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Removal of Toxic Metal Lead from the Surface Water of Naya Raipur and Its Impact on Human Health

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ABSTRACT

Lead is a major environmental concern due to its toxicological importance. The anthropogenic emission of lead is hundred times higher than of natural emissions. Lead particles may enter homes via shoes, clothes and fuels of vehicles. Lead metal at a trace levels, exploitation of these materials has tended to increased contamination of water. Lead has accumulated in the soil clay fraction due to its relatively large surface area and decreases with increasing depth in the soil profile. Now we have been prepared a novel sorben5-Bromo-2-pyridylazo-5-diethylaminophenol and its adsorption ability for the removal of lead(II) from different waters was samples verified . In this investigation we reten the alumina with 5-Bromo-2-pyridylazo-5-diethylaminophenolat at pH 6.8.Here for the separation quantitative recoveries was analysed. The proposed method was successfully implemented for the determination of lead(II) in pond surface water sample found in kotani are as village of naya raipur. Lead is exceptional in that most lead in drinking-water arises from plumbing in buildings and the remedy consists principally of removing plumbing and fittings containing it, which requires both time and money.

Graphical Abstract

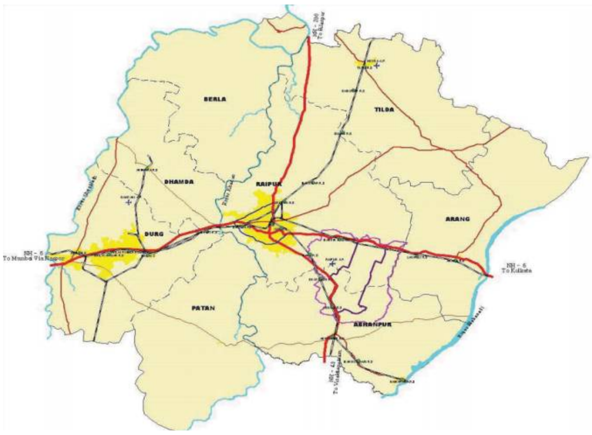

Figure 1. Location of the Sample Collection Site

Keywords: Toxic metals, sorption, Surface water, Lead(II), pH.

INTRODUCTION

The most common name of lead ore is galena, which is less common ores are anglesite, cerussite and hydrocerussite. In the past an anthropogenic source of lead were the exhaust gases of motor vehicles, causing the lead to accumulate on vegetation in the vicinity of roads, polluting the atmospheric water and hence the surface water and groundwater as well. Another source of lead can be the corrosion of the lead parts of water pipes, which, however, is nowadays mostly replaced by pipes of different material. Another source of lead can also be waste water from the processing of ores from ferrous metallurgy, from the production of batteries, or in the glass industry [1, 2].

Demonstration for heavy metal removal, including Pb, Cu, Cd, As, Co and Hg [5-7]. Heavy metals are known to have harmful effects on human health even at trace level concentrations,[5, 6] and among these lead pollution is considered as one of the most significant concerns [7]. Exposure to lead can result in damage to central nervous system, renal, gastrointestinal, hematopoietic, cardiovascular, and reproductive systems and brain function [7, 8].

It is well known that surface functionalization plays an important role in heavy metal removal [9, 10], since it improves the hydrophilicity of the nanocarbon, and it can also enable increased adsorption of the target contaminant *via* electrostatic interactions [10]. In the case of Pb^{2+}, it was reported that the adsorption mechanisms include interaction with oxygen containing and/or negatively charged functional groups, positive charge interaction, and adsorption on defect sites [10]. In general, physisorption, (ion exchange, electrostatic interaction) and chemisorption (surface complexation) processes coexist [11]. In some cases, specific mechanisms have been found to be dominant. 2-(5-Bromo-2-pyridylazo)-5-diethylaminophenol, one of commercially available and cheappyridylazo reagents has been used in determination of trace metals, including cadmium [13, 14] and zinc [15]. There is no report on complexation of PADAP with lead(II) ions or immobilization on thesurface of alumina [17-19]. The preliminary experiments showed that the bare alumina can adsorb a lot of metal ions, but, adsorption was not selective and the recoveries were incomplete. Byimmobilization of the ligand PADAP on the alumina, only, lead(II) can be adsorbed inthe specified pH [20-23]. On the other hand, the coating of alumina with the ligand increases the adsorption capacity for lead (II) [24-27]. Also, since, the conditions of the proposed method, was proper for simultaneous extraction and preconcentration of lead(II) [28].

Therefore, these two elements were selected and examined for the proposed method [29-32]. This work is devoted to the preparation and evaluation of the sorption properties of alumina modified with PADAP to pre-concentration trace amounts of lead(II) from the pond water samples[33-40].

