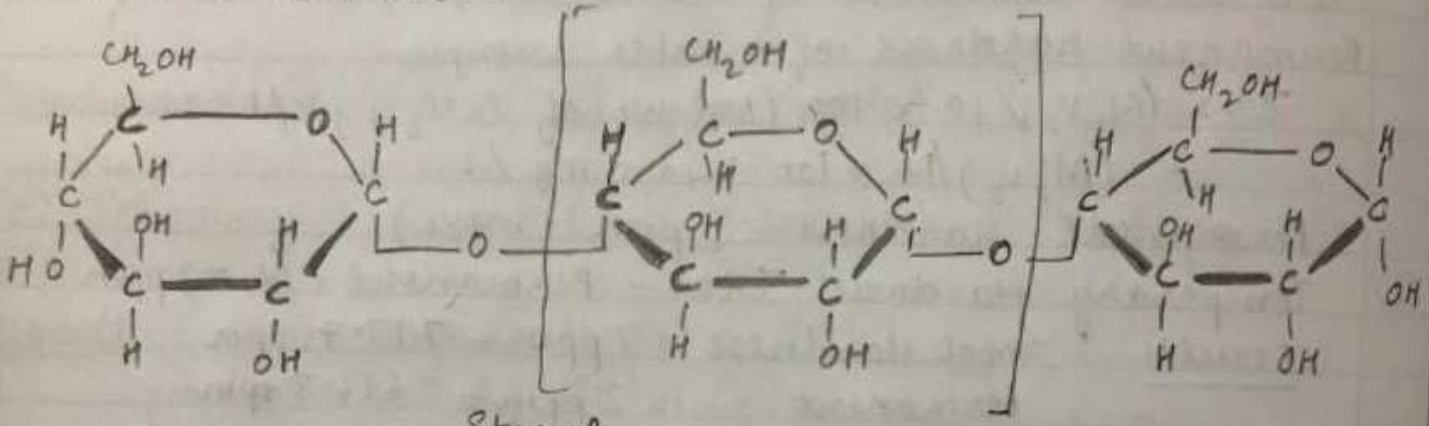
Experiment-3.

Experiment → To determine the copper content of a given sample of copper ore solution using 0.1N sodium thiosulphate iodometrically.

Apparatus → Pipette, burette, beakers, conical flask, funnel, burette stand and clamp.

Chemicals → Copper sulphate ($CuSO_4$), solid sodium bicarbonate ($NaHCO_3$), acetic acid (CH_3COOH), potassium iodide (KI), starch solution and sodium thiosulphate ($Na_2S_2O_3$)

Chemical Structure.



Starch

Chemical Equations

$$2CuSO_4 + 4KI \xrightarrow{H^+} 2CuI_2 + 2K_2SO_4$$

$$2CuI_2 \longrightarrow Cu_2I_2\downarrow + I_2$$

$$2Na_2S_2O_3 + I_2 \longrightarrow 2Na_2S_4O_6 + 2NaI$$

Indicator : Starch solution.

End point → Starch (Pale yellow to deep blue)
Sodium thiosulphate (Deep blue to permanent white)

Expt. No. 3 Page No.

Experiment :- To determine the copper content of a given sample of copper ore solution using 0.1 N sodium thiosulphate iodometrically.

Apparatus :- Pipette, burette, beakers, conical flask, funnel, burette stand and clamp.

Chemicals :- Copper sulphate ($CuSO_4$), solid sodium bicarbonate ($NaHCO_3$), acetic acid (CH_3COOH), potassium iodide (KI), starch solution and sodium thiosulphate.

Theory :- Estimation of copper in the copper ore is based on the fact that copper can quantitatively liberate iodide from potassium iodide solution in an acidic medium. The liberated iodide solution can be titrated against a given standard sodium thiosulphate solution using starch as an indicator

Chemical Equation :-

$$2CuSO_4 + 4KI \xrightarrow{H^+} 2CuI_2 + 2K_2SO_4$$

$$2CuI_2 \longrightarrow Cu_2I_2 + I_2$$

$$2Na_2SO_3 + I_2 \rightarrow 2Na_2S_4O_4 + 2NaI$$

End point is the appearance of white colour due to precipitates of Cu_2I_2. As Cu_2I_2 is soluble in mineral acids but insoluble in weak organic acids (acetic acid), the strongly acidic medium is neutralised with $NaHCO_3$ till a faint permanent precipitates of basic copper carbonate is formed which are dissolved with a few drops of acetic acid.

