

# Bioadsorbents as Green Solution to Remove Heavy Metals from Waste Water - Review

Kamalika Banerjee

Department of Chemistry, Indira Gandhi National Open University (IGNOU), New Delhi, India.

REVIEW ARTICLE

**ABSTRACT:** The living world faces serious threat from the water pollution caused by heavy metal contamination in water. Specially, long term exposure to heavy metals has been found to lead to severe health hazards. Costly methods of removal of heavy metals from waste water may be replaced by cheap bio-adsorbents which are obtained from nature and are effective in removing heavy metals from waste water. This leads to a green solution to the disposal too. The concept of L-3 class (i.e. low cost, locally available, low technologically prepared and used) of bioadsorbents are the solutions that are being researched upon by many scientists all over the world. In this paper the author tries to give a review on the work carried out by researchers globally on L-3 class bioadsorbents to remove heavy metals from waste water. This will solve the problems faced in procuring drinking water by people living in Indian villages which are near industrial areas. Agricultural wastes and peels of fruits whose disposal often pose problem may be effectively used for this purpose. Also, zeolites, clay, peat moss and chitin may be used to remove toxic heavy metals. Thus nanobiotechnology may be aptly utilized to procure drinking water from waste water.

**KEYWORDS:** Contamination, Heavy metals, L-3 class, Bio-adsorbents

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## 1. INTRODUCTION

Heavy metal contamination in water has resulted from a plethora of industrial effluents. This poses serious threat to the living world due to varied life-threatening diseases caused by heavy metal contamination. Specially, long term exposure to heavy metals have been found to lead to severe health hazards. The costly methods of removal of heavy metals from waste water (like chemical precipitation, ion-exchange, reverse osmosis, electro-dialysis, ultra-filtration, nano-filtration, coagulation, flocculation, floatation etc.) are there. These may be replaced by cheap bioadsorbents which are naturally obtained and are effective in removing heavy metals from waste water. This leads to a green solution to the disposal too. Adsorption process is cheap, effective and versatile for removing toxic contaminants from industrial waste water.

World Health Organization (WHO) has suggested that aluminium (Al), chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), cadmium (Cd), mercury (Hg) and lead (Pb) are the metals which are most hazardous for living world. The usual methods of physical and chemical treatment of large volume waste water is very costly indeed. Chemical precipitation methods which involve huge capital and operating costs are not economical. So, ion-exchange and other sorption processes which involves less investment are thus now very attractive. But, commercially available resins and activated carbons are again very costly. Adsorption is the most preferred method because the other methods suffer some disadvantages like huge capital and operating cost or the problem of removal

of the residual metal sludge.

## 2. REVIEW OF LITERATURE

A lot of investigation has been done in this direction. In a review paper [1], how microbial and plant derived biomass can be utilized for heavy metal removal have been discussed. The review [5] was published with the aim to find out the major available technologies which are safe and economical with multiple/integrated approach, for heavy metal removal from water, stressing on the processes involved and applications. Bharat et al [7] has compiled the work done by several scientists on the use of fruit and vegetable peels in water purification.

A very novel idea of using the tea bag waste (obtained from commercial teas) as a bioadsorbent by some researchers [8] has been shared. Samples were taken from tannery waste water which had chromium as the heavy metal contamination. Tea bag waste adsorbents which have been chemically activated with 1.0 M sulfuric acid were used to remove the chromium totally.

Pb(II) can be removed from waste-water by low-cost material like Bilimbi leaves (BL). A new composite biosorbent using the process of coating chitosan onto acid treated oil palm shell charcoal (AOPSC) has been done [14]. Chitosan could enable bioconversion of Cr(VI) to Cr(III). The preparation of the biosorbent, characterization and adsorption studies has been discussed.

Activated carbon both prepared (from used tea dust) as well as purchased were used [15], which was then tested for their chromium removal efficiency. It was a striking finding that activated carbon prepared from used tea dust was about 70%

\*Corresponding Author: [kamalika@ignou.ac.in](mailto:kamalika@ignou.ac.in)

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efficient compared to commercially available activated carbon.

For past 30 years, investigations have been carried out and development of several water treatment technologies that in essence are called, Low cost, Low tech, Local or L-3 technologies [16]. Materials such as orange peels, banana peels, candle nuts from Africa, sawdusts, crab shells, psyllium husk, onion, garlic, various clays, etc have been utilised [16-22]

Some researchers [17] have reviewed low cost adsorbents likes and, used tea leaves, eggshell, rice husk, activated carbon, olive stones, wood sawdust etc.

In a particular study [18] analysis of the different studies on the possibility of both treated and untreated rice husk for removing heavy metals and metalloids (arsenic) have been done. The adsorption efficiency of treated rice husk was better compared with that of untreated rice husk.

In a review paper of Sulyman [19] made comparison between the various technologies of waste water treatment have been reported. Research on the evaluation of the selectivity in metal removal by coffee waste from heavy-metal polluted water has been done. The most interesting finding of this research is that more absorption was found to occur from binary metal solution than from the single metal solution.

Wang et al [23] has shown that different types of nanomaterials, which may include nanocarbon materials, nanometal particles, polymer-supported nanoparticles have been exhibiting high selectivities and adsorption capacities. In this paper, adsorption isotherm model and adsorption kinetics have been used which makes the adsorption procedure clearer.

A common adsorbent which was found to be effective but costly is activated carbon. A lot of investigation has been done in this direction.

### 3. CONCLUSION

The concept of L-3 class (i.e. low cost, locally available, low technologically prepared and used) of bioadsorbents are the solutions that are being researched upon by many scientists all over the world. In this paper the author tries to give a review on the work carried out by researchers globally on L-3 class bioadsorbents to remove heavy metals from waste water. This will solve the problems faced in procuring drinking water by people living in Indian villages which are near industrial areas. Agricultural wastes and peels of fruits whose disposal often pose problem may be effectively used for this purpose. Also, zeolites, clay, peat moss and chitin may be used to remove toxic heavy metals. Thus nanobiotechnology may be aptly utilized to procure drinking water from waste water.

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**Kamalika Banerjee**