J. Indian Chem. Soc.,
Vol. 96, January 2019, pp. 73-75

A novel method of removal of toxic lead ion from the drinking water using medicinal valued bio-adsorbents in dip-tea-bag as point-of-use application

Kathirvel Asokan and Sarangapani Muniraj*

Department of Chemistry, Ramakrishna Mission Vivekananda College (Autonomous), Mylapore, Chennai-600 004, India

E-mail: smuniraj@rkmvc.ac.in

Manuscript received online 27 September 2018, accepted 09 October 2018

Heavy metal pollution occurs in various water sources due to geo accumulation and bioaccumulation. The removal of heavy metal from water source particularly from drinking water is a challenging task and expensive. In the present study a low cost and point-of-use method is adopted by choosing medicinally valued bio-adsorbent taken in dip-tea-bag to remove lead from potable water and the concentration of lead ion was measured by using Atomic Absorption Spectrophotometer. All the experiments were conducted by taking bio-adsorbents in tea-bag and adsorption study was conducted lead ion spiked real sample (TDS around 200 ppm and pH around 7.0).

Keywords: Bio-adsorbent, drinking water, lead ion removal, dip-tea-bag.

Introduction

Industrial activity and pesticides are the main sources of lead ion that contaminated soil and subsequently enter into the ground water. The potential source of lead in water supply is household plumbing. Corrosion is the main reason for dissolving lead pipes and leaded solder due to the chemical characteristic of water. Now-a-days laws have been imposed to restrict the lead content in new pipelines and other fixtures but still most of houses contains the older materials. The stagnant water present in the pipeline contains more amount of lead than the flowing(running) water. Moreover hot water dissolves more amount of lead than cold water. Consider these things in mind, the water should be used with proper flushing before used for potable purpose.

Generally available methods for the removal of lead ions from drinking water are reverse osmosis[1], ultra violet purification[2], ozone water disinfection[3], solar water disinfection[4] etc. The existing methods are expensive and space consuming not possible to carry with where ever to go. In the study, a new novel method is proposed to remove lead from drinking water. The proposed method involves medicinally valued bio-adsorbent taken in tip-tea-bag. The proposed method is easy to adopt and have many advantages such as simple removal of bio-adsorbent from drinking water rather than the tedious filtration procedures.

Experimental

All the bio-adsorbents were prepared according to literature[5–9] and throughout this study a 300 micron particles were used as adsorbent. Each study was conducted by weighing one gram of adsorbent and transferred to a tea-bag tied with glass rod. 100 ml of lead ion spiked real portable water sample (TDS around 200 mg/L and pH around 7 at RT) was taken in a beaker and the tea bag was dipped with the help of glass rod and stirred for particular time period and the experimental setup was as depicted in Fig. 1. After stirring the tea-bag was removed and the treated water sample was analyzed for the residual lead ion presence by AAS method. From the AAS results the amount of lead ion removed was arrived.

Results and discussion

Twelve bio-adsorbents were tested for the removal of lead from potable water by spiking 5 ppm of lead in 100 ml of water and dip-tea-bag contains one gram of bio-adsor-

Fig. 1. Experimental setup of bio-adsorbent packe at in dip-tea-bag for lead ion removal.

bent was dipped in the water and stirred for 15 min at room temperature and best among the bio-adsorbents is neem bark (*Azadirachta indica*) and it removes 93% of lead ion.

Since *Moringa oleifera*[10,11] is palatable and also stands second in the adsorption table it was taken for conduction optimization study. Amount of bio-adsorption material in tea-bag, contact time of bio-adsorption material and concentration of lead ion were varied to optimization lead ion removal method from potable water by fixing volume of water sample to 100 ml and stirring speed to 200 rpm at room temperature.

