Mixed culture of Arsenic oxidizing and Cr(VI) reducing bacteria from local environment in South Africa; Performance evaluation.

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Abstract

Transition metal and metalloid oxyanions such as Cr-compound (CrO$_4^{2-}$) and As-compound (H$_3$AsO$_3$) are common pollutants routinely detected in effluent waste streams from the mining industry around the world. Biological treatment strategies commonly applied for a specific metallic pollutant may not be successful due to a dual toxic effect imposed by the metallic component. In the current study, Cr(VI) reduction linked to As(III) oxidation was observed in a mixed culture of anaerobic bacteria isolated from cow dip in Tzaneen (Limpopo Province), and activated sludge from Brits Wastewater Treatment Works (NW Province), both in South Africa. The cultures were acclimatized for 264 h, and utilized bicarbonate as a carbon source. In an experiment containing 30 to 100 mg/L of Cr(VI) at a constant 120 mg/L As(III) concentrations, near complete Cr (VI) reduction at initial concentrations from 30 to 70 mg/L was observed. Lower removal efficiency was seen when Cr(VI) concentration was increased to 100 mg/L. In a different experiment, As(III) concentrations ranging from 50 to 400 mg/L at a constant 70 mg/L Cr(VI) concentrations was also investigated. Results show that Cr(VI) removal efficiency increases as As(III) concentration was increased from 150 to 400 mg/L. Low Cr(VI) removal rate was seen as As(III) concentration decreased from 100 to 50 mg/L. These experiments suggest that Cr(VI) reduction in the presence of As(III) was not inhibited at higher As(III) concentration, rather As(III) enhanced the redox process by acting as inorganic electron donor for Cr(VI) reduction. Abiotic control shows no insignificant reduction in Cr(VI) or oxidation of As(III) in the absence of these isolates.