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Short Communication

Novel Method for Extraction and Determination of Fe^{2+} Ions From River Patalganga

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ABSTRACT

Iron ranks next to aluminum in abundance of metals in the earth's crust. Natural waters contain only minor amounts of Iron. Iron in natural waters usually occurs in ferrous forms; however it is readily oxidized to ferric form and ferric salts are precipitated as rust colored deposits. The presence of more than traces of iron in river water is an indication of pollution by iron pickling effluents or mine water. This paper presents a novel method for extraction and determination of Fe (II) ions by forming a Prussian blue complex of Ferric ferrocyanide. The ferric ferrocyanide complex is a very stable complex. The results obtained after complexing the standards are highly within the limits of acceptance value of US EPA.

Keywords: Iron, Ferric ferrocyanide Complex, 1-10 phenanthroline method, 2-2Bipyridyl method, Prussian blue complex.

INTRODUCTION

Continious growth and development in the industrial sector is a matter of grave concern for the environment. Main culprit behind this is the contamination of water due to heavy metals such as iron [1]. Iron in its (VI) oxidation state is found to be a strong oxidizing agent as it is found to produce a non-toxic bi-product Fe (III) which can also act as a coagulant [2]. An increase in the iron conent in the water can give stains in plumbing, laundry and even the utensils. It is also observed that the taste and the colour of food changes if the iron levels in the food are elevated. Iron in water may be either in true solution, or in colloidal state or in the form of relatively coarse suspended particles. Iron is easily soluble while it is in Fe (III) oxidation state and is found most prominently in the Fe (II) state in anaerobic and acidic conditions [3]. Fe (II) is rapidly oxidized to Fe (III) oxyhydroxides. This problem can be easily overcome by forming a ferric ferrocyanide complex which can eventually be digested to obtain a stable Fe (II) state. As the Prussian blue complex obtained contains both the ferric and ferrous ions, the estimation of iron in Fe (II) and Fe (III) states, individually, is easily possible.

MATERIALS AND METHODS

Preparation of ferric ferrocyanide complex: Standard iron solutions of various concentrations were taken. To this Potassium ferricyanide was added. Prussian greenish blue colored solution was obtained which contains Ferric-ferro cyanide complex. The precipitated complex was filtered, dried, weighed and dissolved in Con. HCl. The solution obtained was digested to change the oxidation state of iron to (II). The resulting solution was analyzed by 1-10 phenanthroline method and confirmed by 2-2 Bipyridyl method[4] after adjusting the pH to 3.

RESULTS AND DISCUSSION

Determination of iron is a very difficult process mainly due to the presence of two oxidation states which are very difficult to predict. Several attempts are being made by many scholars around the world for estimation of Iron using a variety of methods like Mix –Gas ICP-MS [5]. Cathodic Stripping Voltametry [6]. Flourescence quenching [7]. This difficulty was surmounted by forming a Prussian blue complex of ferric ferrocyanide. During the study it was observed that if NaOH and other components like ammonia and carbonates were used for synthesis, the resulting complex was of ferro ferricyanide. The Ferrous ferricyanide complex is highly unstable[8]. The results obtained using this complex was ridiculous. Hence it was decided to synthesis a complex which would use the ferric ions present in the solution itself. Potassium ferricyanide was preferred for this.The complex gained was confirmed by adding sulphuric acid to the complex which on burning gave a blue flame [9].The prussian blue complex was analysed by 1-10 phenenthroline method and confirmed by the 2-2 Bipyridyl method. The results are displayed in fig. 1 which shows high quality equivalence. This complex was found to have high stability and the results acquired were in agreement with the calculated values (Table 1).The concentrations of standard iron used for complex formation were assimilated without any considerable deviation according to the specified limits laid by USEPA to be < 20%.

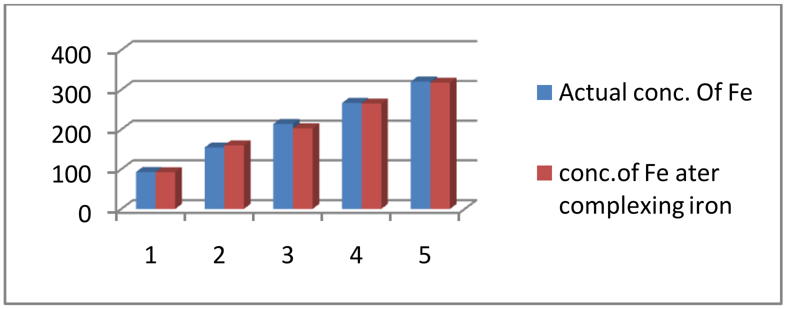

Figure 1: Plot of actual conc. of iron vs. conc. after complexing

Table 1:Concentration of Iron after complexing with correlation to actual values

Sr.No	Standard iron (ppm)	Actual conc. Of Fe (ppm)	conc. of Fe^{2+} after complexing iron (ppm)		EPA acceptable limits (%)	
			1-10 Phen.	2-2 Bipyridyl	Min.	Max.
01	100	92.9	92.5	92.3	80	120
02	150	154.6	160.0	159.4	120	180
03	200	213.6	203.0	203.0	160	240
04	250	266.7	265.4	266.0	200	300
05	300	320.5	317.7	318.2	240	360

This method offers a noble opportunity for estimation of iron in any sample after treating the sample for interferences like phosphates and sulphates, which completely mask the Fe ions. Moreover, this method provides an option of determining Fe in either oxidation state.

APPLICATIONS

This method is applicable for estimation of iron in any sample after treating the sample for interferences like phosphates and sulphates, which completely mask the Fe ions.

CONCLUSIONS

This paper presents a novel method for determination of Iron by overcoming the interferences in the water sample. This method successfully accomplishes the goal of complete estimation of Iron by complex formation rather than treating each interference independently which is highly impossible. This method presents the advantage of estimation of Iron in either of the two oxidation states as per the requirement. This method is more effective as compared to the traditional method for Iron determination which fails to take care of the possible interferences. The two major advantages of this method are its sensitivity and its low cost.

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