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MECHATRONICS ENGINEERING
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1 The two major classification of alkanols are
i) Based on the number of hydrogen atoms attached to the carbon atom containing the hydroxyl group
ii) Based on the number of hydroxyl groups they possess
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Based on the number of hydrogen atoms attached to the carbon atom carrying the hydroxyl group: if there are 3 or 2 hydrogen atoms bound the the carbon atom the alkanol is said to be primary (1°), if it is one hydrogen atom attached it is called a secondary alcanol (2°) and if no hydrogen atom is attached to the carbon atom bearing hydroxyl group it is called a tertiary alcohol (3°).
Examples under this class are:
a) CH_3CH_2OH Ethanol (1°)
b) $CH_3CH_2CHOHCH_3$ Butan-2-ol 2°
c) $(CH_3)_3COH$ 2-Methylpropan-2-ol 3°

ii) Based on the number of hydroxyl groups they possess alkanols are:
a) Monohydric when there is only one hydroxyl group present in their alkanol structure example

$CH_3CH_2CH_2OH$

Propanol

b) Dihydric also called glycols these ones have two hydroxyl group present in their atomic structure

$HOCH_2CH_2OH$ Ethene-1,2-diol

c) Trihydric or triols have three hydroxyl groups present in the alkanol structure example

$OHCH_2CH(OH)CH_2OH$ Propane-1,2,3-triol

(Trihydric alcohol)

d) Polyhydric or polyols have more than three hydroxyl group in their structure. Example

$CH_3CH(OH)CH(OH)CH(OH)CH(OH)CH(OH)CH_3$

Heptane-2,3,4,5,6-pentanol.

2 Using Propyl Magnesium fluoride $CH_3CH_2CH_2MgFl$

$$CH_3CH_2CH_2MgFl + CH_3CH_2CH_2CH_2C{=}O\,CH_2CH_2CH_3$$

$$CH_3CH_2CH_2MgFl + CH_3CH_2CH_2CH_2\overset{\overset{O}{\|}}{C}-CH_2CH_2CH_3$$

$$\downarrow$$

$$CH_3CH_2CH_2CH_2\overset{\overset{CH_2CH_2CH_3}{|}}{\underset{\underset{CH_2CH_2CH_3}{|}}{C}}-OMgFl$$

$$\downarrow H^+ \ominus OH^-$$

$$CH_3CH_2CH_2CH_2\overset{\overset{(CH_2)_2CH_3}{|}}{\underset{\underset{OH}{|}}{C}}+HOMgFl$$

$$CH_3CH_2CH_2CH_2\overset{\overset{(CH_2)_2CH_3}{|}}{\underset{\underset{OH}{|}}{C}}+Mg(OH)Fl$$

~~4-Propyl Octan-5-ol~~ 4-Propyl Octan-4-ol.

3 Ethanol is manufactured industrially from the fermentation of carbohydrates by organic catalysts (enzymes)
The carbohydrates include, molasses, potatoes, cereals rice ... etc
The steps ~~of~~ of conversion are below

i) The carbohydrate is warmed with malt to 60°C over a given period of time and is then converted to MALTOSE by the enzyme diastase in the malt.

ii) The Maltose is converted to glucose on addition of yeast which contains the enzyme MALTASE at a temperature of 15°C

iii) The GLUCOSE at 15°C temperature is then converted into alcohol by the enzyme Zymase contained also in yeast.

The chemical equation is written below.

Step i) $C_6H_{12}O_5 + nH_2O \xrightarrow[60^\circ C]{\text{Malt Diastase}} C_{12}H_{22}O_{11}$ MALTOSE

Step ii) $C_{12}H_{22}O_{11} + H_2O \xrightarrow[15^\circ C]{\text{Yeast Maltase}} 2C_6H_2O_6$ Glucose.

Step iii) $C_6H_2O_6 \xrightarrow[15^\circ C]{\text{Zymase}} 2CH_3CH_2OH + 2CO_2\uparrow$ Gaseous
Ethanol

4 The product obtained from the reduction of Alkanone / ketone is a secondary alcohol

$$RR'C=O \xrightarrow[[H_2]]{LiALH_4 / (C_2H_5)_2O} RR'CHOH$$

2° alcohol

Specific example

$$CH_3CH_2\overset{\overset{O}{\|}}{C}-CH_2CH_3 \xrightarrow[[H_2]]{LiALH_4 (C_2H_5)_2O} CH_3CH_2\overset{\overset{OH}{|}}{\underset{\underset{H}{|}}{C}}-CH_2CH_3$$

pentan-3-ol.

The product obtained from the reduction of alkanal / Aldehyde is a Primary alcohol

$$R\overset{\overset{O}{\|}}{\underset{\underset{H}{|}}{C}}=O \xrightarrow[[H_2]]{NaBH_4 / H_2O} R\,CH_2OH$$

i alcohol.

Specific example

$$CH_3CH_2\overset{\overset{O}{\|}}{\underset{\underset{H}{|}}{C}}=O \xrightarrow[[H_2]]{NaBH_4 / H_2O} CH_3CH_2CH_2OH$$

Propanol