Stability of tris 1,10-Phenanthroline Iron (II) complex in different composition by Absorbance measurement

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Abstract: During the measurements of total iron the composites composition have huge effect of the stability of tris 1,10phenanthroline iron (II) complex. The main aim of this work is to measurement of concentration at which the stability of tris1,10-phenanthroline iron (II) complex in a given time duration is highest for alumina composite. The alumina is use as a composite in different concentration. The stability studied in the time duration of 45 minutes. This study is based on primary sources. Absorbance is measured by using UV Spectrophotometric method. The alumina having concentration 3g/200cm^3 and 4g/200cm^3 are form stable complex and so this concentration are suitable for the analysis of iron in this composite. And the result shows increase in absorbance with the increase in concentration the composite obeys beer Lambert law. And conclusion shows that the researcher has to focus on the stereochemistry of complex formation in the different composites.

Keywords: Ortho-phenanthroline Iron (II) complex, Alumina, composites, Concentration, Absorbance.

I. INTRODUCTION

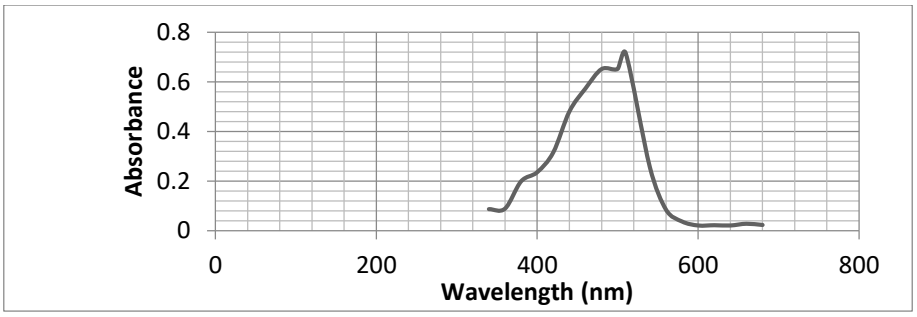
Coordination theory said, the metal in transition series can form bond with the anions and molecule (ligands) in a definite number to form a complex and ligands can distribute themselves in a certain manner to produce a definite shape of complex.[1] complex consist of central metal atoms or ions and ligands are bounds by dative bond. And the term coordination are use for the number of ligands bound to the central metal atom.[2] The coordination number of complexes are depends on the oxidation state of metal atom, size, electronic configuration and the tendency of ligand to bond to the central metal atoms. [3] The ligands are of many types depends on the numbers of atom of an ligand bound to the central metal atom the ligand can be classify into different categories i.e. if the ligand can bound through only one atom is can be called monodentate, through two atoms it can be called bidentate and like this we have tridentate, tetradentate, pentadantate and so on.[3] The coordination number can be 2,3,4,5,6,7,8,9,10 and 12 but 4 and 6 are the most common coordination number we have. The complex formation can change the properties of ligands and central metal atoms.[4,5] 1,10-phenanthroline are an organic reagents having molecular mass of 198.22g/mol. And the organic reagent can be used in quantitative analysis of cuprous ion Cu(I) at wavelength 435nm, cupric ion Cu(III) at 272nm, cadmium at (226 and 270nm), cobalt at (226 and 270nm), iron Fe(II) (508nm), Nickel Ni(II) (228 and 270nm), manganese Mn (226 and 268nm) and some other ions.[4-6] In case of iron the phenanthroline iron complex formed are of dark orange colour and it name given as ferrand. This complex are stable in pH range of 2-9.[11,12] the ferrous ion can be determine by the reduction of ferric ions into the ferrous by adding hydroxylamine hydrochloride solution. [4-6,9-11] The analysis of iron with 1,10 phenanthroline depends on the composition of composites. And the alumina used in this paper as a composite and this composite used for the production of aluminium. Alumina contain 98.6 percentage of Al_2O_3 and the rest remaining material is impurities like iron, silicon, sodium, vanadium, zinc and chromium etc.[12]

