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Determination of Chromium and Manganese in Water by Spectrophotometry and Differential Pulse Polorography –A Comparative Study

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Abstract: Water samples were analyzed for manganese and chromium concentrations using U V visible spectrophotometer simultaneously by the measurement of absorbance of light at two wavelengths. The metals were oxidized to $Cr_2O_7^{2-}$and MnO_4^- ions. Beer's law has been shown to apply closely. $Cr_2O_7^{2-}$has an absorption maximum at440 nm and MnO4- has one at 545 nm.(although a somewhat more intense maximum is at 525 nm, but there is less interference from $Cr_2O_7^{2-}$at 545 nm). In the present study the spectral analysis of the said manganese and chromium concentrations was compared with that of the differential pulse polorographic analysis. The results were observed to be accurate and reproducible.

Key words:U V visible spectrophotometry, differential pulse polorography.

I. INTRODUCTION

Chromium metal that persists in two oxidation states as either Cr(III) or Cr(VI) in the environment have opposing toxicities and mobilities: Cr(III) is benign and immobile in soils while Cr(VI) is toxic and readily transported. These reactions influencing Cr chemistry in waters must be known in order to understand the fate of this hazardous element.(1). The chromium content of natural waters is generally low whereas rocks exhibit a wide range of Cr concentrations. The mineral that controls the dissolved chromium content of natural waters is Fe. Major Cr(III) dissolved species are $Cr(OH)_2^-$ and $Cr(OH)_3$, as well as several organic and a few inorganic complexes, whereas $HCrO_4^-$ and CrO_4^{2-} are the main forms of Cr(VI) in natural waters. The chromium distribution is also controlled by redox processes. Oxidation of Cr(III) to Cr(VI), is poor with dissolved oxygen and is very effective in the presence of solid MnO2. Fe(II)- and organic matter-rich environments favour the reduction of Cr(VI) to Cr(III). Interaction with solid phases can also regulate the chromium content of water. Cr(III) .(2,,3)chromium is widely used in industries and is a serious environmental pollutant. Contamination of soil and water by chromium (Cr) is of recent concern. Cr(VI) is highly toxic and mobile whereas Cr(III) is less toxic. In plants Cr is taken up as sulfate or iron. Cr has toxic effects on plants , in the germination process and also in the growth of roots, stems and leaves. Cr also causes hazardous effects on plants in their physiological processes such as photosynthesis and nutrition(4,5).Mn oxide in soils and sediments affect groundwater and bulk soil composition. These minerals have layer structures and readily undergo oxidation reduction and cation-exchange reactions and play a major role in controlling groundwater chemistry (6).Oxides of manganese are very reactive minerals within the environment, occupying soils, sediments, and waters. The transport of contaminants such as lead, chromiumis controlled by adsorption, co precipitation, and redox reactions mediated by the oxides of manganese(7).

II. METHODOLOGY

A. Spctrophotometric determination of Manganese And Chromium

Manganese and chromium concentrations were determined simultaneously by measurement of the absorbance of light at two wavelengths , after the metals have been oxidized to to $Cr_2O_7^{2-}$ and MnO_4^-ions.Beer's law has been shown to apply closely. $Cr_2O_7^{2-}$ has an absorpyion maximum at 440 nm and MnO_4^- at 545 nm .(although a somewhat more intense maximum is at 525 nm, but there is less interference from $Cr_2O_7^{2-}$ at 545 nm).

Small quantities of manganese and chromium were determined spectrophotometrically by oxidation to permanganic acid. . The two oxidizing agents used were (a)ammoniumpersulphate in phosphoric acid , nitric acid mediumin the presence of a little $AgNO_3$ as catalyst and (b) potassium periodate. In hot acid solution, periodate oxidizes manganese ion to permanganic acid. Phosphoric acid prevents the precipitation of ferric periodate and iodate and also decolourises the ferric ion. The chlorides present if any were evaporated with a mixture of nitric and sulphuric acids until the fumes appeared. Reducing substances reacting with peroxides were destroyed before the periodate solution was added.

