Report Cover Page

AMERICAN INTERNATIONAL UNIVERSITY – BANGLADESH

Department of Natural Science (Chemistry)
Faculty of Science & Technology
Programs: B.Sc. Eng'g (EEE/CSE/IPE)
CHEM 1101: CHEMISTRY

Chemistry Lab Report

Semester: Summer Session: 2021-2022

NO EXPERIMENT, NO REPORT

Experiment No: 06
Name of the Experiment: Estimation of Copper (Cu) contained in a supplied solution of copper salt by Iodometric method.

Date of Performance: 19-07-22, Date of Submission: 26-07-22

Course-Teacher: Dr. Saiful Islam

Instructions:

1. *A lab report consists of three parts: a cover page, body of the report and a data and results sheet (lab-sheet).*
2. *This is the cover page of a report and students will collect and preserve the lab-sheet of a particular experiment to be performed.*
3. *Body of the report includes-(I) Objective of the Experiment, (2) Theory, (3) Name of the Chemicals, (4) Name of the Apparatus, (5) Percentage of Error (if necessary) and (6) Discussion (I. Precautions taken, II. Possible errors).*
4. *Use A4-size off-set paper, write on one side of the paper by hand keeping suitable margin.*
5. *Staple the lab-sheet at the end of the report and cover page on the top.*
6. *Submit the report in time to avoid deduction of marks.*
7. *Students working in a group will write and submit the report individually.*
8. *Copying of the report from others is strictly prohibited.*

Name of the Student: Khondoker Md. Sabit Hasan
ID No: 21-45306-2, Section: M, Group: 9

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Faculty comments: ....., Signature: .....
Date: .....

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Objective: To determine the amount of Cu^{+2} ions in a supplied solution of copper salt by iodometri method.

Theory :

(i) **Method:** Redox titration (also called oxidation-reduction titration) is a type of titration based on a redox reaction between the analyte (substance subjected to analysis) and titrant (standard solution taken in burette). Redox titration may involve the use of a redox indicator and/or a potentiometer.

(ii) **Reaction:** $K_2Cr_2O_7$ is a primary standard substance, an oxidizing agent, orange solid and orange color in water solution. $Na_2S_2O_3 \cdot 5H_2O$ is a secondary standard substance, a reducing agent, white solid and colorless in water solution. $CuSO_4 \cdot 5H_2O$ is an inorganic compound (also called blue vitriol, an oxidizing agent, blue colored) and blue in water solution. The balanced reactions of $CuSO_4$ in presence of NH_4OH, CH_3COOH and KI (white solid, a reducing agent) and $Na_2S_2O_3$ with I_2 are as follows:

1. $2CuSO_4 + 4KI = 2K_2SO_4 + 2CuI \downarrow + I_2$

2. $2Na_2S_2O_3 + I_2 = Na_2S_4O_6 + 2NaI$

For redox half reaction,

For 1: (a) $2I^-_{(aq.)} \longrightarrow I_{2\,(aq.)} + 2e$ (oxid. half reaction)

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(b) $2Cu^{2+}_{(aq.)} + 2e \longrightarrow 2Cu^{+}_{(aq.)}$ (Red. half reaction)

For 2: (a) $2S_2O_3^{2-}{}_{(aq.)} \longrightarrow S_4O_6^{2-} + 2e$ (oxid. half reaction)

(b) $I_{2(aq.)} + 2e \longrightarrow 2I^-_{(aq.)}$ (red. half reaction)

(iii) Indicator: Starch solution is used in this titration involving iodine because it forms an intense blue complex with even a trace of iodine. But starch is not a redox indicator; it responds specifically to the presence of I_2, not to a change in redox potential. The active fraction of starch is amylose, a polymer of the sugar α-d glucose. In the presence of starch, iodine forms I_5^- chains inside the amylose helix and the color turns dark blue.

Apparatus:

Burette (50mL), pipette (10mL), conical flask (250mL) volumetric flask (100 mL), watch glass, pipette filler, dropper, stand and clamp etc.

Required Chemicals:

1. Potassium iodide (KI).
2. Sodium bicarbonate ($NaHCO_3$).
3. Conc. Hydrochloric acid (HCl).
4. Potassium dichromate ($K_2Cr_2O_7$)
5. Sodium thiosulphate ($Na_2S_2O_3.5H_2O$)
6. Starch $(C_6H_{10}O_5)_n$
7. Copper sulphate ($CuSO_4.5H_2O$)
8. Ammonium hydroxide (NH_4OH, 6M)
9. Conc. Acetic acid (CH_3COOH)
10. Ammonium thiocyanate (NH_4SCN)

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Name: Khondoker Md. Sabit Hasan, ID No: 21-45306-2 Section (Group): M (9)

AMERICAN INTERNATIONAL UNIVERSITY – BANGLADESH (AIUB)

Department of Chemistry

Experiment 6

CHEM 1101: CHEMISTRY (EEE/CoE/CSE/IPE)

EXPERIMENT NO. 6: ESTIMATION OF COPPER (Cu) CONTAINED IN A SUPPLIED SOLUTION OF COPPER SALT BY IODOMETRIC METHOD.

OBJECTIVE: To determine the amount of Cu^{+2} ions in a supplied solution of copper salt by iodometric method.

