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Expt. No. 3 Page No. 7

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

THEORY: Estimation of copper in the copper ore is based on the fact that copper can quantitatively liberate iodine from potassium iodide solution in an acidic medium. The liberated iodine can be titrated against a given standard sodium thiosulphate solution using starch as an indicator.
End point is the appearance of white color 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 neutralized with $NaHCO_3$ till a faint permanent precipitates of basic copper carbonate are formed which are dissolved with a few drops of acetic acid.

PROCEDURE:

1. Pipette out 10ml of the copper ore solution into a titration flask.
2. Add small amount of some solid $NaHCO_3$ to the ore solution in small doses 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 5ml of 10% KI solution. Color of the solution changes to dark brown, due to the formation of KI_3.
4. Add about 35ml of distilled water to dilute the contents of the flask. Wait for atleast 3 minutes. Titrate the solution against standard sodium thiosulphate solution till the color turns to

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EXPERIMENT: To determine the copper content of a given sample of copper ore solution using 0.1N sodium thiosulphate potentiometrically.

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

CHEMICALS: Copper sulphate ($CuSO_4$), boiled sodium bicarbonate ($NaHCO_3$), acetic acid (CH_3COOH), potassium iodide (KI), starch solution and sodium thiosulphate ($Na_2S_2O_3$).

CHEMICAL REACTIONS:

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

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

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

CHEMICAL STRUCTURES:

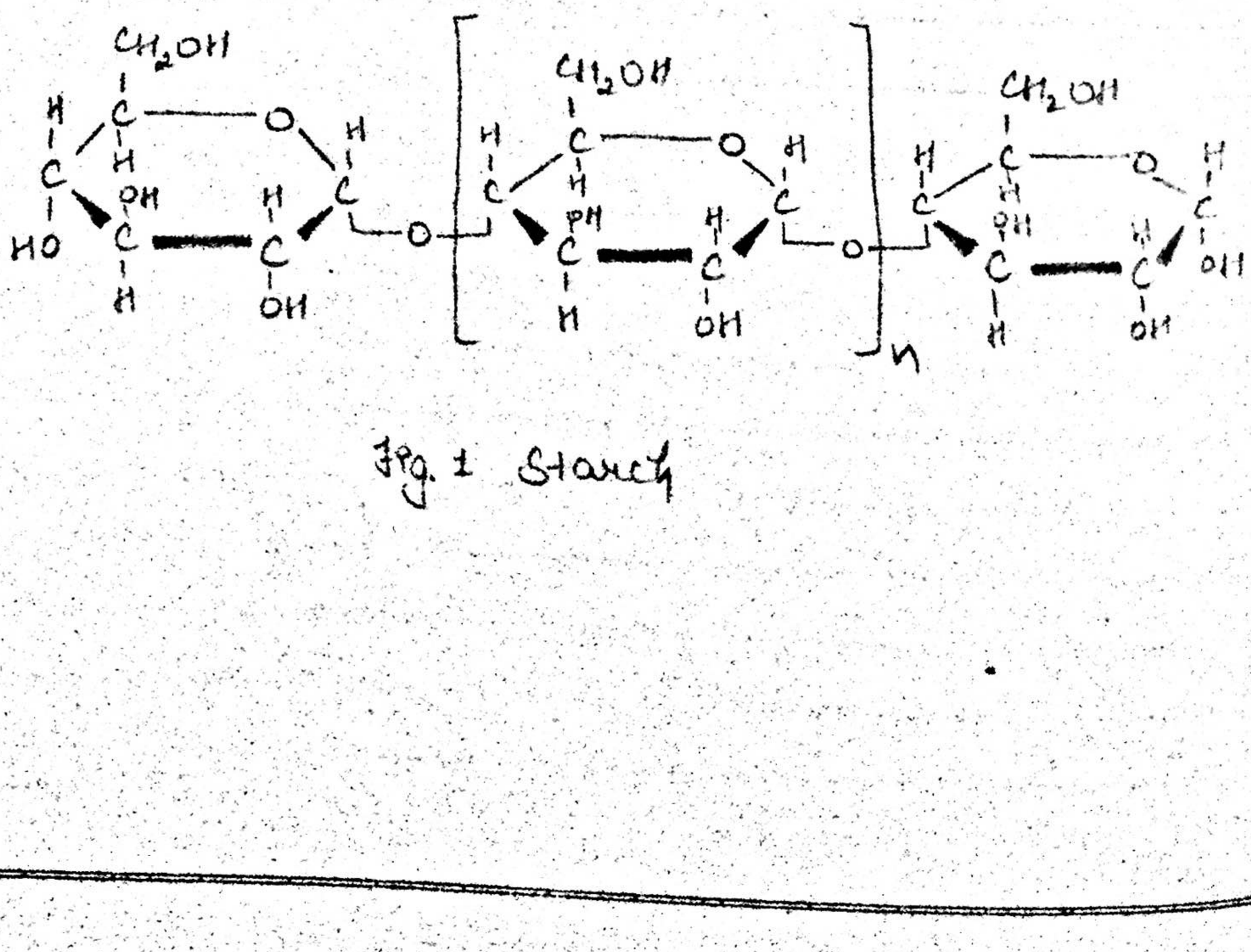

Fig. 1 Starch

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pale / light yellow.

5. Add about 2ml 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 sol^{n} 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 atleast five correct readings till atleast two concordant readings are obtained.

RESULT: The amount of the copper present in copper ore solution is 6.2 gm/L.

PRECAUTIONS:

1. The white color at the end point should be permanent.
2. The copper ore solution should be neutralized 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 solutions, wait for atleast 3 minutes before starting the titration.
5. General precautions of volumetric titrations should be followed.

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OBSERVATIONS:

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

Sr. No.	Burette Reading (ml)		Volume of 0.1 N $Na_2S_2O_3$ sol^n added (ml)
	Initial	Final	
1.	0.0	9.7	9.7
2.	0.0	9.7	9.7
3.	0.0	9.7	9.7

Mean volume of $Na_2S_2O_3$ used (V_2) = 9.7 ml

CALCULATIONS:

Volume of copper ore solution used for each titration (V_1) = 10 ml
Normality of sodium thiosulphate solution = 0.1 N
Let volume of $Na_2S_2O_3$ used = 9.7 ml
Applying the normality equation

$$\text{Copper Ore} \qquad Na_2S_2O_3$$
$$N_1V_1 = N_2V_2$$

N_1 (normality of copper solution) = $\frac{0.1 \times 9.7}{10}$ = 0.097 N

Eq. wt. of copper = 63.5
Amount of copper in the given ore = $N_1 \times 63.5$ gm/l
= 0.097×63.5
= 6.1595 gm/l

RESULT: The amount of copper present in copper ore solution is 6.2 gms/l.

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