B. Differential pulse polorography

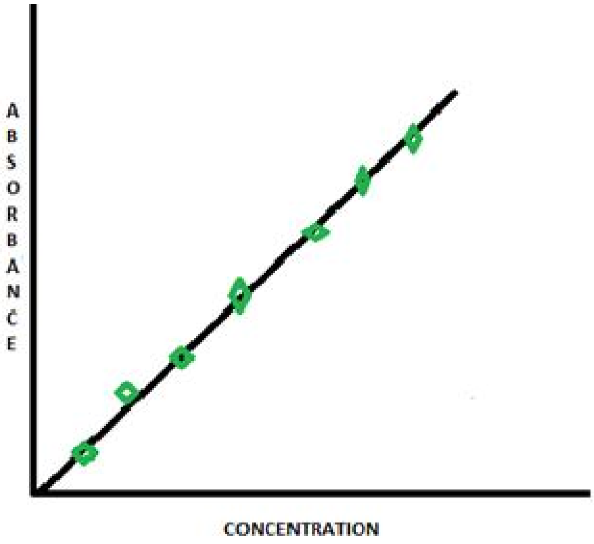
Determination of manganese and chromium was done based on diffetrential pulse polorography at nanogram levels in water samples buffered at pH 10. The procedure is unaffected by the interfering compounds most likely to occur in waters. Interfering cations are separated by co-precipitation with aluminium. No significant losses of chromium(VI) occur in the precipitation step; chromium(VI) is not susceptible to reduction by waste-water constituents at the moderate pH maintained throughout the procedure.

III. RESULTS AND DISCUSSION

A. Spctrophotometric Determination Of Manganese And Chromium

The manganese and chromium concentrations were noted by preparing a series of working standards and equal quantities of nitric acid was added , kept on a hot plate ,a pinch of potassium iodate was added and boiled till the colour developed. The absorbances were noted at 440 nm for chromium and at 545 nm for manganese.
The absorbance at the two wavelengths was noted , a calibration plot is prepared at each wavelength for both $Cr_2O_7^{2-}$ and MnO_4^- as shown in the figure-1 by taking absorbance on y axis and concentration of manganese and chromium on x axis.

Figure-1



IV. CONCLUSION

In the spectrophotometric analysis the oxidizing agents (ammonium persulphate and potassium periodate) were used in acid medium and the concentration of the acid had little influence and may be varied within wide limits. Nextly the boiling may be prolonged beyond the time necessary to oxidize without detriment. And also the permanganic acid solution would be stable for several months if an excess of periodate is present.(8,9)
Polarographic measurements were compared with the spectrophotometric measurements and for the analysis of manganese and chromium and were found to be reproducible. The methods were not only accurate but also less time consuming(10).