II. METHEDOLOGY

For the experiment the aluminium powder was prepared with 1,2,3,and 4g of alumina with flux H_3BO_3 and Na_2CO_3 in the alumina factory and the sample powder was melted up to temperature of 400^{o}C then again it melted up to 1000^{o}C. And the sample which was melt have to cool down and added to the double distilled water containing 1:1 sulphuric acid so after that the solution was transfer to 200cm^3 volumetric flask. This prepared solution was the sample solution for the analysis of iron in a given sample. For the quantitative analysis of iron in alumina the method used was a R805-ISO spectrometric. In this method the iron in ferrous form oxidised and firstly is can be reduced by using hydroxylamine hydrochloride

$$2Fe^{3+} + 2NH_2OH^{+2}\ OH^- \rightarrow 2Fe^{2+} + N_2 + 4\ H_2O$$

and then by addition of 1,10-phenanthroline, the tris1,10-phenanthroline iron(II) complex are formed under pH range of 3.6-4.5 and this pH range can be maintained by addition of buffer called acetate buffer. 511nm wavelength was used for the iron analysis. UV/Vis spectrophotometer Perkin-Elmer was used for the spectrophotometric determination. The 511nm wavelength was selected for determination of iron on the basis of following experiment: the absorbance of the standard iron solution was determined in the range of 340-680 nm. So accordance with the Beer's law the curve obtained between the absorbance and wavelength given that 511nm was the wavelength where the complex adsorption was maximum, So the linear relation between the absorbance and concentration was selected. Figure1. Visible Spectra of tris1, 10phenanthroline iron (II) complex



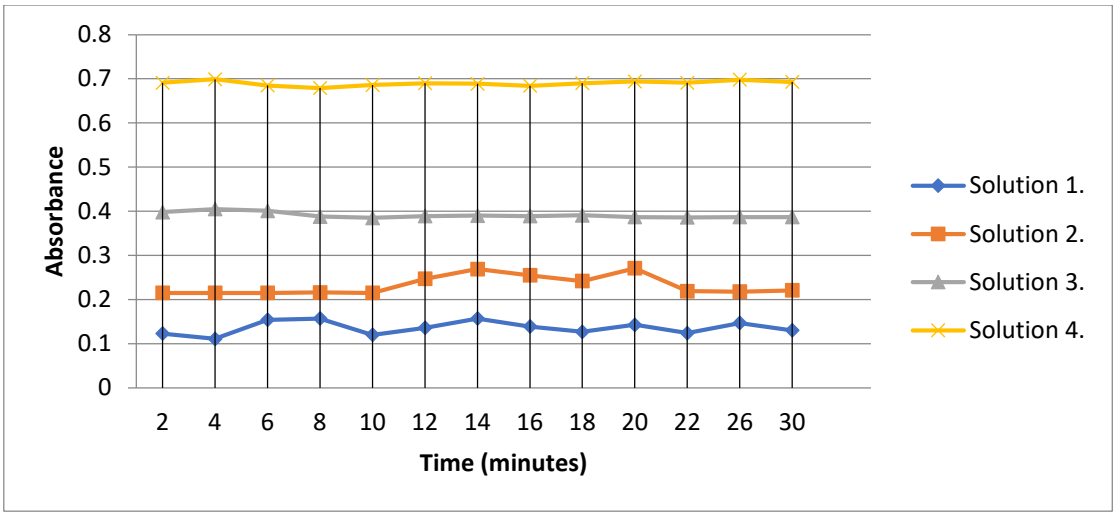
The chemical used in this research was hydroxylamine hydrochloride, H_3BO_3, Na_2CO_3, 1% 1,10-phenanthroline solution, acetate buffer of pH 5.5, standard solution of iron in form of Fe_2O_3 (0.02, 0.04, 0.06, 0.08, 0.10mg/cm^3) was used, HCl acid and 1:1 sulphuric acid.

