EXPERIMENT NO 8

AIM: Determination of % of available chlorine in bleaching powder.

OBJECTIVE : To determine the percentage of available chlorine in the given sample of bleaching powder by Iodometric titration against N/25 sodium thiosulphate ($Na_2S_20_3$) using starch $(C_6H_{10}O_5)_n$ as an internal indicator.

THEORY: Bleaching powder is a mixture of calcium hypo chlorite, basic calcium chloride and free calcium hydroxide. The dilute mineral acid (HCl, H_2SO_4, CH_3COOH) when react with bleaching powder, liberates the free chlorine which is known as the available chlorine.

It is expressed in percentage by weight of bleaching powder.

$$\underset{\text{Bleaching powder}}{Ca(OCl)Cl} + \underset{\text{dilute acetic acid}}{2CH_3COOH} \rightarrow \underset{\text{calcium acetate}}{(CH_3COO)_2Ca} + \underset{\text{available chlorine}}{Cl_2} + H_2O$$

The available chlorine is determined by titrating the liberated iodine against a standard hypo solution. When strongly acidic bleaching powder solution is titrated with an excess of potassium iodide, the iodine is liberated.

The liberated iodine is treated with standard hypo solution

$$Cl_2 + 2KI \rightarrow 2KCl + I_2$$

$$STARCH + I_2 \rightarrow \underset{\text{(Blue – Violet Colour)}}{\text{STARCH – IODINE COMPLEX}}$$

$$2Na_2S_2O_3 + I_2 \rightarrow \underset{\text{(Sodium Tetrathionate) Colourless}}{Na_2S_4O_6 + 2\,NaI}$$

EXPERIMENTAL SETUP:

APPARATUS: Burette, Pipette, Volumetric flask, Beaker, Conical flask, Funnel, Dropper, Pestle – Mortar.

CHEMICALS: Bleaching Powder (1 gm), standard solution of sodium thiosulphate ($Na_2S_20_{3)}$, dilute acetic acid (CH_3COOH), Potassium Iodide (KI).

INDICATOR: Freshly prepared starch solution**.**

EXPERIMENTAL PROCEDURE:

Take 1.00 gm of bleaching powder in a mortar, add 2-3 drops of water to it and rub it with a pestle till a smooth part is formed. Now add one test tube of water to the mortar and stirrer with the pestle. Transfer the supernatant liquid in a 100 ml measuring flask with the help of a funnel. Rub the remaining amount of bleaching powder with pestle, add water to it and transfer to the measuring flask. Repeat the process till whole amount of bleaching powder is transferred to the measuring flask. Now make it upto 100 ml mark with water and stir it to make it homogeneous.

Fill the burette with N/25 hypo solution.

Pipette out 10 ml of bleaching powder solution in a conical flask, add 2 ml of KI solution in it, now add half test tube of acetic acid , a reddish brown colour will appear, leave it in the dark for 2 – 3 minutes as the reaction is slow it will take time to complete.

Now titrate it with standard hypo solution till the colour changes to light yellow.

Now add 2 drops of starch indicator in it, a blue black colour will appear

Further titrate it with hypo solution till the colour disappear, this is the end point.

Repeat the process till two concordant readings are obtained.

OBSERVATIONS:

S No	Volume of bleaching powder solution taken (10 ml)	Burette readings (ml)		Volume of hypo solution used (ml)
		Initial	Final	
1.				
2.				
3.				

CALCULATIONS:

$N_1 V_1 = N_2 V_2$

$N_1 = N_2 \times V_2 / V_1$

$N_1 = N/25 \times V_2/10 = V_2/250$

Strength of $Cl_2 = V_2/250 \times 35.5$ g/l

Now, since 1000 ml of the solution contains = $V_2/250 \times 35.5$ gm of Cl_2

Therefore, 100 ml of the solution contains = $V_2/250 \times 35.5/1000$ x 100 gm of Cl_2

Now, since 1 gm of bleaching powder contains = $V_2/250 \times 35.5/1000$ x 100 gm of Cl_2

Therefore, 100 ml of the B.P solution contains = $V_2/250 \times 35.5/1000$ x 100 gm of Cl_2

= x %

RESULT:

The percentage of available chlorine in the given sample of bleaching power is ---------- %.

RESULT ANALYSIS AND DISCUSSION: The % of available chlorine is a measure of the quality of bleaching powder and is expressed as by weight of bleaching powder. The greater is the percentage of available chlorine in the bleaching powder the better is its quality. It is important to determine the percentage of available chlorine in a sample of bleaching powder before use because the percentage of available chlorine goes on decreasing with time and in presence of moisture.

$$\mathbf{CaOCl_2 + H_2O \longrightarrow Ca(OH)_2 + Cl_2}$$

So to get the right amount of Cl_2 either use for the sterilization of water or to use in paper and pulp industry, estimation of available chlorine before use is must. Theoretical amount of chlorine present in a pure sample of bleaching powder comes out to be about 49%. But a commercial sample of bleaching powder may contain 35-37% of available chlorine. The lesser amount of available chlorine than the theoretical amount may be due to the following reasons.

Incomplete reaction between chlorine and slaked lime [$Ca(OH)_2$].

Impurity of $CaCl_2$ or $CaSO_4$ present in slaked lime which is used for its manufacture.

Loss of chlorine on exposure of bleaching powder to air or storing and transportation.

INFERENCE AND CONCLUSION:

The percentage of available chlorine in the above sample shows that this bleaching powder sample is not a fresh sample (…….%) because fresh sample contain 35-37% but still it can be used for bleaching cotton, linen and wood pulp in textile and paper industry. This bleaching powder sample can also be used as a disinfectant and germicides for sewers and drains, for sterilization of water, manufacture of chloroform and as an oxidizing agent in industry.

$$\mathbf{3Ca(OCl)_2 + 2\,CH_3COCH_3 \longrightarrow 2CHCl_3 + (CH_3COO)_2\,Ca + 2Ca(OH)_2}$$

LEARNING OUTCOME: This experiment is used to find out quality of bleaching powder**.**

APPLICATIONS:

In textile industry bleaching is widely used for whiteing or removing the natural colour of textile fiber and many other materials.

PRECAUTIONS:

1. Always transfer whole amount of bleaching powder into the flask for making 100 ml of solution.
2. All the reagents should be freshly prepared.