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An ecofriendly approach towards remediation of high lead containing toxic industrial effluent by a combined biosorption and microfiltration process: a total reuse prospect

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ABSTRACT

An environment friendly approach involving biosorption, integrated with ceramic membrane-based microfiltration, was employed for treatment of high lead-containing printing industry effluent. Dried sludge from a common effluent treatment plant of a tannery was used for the preparation of a cost-effective biosorbent. The biosorption capacity for lead obtained was about 199 mg/g at pH 4.2 in a synthetic solution with initial lead concentration of about 1,000 mg/L. With a significantly high concentration of lead in effluent, i.e. about 1,000 mg/L, about 99% removal could be achieved using 5 g/L of biosorbent dose. Microfiltration study was conducted using indigenously developed ceramic membranes. The combined process resulted in 99.9–99.5% reduction of total organic carbon and chemical oxygen demand, respectively. The treated effluent was applied in agriculture by conducting the seed quality assessment test. It was observed that germination (%) of three types of seeds, viz. chickpea, soybean, and dry white peas on exposure to treated effluent was comparable to that of control. In the case of the untreated effluent germination, (%) decreased with increasing concentration, i.e. 5–25%. The treated effluent did not affect the protein content of the seeds as compared to the control. The spent biosorbent was utilized for manufacturing of bricks. About 30% of the spent biosorbent in clay could be used to prepare bricks with reasonable compressive strength. The overall study indicated potential of the integrated process with complete recycling approach with respect to a toxic industrial effluent.

Keywords: Lead removal; Printing industry effluent; Biosorption; Microfiltration; Ceramic membrane; Reuse

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