V. ACKNOWLEDGMENTS

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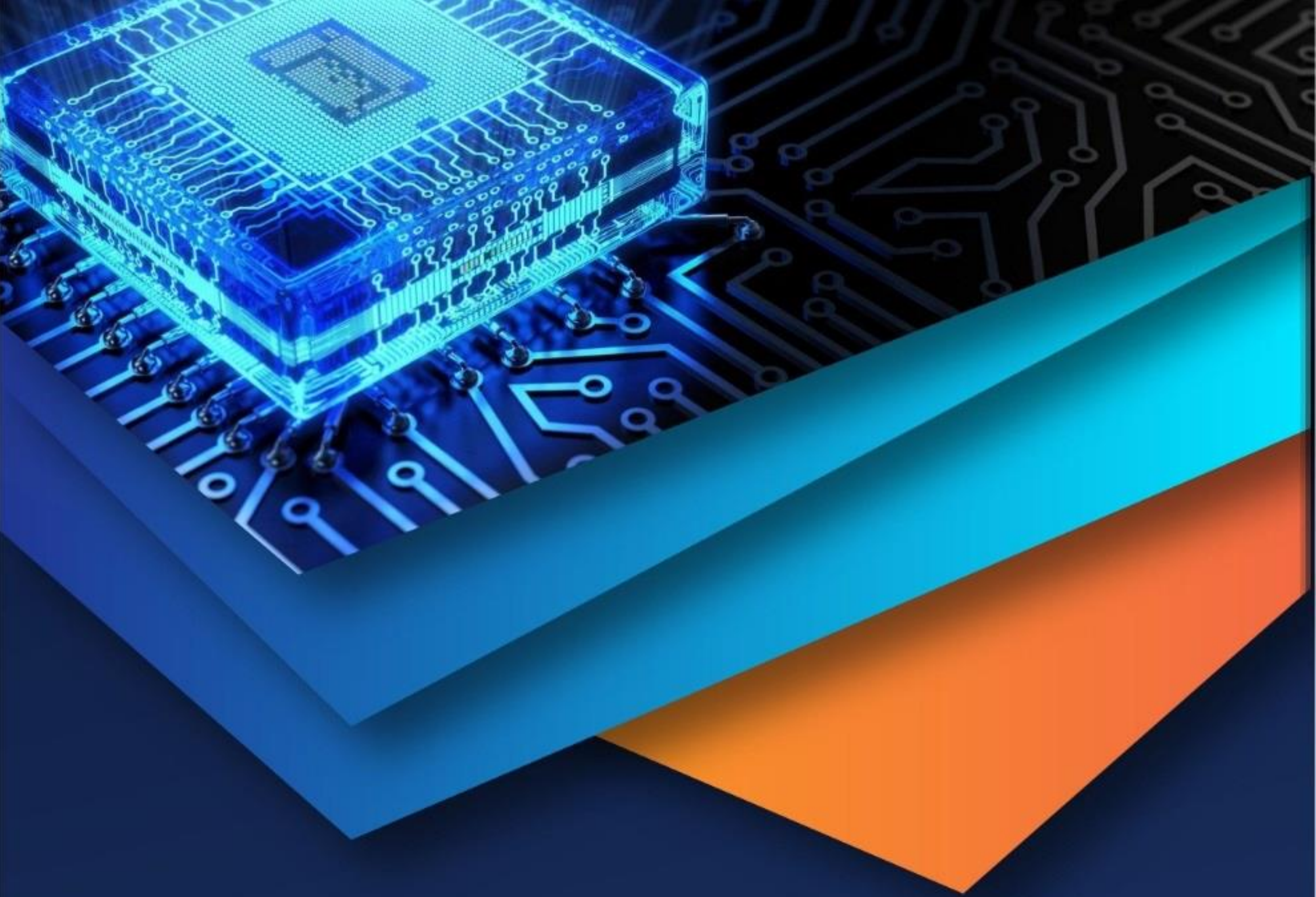
REFERENCES

[1] Enhanced Adsorption of Hexavalent Chromium onto Magnetic Calcium Ferrite Nanoparticles: Kinetic, Isotherm and Neural Network Modeling 2016 Journal of Dispersion Science and Technology
[2] Occurrence and speciation of polymeric chromium(III), monomeric chromium(III) and chromium(VI) in environmental samples . Chemosphere 2016.

[3] Efficient catalytic reduction of hexavalent chromium with Pd-decorated carbon nanotubes .2016 Bulletin of the Korean Chemical Society.
[4] Chromium occurrence in the environment and methods of its speciation Environmental Pollution, Volume 107, Issue 3, March 2000, Pages 263–283.
[5] Biotic and heavy metal stress response in plants: evidence for common signalsFEBS Letters, Volume 566, Issues 1–3, 21 May 2004.
[6] Manganese oxide minerals: Crystal structures and economic and environmental significance.Jeffrey E. Post.
[7] Huang PM (1991) in Rates of Soil Chemical Processes, Kinetics of redox reactions on manganese oxides and its impact on environmental quality, eds Sparks DL, Suarez DL (Soil Science Society of America, Madison, WI), no. 27, pp 191–230.
[8] Junta JL, Hochella MF Jr. (1994) Manganese(II) oxidation at mineral surfaces: A microscopic and spectroscopic study. GeochimCosmochimActa 58:4985–4999.
[9] Perez J, Jeffries TW (1992) Roles of manganese and organic acid chelators in regulating lignin degradation and biosynthesis of peroxidases by Phanerochaetechrysosporium. Appl Environ Microbiol58:2402–2409.
[10] Hansard SP, Easter HD, Voelker BM (2011) Rapid reaction of nanomolarMn(II) with superoxide radical in seawater and simulated freshwater. Environ SciTechnol 45:2811–2817.



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