Bio adsorption of mercury using *Aspergillus niger*

E. SARITHA, R. ANAND, S. SUJA, P. UMA DEVI AND K. SWAMINATHAN

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See end of the article for authors' affiliations

Correspondence to :
E. SARITHA
Department of Biotechnology, Dr. N.G.P. Arts and Science College, Kalapatti Road, COIMBATORE (T.N.) INDIA

SUMMARY

The increasing awareness of dye toxicity and the biomagnifications through food chain are responsible for the demand for detoxification of industrial effluents prior to their discharge into natural streams. The potential of using fungal biosorbents has received considerable attention since this represents a significant by-product from several fermentations. In batch mode studies, the parameters such as contact time, adsorbent dosage and pH were analyzed to optimize the bioadsorption of mercury. Autoclaved *Aspergillus niger* was found to be efficient in mercury removal. Studies on adsorption isotherms revealed that adsorption of mercury by the fungal mycelium followed the Langmuir model and the process of adsorption is favourable. By using Langmuir isotherm, the adsorption capacity (Qo) of live and autoclaved adsorbents was determined with 0.80 and 0.75 mg/g, respectively. The adsorption rate constants (K_{ad}) were calculated from the slope of the linear plots and were observed to be in the range of 0.035 to 0.046 and 0.030 to 0.038 x10^{-2} L/min, respectively for live and autoclaved mycelium.

Key words : Biosorption, Adsorbents, Langmuir, Mercury, *Aspergillus niger*

Pollution of water is no more a local, but it is a global phenomenon (Hedges and Purnaik, 1992). The loss of mercury in industrial effluents would affect the aquatic and terrestrial environment (Parks, 1988). Methyl mercury, a potent neurotoxin is a main form of mercury in fish. When men ingest the fish, it leads to the bioaccumulation of methyl mercury in human beings. This bioaccumulation of methyl mercury ultimately results in fatal neurological disorders like Minammata disease (Fergusson, 1990). Removal of heavy metals is usually achieved by physico-chemical processes like precipitation, coagulation, ion exchange, membrane process and adsorption. Formation of sludge and high cost of activated carbon are the problems for the same (Kapoor *et al*., 1999). Adsorption of heavy metals on fungi occurs as a result of ionic interactions and complex formation between metal ions and ligands, which include chitin, chitosan, phosphate, amine, hydroxyl groups and other pigments (Shumate and Strandberg, 1985; Kapoor and Viraraghavan, 1995). Exposure of microbial cell to metal ions results in the rapid binding of cations to negatively charged sites on the cell wall. Extracellular polysaccharide binds effectively and precipitates heavy metals. Since fungi are widely used in a variety of large-scale industrial fermentation processes, it can be easily procured as a by-product in a cost-effective way.

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MATERIALS AND METHODS

The test fungus, *Aspergillus niger* was isolated from metal contaminated soil from an electroplating industry by soil dilution plate technique. The fungus was sub-cultured and maintained on Czapek Dox agar medium at 27±2°C.

Adsorbent:

Live and autoclaved *Aspergillus niger.*

Preparation of adsorbate solution:

Various concentrations of metal solutions 5, 10, 15, 20 and 25mg/L of mercury (II) chloride were prepared. The wavelength maximum adsorption for Mercury (II) chloride was 565nm.

Batch mode adsorption studies:

Contact time:

1g of adsorbent was added to 50mL of various adsorbate concentrations and agitated on a rotary shaker (150 rpm) at room temperature (27±2°C). The flasks were withdrawn at predetermined time intervals at 15 minutes. The adsorbent and adsorbate were separated by centrifugation at 3000 rpm for 5 minutes. The remaining adsorbate concentration in the supernatant was determined spectrophotometrically at 565 nm.

Adsorbent dosage:

Adsorbate solutions were agitated with