CHAPTER THIRTEEN

SOAP, ACID, BASE AND SALT

Soap: This is the sodium or the potassium salt of a long fatty (organic) acid. There are two types of soap and there are hard soap and soft soap. While soft soap consists of potassium salts, hard soap consists of sodium salts.

Saponification: This is the reaction between fat (oil) and an alkali to form soap and glycerol, i.e. oil (fat) + alkali -> soap + glycerol.

Detergents: These are cleaning agents. There are two types and these are:

(1) Soapy detergents, which are known ordinarily as soap, for soaps are examples of detergents. Other examples of soapy detergents are key soap, sunlight and lux.
(2) Synthetic (soapless) detergents which are often referred to as detergents, with examples being omo, surf, tide and klina.

Manufacturing of soap:

The basic steps involved in the manufacture of soap are:
(1) Saponification.
(2) Salting out, i.e. the separation of the soap and the glycerol.
(3) Fitting, i.e. adding water to the mixture and boiling the resultant mixture.
(4) Drying.

Laboratory preparation of soap:

The needed materials are:
(1) Fat (oil), such as palm oil or palm kernel oil.
(2) An alkali.
(3) Sodium chloride (NaCl).
(4) Water.
(5) Beaker and stirring rods.

Method of preparation using palm oil:

(1) Heat the palm oil in a beaker till it is decolorized.
(2) Carefully add about 5MNaOH solution (i.e. 10cm^3) to the oil, and stir till the saponification process is completed.
(3) Add sodium chloride solution and stir constantly while the mixture is boiling.
(4) Allow the mixture to cool.
(5) The curdy (raw) soap is then scooped, and washed several times with water. (6) If the soap is not properly washed and it is used, skin itching occurs.

Industrial preparation of soap:

(1) In the industrial preparation, the oil is first decolorized using animal charcoal before it is used.
(2) Add 5M NaOH solution and stir till the saponification process is completed.
(3) Add NaCl solution and stir constantly while the mixture is boiling.
(4) Allow the mixture to cool and scoope the curdy or raw soap.
(5) After washing it several times with water, perfumes and dyes are added to it to get toilet soap. N/B:
Indigenous soap is the same as the native or anago soap.

Manufacturing of local or native soap (anago soap):

For this, the needed materials are palm oil, dried cocoa husks or un-ripped plantain peels.

The method of preparation:

(1) Burn the dried cocoa husks or the un-ripped plantain peels into ashes.
(2) These ashes which contain potassium trioxocarbonate are added to water and filtered.
(3) The filtrate had is an alkali called potassium hydroxide.
(4) This filtrate is then added to the decolorized oil and stirred.
(5) After the completion of the saponification process, NaCl solution is added.
(6) Stir constantly while the mixture is boiling.
(7) Allow the mixture to cool and scoope the curdy or raw soap called anago soap, and to improve its quality dyes and perfumes may be added to it.

Uses of soap:

The main use of soap is to improve the cleansing power or action of water.

The effect or action of soap in hard water:

- Hardness in water is caused by the presence in water of calcium or magnesium ions, i.e. Ca^{2+} and mg^{2+} ions. - Soap when used in hard water do not easily form a lather, because the soap together with these ions will form a precipitate or scum. - Until the soap reacts with all the Ca^{2+} and the mg^{2+} ions found in the water, lather will not form. - In this way the soap is wasted.

Reasons why detergents are preferred to soap:

- Detergents normally have a stronger cleansing power than soap.
- Detergents easily lather with hard and soft water, and do not produce scum in hard water and as such not wasted.

Differences between soapy and soapless detergents:

Soapy detergent	Soapless detergent
(1) It is made from fat/ oil of long chain fatty acid.	(1) It is made from sulphonic acid.
(2) It form scum with hard water.	(2) It does not form scum with hard water.
(3) It does not easily lather with hard water.	(3) It lathers easily with hard water.
(4) It causes greying, when it is used to wash white materials.	

(4) It does not cause greying, when it is used to wash white materials.

Acids:

- An acid is a compound which dissolves in water to produce hydroxonium ions (H_3O^+), or hydrogen ions (H^+). Examples:

$HCl \rightleftharpoons H^+ + Cl^-$

$H_2So_4 \rightleftharpoons 2H^+ + So_4^{2-}$

$HNO_3 \rightleftharpoons H^+ + NO_3^-$

- But since the hydrogen ions produced are highly unstable, they combine with the water molecules to form hydroxonium ions. - For this reason, acids are defined as compounds when dissolved in water produce hydroxonium ions as the only positive ions. - The sour taste of many unripe fruits such as lemon, lime and orange is due to the presence of certain acids which they contain.
- Also the stiffness due to tired muscles and the sting of bees is due to the presence of acids.

Types of acids:

There are two types and there are:
(1) Inorganic acids. (11) Organic acids:

Inorganic acids: These are those acids which can be prepared from the reaction of mineral substances and examples are;
(1) HCl = Hydrochloride acid.
(2) H_2So_4 = Tetraoxosuplhate IV acid or sulpheric acid.
(3) HNO_3= Trioxonitrate (V) acid or nitric acid.
(4) H_3PO_4 = Tetraoxophosphate (V) acid or phosphoric acid.

Organic acids: -

These are those acids which are found naturally in plants and animals.
- Examples of organic acids, their sources and uses are:

(1) Methanoic acid:

- Its sources are ants and bees and it is used to remove scales from kettle.

