

Research Progress of Microbial Adsorption of Heavy Metals

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Abstract

This article discusses the current application of microorganisms in the adsorption of heavy metals. The mechanism of microbial adsorption of heavy metals, the factors that affect microbial adsorption, and the prospect of microbial adsorption of heavy metals in activated sludge are studied, and the focus of the next research is proposed to provide conditions for engineering.

Keywords

Microorganisms; Sludge; Heavy Metals; Adsorption; Cells.

1. Introduction

The mechanism of microbes adsorbing heavy metals is very complicated, and heavy metals are adsorbed on the surface of their cells through a variety of ways. The adsorption of heavy metals by living cells is divided into two stages. The adsorption mechanism of the first stage is the same as that of dead cells. The second stage is the accumulation of heavy metal ions in microorganisms. This process requires cell metabolism to provide energy. Because excessive heavy metals are toxic to the growth of microorganisms, the ability to accumulate heavy metal ions in living cells is limited. Adsorption experiments also show that The adsorption capacity of cells is not higher than that of dead cells.

At present, a large number of studies at home and abroad have shown that some microorganisms such as bacteria, fungi and algae and some aquatic animals and plants play a unique role in water purification [1]. Bacteria are generally small in size and have a strong ability to adapt to the environment, so they are widely used as biosorbents. At the same time, filamentous fungi and yeasts have been paid more attention to in the study of heavy metal adsorption. Because of their easy growth and high yield [2], fungi are convenient for genetic modification to form specific biological agents, so their research potential is huge.

2. Influencing Factors of Microbial Adsorption

There are many factors that affect the adsorption of microorganisms, which are affected by the physical and chemical properties of the adsorbent, the metal ion itself, and various operating environmental conditions [3]. The influencing factors of different processes are different. The main factors affecting the biosorption of metal ions are as follows: (1) temperature; (2) heavy metal concentration; (3) reaction time; (4) pH value; (5) others Influencing factors, such as the adsorption environment conditions, the selectivity of the adsorbent to heavy metal ions, the inhibitory factors produced by cell metabolism, and the interaction between coexisting ions

also have a certain impact on the adsorption process. Existing studies mostly focus on the biosorption of single ions, but in practical applications, the coexistence of multi-component metal ions is often involved, and there is not much research on the simultaneous adsorption of multi-component metal ions.

3. Study on the Mechanism of Microbial Adsorption

The study of microbial biosorption mechanism has always been an important field explored by scholars at home and abroad. Although a lot of work has been done, a complete and detailed theoretical system has not yet been formed. This is mainly determined by the breadth and diversity of biosorbents and the complexity of the composition of the metal solution [4]. It is generally believed that there are several mechanisms for microorganisms to separate metal ions from solution: (1) Extracellular enrichment/deposition; (2) Cell surface adsorption or complexation; (3) Intracellular enrichment. Among them, adsorption on the cell surface exists for both dead and living microorganisms, while a large amount of extracellular and intracellular enrichment often requires microorganisms to be active. In an adsorption system, there may be one or more of the above mechanisms.

4. Prospects of Microorganisms in Sludge in the Field of Heavy Metal Adsorption

Activated sludge has a high specific surface area and a large number of biologically active sites, and related studies have shown [5] that the microorganisms in the sludge have the effect of intracellular absorption of heavy metals, and extracellular polymers can have high adsorption capacity for heavy metals. The sludge has a high-efficiency enrichment effect on heavy metals and toxic organic compounds that are difficult to degrade. Especially after the treatment of industrial water containing heavy metals, high concentration, and refractory degradation, the sludge contains a certain concentration of heavy metals [6], and the sludge is usually treated by physical methods, and the cost of heavy metal removal methods is relatively high. The effect is poor and it is easy to cause secondary pollution. Therefore, it is particularly important to explore the characteristics and distribution of heavy metals adsorbed by microorganisms in sludge.

5. Conclusion

In summary, microbial adsorption of heavy metals is a new type of treatment technology. Extracting microbes from sludge for heavy metal adsorption has the advantages of rich sources and adaptability to specific wastewater, which can attract the attention of many scholars. However, due to technical means and research limitations, it has not been applied in large-scale production practice. Therefore, it is necessary to continue to study the mechanism of microbial adsorption of heavy metals and use genetic engineering technology to construct engineered bacteria with strong adsorption capacity or specific metal adsorption capacity. Can create conditions for large-scale industrial application of microbes adsorbing heavy metals.

References

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