Experiment 9

AIM

To identify washing soda or baking soda among given samples of chemicals.

THEORY

Washing soda ($Na_2CO_3.10H_2O$) and baking soda (mainly $NaHCO_3$) are white solids. Their aqueous solutions are alkaline and turn red litmus blue. Carbonates and hydrogencarbonates react with dilute acids and produce carbon dioxide gas which turns lime water milky.

$$CO_3^{2-}(aq) + H_2O(l) \rightarrow H_2CO_3(aq) + 2OH^-(aq)$$

$$HCO_3^-(aq) + H_2O(l) \longrightarrow H_2CO_3(aq) + OH^-(aq)$$

$$Na_2CO_3(s) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

$$NaHCO_3(s) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l) + CO_2(g)$$

$$Ca(OH)_2(aq) + CO_2(g) \longrightarrow CaCO_3(s) + H_2O(l)$$

Lime water Milky

On passing excess of CO_2 through limewater, calcium hydrogencarbonate is formed. It is soluble in water and forms a colourless solution.

$$CaCO_3(s) + H_2O(l) + CO_2(g) \longrightarrow Ca(HCO_3)_2(aq).$$

Materials Required

Samples: sodium carbonate (washing soda), sodium hydrogencarbonate (baking soda), ammonium chloride, sodium chloride etc., red litmus paper strips, freshly prepared lime water, dil. hydrochloric acid, five test tubes, a test tube stand, a boiling tube, a thistle funnel, a double bored cork, a delivery tube, and a glass rod.

Procedure

1. Take about 1 g each of the four given samples separately in four boiling tubes and label them as A, B, C, and D.
2. Add about 5 mL distilled water in each boiling tube. Gently shake the contents of the tubes.
3. Put a drop of every salt's solution on separate red litmus paper strips, using a glass rod. (Wash the glass rod used for one sample before using it for other sample.) Note the change in colour of the litmus paper, if any in each case.
4. Add 1 mL of dil. hydrochloric acid in each test tube. Do you see any effervescence from any test tube? If yes, perform the lime water test as detailed below.
5. For performing lime water test, take the solution of test tube A in a boiling tube and set up the apparatus (delivery tube, thistle funnel etc.) as shown in Fig. 9.1.
6. Add dil. hydrochloric acid drop by drop to the solution through the thistle funnel.
7. Pass the liberated gas evolved through the lime water in a test tube. Does the lime water turns milky? If yes, then it shows the presence of CO_2 gas.
8. Continue passing the liberated gas through the lime water. Does it again become colourless? This reconfirms that the liberated gas is CO_2.
9. Repeat the lime water test on all samples that give effervescence in step 4. Do not forget to wash the boiling tube when you change the sample in it for performing the lime water test.

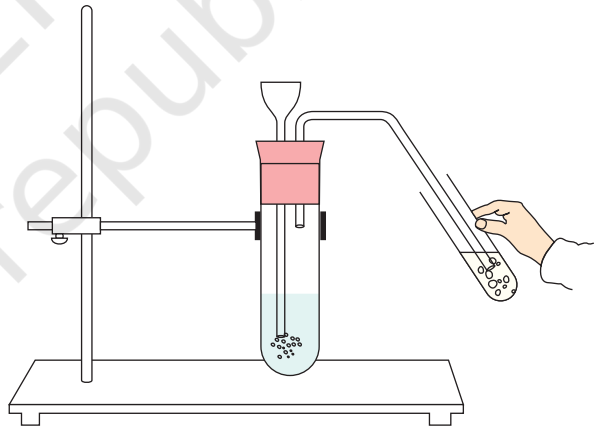

Fig. 9.1 : *Carbon dioxide gas formed by the reaction of dil/hydrochloric acid on washing soda or baking soda is being passed through lime water*

Observations

Sl. No.	Sample	Colour	Solubility in water (Soluble/ insoulble)	Action on red litmus paper (Changes to blue or not)	Action of dil. HCl acid (Effervescence observed or not?)	Lime water Turns milky or not?
1.	A					
2.	B					
3.	C					
4.	D					

Results and Discussion

Infer from the observations about the identification of washing soda or baking soda out of the samples given for testing. Discuss about the litmus paper and lime water tests performed.

Sample in test tube ___ is washing soda/baking soda.

Precautions

- Add dil. hydrochloric acid to the salt solution drop by drop. If the addition of dil. hydrochloric acid is not slow, a vigorous reaction may occur and the reaction mixture may come out of the reaction tube and pass into lime water.
- Handle hydrochloric acid and washing soda carefully. These should not touch your skin.
- Freshly prepared lime water should be used for performing lime water test

Note for the Teacher

- Students may be given three or four samples of salts, of which one of the salts is washing soda or baking soda. The remaining samples of salts should not be carbonates, hydrogencarbonates, sulphites or hydrogensulphites. These salts liberate either CO_2 or SO_2. Sulphur dioxide also turn lime water milky.
- *Preparation of lime water*: Shake 5 g calcium oxide CaO, with 100 mL water. Allow it to stand for about 24 hours. Decant the supernatant liquid and use it for the tests. It is suggested to always use freshly prepared limewater.

QUESTIONS

- Explain why should dil. hydrochloric acid be added dropwise to the salt solution while performing lime water test?
- What will happen if crystalline washing soda is left open in air?
- CO_2 and SO_2 both turn lime water milky and their aqueous solutions turn blue litmus paper red. How can you then distinguish between these?
- Why should carbon dioxide be soluble in aqueous solution of potassium carbonate?