

To Determine the Reaction Products of Reaction between Ferrous Fumarate and Ceric Sulphate

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ABSTRACT

The result of reaction between Ferrous Sulphate and Ceric Sulphate are summarized below:

- (1) The reaction is first order with respect to Ce(IV) and first order with respect to Ferrous Fumarate.
- (2) The overall order of the reaction is two.
- (3) The reaction is appreciably catalysed by Cu^{2+} , Zn^{2+} , Fe^{2+} and Mn^{2+} But the activity of Cu^{2+} is greater than rest of all metal ions.
- (4) The specific rate is linearly related to the concentration of Cu^{2+} and is governed by the equation $K = K_0 + \text{Conc } \text{Cu}^{2+}$
- (5) The final product is identified to be Ferric Fumarate.

Keywords— Chemical, Oxidant, Hydrochloric

I. INTRODUCTION

The kinetics of oxidation of ferrous fumarate has been reported by the following workers with different oxidant, Leonhardt and Moeser¹⁸⁹ with Chloramine T, S.K. Ganguly¹⁹⁰ with iodine, M.A.Barakat, S.K.Shehab and M.M.El-Sader¹⁹¹⁻²⁰² with N-Bromosuccinamide and 1,2-Napthaquinone-4-sulphonate, M.B.Devani, C.J.Shishoo and N.M.Patel¹⁸¹ with Hexamine Cobalt(III) Tricarbonato Cobaltate(III), M.Schmall, C.W.Pifer and E.G.Wollish.¹⁸²⁻¹⁸³ have shown that the reaction with diazotized 4-methoxy-2-Nitroaniline in acidic medium, followed by the development of a blue colour in alkaline solution with a maximum absorbance at 570nm.

Its Molecular formula $\text{C}_4\text{H}_2\text{FeO}_4$. At normal condition it get oxidised to Ferric Fumarate is a reversible reaction in presence of oxidising agent. Ferrous fumarate displays an absorption maximum at 265 nm in Alkaline solution.

This λ_{max} is shifted to 240nm in acidic medium²⁰. This led to conclude that the kinetics of ferrous fumarate possibly be carried out with U.V. spectrometrically. After trying a number of solvent like ethanol, Methanol, Acetic acid, 1,4-dioxime,

Dimethylformamide, Hydrochloric Acid, Ferrous Fumarate as well as Ferric fumarate remained soluble for a considerable length of period depending upon the experimental condition. Hence the kinetics of this reaction (Ferrous Fumarate) is carried out spectrometrically using 0.01N Hydrochloric Acid as solvent, because it does not have any absorbance in this region.

II. EXPERIMENTAL

Since the redox reactions involving Ce(IV) ion are highly sensitive to traces of impurities, A great care has been taken to ensure the purity of chemical and Reagents. Hence double distilled water from a Borosil glass distillation unit has been used for preparing and making solutions throughout the course of study.

Ferrous Fumarate I.P. Manufactured by M/S Jayant Vitamins Ltd. has been procured from local market. It was analysed as per I.P. 1996 and found of standard quality. I.R. spectrum was also carried out^{1,3,4} Ferrous Fumarate was kept in dark brown bottle in the inert medium, as if get oxidised on exposure to air, light and humidity. The strength or purity was checked by titration method using Metrohom Auto Titration model^{1,2,3,5,6} and was found of standard quality.

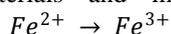
Ceric Ammonium Sulphate, A.R. grade of M/S E.Merck Ltd was used after testing as per I.P.¹ since Ceric Ammonium Sulphate was used to E.Mark India Ltd. The standard solution of Ceric Ammonium Sulphate was prepared and standardised as per I.P. 1996. The strength of Ceric Ammonium Sulphate was checked daily before starting the reaction. Hydrochloric acid G.P.R. grade of M/S E.Merck Ltd was used after testing for its purity and standard solutions was prepared as per IPBP & USP¹⁻³. The reaction was carried out in dark in a borosil glass flask of 250ml capacity. The reaction was always carried out in dark to eliminate the possibility of any photochemical change in the reaction mixture. The reaction mixture was thoroughly washed, cleaned and dried before use. The

reaction was started by running a known volume of Ceric sulphate (already thermostat) into the reaction vessel containing the other reactant emerged in thermostatic water bath maintained at the desired temperature with an accuracy of $\pm 0.1^\circ\text{C}$. The reaction vessel was stopped and then rapidly shaken to make the reaction mixture homogeneous varies volumetric methods and their modifications were tried for the estimation of Ceric sulphate, but none of them was found to be applicable to the present investigation.