Location of the Sample Collection Site: The latitude of Naya Raipur, Chhatisgarh, India is 21.164993 and the longitudeis 81.775307. Naya Raipur, Chhattisgarh, India is located at India country in the *Cities* place category with the GPS coordinates of 21° 9' 53.9748" N and 81° 46' 31.1052" E (Figure 1). Naya Raipur is a small city and an official legislative capital of Chhattisgarh state in India. Naya Raipur is situated about 18 miles southeast of Raipur city, and it is considered to be one of the fastest developing neighborhoods of Raipur, with the population close to 200,000 people. In addition to being an official center, it is also a developing technology and business spot, with a few large technology parks and huge business centers newly opened in the central part of the city. There are also modern health care, educational, and consumer care facilities and services operating in the city. (source:https://www.latlong.net/place/naya-raipur-chhattisgarh-india-19418.html)

MATERIALS AND METHODS

A stock solutions of lead(II) (500.0 mg L^{-1}), were prepared by dissolving 0.400 g of lead nitrate , in distilled water and 0.120 $HgCl_2$ in 1 M HCl and diluting to 100.0 mL with distilled water. A 0.01%

solution of 5-Br-PADAP was prepared by dissolving 0.01 g of this reagent in ethyl alcohol and diluting upto 100.0 mL. Buffer solution was prepared from 0.1 M sodium dihydrogen phosphate and 0.1 M sodium dihydrogen phosphate for pH 6.2. A solution of thiourea 1.0 M was prepared by dissolving 5.231 g of thiourea , in distilled water and diluting to 100.0 mL with distilled water. Here Aluminum oxide was used as a sorbent.

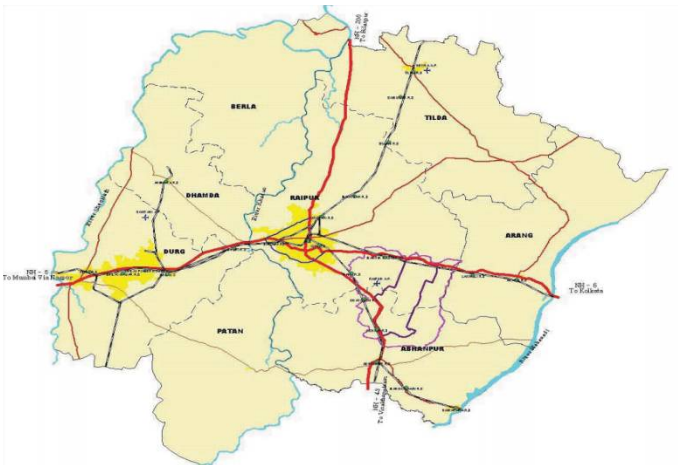

Figure 1. Location of the Sample Collection Site.

To determine the lead(II) from samples of different pond surface water and also some ground water from kotani village of nayaraipur. The water samples were filtered through a cellulose membrane filter of 0.50 µm pore size. A volume 25.0 mL of water samples was transferred to a beaker and maintained a pH range from 6.2 to 6.8 by adding of ammonium hydroxide as a buffer solution. The levels of ions were detected by using flame atomic absorption spectrophotometer.

RESULTS AND DISCUSSION

Here the experimental analysis shown that the alumina can adsorb lot of metal ions, but, adsorption was not selective and the recoveries were incomplete. By immobilization of the ligand PADAP by using alumina, only, lead(II) can be adsorbed in the particular pH range. On the other hand, the coating of alumina with the ligand increases adsorption capacity for sorption of lead(II) .

Effect of pH on Surface water: The influence of pH on the recovery of analyte ions was examined in pH range of 5-10 by using diluted solutions with buffers. As we seen from figure 2, lead(II) ions were quantitatively recovered at pH range of 5-7. In order to avoid hydrolyzing and determine these elements, simultaneously, pH 6.8 was selected for further study.

Desorption of the retained lead(II) from the column was tested using various eluting agents. Since the complex of the lead(II) with PADAP is stable, many of the reagents could not elute mercury(II) from the column. Here table 1, explain the maximum recoveries.

Table 1. Effect of elution solutions on the recoveries of lead(II)

Solutions	%Recovery of lead(II)
2 mL of 1 M HCl	75.0
2 mL of 1 M HNO_3	79.0
2 mL of 1 M thiourea	80.0
2 mL of 1 M Na_2SO_3	60.0
2 mL of 1 M H_2SO_4	70.0
2 mL 2 M HCl +1M thiourea	92.0
1 mL 1.0 M thiourea + 1 mL 1 M HCl	97.0

Effect of amount of the sorbent: Different amounts of the sorbent (10-200 mg) were examined. The results showed that quantitative recoveries (>95%) of the metal ions were obtained when the sorbent quantity was greater than 50 mg. 100 mg of the sorbent was selected for further experiments. The column filled with 100 mg adsorbent can be regenerated over 100 cycles of adsorption-desorption cycles without any significant change in the retention of lead (II). It can be recovered with about 10 mL of the elution solution and then water [**41, 42**].

