

Study on detoxification and removal mechanisms of hexavalent chromium by microorganisms

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Abstract

Extensive industrial activities have led to an increase of the content of chromium in the environment, which causes serious pollution to the surrounding water, soil and atmosphere. The enrichment of chromium in the environment through the food chain ultimately affects human health. Therefore, the remediation of chromium pollution is crucial to development of human society. A lot of scholars have paid attention to bioremediation technology owing to its environmentally friendly and low-cost. Previous reviews mostly involved pure culture of microorganisms and rarely discussed the optimization of bioreduction conditions. To make up for these shortcomings, we not only introduced in detail the conditions that affect microbial reduction but also innovatively introduced consortium which may be the cornerstone for future treatment of complex field environments. The aim of this study is to summary chromium toxicity, factors affecting microbial remediation, and methods for enhancing bioremediation. However, the actual application of bioremediation technology is still facing a major challenge. The detoxification process inclusive of bioreduction and biosorption. When microorganisms are exposed to Cr(VI), related genes will be up-regulated (Chr promoter and copZ) to prevent intracellular molecules from being destroyed. Microorganisms provide electrons to reduce Cr(VI) through autogenous enzymes or externally added reducing substances. The pH, temperature, concentration, and electron donor are the major factors affecting the bioreduction owing to their close correlation with enzyme activity. Biosorption is mainly based on electrostatic force, combined with chromium oxide anions through functional groups (hydroxyl, carboxyl, amino etc.) on the cell surface. Bioaccumulation is the active uptake of Cr(VI) by living cells, a process that usually depends on the forms and bioavailability of Cr(VI) and is also dependent on nutrients such as energy and carbon sources. The combination of these exogenous additives and mixed culture microorganisms greatly improves the tolerance and reduction efficiency of microorganisms. In previous reports on bioremediation technology, the main object of remediation was water bodies, and arable land is currently facing severe heavy metal pollution, so the future microbial remediation technology should also target the soil and atmosphere. In response to the research deficiencies has been proposed, the following suggestions are put forward: 1. Due to the complex actual environmental conditions, especially the soil, it is difficult to achieve the purpose of governance using purely cultured microorganisms. The use of mixed culture of microorganisms can improve the adaptability to the environment and the efficiency of treatment through the synergy between microorganisms. 2. For the complex medium of soil, the effect of using microorganisms alone may not be obvious. Therefore, combining plants and microorganisms can promote the application o

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of bioremediation is lower than that of physical and chemical materials and it also takes a long time to remove heavy metals. Future research can focus on the combination of microbes and nanomaterials or consortium to improve treatment efficiency.