Table 1. Percentage of lead ion removal using various bio-adsorbent

Bio-adsorbent (Botanical/Scientific name)	Percent of Pb ion removed from water sample by adsorbent
Zingiber officinale	56.8
Murraya koenigii	46.4
Cocos nucifera	79.8
Phyllanthus emblica	24.8
Cinnamomum zeylanicum	71.5
Citrus sinensis	59.2
Moringa oleifera	86.8
Coriandrum sativum	40.4
Mentha piperita	43.9
Azadirachta indica	93.6
Moringa oleifera	54.7
Camellia sinensis	63.4

Apart from above mentioned reaction conditions the reaction time was fix to 10 min for Fig. 2. The percentage removal indicates that 0.75 g is enough for adsorption study. To avoid flotation of the tea-bag at low weight of adsorption, 1.0 g was fixed for further experiments.

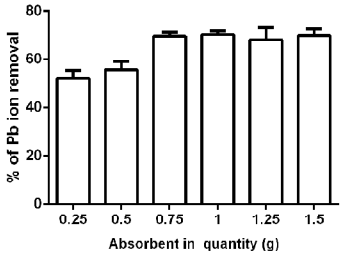

Fig. 2. Optimization of bio-adsorbent quantity.

The time variation plot indicates that 30 min is optimum for the removal of lead ion (Fig. 3). But for the point-of-use purpose 15 min is enough, since the percentage removal difference between 15 min and 30 min was very minimum (7%).

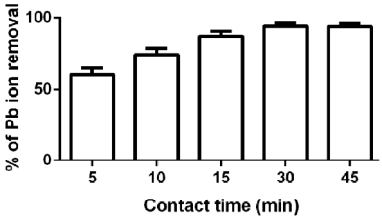

Fig. 3. Optimisation of bio-adsorbent contact time with water sample.

The lead ion removal with varying concentration showed about 80% for 3 ppm and further increase of lead ion concentration gradually decrease the adsorption percentage (Fig. 4), this may be due to increase of concentration of lead ion will decrease of adsorption due to fixed adsorbent quan-

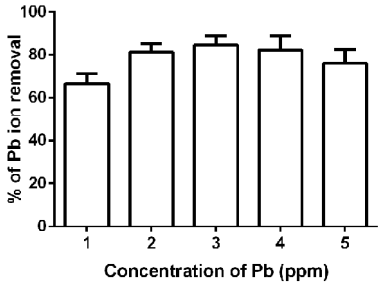

Fig. 4. Optimization of lead ion concentration.

tity and may be overcome by varying the adsorbent quantity depends upon the lead ion present in the real sample.

Conclusions

A novel point-of-use medicinal valued bio-adsorbent method has been developed. If potable water is contaminated with lead ion it can be treated by the proposed method as a point-of-use application. The biomass produced out of this procedure may be used as fertilizer. Further studies are under progress for the removal efficiency of other toxic metal ions using various bio-adsorbents.

References

1. A. Ghabris, M. Abdel-Jawad and G. Aly, *Desalination*, 1989, **75**, 213.
2. B. Eccleston, *Water Tech*., 1998, **21(5)**, 61.
3. T. A. Koski, L. S. Stuart and L. F. Ortenzio, *Appl. Microbio*., 1966, **14 (2)**, 276.
4. O. Boubaker, R. M. Hiri, M. M. Ksouri and J. Babary, *UKACC Int. Conf. Cont.,* 1998, **1**, 229.
5. B. Kasemo, *Curr. Opin. Solid State Mater. Sci.,* 1998, **3(5)**, 451.
6. B. Kasemo, *Surf. Sci,* 2002, **500(1-3)**, 656.
7. S. J. Kulkarni, *Int. J. Res.,* 2015, **2(1)**, 718.
8. A. H. Mahvi, D. Naghipour, F. Vaezi and S. Nazmara, *Am. J. Appl. Sci*., 2005, **2(1)**, 372.
9. S. J. Kulkarni, *Int. J. Res.,* 2014, **1(10)**, 1689.
10. F. Anwar, S. Latif, M. Ashraf and A. H. Gilani, *Phytother. Res.,* 2007, **21**, 17.
11. F. Farooq, M. Rai, A. Tiwari, A. Arif khan and S. Farooq, *J. Med. Pla. Res*., 2012, **6(27)**, 4368.