

NOTE

Study of Dissolved Iron in Some Ground Water Samples of Rajnandgaon Region of Madhya Pradesh Using N-Hydroxyamidine and Thiocyanate

SUSHIL TIWARI†, SHABAZ KHAN† and (Miss) HEMLATA MOHABEY*
Department of Chemistry, Govt. K.D.M. College, Rajnandgaon-491 441, India

Ground water delivered by some bore wells of Rajnandgaon area are slightly turbid, having slow sedimentation causing reddish precipitate. Ten such spots were selected for the collection of ground water samples through borewells. These water samples have been characterised in terms of pH, total dissolved solid, total hardness and iron concentration. A new method has been developed for determination of iron(III) using N-hydroxy-N-*o*-chlorophenyl-N'-(3-methyl) phenyl *p*-toluimidine hydrochloride in presence of thiocyanate. The orange-red complex is easily extractable in benzene and suitable for spectrophotometric determination. The coloured system obeys Beer's law in the range. 0.4–4.0 ppm. The ternary complex shows maximum absorbance at 460 nm having its molar absorptivity to be $12000 \pm 50 \text{ l mole}^{-1}$. The method is free from interference of many common ions. The pH values of the selected samples are within permissible limit (6.8–8.3). TDS is in the range 130–900 ppm and total hardness 330–1130 ppm. The iron content was found to be in the range 0.1–3.0 ppm.

Ground water is the most widely distributed resource of the earth and more than 85% of the public water supplies are obtained from wells. Ground water is also getting polluted due to improper disposal of liquid waste, industrial effluents, etc.

Ground water delivered by some borewells of villages of Rajnandgaon district and Rajnandgaon town exhibits a mild opaqueness followed by slow sedimentation, resulting in reddish deposit. Ten such spots were selected for collection of ground water samples through bore wells and were characterised on the basis of pH, total dissolved solid (TDS), hardness and iron content. The maximum permissible limit for iron in drinking water prescribed by W.H.O. is 0.3–1.0 ppm, USSR State Agency 0.0 ppm, ICMR Vs. 0.1 ppm and IST has maximum limit 0.3 ppm.^{1–4}

The undesirable effects of iron when present beyond the prescribed standards are: astringent taste, discolouration, turbidity, sedimentation and growth of iron

†Govt. Digvijay College, Rajnandgaon, India

bacteria.⁵ Long term exposure of iron beyond the limit produces toxic effects. A toxicity of hygienic significance is the mottling of lungs. Siderosis and iron pigmentation are of low order of severity and usually require 6 to 10 years of exposure before diagnosable changes occur.⁶ The objection to the presence of iron in water is also aesthetic in nature. High concentration of iron also stains cloth.

Most commonly occurring compound of iron in ground water is ferrous carbonate. The dissolution process can be typically described by the following reaction:



The solubility of ferrous form is higher than ferric form in natural system, the moment ground water is taken out. It is oxidised by atmospheric oxygen forming ferric hydroxide sol. Determination of iron content in water sample needs sensitive and selective method. N-Hydroxyamidines are a new type of organic reagents useful for the detection and determination of transition metal ions.⁷⁻¹² A newly synthesised hydroxyamidine N-hydroxy-N-(*o*-chloro) phenyl-N'-(3 methyl) phenyl *p*-toluidine hydrochloride (HCPMPH) and thiocyanate has been used for extraction spectrophotometric determination of iron(III) in water samples. The method is simple, rapid and free from interferences of many anions and cations. The concentration of the dissolved iron in selected borwell water was found to be in the range 0.1 to 3.0 ppm. The high value of TDS, hardness, iron concentration make water unsuitable for drinking purpose and need pretreatment.

A systronic pH meter type 321 was used for pH measurements. Absorbance measurements were made with Carlzeiss-Zena SPEKOL spectrophotometer. All the chemicals used were of AR grade.

HCPMPH was prepared by the condensation of equimolar quantities of N-3-methyl phenyl *p*-toluimidoyl chloride and N-*o*-chlorophenyl hydroxylamine. The crystals of HCPMPH were purified by recrystallisation with absolute alcohol. The newly synthesised compound was characterised by elemental analysis and IR spectral procedure.

Procedure: pH of the selected water sample was measured with Systronics pH meter type 321. TDS values were found to be in the range 130 to 900 ppm. Total hardness was determined by EDTA titration and was found to be in the range 320–1130 ppm.

Determination of Iron: 100 mL water sample was taken in a separatory funnel. To this 5 mL of 2% NH₄SCN solution was added. The acidity of the content was adjusted between 0.2 to 0.5 M HCl. Now added 25 mL of 0.1% reagent solution in benzene and shaken vigorously. The benzene layer was separated and dried over anhydrous sodium sulphate. The absorbance of coloured layer was measured at 460 nm, and iron concentration was calculated from calibration curve. The results were compared with 1,10-phenanthroline method.¹⁴

The results obtained (Table-1) show that out of ten bore-well samples, eight bore-well samples selected from different areas of Rajnandgaon district contain dissolved iron beyond permitted value. The concentration of the iron was found

in the range 0.154 to 3.4 ppm. The pH values of the water samples were in permissible limit (6.8–8.4). TDS was in the range 130–190 ppm and total hardness 320–1130 ppm. The higher values of TDS, total hardness and dissolved iron concentration make these water samples unsuitable for drinking purpose and need pretreatment before use.

TABLE-1
WATER QUALITY PARAMETERS OF SOME BORE WELL WATER OF
RAJNANDGAON DISTRICT

Sample site	pH	Total dissolved solid (ppm)	Total hardness (ppm)	Fe AAS*	Concentration phenanthroline	HCPMPH
1. Digvijay College	7.2	560	410	0.160	0.164	0.160
2. Choukhadiya para	7.3	900	1100	0.336	0.340	0.338
3. K.D.M. College Rajnandgaon	6.8	130	320	–	0.120	0.100
4. Shanti Nagar	7.1	2500	980	NAD	NAD	NAD
5. Manpur	7.4	580	640	–	1.240	1.240
6. Chowki	6.8	610	510	–	3.000	3.000
7. Dongargarh	6.8	310	680	–	0.480	0.450
8. Bortalab	7.0	310	635	–	1.460	1.420
9. Gandai	6.8	440	580	–	1.520	1.500
10. Silati	8.3	910	720	–	1.380	1.380

ACKNOWLEDGEMENT

Authors are thankful to Dr. B.L. Sharma, Principal, Govt. Digvijay P.G. College, Rajnandgaon for providing laboratory facilities.

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