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: 7
Name of the Experiment: DETERMINATION OF FERROUS ION (Fe^{2+}) IN A SUPPLIED SOLUTION OF IRON SALT BY STANDARD POTASSIUM DICHROMATE ($K_2Cr_2O_7$) SOLUTION.

Date of Performance: 28-03-23, *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 A_4-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 know the amount of iron (Fe^{2+}) in supplied solution of iron salt by standard $K_2Cr_2O_7$ solution

Theory:

Method: Redox Titration

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

$K_2Cr_2O_7$ is a primary substance, an oxidizing agent, orange solid (mol. wt 294, gram-equiv wt. 49) and orange color in water solution.

Iron salt, ferrous ammonium sulphate, $FeSO_4(NH_4)_2SO_4.6H_2O$ is an organic compound (also called mohr's salt, a reducing agent, blue-gree solid, mol-wt. 392.14) and blue-green in water solution.

Reaction:

The balanced reactions of $FeSO_4$ with $K_2Cr_2O_7$ in presence of 5% H_2SO_4 and conc H_3PO_4 and diphenyl amine.

$$6FeSO_4 + K_2Cr_2O_7 + 7H_2SO_4 = 3Fe_2(SO_4)_3 + K_2SO_4 + 7H_2O + Cr_2(SO_4)_3$$

Redox Half Reaction:

(a) $6Fe^{2+} \longrightarrow 6Fe^{3+} + 6e^-$ (oxidation half reaction)

(b) $Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$ (reduction half reaction)

Indicator: (Diphenyl ammine $(C_6H_5)_2NH$

Dyphenyl amine is used as a redox indicator because it shows a very clear color change from green to violet when endpoint of the titration is reached 1 gm solid in 100 ml conc. H_2SO_4

- Conc. H_3PO_4 : It is used to reduce the oxidation potential by forming complexes with Fe^{3+} ions produced in the reaction.
- 5% H_2SO_4 : It is the main source of H_3O^+ which supply proton to remove oxygen such as such as those in dichromate ions.

Required Chemical:

Name of the chemical	chemical Formula
1. Mohr's salt	$FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$
2. 5% sulfuric acid	H_2SO_4
3. Conc. Phosphoric acid	H_3PO_4
4. Pottassium dichromate	$K_2Cr_2O_7$
5. Diphenyl ammine	$(C_6H_5)_2NH$

Apparatus:

1. Burette (50ml)
2. Pipette (10ml)
3. Conical Flask (250ml)
4. Funnel.
5. Pipette Filler.
6. Stand.
7. Clamp.
8. Washing Bottle.
9. Dropper.

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AMERICAN INTERNATIONAL UNIVERSITY – BANGLADESH (AIUB)

Department of Chemistry

Experiment 7

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

EXPERIMENT NO. 7: DETERMINATION OF FERROUS ION (Fe^{2+}) IN A SUPPLIED SOLUTION OF IRON SALT BY STANDARD POTASSIUM DICHROMATE ($K_2Cr_2O_7$) SOLUTION.

OBJECTIVE: To know the amount of iron (Fe^{2+}) in a supplied solution of iron salt by standard $K_2Cr_2O_7$ solution.

THEORY:

(i) Method: Redox titration

(ii) Reaction:

$$6FeSO_4 + K_2Cr_2O_7 + 7H_2SO_4 = 3Fe_2(SO_4)_3 + K_2SO_4 + 7H_2O + Cr_2(SO_4)_3$$

Redox half reactions: $6Fe^{2+} \rightarrow 6Fe^{3+} + 6e$ (Oxidation)

$Cr_2O_7^{2-} + 14H^+ + 6e = 2Cr^{3+} + 7H_2O$ (Reduction)

(iii) Indicator: Diphenyl amine, $(C_6H_5)_2NH$

APPARATUS:

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

REQUIRED CHEMICALS:

1. Iron salt solution,
2. 5% Sulfuric acid,
3. Conc. Phosphoric acid,
4. Standard $K_2Cr_2O_7$ solution,
5. Diphenyl Amine indicator

PREPARATION OF APPROX. 0.1N POTASSIUM DICHROMATE SOLUTION.

Transfer approx. 0.49 gram of pure $K_2Cr_2O_7$ into a 100 mL measuring flask and then dissolve it with distilled water up to the mark.

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

$$= \frac{0.5 \times 0.1}{0.49}$$

$$= 0.102 \text{ N}$$

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(Expt. 7 contd.)

PROCEDURE: Take 10 mL of the supplied iron salt (Mohr's salt) solution in a conical flask. Add 50 mL 5% sulfuric acid and 5 mL of conc. phosphoric acid. Then add 4-5 drops of diphenyl amine indicator and titrate slowly against the standard potassium dichromate solution drop wise maintaining an interval of few seconds between each drop until the addition of one drop causes the formation of intense purple or violet blue coloration which remains permanent and is unaffected by further addition of dichromate solution. Repeat the experiment at least thrice. Calculate the amount of iron per 500 mL of iron salt solution.

EXPERIMENTAL DATA:

Table: *Determination of the amount of iron in Mohr's salt solution using standard $K_2Cr_2O_7$ solution.*

No. of reading	*Vol. of Mohr's salt solution (in mL)*	*Vol. of $K_2Cr_2O_7$ (burette reading) (in mL)*			*Mean (in mL) (V)*
		Initial	*Final*	*Difference*	
1	10	0.0	7.20	7.20	6.20
2	10	7.20	12.40	5.20	
3	10				
4	10				

CALCULATIONS: 1 mL 1N $K_2Cr_2O_7$ ≡ 0.05584 gm of Fe^{2+}

Amount of iron in 10 mL of iron salt solution = 0.05584 × V × S gm
= 0.05584 × 6.2 × 0.102
= 0.035 gm

Amount of iron in 500 mLof iron salt solution = 0.05584 × V × S × 50 gm
= 0.035 × 50 = 1.75 gm

Observe value of Fe^{2+} (in 500mL solution) = 1.75 gm

Known value of Fe^{2+} (in 500mL solution) = $\frac{55.84 \times 10}{392.14}$ = 1.4239

RESULTS: Amount of Fe^{2+} ions in 500 ml of supplied Mohr's salt solution is 1.75 gm

PERCENTAGE OF ERROR:

$$\frac{Known\ value - Observed\ value}{Known\ value} \times 100 = \frac{1.4239 - 1.75}{1.4239} \times 100$$

$$= -22.90\%$$

Students should know

- Why it is necessary to use both the *sulfuric acid* as well as *phosphoric acid* in the reaction?
- Atomic weight, molecular weight of $K_2Cr_2O_7$ and $KMnO_4$.
- Could you use $KMnO_4$ instead of $K_2Cr_2O_7$?
- Why the solution shows light bottle green colour after addition of $K_2Cr_2O_7$.

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

Discussions:

Precautions Taken:

1. The apparatus were washed with distilled water
2. The burette readings were taken carefully.
3. The percentage of error was calculated properly

Possible Errors:

1. While taking readings from the burette there might have been parallox error
2. The dyphenyl amine might be added early
3. Might have added more than 10ml iron salt solution.