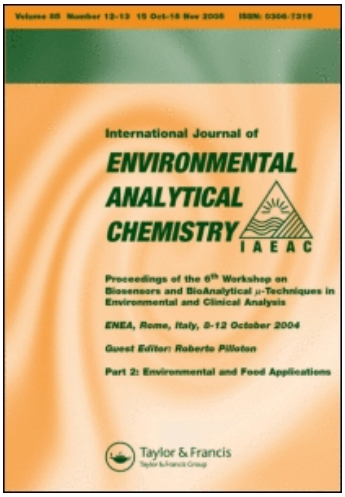

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Polarographic Determination of Lead in Drinking Water Samples of Western U.P. Districts with 3-Hydroxypyridine-2-Thiol

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Polarographic Determination of Lead in Drinking Water Samples of Western U.P. Districts with 3-Hydroxypyridine-2-Thiol

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The polarographic determination of lead in presence of 3-hydroxypyridine-2-thiol (HPT) has been investigated. The method was applied to the determination of the lead concentration in drinking water samples from Western U.P. (Province) of India.

KEY WORDS: Lead, drinking water, polarography, 3-hydroxypyridine-2-thiol.

INTRODUCTION

Lead ions are highly toxic and produce various pathological changes in living beings even if consumed in small doses.[1] They find their way in water sources from, e.g., paper, chemical, petrochemical industry and fertilizers.

Various analytical techniques, e.g., flame AAS,[2,3] colorimetric,[4] ultrasonic velocity,[5] electrochemical[6–12] have been used for the determination of lead in water samples. Some of these are costly and time consuming. On the other hand, the polarographic technique is simple and rapid and if suitable chelating reagent is used it leads to higher sensitivity and selectivity. In the present investigation 3-hydroxypyridine-2-thiol (HPT) has been used as a chelating reagent

in the polarographic determination of lead and the method has been applied to drinking water samples.

EXPERIMENTAL

Polarograms were obtained on a manual polarograph recommended by Kolthoff. Current was measured on a galvanometer (General Electric Co., U.S.A.) which was standardized by passing a known current. The potential was measured by leads Northrup Students potentiometer standardized against a standard cadmium cell. All the potentials are expressed versus S.C.E. The capillary used had the following characteristics: $m^{2/3}t^{1/6} = 2.054\,mg^{2/3}s^{-1/2}$ and $t = 3.8$ seconds. All the studies were made at $30 \pm 0.1°C$.

Standard stock solution of lead nitrate was prepared in deionized water and solution of HPT (Fluka AG, Switzerland) was prepared in purified methanol due to its limited solubility in water. Ammonia buffer (NH_4OH/NH_4Cl) was used to maintain the pH (9.0). KNO_3 was used as the supporting electrolyte ($\mu = 0.1$ M).

Working procedure

To a suitable aliquot containing 0.02–40 μg lead ions, add 2 mg HPT (solution), KNO_3, ammonia buffer and make up the volume to 20 ml suitably keeping the medium 40% methanolic. Bubble nitrogen gas in the cell to make the solution oxygen free and record the polarogram. Refer the measured diffusion current to calibration curve to find out the amount of the metal ion.

RESULTS AND DISCUSSION

Under the experimental conditions of the present study lead ions give well defined single reversible and diffusion controlled reduction waves. For constant lead nitrate concentration (0.1 μg per ml), increase in HPT concentration (1 μg–10 μg per ml) results in shift of $E_{1/2}$ towards more negative potential which indicates complex formation. It was found that 50 fold excess of HPT was necessary for complete complexation. Polarograms were recorded for different

metal ion concentrations keeping HPT concentration constant (50 times higher) and it was found that diffusion current could be measured accurately in the range 0.001 μg to to 2 μg lead per ml.

Interference of foreign ions

The metal ions thorium, iron, bismuth, manganese and uranium are precipitated in the medium.

Under the experimental conditions employed for the determination of lead ions, tolerance limit of other interfering metal ions is shown in Table I.

Application of the method

Water samples from household taps of five district headquarters: Ghaziabad, Bulandshahar, Meerut, Muzaffarnagar and Saharanpur were collected. Pre-treatment of this water for preparing sample solution was done by standard methods.[13] Water samples were evaporated to an appropriate volume and filtered. 2 ml of this sample solution was taken and lead ion content was determined as mentioned in the working procedure. The results of the determinations following standard addition method after taking the mean of eight measurements are given in Table II.

TABLE I

Tolerance limit of metal ions giving a diffusion current not more than 1% absolute different from that of lead (10 μg) alone

Metal ions	Tolerance limit (μg)
Zn^{2+}	100
Ni^{2+}	100
Pd^{2+}	100
Ti^{4+}	30
Cd^{2+}	20
Cu^{2+}	80

TABLE II

Determination of lead contents in water samples

	Lead ions (Standard error of the mean = ±0.03) (μg/l)									
	Ghaziabad		Bulandshahar		Meerut		Muzaffarnagar		Saharanpur	
Samples	Added	Found	Added	Found	Added	Found	Added	Found	Added	Found
1.	0	12	0	2	0	7.5	0	2.2	0	12.2
2.	15	27	15	17	15	22.5	15	17.3	15	27.2
3.	20	32	20	22	20	27.4	20	22.2	20	32.2

From the perusal of Table II we find that lead concentrations found in different districts are below the permissible values for lead in drinking water (50 μg/l) as recommended by the committee of public health Engineering Manual and Code of Practice by the Ministry of Health, Government of India (March, 1962).

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