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MECHATRONICS ENGINEERING

CMH 102 ASSIGNMENT

CARBOXYLIC ACIDS

1.

2. PHYSICAL PROPERTIES

Physical appearance: All simple aliphatic acids up to C10 are liquids at room temperature. Most other carboxylic acids are solid at room temperature although anhydrous carboxylic acid(acetic acid) also known as glacial ethanoic acid freezes to an ice-like solid below the room temperature.

Boiling point: Boiling point increases with increasing relative molecular mass. Aromatic carboxylic acids are crystalline solids and have higher melting points than their aliphatic counterparts of comparable relative molecular mass.

Solubility: Lower molecular mass carboxylic acids with up to four carbon atoms in their molecules are soluble in water; this largely due to their ability to form hydrogen bonds with water molecules. The water solubility of acids decreases as the relative molecular mass increases because the structure becomes relatively more hydrocarbon in nature and hence covalent. All carboxylic acids are soluble in organic solvents.

3. INDUSTRIAL PREPARATION OF CARBOXYLIC ACIDS

* From Carbon (II) oxide: Methanoic acid is manufactured by adding CO under pressure to hot aqueous solution of sodium hydroxide. The free carboxylic acid is liberated by careful reaction with H2SO4.

CO----NaOH--------->HCOONa----H2SO4---------->HCOOH + NaHSO4

* From ethanol: Ethanoic acid is obtained commercially by the liquid phase air-oxidation of 5% solution of ethanal to ethanoic acid using manganite (II) ethanaote catalyst. Ethanal itself is obtained from ethylene.

HC= CH ---dil. H2SO4-------->CH3CHO---O2/(CH3COO)2Mn-------> CH3COOH

* From Petroleum: Liquid phase air oxidation of C5-C7 alkanes, obtainable from petroleum at high temperature and pressure will give C5-C7 carboxylic acids with methanoic, propanoic, and butanedioic acids as by-products.

C5-C7 ------O2/High temp. and pressure------------> C5-C7 carboxylic acids

4. SYNTHETIC PREPARATION OF CARBOXYLIC ACIDS

* Oxidation of primary alcohols and aldehydes: Oxidation of primary alcohols and aldehydes can be used to prepare carboxylic acids using the usual oxidizing agents (i.e. K2Cr2O7 or KMnO4) in acidic solution.

RCH2OH---- [O], excess acid/KMnO4---------->RCHO---[O]------->RCOOH

* Carbonation of Grignard reagent: Aliphatic carboxylic acids are obtained by bubbling CO2 into the Grignard reagent and then hydrolyzed with dilute acid.

RMgBr +CO2--- (C2H5)2O------->RCOOMgBr----H2O/dil. Acid ------>RCOOH+ MgBrOH

R may be 1\*, 2\*, 3\* aliphatic alkyl or aryl radical.

In the preparation of benzoic acid, the reagent is added to solid CO2(dry ice) which also serves as coolant to the reaction mixture.

C6H5MgBr + CO2---(C2H5)2O------->C6H5COOMgBr----H2O/H+----->C6H5COOH + MgBrOH

1. REDUCTION

4RCOOH + 3LiAlH4----(C2H6)2O------->(RCH2O)4AlLi + 2LiAlO2 + 4H2

­ 4H2O

4RCH2OH + Al(OH)3 + LiOH

CH3CH2CH2COOH----LiAlH4---------->CH3CH2CH2CH2OH

Butanoic acid Butanol

DECARBOXYLATION

CH3CH2CH2COONa + NaOH---fuse------> CH3CH2CH3 + Na2CO3

ESTERIFICATION

CH3CH2CH2­­­COOH + CH­3CH2­CH2­OH<----H+----> CH3CH2CH2COOCH2CH2CH3 + H2O