Chapter 3
Low Cost Absorbents, Techniques, and Heavy Metal Removal Efficiency

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ABSTRACT

Heavy metal contamination in water is a serious concern to the environment and human health. High concentrations of heavy metals in the environment can be toxic to a variety of living species. Natural bio-absorbents are abundant and inexpensive and considered a waste if not managed properly. The role of bio-absorbents has been widely studied and has been utilized for the removal of heavy metals. The objective of the chapter is to search the database for different absorbents and their efficiency for the removal of heavy metals. Key words related to the study have been used to select different papers published by the researchers all over the world. A rigorous three-tier process has been utilized by the authors to select the papers from the database for the current study. This chapter has identified a few research gaps in the field of heavy metal removal by using different low cast absorbents that need to be taken into account in future research.

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INTRODUCTION

Due to rapid industrialization and population growth the load of different pollutants is increasing and causing damage to almost every sphere of life (Banerjee, Chen, 2007; Zhou et al., 2009). The toxic pollutants, especially heavy metals are cause of serious concern for the environment and human health (Kanan & Sundarbam, 2001). The different heavy metals like chromium, nickel, zinc Cadmium and zinc are used for various industrial purposes and their importance can't be ignored. However, their excess concentration is equally responsible for great damage to different ecosystem and human beings. The use of heavy metals in wood preservation, tanning, of leather, fabrication of steel, and finishing of metals have changed the scenario of industrialization over a period of time (Jaing, 2013; Zongo et al., 2009). The minimum permissible limit Cr (VI) of drinking water is 50ppm and its adverse effects on the human health is related to deadly diseases like cancer and hence their removal becomes significant (Jaing et al., 2013). Adsorption is highly effective when compared to other conventional methods for the removal of heavy metals from waste water. Adsorption method is used for removing a large number of pollutants from waste water along with low concentration pollutants. The different adsorbents that were used for removal of heavy metals include few biomaterials (Li et al., 2003; Ekmekyaper et al,. 2006) zeolites (Biskup & Subotic, 2010), manganese oxides (Sublet et al., 2003), kaolinite (Arias et al., 2002), resins (Diniz et al., 2002), peanuts hulls (Brown et al., 2000), algal biomass (Gupta et al., 2010) and recycled alum sludge (Chu, 1999) etc due to low cost efficiency of these materials considered a hindrance for their use in commercial sector. Hence, a search to develop new adsorbents, that are cost effective and can be tested for commercial scale in recent years. Although coagulation, filtration, ion exchange reverse osmosis, adsorption are used to reduce the concentration of heavy metals from waste water but adsorption on activated carbon is one of the most practical and economical ways for water treatment (Girgis, 1997).

Biosorption is an ideal alternative for decontamination of metal containing effluents (Modak &Natarajan, 1995) and biosorption is a fast method of passive metal uptake sequestration by non-growing biomass (Beveridge & Doyle, 1989). Further, the efficiency of removal is convincing and binding capacity of certain biomass is comparable with the commercial synthetic cation exchange resins (Wase & Foster, 1997). The biosorption efficiency depends upon many factors, including the capacity, affinity and specificity of the biosorbents and their physical and chemical conditions in effluents (Sarbjeet & Goyal 2007).

The different physical forces with exception of chemisorptions are involved in the process of adsorption that may be due to the presence of various minerals and carbon moieties. The process of adsorption is controlled by van der waals forces, hydrophobicity, hydrogen bonds, polarity and steric interaction, dipole induced