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Course ⇒ Chem 102
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1 Classification of Alcohols with one example each

a) They may be classified as primary (1°), secondary (2°) or tertiary (3°) depending on the number of hydrogen atoms attached to the carbon atom containing the hydroxyl group. If the numbers of hydrogen atoms attached to the carbon atom bearing the hydroxyl group are three or two, it is a primary alcohol; if it is one hydrogen atom, it is secondary alcohol and if no hydrogen atom is attached to the carbon atom bearing the hydroxyl group, it is a tertiary alcohol.

E.g

CH_3OH

group, it is a tetrary alcohol.

E.g

CH_3OH

Methanol (1°)

2. Alcohols are also classified as mono-, di-, tri- or polydric, depending upon the no of hydroxyl groups they posses. Alcohols containing one hydroxyl group are described a MONOHYDRIC ALCOHOLS, those containing two hydroxyl groups are DIHYDRIC

2) The solubility of alcohols in water, Organic solvent

Lower alcohols, with up to three carbon atoms in their molecule are soluble in water because these lower alcohols can form hydrogen bonds with water molecules. The water solubility of alcohols decreases as their relative molecular mass increases. because the structure becomes relatively more hydrocarbon in nature. The order of solubility in water of some alcohols is:

$CH_3OH > CH_3CH_2OH > CH_3CH_2CH_2OH > CH_3CH_2CH_2CH_2OH$

Decreasing order of solubility in water

All monohydroxy alcohols are soluble in organic solvents. Addition of hydroxyl (-OH) group without increasing the number of carbon atoms increases the solubility in water and decreases the solubility in water, and boiling point of some typical alcohols are

$C_6H_8(OH)_4 > C_3H_5(OH)_3 > C_3H_6(OH)_2 > C_2H_5OH$

(sugar alcohol)

Decreasing order of sweetness, boiling points and solubility in water.

The solubility of simple alcohols and polyhydroxy alcohols is largely due to their ability to form hydrogen bonds with the water molecules.

50 17
53 20
57 24

ALCOHOLS - DIOLS or GLYCOLS, those containing two groups are TRIHYDIC ALCOHOLS or TRIOLS and those containing more than three hydroxyl groups are POLYHYDRIC ALCOHOLS or POLYOL.

Eg:- $CH_3CH_2CH_2OH$;
Propanol
(Monohydric alcohol)

3.) Alcohols can also be characterized by the molecular configuration of the hydrocarbon portion. The hydrocarbon portion. The hydrocarbon portion may be aliphatic, cyclic, heterocyclic or unsaturated.

1.) Aliphatic hydrocarbon portion

The aliphatic hydrocarbon portion may be saturated or unsaturated. If it is saturated, the

Eg: $CH_3CH_2CH_2CH_2OH$
Butanol
(Alkyl alcohol)

ii) cyclic hydrocarbon portion may be saturated or unsaturated. If it is saturated, the general mole

Step m

3. Industrial manufacture of ethanol with carbohydrates like starch are major group of natural compounds that can be made to yield ethanol by the biological process of fermentation

Step 1:

The starch containing content are warmed with malt to 60°C for a specific period of time are converted to maltose.

$$\underset{\text{carbohydrate}}{2(C_6H_{10}O_5)_n} + nH_2O \xrightarrow[\text{diatase}]{60^\circ C} \underset{\text{maltose}}{nC_{12}H_{22}O_{11}}$$

NB: where n is large.

Step 2:

The maltose is broken down to glucose on addition of yeast (maltose) at temp 15°C.

$$H_2O + \underset{\text{maltose}}{C_{12}H_{22}O_{11}} \xrightarrow[\text{maltase}]{15^\circ C} \underset{\text{glucose}}{C_6H_{12}O_6}$$

Step 3

The glucose at constant temperature 15°C is then converted into alcohol by the enzyme zymase contained also in yeast

presence of complex catalysts. Esters are also reduced to alcohol by high pressure hydrogenation over a copper oxide-chromium oxide catalyst or ...
alcohol. This method is useful for the ...

$$C_6H_{12}O_6 \xrightarrow[\text{zymase}]{15^\circ C} 2\,CH_3CH_2OH + 2\,CO_2$$

ethanol

Therefore ethanol is produced.

4.) Reaction between 2-methylpropanal and butylmagnesium chloride Hint: Grignard synthesis with all structures:

4) 2-methylpropanal , butylmagnesium chloride

$(CH_3)_2CHCHO + CH_3CH_2CH_2MgCl$

$$(CH_3)_2CH-\underset{\underset{OH}{|}}{C}=O + CH_3CH_2CH_2CH_2MgCl$$

5) 2methylpropanone, butylmagnesium chloride

$(CH_3)_2CHCOCH_3 + CH_3CH_2CH_2MgCl$

$$(CH_3)_2CH\underset{\underset{CH_3}{|}}{C}=O + CH_3(CH_2)_3MgCl$$

$$\downarrow$$

$$(CH_3)_2CH-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3(CH_2)_3}{|}}{C}}-OMgCl \xrightarrow{+H_2O} (CH_3)_2\underset{\underset{OH}{|}}{CH}-CH_3$$

$$(CH_3)_2CHCOH \xrightarrow[LiAlH_2]{H_2} (CH_3)_2\underset{\underset{OH}{|}}{CH}-H$$

reduced to alcohol in the

8 Propan-1-ol to propan-2-ol