Figure 2. X-ray reports of one villagers and snap of children's.

Effect lead on Human Health: Lead can enter drinking water when a chemical reaction occurs in plumbing materials that contain lead. This is known as corrosion-dissolving or wearing a way of metal from the pipes and fixtures. This reaction is more severe when water has high acidity or low mineral content.

Lead is a cumulative general poison, with infants, children up to 6 years of age, the fetus and pregnant women being the most susceptible to adverse health effects. Its effects on the central nervous system can be particularly serious. Acute Pb toxicity symptoms in man are lassitude, vomiting, headache, loss of appetite, loss of memory, uncoordinated body movements, encephalopathy, convulsion, stupor and coma. The other symptoms take a long time to appear as chronic toxicity. They are renal malfunction, anemia, brain and liver damage, joint pain, cancer, hyperactivity and general psychologic impairment. Lead toxicity in experimental animals includes reduced growth and longevity, impaired renal and reproductive function, splenomegaly, damage to hemo-poietic, central and peripheral nervous system, premature loss of teeth and reduced immune capacity. Acute symptom occurs at the blood level of 100–200 µg dL^{-1} in adults and 80-100 µg dL^{-1} in children. Chronic symptoms occur at blood level of 50–80 µg dL^{-1} [**54, 55**].

Acute and long-term exposure: Overt signs of acute intoxication, including dullness, restlessness, irritability, poor attention span, headaches, muscle tremor, abdominal cramps, kidney damage, hallucinations, loss of memory and encephalopathy, occur at blood lead levels of 100-120 µg dL^{-1} in adults and 80-100 µg dL^{-1} in children. Signs of chronic lead toxicity, including tiredness, sleep-lessness, irritability, headaches, joint pain and gastrointestinal symptoms, may appear in adults at blood lead levels of 50-80 µg dL^{-1}. After 1-2 years of exposure, muscle weakness, gastrointestinal symptoms, lower scores on psychometric tests, disturbances in mood and symptoms of peripheral neuropathy were observed in occupationally exposed populations at blood lead levels of 40–60 µg dL^{-1}.

Renal disease: Renal disease has long been associated with lead poisoning; however, chronic nephropathy in adults and children has not been detected below blood lead levels of 40 µg dL^{-1} [**43, 44**]. Damage to the kidneys includes acute proximal tubular dysfunction and is characterized by the appearance of prominent inclusion bodies of a lead–protein complex in the proximal tubular epithelial cells at blood lead concentrations of 40–80 µg dL^{-1} [**45-50**].

Carcinogenesis: The carcinogenicity of lead in humans has been examined in several epidemiological studies, which either have been negative or have shown only very small excess mortalities from cancers. In most of these studies, there were either concurrent exposures to other carcinogenic agents or other confounding factors such as smoking that were not considered [**51-53**].

Neurological effects in children's: A number of cross-sectional and longitudinal epidemiological studies have been designed to investigate the possible detrimental effects that exposure of young children to lead might have on their intellectual abilities and behavior. These studies have been concerned with documenting effects arising from exposure to "low" levels of lead [**54, 55**].

APPLICATION

This technique is very useful for the removal of lead metal from the surface water. Softening of hard water, removal of toxic metals, decolourisation and purification [**56, 57**]. It decreases the effects on health issues in mankind particularly fatal diseases like vomiting, headache, loss of appetite, loss of memory, uncoordinated body movements, encephalopathy, convulsion, stupor and coma. Remedy consists principally of removing plumbing and fittings containing it, which requires both time and money. Further, through this paper villagers become alert about the presence of heavy metal pollution in surface water at nayaraipur. Based on this study, we also organized awareness program for the local residents [**58, 59**].

CONCLUSION

A novel sorbent method developed by 5-Bromo-2-pyridylazo-5-diethylaminophenolat could be successfully applied for simultaneous separation and pre-concentration of lead (II) in different pond surface water samples from Spt.2020 to Dec.2020 . The modified alumina can be regenerated over 10 cycles of adsorption-desorption without any significant change in the retention of lead(II). Thus, it may be concluded that the method is effective for the separation and pre-concentration of lead in different pond water samples. Lead is exceptional in that most lead in drinking-water arises from plumbing in buildings, and the remedy consists principally of removing plumbing and fittings containing it, which requires both time and money. In the interim, all practical measures to reduce total exposure to lead, including corrosion control, should be implemented.

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Conflict of Interest: Conflict of interest declared none.

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