THEORY:

(i) Method: Redox titration

(ii) Reaction:

1. $2CuSO_4 + 4KI = 2K_2SO_4 + 2CuI\downarrow + I_2$
2. $2Na_2S_2O_3 + I_2 = Na_2S_4O_6 + 2NaI$

(iii) Indicator: Starch

APPARATUS:
Burette (50mL), pipette (10mL), conical flask (250mL), volumetric flask (100mL), watch glass, pipette filler, dropper, Stand and clamp etc.

REQUIRED CHEMICALS:
(1) 12% KI solution, (2) Copper salt solution (3) $NaHCO_3$ solid,
(4) 6M NH_4OH (5) Conc. HCl acid, (6) Conc. CH_3COOH
(7) Standard $K_2Cr_2O_7$ solution, (8) 10% NH_4SCN solution, (9) $Na_2S_2O_3$ solution,
(10) Starch solution,

(A) Standardize sodium thiosulphate solution as **Expt. No. 4.**

Table-1: *Standardization of supplied $Na_2S_2O_3$ solution against standard $K_2Cr_2O_7$ solution by oxidation-reduction titration.*

No. of reading	*Vol. of $K_2Cr_2O_7$ (in mL)*	*Vol. of $Na_2S_2O_3$ (burette reading) (in mL)*			*Mean (in mL)*
		Initial	*Final*	*Difference*	
1	10	0	11.3	11.3	11.25
2	10	11.3	22.5	11.2	

$$\text{Strength of } K_2Cr_2O_7 \text{ solution} = \frac{\text{Weight taken(in gm)} \times 0.1}{0.49} \text{ (N)}$$

$$= \frac{0.49 \times 0.1}{0.49} = 0.1 \text{ (N)}$$

Strength of supplied $Na_2S_2O_3$ solution (S): $V_{thio} \times N_{thio} = V_{dichromate} \times N_{dichromate}$

$$\Rightarrow 11.25 \times N_{thio} = 10 \times 0.1$$

$$\Rightarrow N_{thio} = 0.089 \text{ N}$$

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(Expt. 6 contd.)

(B) Estimation of Cu ions:

PROCEDURE: Pipette out 10 mL of copper salt solution into a conical flask. Add 3-4 drops of 6M NH_4OH until a faint permanent ppt remain and then add 6-8 drops of conc. CH_3COOH. Now add about 10 ml of 12% potassium iodide (KI) solution and titrate the liberated iodine against the standard sodium thiosulphate solution (standardized previously) until the brown color of iodine changes to light yellow. Add approx. 1 mL of starch solution, solution turns intense blue and continue titration till the blue color begins to fade. Now add few drops of 10% ammonium thiocyanate solution and continue titration until the blue color is just discharged (off-white). Calculate the amount of copper present in 500 mL of copper salt solution.

EXPERIMENTAL DATA:

Table-2: *Determination of the amount of copper in a supplied solution of blue vitriol by iodometric method.*

No. of reading	*Vol. of Copper salt solution (in mL)*	*Vol. of $Na_2S_2O_3$ (burette reading) (in mL)*			*Mean (in mL) (V)*
		Initial	*Final*	*Difference*	
1	10	[illegible]	—	—	4.83
2	10	25	30	5	
3	10	30	35	5	
4	10	35	39.5	4.5	

CALCULATIONS: $2\,CuSO_4 \equiv I_2 \equiv 2\,Na_2S_2O_3$

1 ml 1N $Na_2S_2O_3$ $\equiv$ 0.06354 gm of Cu^{2+}

Amount of copper ions in 10 mL of copper salt solution $= 0.06354 \times V \times S$ gm

$= 0.0635 \times 4.83 \times 0.089$

$= 0.0273$ gm

Amount of copper ions in 500 mL of copper salt solution $= 0.06354 \times V \times S \times 50$ gm

$= 0.0273 \times 50 = 1.365$ gm

Observe value of Cu^{2+} (in 500mL solution) $= (0.06354 \times 4.83 \times 0.089) \times 50$

$= 0.0273 \times 50 = 1.365$ gm

Known value of Cu^{2+} (in 500mL solution) $= \frac{63.54 \times 4}{249.68} = 1.01794$ gm

RESULTS:

Amount of cupper ions in 500 ml of copper salt solution is 1.365 gm.

PERCENTAGE OF ERROR:

$$\frac{Known\ value - Observed\ value}{Known\ value} \times 100 = \frac{1.01794 - 1.365}{1.01794} \times 100 = -34.09\%$$

Students should know

- Why it is necessary to keep your experimental solution in the dark?
- Is it iodometric or iodimetric that you are performing?
- Tell molecular weight and gram equivalent weight of $K_2Cr_2O_7$ and $Na_2S_2O_3$.
- What is the function of starch?
- What is the purpose of adding NH_4SCN solution?

Text: M. Mahbubul Huque and A. Jabber Mian, "Practical Chemistry", 2nd ed. (1972)

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Discussion:

(a) Precautions taken:

1. Avoid skin and eye contact with the chemicals.
2. Identify the safety equipment.
3. Wear clothing that covers torso and legs.

(b) Possible errors:

1. Weight was not taken properly.
2. Error might be occured while taking the burette reading
3. Using the equipment incorrectly.

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