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Opinion Article

# Fundamental Process of Bio-Sorption Process in Heavy Metals

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## DESCRIPTION

The human progress and their numerous industrial activities are accompanied by the entry of versatile contaminants into the environment, which in some cases contradicts and reach their threshold limits and the standards are defined by the Environmental Protection Agency (EPA) and World Health Organization (WHO). The exposure of some metal ions such as lead, arsenic, cadmium, mercury, and chromium leads to the appearance of hazards and cause injuries, and consequently endanger for human life, living things and environment.

The contamination and re-distribution of various types of pollutants (such as heavy metals, synthetic organic materials, and waste nuclear compounds) in the waters encourage and necessary for testing of ever-increasing standards of detection that contaminate and remove them at levels which is known as "Pollutant".

Bio-sorption occurs naturally in certain biological materials which can accumulate metals such as Cadmium(II), Chromium(III), Chromium(VI), Copper(II), Palladium(II), Nickel(II) and Zinc(II) from wastewater. It is a complex process involving in different interaction mechanisms such as absorption, ion exchange, complexation, and precipitation. It involves in various functional groups such as carbonyl, phosphoryl, hydroxyl, etc., present on the extracellular surfaces of the biological materials that are responsible for the efficient metal.

The biological materials that are suitable for bio-sorption processes include microbial biomasses, agricultural waste, industrial by-products, or natural materials, which have been heralded as promising substrates for the metal removal by bio-sorption due to their high efficiency, low cost, and large abundance. For example, the water hyacinth has been used as cell separator inorder to reduce the concentration of nickel from 2200 g/L to 0.4 g/L in 72 h. The major advantages of bio-sorption over chemical methods for metal removal are at low cost, limited use of chemicals, no sludge generation, and the regeneration of bio-sorbents. However, the regeneration of the bio-sorbents is limited, and the bio-absorption capacity can decrease after several regeneration cycles.

The advantages of bio-sorption include:

- Use of cheap and renewable abundant biomaterials;
- Treatment of a huge volume of wastewater due to fast kinetics;
- High selectivity and recovery of specific heavy metals;
- Multiple heavy metals treatment and mixed wastes;
- Relatively low operational cost and low capital investment;
- Temperature, pH and coexisting ions as a wide range of physicochemical conditions;
- Highly reduced volume of hazardous waste formed.

This process also includes simple operation, no additional nutrient requirement, low quantity of sludge generation and operational cost, high efficiency, regeneration of bio-sorbent, and no increase in the Chemical Oxygen Demand (COD) of water, which have major limitations for most of the conventional techniques. Bio-sorption can remove contaminants even in dilute concentrations and has special relevance with respect to heavy metal removal owing to toxicity at ppb levels. Microorganisms (live and dead) and other industrial and agriculture byproducts can be used as bio-sorbents for the process of bio-sorption.

The mechanism of bio-sorption is a complex process which involves the binding of sorbate onto the bio-sorbent. Many natural materials can be used as bio-sorbents which involve the binding of metal ions by physical or chemical (displacement of either bound metal cations or protons) binding, chelation, reduction, precipitation, or complexation. Bio-sorbents contain chemical/functional groups like amine, amide, imidazole, thio-ether, sulfonate, carbonyl, sulfhydryl, carboxyl, phosphodiester, phenolic, imine, and phosphate groups that can attract and sequester metal ions. The key factors controlling and characterizing these mechanisms are chemical, stereochemical, and coordination characteristics of metal ions like molecular weight, ionic radius, and oxidation state of the targeted metal species and properties of the bio-sorbent that is, the structure and nature.

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## CONCLUSION

Due to the rapid industrialization and overcrowding population, the heavy metals have been extremely released into the environment. Then, the presence of nature and wastewater is considered as a major global and can affect all forms of life. Biosorption cumulates as the most economically and technically feasible alternative to deal with heavy metals in water. Biosorption is considered as an emerging technology and passive uptake process, which mostly reversible and metabolism-independent involving adsorption on the cell surfaces of biological materials. The pollutants such as Lead (Pb), Cadmium (Cd), Copper (Cu), Chromium (Cr), Mercury (Hg), Nickel (Ni), Zinc (Zn), etc. are concerned during this process. Generally, the biological bio-sorbents uses for heavy metals treatment are bacteria, fungi, and algae.