CHROMIUM REMOVAL FROM INDUSTRIAL EFFLUENTS USING FUNGAL ISOLATE

by

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CERTIFICATE

This is to certify that the thesis entitled **"Chromium Removal from Industrial Effluents using Fungal Isolate"** being submitted by **Ms. Shweta Sharma (nee Kaushik)** to the Indian Institute of Technology Delhi for the award of the degree of 'Doctor of Philosophy' is a record of bonafide research work carried out by her. She has worked under our guidance and supervision and has fulfilled the requirements for the submission of this thesis. To the best of our knowledge the results contained in this thesis have not been submitted in part or full to any other University or Institute for the award of any degree or diploma.

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Ohm Namah Shivay

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ABSTRACT

Present study is an attempt to develop a suitable operational strategy for biological removal of Cr (VI) from effluents of small-scale industries. To begin with, a Cr (VI) resistant fungal strain was isolated from an industrial effluent and has been identified as *Aspergillus lentulus* by 28S rDNA sequencing. This fungal strain could tolerate upto 550 mg/l of Cr (VI) and caused 100% Cr (VI) removal and 78% total Cr removal at 100 mg/l initial concentration within 120 hours. *A. lentulus* also displayed special ability to grow over a broad range of pH, temperature, salinity and high concentration of Cr (VI). Surprisingly so far no study has been reported on heavy metal removal using *A. lentulus*. The mechanism of Cr (VI) tolerance and removal by *A. lentulus* was also investigated employing Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), and Energy Dispersive X-ray Spectroscopy (EDXS) along with the mass balance of Cr. The results revealed that chromium removal by growing *A. lentulus* takes place by several mechanisms such as sorption, bioaccumulation within cells as well as extracellular reduction.

Identification of the critical component in the nutritional requirements of *A. lentulus* using response surface methodology (RSM) showed that yeast extract was most important component while glucose played only a supportive role for growth and Cr (VI) removal by *A. lentulus*. Thus, a significant enhancement in Cr (VI) removal from 68 % to 99.8 % could be obtained using optimized media. In view of high cost and certain constraints in procurement of commercial media in remote rural areas, alternative media sources based on locally available biomass were explored. A new medium using *Leucaena leucocephala* pods and *Sesbenia* sp. seeds together as sole carbon and nitrogen source for substituting glucose and yeast extract has been developed. Alternative medium

performed well for growth of the above fungus and complete removal of Cr (VI) upto 50 mg/l of initial concentration [coinciding with concentration in Combined Effluent Treatment Plant (CETP) effluent used in the present study] was achieved. The cost of alterative medium was found to be $1/10^{th}$ of the commercial media. In the non-growing mode (resting, immobilized, autoclaved) also, *A. lentulus* performed well at pH 2, however the system was very much sensitive to pH conditions. In order to see the feasibility of *A. lentulus* under field conditions, Cr (VI) removal studies were conducted with actual industrial effluents using both growing and non growing biomass. In CETP effluent, where Cr (VI) initial concentration was 47 mg/l, complete removal was obtained. However, while treating the electroplating effluent (initial Cr (VI) concentration = 259.1 mg/l) 87%, 75% and 91% removal was obtained by growing, resting and autoclaved biomass, respectively. Finally, for facilitating the field applicability of *A. lentulus*, its formulations using a few organic bases were developed and evaluated in terms of shelf life and Cr (VI) removal. Rice based fungal formulation (RBFF) was found most efficient followed by maize based fungal formulation (MBFF) while performance of wheat based fungal formulation (WBFF) was found to be the poorest. These formulations could be stored for 3 months under ambient conditions and 6-12 months under controlled conditions ($30^{\circ}C$). Overall, the results demonstrated the applicability of *A. lentulus* for effluent treatment using simple, low cost alternative media in both growing and nongrowing modes, thus developing a simple biological system (providing synergistic contribution by native microbes & fungal isolate) for Cr (VI) detoxification under ambient pH conditons in small scale industrial units located especially in remote rural or semi urban sector.

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