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Effects of Chromium-Resistant Bacteria (CRB) on Detoxification of Cr(VI) in Cr-contaminated Sediments

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ABSTRACT

Cr(VI) is a serious environmental pollutant due to the wide use of chromium compounds in industries such as tanning, plating, corrosion control and pigment manufacture. Cr(VI) is easily released the surrounding environment from the contamination sources because Cr(VI) exists as a soluble form at neutral pH. Chromium-resistant bacteria (CRB) can convert Cr(VI) to Cr(III) which is much less toxic and soluble. In this study, CRB was isolated from Cr-contaminated sediments which was sampled near pigment manufacturing factories and effects of CRB on Cr(VI) detoxification were investigated under anaerobic condition.

All procedures during preparation of Postgate culture medium and manipulations with bacteria were performed under anaerobic condition. 5mM of lactate, glucose and acetate were added to the medium as carbon sources. Cells were grown at 30 ℃ and pH 7.3±0.2. Cr(VI) was quantified by the colorimetric diphenylcarbazide (DPC) method at 540 nm. For the measurement of bacterial growth, Bradford assay was adopted to quantify the total amount of proteins in culture samples instead of directly measuring the optical density (OD).

High level of 700 total Cr mg/kg was found in Cr-contaminated sediment from the study area. From the onset of the experiment with lactate as a carbon source, 99 % of dissolved Cr(VI) was rapidly reduced until 96 hours and then the reduced form was maintained for the rest of experiment. In comparison, non-inoculated control did not show a significant variation in dissolved Cr(VI) concentration. The amount of total

dissolved Cr also decreased simultaneously as Cr(VI) was reduced. The relationship between anaerobic growth of bacteria and the reduction of Cr(VI) was investigated in order to examine whether the Cr(VI) reduction was dissimilatory. In the present study, the amount of protein did not vary with time and Cr(VI) reduction did not necessarily accompany bacterial growth. The Cr(VI) reduction observed in this study was not likely due to dissimilation but detoxification.

The addition of lactate, glucose and acetate to the medium improved the efficiency of Cr(VI) reduction. 99 % of dissolved Cr(VI) in medium was reduced within 288 hours (lactate+cells), 384 hours (glucose+cells), and 480 hours (acetate+cells) and the reduced form was maintained (Fig. 1). In conclusion, the CRB can reduce Cr(VI) in contaminated sediments and this ability of CRB has a potential for the remediation of Cr-contaminated environments.

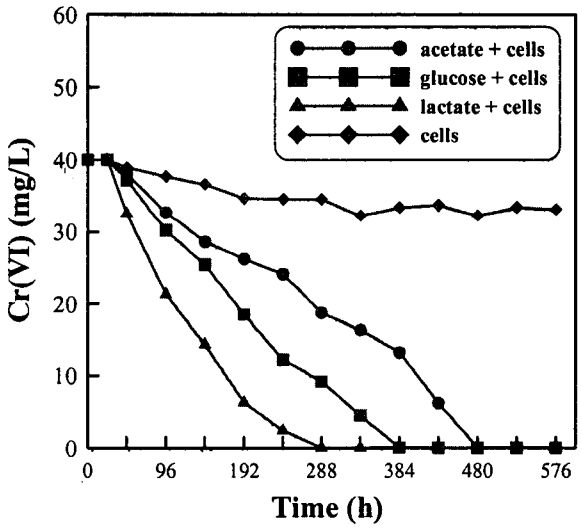

Fig. 1. Effect of carbon sources on Cr(VI) reduction by the enrichment culture

Key words: Cr(VI), Chromium-resistant bacteria (CRB), Detoxification

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