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: Spring **Session:** 2022-2023

NO EXPERIMENT, NO REPORT

Experiment No: 6
Name of the Experiment: Estimation of Copper (Cu) Contained in a Supplied Solution of Copper Salt by Iodometric Method.

Date of Performance: 22-3-23, Date of Submission: 29-3-23

Course-Teacher: Dr. Mohammad Tariqul 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-(1) 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: TRIDIB SARKAR
ID No: 22-46494-1, Section: F, Group: 03

FOR FACULTY USE ONLY

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

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

Theory:

(i) **Method:** A redox titration is based on the oxidation-reduction between the analyte and titrant. This one used a redox indicator to determine the endpoint. Frequently either the ~~reactants~~ reactants or the titrant have a colour intense enough that an additional indicator is not needed.

(ii) **Reactions:**

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

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

For reaction - 1

a) $2I^-_{(aq)} \rightarrow I_{2(aq)} + 2e$ (oxid. half reaction)

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

For reaction - 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: Starch is the indicator of choice for those procedures involving iodine because it forms an intense blue complex with iodine. 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.

Required Chemicals:

Name of the chemicals		chemical formula
1. 12% Potassium Iodide Solution	——	KI
2. Copper salt solution	——	$CuSO_4 \cdot 5H_2O$
3. Sodium bycarbonate solid	——	$NaHCO_3$
4. 6M Ammonium Hydroxide	——	NH_4OH
5. Conc. Hydrochlorie acid	——	HCl
6. Conc. Acetic acid	——	CH_3COOH
7. Standard Potassium dichromate solution	——	$K_2Cr_2O_7$
8. 10% Ammonium Thiocyanate	——	NH_4SCN
9. Sodium Thiosulphate solution	——	$Na_2S_2O_3$
10. Starch solution	——	$(C_6H_{10}O_5)_n$

Apparatus:

(i) Burette (50 ml)

(ii) Pipette (10 ml)

(iii) Conical flask (250 ml)

(iv) Volumetric flask (100 ml)

(v) Watch glass.

(vi) Pipette filler.

(vii) Dropper.

(viii) Stand and clamp.

Name: TRIDIB SARKAR ID No: 22-46999-1 Section (Group): F-(03)

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	11.00	11.00	10.75
2	10	11.00	21.50	10.50	

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

0.51

$= 0.10408$ N

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

$\rightarrow 10.75 \times N_{thio} = 10 \times 0.10408$

$\Rightarrow N_{thio} = 0.09681$

Name: TRIDIB SARKAR ID No: 22-46444-1 Section (Group): F (63)

(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	21.50	25.10	3.60	3.50
2	10	25.10	28.50	3.40	
3	10	28.50	32.00	3.50	
4	10				

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

$= 0.06354 \times 3.50 \times 0.09681$ gm

$= 0.02153$ gm

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

$= 0.06354 \times 3.50 \times 0.09681$ gm

$= 1.07648$ gm

Observe value of Cu^{2+} (in 500mL solution) $= 1.07648$ gm

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

RESULTS:

Amount of Cu ions (in gm) in 500 ml of supplied $CuSO_4$ solution 1.08 gm

PERCENTAGE OF ERROR:

$$\frac{\text{Known value} - \text{Observed value}}{\text{Known value}} \times 100 = \frac{1.01794 - 1.07648}{1.01794} \times 100$$

$= -5.75\%$

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)

Discussion:

(i) Precautions:

1. The apparatus was washed first two times with normal water and one time with distilled water.
2. Care was taken while adding KI salt.
3. Carefully added $Na_2S_2O_3$ dropwise.
4. The liberated iodine solution was shaken continuously.
5. Iodine solution was taken into black box for 5 minutes.

(ii) Possible errors:

1. Error might be occured while taking the burette reading.
2. The starch solution might be added early in the titration because of the absorption of the Iodine by starch.
3. Might have added more than 46 ml distilled water while making the solution.
4. Error might be occured while calculating the concentration.