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Analysis of an Impure Sample of Sodium Carbonate

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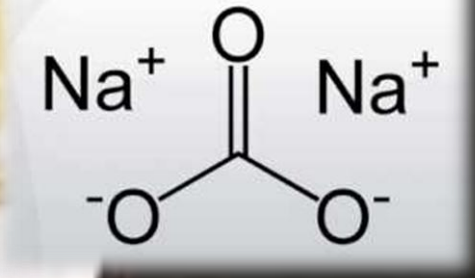


Many samples of chemicals are not pure. The percent of impurities of an impure sample can be determined by titration as in an acid - base titration.

$$\%\ \text{impurities in a sample} = \frac{\text{mass of impurities in the impure sample}}{\text{total mass of the impure sample}} * 100$$

The properties of the impurities present in the impure sample:

1- **Inert , will not react with Na_2CO_3 & HCl .**
2- **Soluble , not to affect the determination of the titration end point.**
3- **Coloureless , not affect the colour of the indicator used in the titration.**

Name of experiment : **Analysis of an impure sample of Na_2CO_3**

Aim of the experiment : **Determination of the % impurities present in our unknown Na_2CO_3 impure sample**

Preparation of the sample:

1- Weigh out exactly 0.5g of the unkn. sample.

2- Dissolve it with 50–60 ml of DW in a beaker.

3- Filter the sln. if necessary, (i.e.) when the solution is not clear.

4- Transfer the sln. quantitatively into 100 ml volumetric flask & complete the volume to 100ml with DW. stopper the flask & shake well.

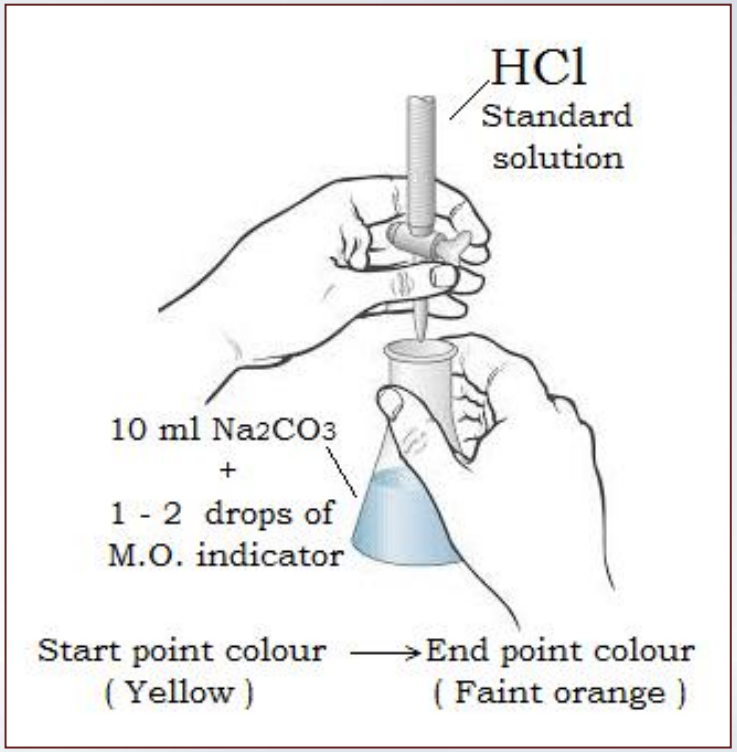
Procedure of analysis :

1- Fill the burette with std. HCl sln.

2- Transfer 10 ml of the prepared Na_2CO_3 sln. to a conical flask.

3- Add 1-2 drops of M.O. as an indicator.

4- Titrate the sln . with std. HCl solution until a faint orange color appears.



Results and Calculations :

The % impurities in our unknown sample can be calculated from the following equation:

$$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$$

$$N_1 \; V_{1\ of\ HCl} = N_2 \; V_{2\ of\ Na_2CO_3}$$

$$N_1 \; V_{1\ of\ HCl} = \frac{\text{Mass of } Na_2CO_3}{\text{Eq. mass of } Na_2CO_3} * 1000$$

HCl solution must be standard, i.e. , it is previously standardized against exactly 10 ml of 0.1 N primary standard solution .

just an Example

Calculate the % impurity in a 0.4g of Na_2CO_3 imp. sample that required 20ml of 0.1N HCl standard solution ?

$$N_1 \; V_1 \;_{of\ HCl} = N_2 \; V_2 \;_{of\ Na_2CO_3}$$

$$N_1 \; V_1 \;_{of\ HCl} = \frac{\text{Mass of } Na_2CO_3}{\text{Eq. mass of } Na_2CO_3} * 1000$$

$$0.1 * 20 = \frac{\text{Mass of } Na_2CO_3}{53} * 1000$$

Mass of Na_2CO_3 = 0.106 g of Na_2CO_3 in the sample.

Mass of impurities = 0.4 - 0.106 = 0.294 g

$$\%\ \text{impurities} = \frac{\text{Mass of impurities in the sample}}{\text{Total mass of the impure sample}} * 100$$

$$= \frac{0.294\ g}{0.4\ g} * 100 = 73.5\ \%$$

A 100 ml solution contains 0.5g of impure Na_2CO_3 sample , from this sln. 10 ml was titrated with 0.1N HCl std. sln., it required 7ml of HCl std. sln. to reach the end point. Calculate the % impurity in this sample?

$$N_1 * V_{1\,HCl} = \frac{\text{Mass of } Na_2CO_3 \text{ in the sample}}{\text{Equivalent mass of } Na_2CO_3} * 1000$$

$$0.1 * 7 = \frac{\text{Mass of } Na_2CO_3 \text{ in the sample}}{53} * 1000$$

Mass = 0.0371 g of Na_2CO_3 in 10 ml sample.

0.037 g	10 ml
X	100 ml

X = 0.371 g of Na_2CO_3 in 100 ml sample.

0.5 g - 0.371 g = 0.129 g of impurities present in the sample.

$$\% \text{ impurities} = \frac{0.129\ g}{0.5\ g} * 100 = 25.8\ \%$$

Worked exercise :

Mention if the following cpd.s are primary or secondary std.s ? Explain your answers.

a- HCl : It's a secondary std., (Strong acid has vapours).

b- Na_2CO_3: 1° std., (Meets the requirements of a 1° std).

c- $CaCl_2$: It's a secondary std., (Hygroscopic substance).

d- $AgNO_3$: It's a secondary std., (Sensitive to light).

HOMEWORK

In a chemistry lab, from a container of Na_2CO_3 with 20% impurities , a student prepared a solution by dissolving 1g of this impure Na_2CO_3 in 80 ml of D.W. From this sln. , each of the two students (**A** & **B**) had taken 5ml & titrated them against 0.0944N HCl std. sln. separately.

The results were that student **A** used 10 ml of the std. sln. inorder to reach the end point for his sample titration .

While student **B** used 11 ml .

a- Accordingly, which one of the two students got the more accurate results ?

b- Mention the technical error(s) that could account for the inaccuracy if present?

c- Write the chemical equation for this titration.

Colour changes of M.O. indicator

Before end point
(*Basic media*)

End point

After end point
(*Acidic media*)