Before you come to class:

• Record the molar mass of sodium carbonate, Na_2CO_3.
• Complete each of the three equilibria reactions (see above).
• Use your actual laboratory notebook for rough **and final version.**

No one will be entertained with additional rough copies. Please bring your laboratory notebook and write directly on that. We shall check your copy immediately after the experiment is over, before you leave for the day.

Titrimetric Determination of Alkanity of Water

Introduction: This experiment involves the estimation of alkanity (the buffering capacity of natural waters) in soda ash water or normal water using strong acid, HCl. This estimation is important for controlling the corrosion, to calculate the amount of lime and soda needed for water softening; in conditioning the boiler feed water, etc. and can also be extended to estimate the amount of soda in cool drinks available in market.

Alkalinity of a sample of water is due to the presence of OH^- (hydroxide ion) and CO_3^{2-} (carbonate ion) ions present in water. Therefore the alkalinity due to different ions can be estimated separately by titration against standard acid solution, using selective indicators like phenolphthalein and methyl orange.

The equilibria reactions are:

i) $OH^- + H^+ > H_2O$
ii) $CO_3^{2-} + H^+ > HCO_3^-$
iii) $HCO_3^- + H^+ > H_2O + CO_2$

The completion of reactions (i) and (ii) (OH^- and CO_3^{2-}) and (CO_3^{2-} and HCO^{3-}) can be estimated by the neutralization reaction of phenolphthalein end point. The amount of acid used thus corresponds to complete neutralization of OH^- plus half neutralization of CO_3^{2-}. The titration of water sample using methyl orange indicator marks the completion of the reactions (i), (ii) and (iii). The amount of acid used after phenolphthalein end point corresponds to one half of normal carbonate and all the bicarbonates. Total amount of acid used represent the total alkalinity due to all ions present in water sample

Reagents Provided:

Sodium carbonate dry powder

Unknown water sample

HCl (~0.05 M)

Indicators: Phenolphthalein and Methyl Orange

Experimental Procedure:

1. Standardization of given Hydrochloric acid (HCl) against pure sodium carbonate, prepared by the experimentalist:

Pipette out 10 mL of Na_2CO_3 solution in a conical flask, add 2 drops of methyl orange indicator, fill up the burette with (~N/20) HCl solution and titrate till the color of the solution changes from yellow to red.

2. Standardized HCl will be used to determine the alkanity of unknown sample:

i) **(a)** Pipette 20 mL of the sample of water into a 100 mL conical flask and add 2 drops of phenolphthalein
(b) Titrate against standardized HCl till the color of the solution changes from pink to colorless. Corresponding burette reading indicates the phenolphthalein end point (V_1).

ii) **(c)** Again pipette out 20 mL of the water sample in a conical flask, add 2 drops of methyl orange indicator. Color of the solution becomes yellow.
(d) Continue the titration against the standard HCl solution till the color changes to red. This burette reading corresponds to the methyl orange end point (V_2).

Observations and Calculations

Table 1:- Standardization of HCl solution

Strength of Na_2CO_3 solution (S1) used = ----------(N)

Calculation after the table

Table 2:- Analysis of water using phenolphthalein indicator

Strength of HCl solution (S2) used = ____ (N)

Calculation after the table

Table 3:- Analysis of water using methyl orange indicator

Strength of HCl solution (S2) used = ____ (N)

Calculation after the table

Results and Discussion

Conclusion