols

Simple ethers are manufactured from alcohols by catalytic dehydration. The alcohol in excess and concentrated tetraoxosulphate(vi) acid is heated at a carefully maintained temperature of 140oC. this process is known as continuous etherification. If excess alcohol is not used, the temperature is as high as 170-180oC, further dehydration to yield alkene occurs

2ROH conc. H2SO4 /140oC R-O-R + H2O

Examples

2CH3CH2OH conc. H2SO4 /140oC CH3CH2-O-CH2CH3 + H2O

1. Controlled catalytic hydration of olefins

2CH3CH=CH2 + H2O (CH3)2CH-O-CH(CH3)2

2-isopropoxypropane

1. From Haloalkanes and dry silver (I) oxide

2RX + Ag2O warm R-O-R + 2AgX

2CH3CH2CH2Cl + Ag2O warm CH3CH2CH2O CH2CH2CH3 + 2AgCl Propoxypropane

**CHEMICAL REACTIONS**

Ethers are relatively inert with regards to chemical reaction and in this regard they resemble the corresponding alkanes which carry no functional groups. However, the oxygen atom is sufficiently basic to undergo protonation in an acidic medium by the donation of a lone pair of electron, that is, it functions as a Lewis base. The protonated species is then susceptible to subsequent attack by a nucleophile. It is as a result of this phenomenon that ethers unlike alkanes do form salts with hydrogen chloride gas or concentrated tetraoxosulphate(vi) acid. Below are some of the reactions they undergo

1. Cleavage
2. Heat decomposes ethers especially in the presence of alumina catalysts to form olefins and water as principal products

CH3CH2-O-CH3 Al2O3/heat CH3CH=CH2 + H2O

1. Ethers undergo carbon –oxygen fission on heating with strong acids such as hydriodic, hydrobromic and nitric acids. This cleaves one or both of the carbon-oxygen linkages to form alkyl derivatives and in cases in which only one bond is cleaved, an alcohol is one of the products

CH3CH2OCH2CH3 HI/reflux CH3CH2I + CH3CH2OH

CH3CH2OCH2CH2CH3 2HI/reflux CH3CH2I + CH3CH2CH2I + H2O

1. Autoxidation

In the presence of oxygen, ethers undergo self-oxidation to unstable peroxides and this reaction may create the danger of explosion in stored ether. For this reason, ethers should be stored in dark bottles and should contain an antioxidant

CH3CH2OCH2CH2CH3 + O2 hv CH3CH2-O-CH(OOH)CH2CH3

**CYCLIC ETHERS**

Ethylene Oxide (Oxirane)

Several cyclic ethers are of considerable importance and interest. The simplest of these is ethylene oxide (epoxyethane or oxirane)

O

It is made industrially by oxidation of ethylene with air over a silver catalyst

CH2 =CH2 + O2 Ag cat O Uses of ethylene oxide

1. Ethylene oxide is used as an intermediate in the hydrolytic manufacture of ethylene glycol
2. Ethylene oxide is used in the preparation of nonionic emulsifying agents, plastics, plasticizers and several synthetic textiles
3. Ethylene oxide is used as a gaseous sterilizing agent