Experiment No: 05

Experiment name: Standardization of Sodium Thiosulphate Penta hydrate ($Na_2S_2O_3 \cdot 5H_2O$) solution with standard Potassium Dichromate ($K_2Cr_2O_7$) solution

Theory:

In this experiment the strength of Sodium Thiosulphate solution is determined with the help of a standard Potassium Dichromate solution. This is an oxidation and reduction reaction, as well as 'Iodometric reaction'. Titration involving with iodine or dealing with iodine liberated in chemical reaction is called Iodometric and Iodometric titration respectively. This reaction is Iodometric because iodine is got from KI. The reactions of this experiments are:

$$6KI + 7H_2S_2O_4 + K_2Cr_2O_7 \longrightarrow Cr_2(SO_4)_3 + 3I_2 + 7H_2O + K_2SO_4$$

$$(6I^- + 14H^+ + Cr_2O_7^{2-} + 6e^- = 2Cr^{3+} + 3I_2 + 7H_2O)$$

$$2Na_2S_2O_3 + I_2 = Na_2S_2O_6 + 2NaI$$

$$(S_2O_3^{2-} + e^- = S_4O_6^{2-} + I^-)$$

Here $K_2Cr_2O_7$ is an oxidizing agent and I is a reducing agent. Again in the second reaction I_2 is an oxidizing agent and S_2O_3 is a reducing agent. In the second step of the reaction a specific indicator is used that is strach which has a significant characteristic on iodine.

Starch + I_2 = Starch - Iodine (blue color) Starch Iodin $+6S_2O_3$ = Starch $+6I^- + 3S_4O_6$. If to a solution containing a little iodine, some starch solution is added and $Na_2S_2O_3$ is run in from the burette, the blue color of the starch-iodine complex will disappear from the solution as soon as all the iodine has been reduced to iodin ion.

2. Apparatus: Volumetric flask (100 ml), Conical flask (100 ml), Burette, Pipette (10 ml), Funnel, Iron stand, Wash bottle.

3. Chemicals: 1. Potassium dichromate ($K_2Cr_2O_7$)
2. Sodium Thiosulphate Pentahydrate
3. Potassium Iodine
4. Sulfamic Acid (H_3SO_4)

5. Sodium bicarbonate

6. Starch

4. Phase: The experiment can be done two phases.

a. Prep of standard 0.1 (N) Potassium dichromate solution.

b. Standardization of sodium Thiosulphate solution with standard $K_2Cr_2O_7$ solution.

5. Procedure:

a. Prep of standard 0.1 (N) Potassium dichromate solution: Wt out 0.49gm of $K_2Cr_2O_7$ and transfer into a 100 ml volumetric flask. Then dissolve and make up to the mark with distilled water.

Strength of $K_2Cr_2O_7$ = Wt taken in gm / Wt to be taken $\times \frac{1}{1}$

$$= \frac{0.49}{0.49} \times \frac{1}{10}$$

$$= 0.1N$$

b. Standardization of approx 0.1(N) sodium Thiosulphate with standard $K_2Cr_2O_7$ solution:

1. Take 10 ml 12% potassium Iodine (KI) solution into a conical flask.
2. Add about 80 ml distilled water and about 2gm of sodium bicarbonate.
3. Add 10 ml of 3N sulphuric acid.
4. Add 10 ml of standard $K_2Cr_2O_7$ solution, shake cover with watch glass and keep in dark place for 10 minutes.
5. Reddish color appears, rinse the rise watch glass sharply and dilute up to 100 ml with distilled water.
6. Light yellow color appears.
7. Add strach indicator solution and dark color appears.
8. Light green or light blue color appears at the end point.

Table for Vol of $Na_2S_2O_3 \cdot 5H_2O$

No of obs	Vol of $K_2Cr_2O_7$ sol'n (ml)	Vol of $Na_2S_2O_3 \cdot 5H_2O$				Remarks
		IBR (ml)	FBR (ml)	Diff (ml)	Mean	
01	10	0	11.4	11.4		
02	10	11.4	22.7	11.3	11.5	
03	10	22.7	34.2	11.5		

6. Experimental Data:

V_1 (Vol of $K_2Cr_2O_7$ soln) = 10 ml

S_1 (Str of $K_2Cr_2O_7$ soln) = 0.1 N

V_2 (Vol of $Na_2S_2O_3 \cdot 5H_2O$) = 11.5 ml

S_2 (Str of $Na_2S_2O_3 \cdot 5H_2O$ soln) = ?

7. Calculation: $S_2 = V_1 S_1 / V_2$

$= \frac{10 \times 0.1}{11.5}$

$= 0.086956$ N

8. Result: The strength of solution $Na_2S_2O_3 \cdot 5H_2O$ soln is 0.086956 N

9. % of error:

$$\left| \frac{\text{Std result} - \text{Obs result}}{\text{Std result}} \right| \times 100\%$$

$$= \left| \frac{0.09092 - 0.086956}{0.09092} \right| \times 100\%$$

$= 4.4\%$

Discussion:

1. Some error might be gotten due to parallax error. Before starting the experiment the burette should be placed vertical position precisely.

2. Overshaking or undershaking of the volumetric flask where the sodium thayosulphate with distilled water were placed might be happened Due to that reason some error were come.

3. Due to overflowing from the burette some error were gotten. The speed should be maintained very carefully.

4. Errors might be come due to inappropriate calculation. While calculating the data enough consciousness should be ensured.

5. Due to placing the conical flask where the mixer of H_2SO_4, $K_2Cr_2O_7$, KI was placed more time in the light some iodine molecule

Key Points

1. Oxidation Number: The oxidation number of an atom is the charge that atom would have if the compound was composed of ion.

2. Equivalent weight of $K_2Cr_2O_7$:

$$\frac{\text{molecular weight}}{\text{no of } e^-} = \frac{294}{6} = 49\,g/mol$$

3. Iodometric Titration: Its a method of volumetr chemical analysis, a redox titration where the appearance or disappearance of elementa iodine indicates the end point.

4. Reaction with balance: A balanced chemical equation is an equation where the number of atoms of each type in the reaction is the same on both reactants and product sides.

5. Why keep dark for iodometric titration:

=) The reaction mixture should be kept in dark before titration because light accelarate a side reaction in which iodine ions are oxidized to iodine by atmospheric oxygens.

6. Why use $NaHCO_3$ for iodometric titration?

=) To keep the thiosulphate solution stable $NaHCO_3$, which is a weak base helps to keep the solution slightly alkine to slow down the decomposition of thiosulphate.