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: 21-03-2023, *Date of Submission:*

Course-Teacher: DR. MOHAMMAD ANISUR RAHMAN JAMIL

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: MD. SHOHANUR RAHMAN SHOHAN
ID No: 22-46013-1, *Section:* M, *Group:* 08

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

Objective:

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

Theory:

Method: Redox titration.

A redox titration is based on an oxidation reduction between the analyte and titrant. This one use a potentiometer or a redox indicator to determine the endpoint. Frequently either the reactants or the titrant have a color intense enough that an additional indicator is not needed.

$K_2Cr_2O_4$ is a primary standard substance, an oxidizing agent orange solid (mol. wt. 294, gram equiv wt 49) and orange color in water solution.

$Na_2S_2O_3 \cdot 5H_2O$ is a secondary standard substance, a reducing agent, white solid (mol. wt 248, gram equiv wt 248) and colorless in water solution.

$CuSO_4 \cdot 5H_2O$ is an organic compound (also called blue vitriol, an oxidizing agent, blue colored, mol, wt 249.68) and blue in water solution.

Reaction:

The balanced reactions of $CuSO_4$ in presence of NH_4OH, CH_3COOH and KI (white solid, a reducing agent) and of $Na_2S_2O_3$ with I_2 are as follows:

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

2. $2Na_2SO_3 + I_2 = Na_2S_4O_6 + 2NaI$

Redox Half Reaction:

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

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

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

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

- 6M NH_4OH : 4 drops for each reading to adjust the acidity or to keep high pH in the solution.
- CH_3-COOH: 4-5 drops for each reading to remove or dissolve the ppt by adjusting the acidity
- 10% NH_4SCN: to separate the adsorbed iodine from ppt (CuI solid)

Indicator: starch

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 specially 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 amylase helix and the color turns dark blue.

Solution turns brown when I_2 (brown solid) is produced during first reaction above. with addition of $Na_2S_2O_3$ solution it turns yellow due to presence of trace of I_2. starch forms intense blue color complexes with trace of iodine. With further addition of $Na_2S_2O_3$ solution iodine is compeletly consumed. end point is achived and solution trunss off white at the end point due to presence of insoluble CuI.

Required Chemicals:

Name of the chemicals	chemical formula
1. 12% Potassium iodine solution	KI
2. Sodium bicarbonate	$NaHCO_3$
3. Conc. Hydrochloric Acid.	HCl
4. Potassium diahromate	$K_2Cr_2O_7$
5. Sodium thiosulphate	$Na_2S_2O_3 \cdot 5H_2O$
6. Starch	$(C_6H_{10}O_5)_n$
7. Copper sulphate	$CuSO_4 \cdot 5H_2O$
8. 6M Amonium Hydroxide	NH_4OH
9. Conc. Acetic Acid	CH_3COOH
10. 10% Ammonium Thiocynate	NH_4SCN

Apparatus:

1. Burette (50 ml)
2. Pipette (10 ml)
3. Conical flask (250 ml)
4. Volumetric flask (100 ml)
5. Watch glass.
6. Pipette filler.
7. Dropper.
8. Stand.
9. Clamp.
10. Wash Bottle
11. Funnel
12. Measuring Cylinder.

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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	0.00	10.60	10.60	10.10
2	10	10.60	20.20	9.60	

$$\text{Strength of } K_2Cr_2O_7 \text{ solution} = \frac{\text{Weight taken (in gm)} \times 0.1}{0.49} \text{ (N)} = \frac{0.456 \times 0.1}{0.49}$$

$$= 0.09306 \text{ N}$$

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

$$10.10 \times N_{thio} = 10 \times 0.0936$$

$$N_{thio} = 0.0921 \text{ (N)}$$

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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	20.20	23.6	3.4	3.65
2	10	23.6	27.5	3.9	
3	10				
4	10				

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

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

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

$= 0.06354 \times 3.65 \times 0.0921 = 0.02136$ gm

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

$= 0.06354 \times 3.65 \times 0.0921 \times 50$

Observe value of Cu^{2+} (in 500mL solution) = 1.0679 gm

Known value of Cu^{2+} (in 500mL solution) = $\frac{63.54 \times 4}{239.54} = 1.0610$ gm

RESULTS: The Amount of copper ions in 500 ml of copper salt solution = 1.068m

PERCENTAGE OF ERROR:

$$\frac{\text{Known value} - \text{Observed value}}{\text{Known value}} \times 100 = \frac{1.0610 - 1.0679}{1.061} \times 100$$

$= -0.65\%$

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:

Precautions Taken:

1. The apparatus were washed with distilled water.
2. The burrette readings were taken carefully.
3. The iodine solution was shaken continuously.

Possible Errors:

1. While taking reading from burette there might have been parallax error.
2. Starch solution might be added early in the titration
3. might have added more than 46 ml distilled water, while making solution