Chapter 6
Various Biosorbents and Their Mechanisms for the Removal of Heavy Metals From Wastewater

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ABSTRACT

Heavy metals are threatening to human health as they are arduous to remove from water bodies. Many technologies like photocatalysis, reverse osmosis, precipitation, and adsorption are used to get rid of those heavy metals from water. Among all these methods, adsorption is one of the most efficient methods to remove those heavy metals. In this chapter, the adsorption of heavy metals by dead biomass like algae, fungi, bacteria, and other biomass from waste will be discussed elaborately. The mechanisms of adsorption by these biomasses will be discussed, and the factors affecting their adsorption efficiencies are also included. The newest approach and emerging techniques are also considered. The future aspects and limitations are also considered.

1. INTRODUCTION

As the population is growing day by day, industrialization is also spiking up. Industrial waste has now become one of the most common concerns in the world. Heavy metals are toxic, incessant, non-degradable, and detrimental to ecosystem health (Arief et. Al, 2008). Industrial activities produce an enormous number of pollutants like dyes, pharmaceutical products, heavy metals metalloids, etc. and their wastewater directly goes into the terrestrial and aquatic ecosystems as they have always had problems with the demolition of these pollutants (Volesky and Holant, 1995). The dissipation of heavy metals into the environment is detrimental to human and aquatic health. Heavy metals like Cr, Mn, Fe, Ni, Cu, Pb, As, Cd, Zn, Hg, Co, etc. are very injurious to environmental and human health as they can cause many health issues like cancer, growth inhibition, organ and nervous system damage, etc. (Javanbakht et al., 2014). According to the World Health Organization (WHO), the concentration of these heavy metals should not be greater than 10 ppm (Wase and Forster, 1997). Although the toxicity of these contaminants is very

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brutal, however as, the concentration of these contaminants is very low in water bodies, it is very hard to detect this type of contamination. Among those heavy metals: lead, mercury, chromium, cadmium, and arsenic are considered the most toxic ones among them (Wase and Forster, 1997). According to the International Agency for Research on Cancer (IARC), these heavy metals are classified as probable or known human carcinogens (Wase and Forster, 1997). These heavy metals are becoming one of the biggest threads for the life of aquatic systems and therefore, the removal of these heavy metals is pivotal for the upcoming days. Some heavy metals and their effects are shown in the table

Table 1. Some heavy metal ions and their permissible concentration (ppm) and their effects on human health

Metal Ions	Allowed Value in Drinking Water (WHO) (ppm)	Health Effects
Copper	1.5	Liver damage, insomnia
Lead	0.05	Kidney diseases and the nervous system affect
Arsenic	0.05	skin infection and cancer
Mercury	0.001	Nervous system diseases and arthritis
Zinc	5	Vomiting. depression
Cadmium	.005	Acute and chronic intoxications
Iron	0.3	Diabetes, nausea
Chromium	0.05	Lung tumor, diarrhea

A schematic diagram is given to represent the different origins and sources of the heavy metals and the different pathways to enter the human body (Elnabi *et al,* 2023).