III. RESULT AND DISCUSSION

There was four solution of ortho-phenanthroline iron (II) complex containing different amount of alumina i.e. 1,2,3 and 4 g/200cm^3 .the composite alumina solution was monitored in time period of 0-45 minutes. With the increasing amount of alumina the concentration of iron also increase it suggest that there are direct relation between the amount of alumina and concentration of iron in a given solutions. For the solution contain 1g/200cm^3 of alumina, tris1,10 phenanthroline Iron (II) complex in stable up to first 8 minutes after that the absorbance change from 8-20minutes and then it reach the initial value. For the complex solution containing 2g/200cm^3 the curve change after 12 minutes and in the initial situation the curve remain almost the same. But in case of the solution containing 3g/200cm^3 and 4g/200cm^3 the value of absorbance dependence on concentration and time, and the curve was near about same and there were some negligible deviation shown. In the solution containing 1g/200cm^3 and 2g/200cm^3 and during measurements of very low concentration the deviation were higher, the higher deviation in the curve shows that there were more chances to occur error in measurements. Table1. Dependence between the Absorbance, Concentration and time for Solution1. 1g/200cm^3, Solution2. 2g/200cm^3, Solution3. 3g/200cm^3, Solution 4. 4g/200cm^3.

Time (mins)	Solution 1. (1g/200cm^3)		Solution 2. (2g/200cm^3)		Solution 3. (3g/200cm^3)		Solution 4. (4g/200cm^3)	
	A	C mg/cm^3	A	C mg/cm^3	A	C mg/cm^3	A	C mg/cm^3
2	0.123	51.57	0.215	111.15	0.398	158.42	0.691	205.12
4	0.111	48.86	0.215	111.15	0.405	157.51	0.699	204.43
6	0.154	75.25	0.215	112.06	0.401	157.80	0.685	205.16
8	0.157	74.56	0.216	111.20	0.388	159.36	0.679	204.52
10	0.120	49.50	0.215	120.07	0.385	158.24	0.686	203.93
12	0.136	58.62	0.247	151.84	0.389	160.52	0.690	204.24
14	0.157	68.31	0.269	162.96	0.390	158.86	0.689	204.74
16	0.139	59.34	0.255	153.24	0.389	157.87	0.684	203.85
18	0.127	53.65	0.242	149.82	0.391	158.54	0.690	205.56
20	0.143	61.13	0.271	164.73	0.387	159.26	0.694	204.42
22	0.124	49.99	0.219	113.86	0.386	158.91	0.691	204.63
26	0.147	62.83	0.218	114.12	0.387	159.34	0.698	204.17
30	0.130	54.21	0.221	116.27	0.387	157.92	0.693	205.50

On the basis of the analysis the concentration of iron in alumina and error occurred in the measurement were two factor which were related each other inversely as the concentration increase the relative error decrease. This method is perfect choice for the determination of tris 1,10-phenanthroline iron (II) complex. In the given table the measurements of absorbance in alumina solution indicated that there were a very stable tris 1,10-phenanthroline iron(II) complex were produced. Figure2. Dependence between the Absorbance , Concentration and time for Solution1. 1g/200cm^3, Solution2. 2g/200cm^3, Solution3. 3g/200cm^3, Solution4. 4g/200cm^3.