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(2) Ethanoic (acetic acid):

- Its sources include vinegar as well as sour palm wine, and it is used for the preservation of food.

(3) Citric acid:

- Its sources include oranges, lemon as well as grape fruits and it is used for food flavouring.

(4) Ascorbic acid (Vitamin c):

- Its sources include citrus, tomatoes as well as green vegetables and it is used for the formation of connective tissues and membranes.

(5) Tartaric Acid:

- Its source is grape and it is used for the baking of bread.

Properties of acids:

(1) Most acids have sour taste.
(2) Concentrated acids are sometimes corrosive or burning liquids.
(3) Aqueous solutions of acids turn blue litmus paper red.
(4) Dilute acids react with bases to produce water and salt only.
(5) Their p.H value is less than 7. (6)
Reactive metals such as mg, Al, Zn, Sn, Ca and Fe displaces hydrogen from acids.

Examples:

(a) $Zn + 2HCl \rightarrow ZnCl_2 + H_{2(g)}$ (b) $Mg + H_2SO_4 \rightarrow MgSO_4 + H_{2(g)}$ -
But less reactive metals such as Cu, Ag and Au do not displace hydrogen from acids.
(7) Acids react with trioxocarbon (IV) and hydrogen trioxocarbonate (IV) salt, to give

carbon dioxide gas,
i.e (1) $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + C0_2$ (2) $NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$.

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Strong and weak acids:

Strong acids:

- These are those acids which dissociate very easily or ionize almost completely in water or aqueous solution. -
For this reason, a strong acid will dissolve in water to produce more H_3O^+ or H^+ ions, i.e. they produce more H_3O^+ or H^+ions in solution. -
Since these ions are responsible for the conduction of electricity, strong acids are very good conductors of electricity.
- Examples of strong acids are HCl, HNO_3 as well as H_2SO_4, and since HCl is a strong acid, then when a quantity of HCl is put in water, almost all of it or all of it will break-down to give $H^+$and Cl^- ions.

Weak acids:

- There are those acids which dissociates or ionizes partially (slightly) in aqueous solution (water). - For this reason when a weak acid such as ethanoic acid (CH_3CoooH) is put in water (solution), it is only a small fraction of it which will break down to give the ions CH_3C00^- and H^+, i.e $CH_3CooH \rightarrow CH_3Coo^- + H^+$. - With respect to a weak acid, the proton or the $H^+$is released with difficulty. - Generally organic acids are weak acids and for this reason, the proton (H^+) is not released easily.
- This explains why a solution $HN0_3$ which is a strong acid, has a higher concentration of H^+ions than a solution of CH_3CooH which is a weak acid.
- Since the solution of HNO_3 contains more H^+ ions than that of CH_3CooH_3, then the p.H of the HNO_3 solution will be lower than that of CH_3CooH.

Some methods of preparation of acids:

(1) Acids can be prepared by the action of water on an acid anhydride i.e. an oxide of a non-metal.

- Examples of acid anhydrides are SO_2, SO_3 and Co_2.

(a) $So_2 + H_2O \rightarrow H_2So_3$

(b) $CO_2 + H_20 \rightarrow H_2Co_3$.

(c) $So_3 + H_2O \rightarrow H_2SO_4$.

(2) By displacing a weaker or a more volatile acid from its salt by a stronger or less volatile acid.

$NaCl + H_2SO_4 \rightarrow NaHSo_4 + HCl$

$2KNo_3 + H_2SO_4 \rightarrow K_2SO_4 + 2HNO_3$.

Some uses of acids:

- Used in the making of baking powder e.g. tartaric acid.
- Used in the making of soap e.g. fatty acid.
- Used in the making of artificial fertilizers, dyes and plastics.

(Q1) Compare the H^+ ion concentration of 0.1M CH_3ooH and 0.1M HCl.

Soln:

- Since HCl or the 0.1MHCl is a strong acid, then it will undergo complete dissociation in solution, to produce more H^+ ions. - Therefore the H^+ ion concentration of 0.1MHCl will be high. - 0.1M CH_3CooH or CH_3CooH is a weak acid and as such, it will undergo partial dissolution to produce only a few H^+ions. - For this reason, the H^+ ion concentration of CH_3CooH will be very low as compared to that of HCl.

Preparation and uses of tetraoxosulphate (VI) acid (Sulpheric acid):

Sulphuric acid is important since it has many uses. It is used:

(a) As an electrolyte in car/ lorry batteries.
(b) In the manufacture of fertilizers.
(c) In the manufacture of detergents.
(d) In the refining of petroleum.
(e) In the manufacture of synthetic fibre.
(f) In the extraction of metals.
(g) In the manufacture of chemicals such as alum, HCl and tetraoxonitrate (V) acid.

Preparation:

- Due to its extensive use, H_2SO_4 is prepared on large scale for industry, using a process called the contact process. - The steps involved in this process are:

(1) Burning sulphur in the air to get suphur dioxide i.e. SO_2.

(2) The SO_2 is made to react with oxygen in the presence of a catalyst, to form sulphur trioxide (SO_3) at a temperature of 450^0C. (3) The catalyst used is vanadium (V) oxide (V_2O_5), and this speeds up the reaction.

(4) The SO_3 is then dissolved in concentrated sulphuric acid to form a liquid called "oleum".

(5) The oleum is then diluted with water to get H_2SO_4.