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: 07

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: 26-07-22, Date of Submission: 02-08-22

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

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

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 (also called oxidation-reduction method) 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. Iron salt, ferrous ammonium sulphate, $FeSO_4.(NH_4)_2SO_4.6H_2O$ is an inorganic compound (also called Mohr's salt, a reducing agent, blue-green solid) and blue-green in water solution. The balance reaction of $FeSO_4$ with $K_2Cr_2O_7$ in presence of 5 % H_2SO_4 and conc. H_3PO_4 and diphenyl amine is as follows:

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

Redox half reactions:

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

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

(iii) Indicator: Diphenylamin is an organic compound with the formula $(C_6H_5)_2NH$. The compound is a derivative of aniline, consisting of an amine bound to two phenyl groups. The compound is a colorless solid, but commercial samples are often yellow due to oxidized impurities.

Apparatus:

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

Required chemicals:

1. Mohr's salt. $[FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O]$
2. Sulphuric acid. $[H_2SO_4, 5\%]$
3. Conc. Phosphoric acid. $[H_3PO_4]$
4. Potassium dichromate. $[K_2Cr_2O_7]$
5. Diphenylamine. $[(C_6H_5)_2NH]$

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

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.

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

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

$$= 0.1 \text{ (N)}$$

Name: ..... ID No: ..... Section (Group): .....

(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	8.6	8.6	
2	10	8.6	17	8.4	7.325
3	10	17	24.2	7.2	
4	10	24.2	29.3	5.1	

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 × 7.325 × 0.1 = 0.0409 gm

Amount of iron in 500 mL of iron salt solution = 0.05584 × V × S × 50 gm
= 0.0409 × 50 = 2.04514 gm

Observe value of Fe^{2+} (in 500mL solution) = 2.04515 gm

Known value of Fe^{2+} (in 500mL solution) = $\frac{55.84 \times 10}{392.14}$ = 1.424 gm

RESULTS:
Amount of Fe^{+2} ions in 500 ml of supplied Mohr's salt solution is 2.04515 gm.

PERCENTAGE OF ERROR:

$$\frac{\text{Known value} - \text{Observed value}}{\text{Known value}} \times 100 = \frac{1.424 - 2.04514}{1.424} \times 100$$

$$= -43.619\ \%$$

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)

Discussion:

(a) Precautions taken:

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

(b) Possible errors:

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