PROCEDURE :- 1.) Pipette out 10 ml of the copper ore solution into a titration flask.

Teacher's Signature :

Observations

Volume of copper ore solution taken for each titration = 10 ml.

S.no.	Burette Reading (ml)		Vol. of 0.1 N $Na_2S_2O_3$ soln (ml)
	Initial	Final	
1	0	9.7	9.7
2	0	9.7	9.7
3	0	9.7	9.7
4	0	9.7	9.7

Mean Volume of $Na_2S_2O_3$ used = (V_2) = 9.7 ml.

Calculations:

Volume of copper ore solutions used for each titration (V_1) = 10 ml.

Normality of sodium thiosulphate solution = 0.1N.

Vol volume of $Na_2S_2O_3$ used = V_2 ml. = 9.7 ml.

Using normality equation

$$N_1V_1 = N_2V_2$$

10 ml of N_1 copper ore soln. = V_2 ml of 0.1 N $Na_2S_2O_3$ solution

N_1 (Normality of copper solution]

$$= 0.1 \times V_2 / 10 = \frac{0.1 \times 9.7}{10}$$

$$\Rightarrow 0.097N$$

Equivalent weight of copper = 63.50 g

Amount of copper in the given ore $\Rightarrow N_1 \times 63.5$ gm/L.

$$0.097 \times 63.5$$

$$= 6.1595 \text{ gm/L}$$

Expt. No. ---------- Page No. ----------

2. Add small amount of some solid $NaHCO_3$ to the ore solution in small does till there is no effervescence the solution turns milky at this stage.
3.) Add dilute acetic acid dropwise, just sufficient to remove the milkiness. To the clear blue solution, add 5 ml of 10%. KI solution. Color of the solution changes to dark brown due to the formation of KI_3.
4.) Add about 35 ml of distilled water to dilute the contents of the flask. Wait for atleast 3 min. Titrate the solution against standard sodium thiosulphate solution till the color turns to pale/light yellow
5.) Add about 2 ml of 1% freshly prepared starch solution. Color of the solution turns to deep blue.
6.) Continue the titration (same conical flask) with more sodium thiosulphate solution till the color changes from blue to permanent white.
7.) Keep the contents of the flask for some time on the table-shelf. It should not turn blue again. If this happens, add a few more drops of $Na_2S_2O_3$ solution to get permanent white color again.
8.) Repeat the experiment to get at least five correct readings till atleast two concordant readings are obtained.

General Calculations:

Volume of copper ore solution used for each titration (V_1) = 10 ml.

Normality of $Na_2S_2O_3$ = 0.1 N

Let volume of $Na_2S_2O_3$ used = V_2 ml.

Applying the normality equation:-

Teacher's Signature : _____

Result : The amount of copper present is copper ore solution is 6.1595 gm/L.

Expt. No. ..... Page No. .....

(Copper ore) $N_1V_1 = N_2V_2$ ($Na_2S_2O_3$)

10 ml of N_1 copper ore soln = V_2 ml of 0.1 $Na_2S_2O_3$.

$N_1 = (0.1 \times V_2)/10$

Amount of copper in given ore = $N_1 \times 63.5$ gm/L

Results :- The amount of the copper present in copper ore solution is 6.1595 gm/L

Precautions :- 1.) The white color at the end point should be permanent.

2.) The copper ore solution should be neutralised before titration

3.) The contents of the titration flask should be diluted to observe better change of color at the end point.

4) After mixing the initial solution, wait for atleast 3 min before starting the titration

5.) General precaution of volumetric titrations should be followed.

Daily life Application :- As both excess and low levels of copper can have adverse effect, e.g. excess of copper in body can cause "Wilson Disease".

Teacher's Signature : _____