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Preparation of Alcohols (continued....)

From esters : Esters on hydrolysis in the presence of mineral acids or alkalies give alcohols.

$$\underset{\text{Ester}}{RCOOR'} + H_2O \xrightarrow[\Delta]{H^+} \underset{\text{carboxylic acid}}{RCOOH} + \underset{\text{alcohol}}{R'OH}$$

$$\underset{\substack{\text{Methyl acetate} \\ \text{methyl ethanoate}}}{CH_3-\overset{\overset{O}{\|}}{C}-OCH_3} + H_2O \xrightarrow[\Delta]{H^+} \underset{\text{acetic acid}}{CH_3-\overset{\overset{O}{\|}}{C}-OH} + \underset{\text{methanol}}{CH_3-OH}$$

Industrial Preparation of Alcohols :

Alcohols are obtained on the industrial scale by the following methods :

A] **By Direct Addition of water**

Alkenes are converted into alcohols by direct addition of water in the presence of phosphoric acid, H_3PO_4.

$$\underset{\substack{\text{2-methylbut-1-ene} \\ \text{(isobutylene)}}}{CH_3-\overset{\overset{CH_3}{|}}{C}=CH_2} + H-\underset{\underset{H}{|}}{O} \xrightarrow[H_3PO_4]{H^+} \underset{\substack{\text{2-methylpropan-2-ol} \\ \text{(tert-butyl alcohol)}}}{CH_3-\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3}$$

[B] By Indirect method of hydration :

Alkenes when treated with concentrated sulphuric acid, and the product is hydrolysed with water, alcohols are obtained.

Ethene gives ethanol by this method, while higher alkenes gives secondary or tertiary alcohols.

$$CH_2=CH_2 + H_2SO_4 \xrightarrow[30\,atm]{353\,K,} CH_3-CH_2-HSO_4 \xrightarrow{+H_2O}$$

Ethene (Conc.) — Ethyl hydrogen sulphate

$$CH_3-CH_2OH + H_2SO_4$$

Ethanol (Primary alcohol)

Propene gives a secondary alcohol Propan-2-ol.

$$CH_3-CH=CH_2 + H_2SO_4 \longrightarrow CH_3-\underset{\displaystyle OSO_3H}{\underset{|}{CH}}-CH_3$$

Propene — Propyl hydrogen sulphate

$$\xrightarrow{H_2O} CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3 + H_2SO_4$$

Propan-2-ol (Isopropyl alcohol)

Addition of H_2SO_4 to unsymmetrical alkenes takes place in accordance with the 'Markownikoff's rule'.

[c] By OXO Process :

$CH_2 = CH_2$ + $CO + H_2$ $\xrightarrow{[Co(CO)_4]I_2}$ $CH_3 - CH_2 - CHO$

Ethene — Water gas — Propanal (Propionaldehyde)

$\xrightarrow{H_2/Ni}$ $CH_3 - CH_2 - CH_2 - OH$

Propanol

[d] By fermentation of carbohydrates :

Slow decomposition of large organic molecules into simpler ones in the presence of enzymes is known as fermentation.

Fermentation method is the oldest method for the preparation of ethanol from carbohydrates (sugar and starch) in the presence of suitable enzymes.

For example, fermentation of glucose gives ethanol.

$C_6H_{12}O_6 \xrightarrow[\text{Yeast}]{\text{zymase}} 2C_2H_5OH + 2CO_2\uparrow$

Glucose — Ethanol