Iodometric estimations of Ce(IV) sulphate cannot be applied because Iodine will observe Photometrically oxidise to Ferrous Fumarate. Therefore kinetics of the reaction was observed photometrically. The concentration of reactant was kept such that the concentration of product formed may be in range of applicability of Beer & Lambert's Law.

Aliquot quantity of sample was taken from time to time with the help of glass Pipette of broad tip for quick transfer for cuvette. The absorbance was measured on unicom UV visible spectrophotometer. The absorption maximum of the solution was found at 244nm. The whole process of piping out transferring and measuring the absorbance of reaction took only 18-20 seconds from the value of absorbance recorded at different interval of time, order of reaction was calculated by integration method. First of all preliminary observations were made in order to find suitable concentration of reactants. The reaction of ferrous fumarate and Ceric sulphate in hydrochloric acid was found to have maximum absorption at 244nm. It is worth mentioning that the maxima didn't shift during the course of kinetic study when absorption maximum have been measured at various concentrations of the reactants as the reaction has a measurable rate at 30°C without use of catalyst.

The reaction of ferrous fumarate was first of all studied in an inert atmosphere of nitrogen IOLR-1 and found that the kinetics of oxidation has marked effect of air. The oxidation in inert medium is very slow as compared to air. The reaction was repeated at several times at different concentrations of reactants to see whether results were reproducible or not. It was observed that results were fairly reproducible and lie within range of experimental error when necessary precautions about the purity of the materials and medium were taken.



Ferric fumarate is not absorbed in the system.

III. COMPARATIVELY CATALYTIC EFFECT OF COPPER SULPHATE, ZINC SULPHATE AND MANGANESE SULPHATE

It has been observed that all about transition metals have marked effect on the oxidation of ferrous

fumarate. The catalysed and uncatalysed oxidation of ferrous fumarate was carried out using Metrohm DMS Autotitrator and 0.1 N Ceric Ammonium Sulphate as a titrant. The remaining or unoxidised ferrous fumarate was determined by Titrametric method.

IV. PROCEDURE

5.0 g of ferrous fumarate was weighed accurately in a 500 ml volumetric flask, dissolved in 0.1N sulphuric acid. Then it was divided in four sets. Each set (3 catalysed and 1 uncatalysed) was titrated at 0 hours, 12 hours, 24 hours and 36 hours.

V. MOLE RATIO

Mole ratio between Ce(IV) and ferrous fumarate was determined by estimating the unreacted Ce(IV). After the completion of reaction by Ferrous Ammonium Sulphate method. This method is only valid when we are sure that the ferrous fumarate was consumed, otherwise if ferrous fumarate is left behind, it will be oxidised by KMnO_4 . Due to this fact that Ce(IV) is taken in excess. Two kinetic runs were carried out simultaneously one in presence of ferrous fumarate and other in absence of ferrous fumarate. Ten boiling test tubes of borosil glass were taken, 5 containing Ce(IV) and ferrous fumarate; and other 5 containing Ce(IV). The only amount of Ce(IV) was taken in both sets of 5ml of the supernatant liquid was taken from each set and added to separate chemical flask containing 10ml of 0.05N Ferrous Ammonium Sulphate. The solution was kept of few minutes in order to complete the reaction of Ce(IV) and Ferrous Ammonium Sulphate left behind was then titrated against the standard solution of 0.05N Potassium Permanganate.

VI. CONCLUSION

Similarly after 24, 48, 72, 96 hours 5.0ml of the supernatant liquid from separate boiling tubes, both in presence and absence of Ferrous Fumarate, was withdrawn and added to 10.0 ml of Ferrous Ammonium Sulphate and finally titrated against standard of KMnO_4 (0.05N). The amount of Ceric Sulphate consumed by Ferric Fumarate was then calculated. Two experiments were conducted by taking Ce(IV), four & five times to that of the concentration of Ferrous Fumarate. The mole ratio was calculated at 24, 48, 72 & 96 hours.

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