For the determination of calibration curve for Iron (II) ion, five solutions are prepared from standard solution of Fe_2O_3 (0.2 g/dm^3). And these five solution were have different concentrations (0.02, 0.04, 0.06, 0.08, 0.10mg/cm^3) Fe_2O_3. And these were used for the measurement of absorbance at same time interval 0-45 minutes. On the basis of data obtained the stability of a given standard solution was observed. As the concentration of Fe_2O_3 was increased the absorbance of the solution also increased So it concluded that there were a direct relation between the absorbance and concentration of standard solution of Fe_2O_3. And both the term is dependence on each other. As the observation indicated the absorbance and concentration of the standard solution remain constant over given time period. Which shown that the use of UV Spectrophotometric method was correct choice for the determination of iron in a given sample. Using calculated value of absorbance and concentration of Fe_2O_3 and K that is calibration constant can be calculated. In the determination of concentration of standard iron solution the absorbance was very stable which is due to there was negligible of impurities that affect the absorbance value and in other words that influence the complex formation of tris 1,10phenanthroline iron(II) complex. Table2. Dependence among the Absorbance, Concentration and time for the standard solution of (0.02, 0.04, 0.06, 0.08, 0.10mg/cm^3) Fe_2O_3.

Time (mins)	Solution 1		Solution 2		Solution 3.		Solution 4		Solution 5	
	A	C mg/cm^3	A	C mg/cm^3	A	C mg/cm^3	A	C mg/cm^3	A	C mg/cm^3
2	0.139	0.02	0.280	0.04	0.426	0.06	0.555	0.08	0.710	0.10
4	0.139	0.02	0.280	0.04	0.425	0.06	0.556	0.08	0.711	0.10
6	0.139	0.02	0.282	0.04	0.425	0.06	0.555	0.08	0.720	0.10
8	0.140	0.02	0.280	0.04	0.427	0.06	0.557	0.08	0.714	0.10
10	0.141	0.02	0.281	0.04	0.426	0.06	0.555	0.08	0.716	0.10
12	0.139	0.02	0.280	0.04	0.427	0.06	0.556	0.08	0.716	0.10
14	0.139	0.02	0.280	0.04	0.425	0.06	0.557	0.08	0.711	0.10
16	0.142	0.02	0.284	0.04	0.425	0.06	0.559	0.08	0.720	0.10
18	0.139	0.02	0.280	0.04	0.425	0.06	0.555	0.08	0.714	0.10
20	0.139	0.02	0.283	0.04	0.424	0.06	0.560	0.08	0.712	0.10
22	0.144	0.02	0.280	0.04	0.425	0.06	0.555	0.08	0.711	0.10
26	0.139	0.02	0.280	0.04	0.425	0.06	0.556	0.08	0.719	0.10
30	0.139	0.02	0.281	0.04	0.425	0.06	0.556	0.08	0.714	0.10

(Abbreviation A= Absorbance, C= Concentration)

In case of alumina the solution prepared shown that the absorbance was very stable which was due to very rare chances of interaction of 1,10-phenanthroline iron (II) complex with the other component. Under given pH condition the determination of iron concentration and wavelength are systematic and limited, partially due to formation of disturbed complex and partially due to stability of the complex because other components present in composite.

IV. CONCLUSION

All prepared solution obeys beer's Lambert law as there was a linear relation between the absorbance and concentration of the solution. For the solution having concentration alumina 1g/200cm^3, orthophenanthroline iron (II) complex was not stable in the given time interval of 8-20 minutes and for the solution containing 2g/200cm^3 alumina, the tris 1,10 phenanthroline iron (II) complex show deviation in absorbance after 12 minutes which indicated that the low concentration of iron in alumina shows a large error in Iron analysis. But in case of 3g/200cm^3 and 4g/cm^3 concentration of alumina the tris 1,10 phenanthroline iron (II)

complex was stable throughout the whole time interval 0-45 minutes, the chances of error in this higher concentration was negligible so this concentration for the determination of Iron in a given composites are suitable for the UV Spectrophotometric method. Whereas the analysis of iron in five standard solution, the absorbance of tris 1,10 phenanthroline iron (II) solution remain constant throughout the whole period because the complex is stable and this concludes that the composition of the sample composites effect the stability of complex. Under given pH condition the determination of iron concentration and wavelength are systematic and limited, partially due to formation of disturbed complex and partially due to stability of the complex due to other components present in composite. The conclusion shows that the researchers have to focus on the stereochemistry of complex formation in the different composites likes alumina and zeolite.

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