INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Heavy metals are extensively used for several applications, and as a consequence of which these metals are discharged into the environment from different sources. Owing to their non biodegradable and non persistent nature, metals can merely be transformed to less toxic and insoluble forms. Besides heavy metals, sulfate is found abundant in wastewater streams which pose many environmental issues. Therefore, elimination of metals and sulfate from wastewater prior their discharge into the environment is mandatory. This study was focused on the application of sulfidogenic bioreactor systems for heavy metal removal from metallic wastewater. Initial studies were carried out to screen suitable anaerobic biomass for the removal of different heavy metals and to investigate the mechanism of metal removal from both single and multi-component systems by SRB. The SRB biomass obtained from the experiments was characterized using FTIR, TEM-EDS and FESEM-EDX and the heavy metal removal mechanism was attributed to the sulfate reducing capability of the biomass, which resulted in precipitation of the metals as their corresponding sulfide salts. FTIR spectroscopy analysis of the biomass confirmed the presence of functional groups in the SRB that were similar to that of an earlier reported SRB, *Desulfovibrio*. species. For a successful application of this method, the choice of a suitable reactor system is essential. Therefore, continuous metal removal from synthetic wastewater by immobilized SRB was evaluated using two lab-scale sulfidogenic bioreactor systems: anaerobic rotating biological contactor (An-RBC) reactor and a downflow column reactor (DFCR) packed with immobilized SRB beads. Best heavy metal removal results were obtained at 48 h HRT than at 24 h HRT in case of both the reactor systems. However, the removal values were reduced at a high inlet concentration of the heavy metals, which matched well with low COD and sulfate removal efficiencies, but the metal removal results were better using the An-RBC reactor than those results obtained using the DFCR. V3-V4 metagenomics sequencing and analysis revealed that SRB immobilized in the An-RBC reactor is predominant with *Desulfovibrio*. sp. Combined effect of different heavy metals on the removal of metals, sulfate and COD by SRB using both the reactor systems was evaluated under continuous operating condition by employing the statistically valid fractional factorial design of experiments. Continuous metal removal from a mixture of the heavy metals showed that Cu(II) removal was maximum (> 98%), followed by Zn (II) (96%) and other heavy metals at their respective low inlet concentrations, and metal removal order in the mixture study using both the reactor systems was Cu > Zn > Cd > Pb > Fe > Ni. These results strongly indicate that the passive biofilm based bioreactor (An-RBC reactor) could be preferred over DFCR for large-scale treatment of sulfate and metal rich wastewater.