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Biomass of *Aspergillus sydowi* act as a bioadsorbent for removal of heavy metals from refinery effluent

Sushila Sangwan* and Rajesh Dhankhar**

*Department of Botany, Government College, Mahendergarh- Haryana

**Ecology Laboratory, Department of Bioscience, M.D.U., Rohtak-Haryana

ABSTRACT

Heavy metal pollution at disposal sites due to Refinery effluent / waste water is very dangerous to human society. To minimise this pollution, a treatment process is required, which involves removal of heavy metals from industrial waste water. Various methods used for removal of heavy metals from industrial effluents / waste water were precipitation of metals, ion exchange resin, electrochemical reduction, membrane separation processes. These methods of heavy metal removal from industrial waste water were encountered with certain major disadvantages e.g. high energy requirement, generation of large quantities of toxic waste sludge etc, moreover these processes were expensive. Due to expensive nature of above processes there was an increasing demand for new technologies with low cost. In this bio-adsorption seems to be eco-friendly and viable method. Removal of heavy metals by bioadsorbents developed from plant and fungal biomass become a unanimous choice. Furthermore, removal of pollutants from industrial effluent / waste water by using a immobilised bioadsorbents of plant and fungal biomass can proves to be best option for commercial application.

Key Words : Bio-adsorption, *Aspergillus sydowi*, Heavy Metals, Fungal Biomass

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INTRODUCTION

To compensate the increasing agricultural demand of water, some work has also been done on recycling and utilization of certain industrial effluents for agricultural purposes. Effluent generation in the industry depends upon the size and activities of the industry and industrial waste can be defined as end by-product not usable for the industry, hence has been discharged out. So this waste water / Effluent contains harmful pollutants such as heavy metals etc., and its direct use without its treatment process in agriculture could be very dangerous for human society.

In consequent of the endeavours of the central government, in our country, the past few years saw a significant reduction in pollution levels as out of the 1551 industries, Only 20 industries were found not meeting minimum national standard (Balu, 2002). The effluent after treatment process for removal of toxicants seemed to be used judiciously for irrigation purposes and hence prevent pollution and disposal problems (Anae *et al.*, 1993; Ranganathan *et al.*, 1999; Chhankar *et al.*, 2000; Dhankhar & Dahiya, 2000; Rao & Rao, 2002).

Average petroleum refinery generates about 0.6 barrels of wastewater per barrel of oil processed to that must be treated to meet environmental discharge (Tom Shultz, Jan. 2005). The problem of disposal and treatment process of refinery effluent has drawn considerable concern by scientists, technologist and environmental government regulators etc. United States Environmental Protection Agency (USEPA) considered following heavy metals (Cr, Cu, Zn, Ni, Pb and Hg) contamination in water and soil as critical situation for humans and animals (Arther & Vohra, 1995). Various methods were used to remove contaminants from oil refinery effluent

and in this biological material has emerged as eco-friendly substitute (Kannan & Srinivasan, 1998; Volesky & Holan, 1995).

Bio-sorption is a non directed physico-chemical interaction between metal or radionuclide species and cellular compounds of biological species (Shumate & Strandberg, 1985). Activated carbon and peat occupied the case of bio-sorbent from a long time, but they were geographically restricted in distribution(Lodeiro *et al.* 2006). Hence, biosorbents developed from plant and fungal biomass become a unanimous choice. So, bio-adsorbent developed from *Aspergillus sydowy* isolated from soil contaminated from refinery effluent(Ahluwalia, S.S. and Goyal, D. 2005, Khambhaty *et al.* 2009). Furthermore, removal of pollutants from effluent by using cosmopolitan fungi as bio-sorbents proves to be best option for commercial application.

MATERIAL & METHODS

The effluent of Panipat oil refinery located in Haryana, was collected from disposal site and was used for study in Rohtak. Chromium, nickel and lead were analysed by the method as outlined in Gupta (2000). The concentration of heavy metals i.e. chromium, lead and nickel was determined by atomic absorption spectrophotometer by atomizing triacid (conc. nitric, conc. sulphuric and 70% perchloric acids in 2:1:0.5 ratio) digested aqueous samples in air acetylene flame (APHA, 1985).

Fungal species were isolated from the soil supplemented with Panipat Oil Refinery effluent. Isolation of pure colonies of fungus was done on the solid rose-Bengal medium. Isolated pure colonies were identified from Pathology Division, IARI, New Delhi. All the species were routinely maintained at 25°C on a initial rose Bengal medium except agar.

For mass culturing experiments, fungal species were cultured in liquid phase using incubated shaker. For *Aspergillus sydowi*, inoculums was transferred to 250 ml Erlenmeyer flasks filled with 100 ml of a culture medium. The liquid phase pH was adjusted to 5 by using the 1NHC. Once incubated, the flasks were shaken on a rotary shaker at 125 rpm for five days at 25°C. The biomass produced was collected by vacuum filtration and boiled in 0.5N NaOH solutions for 15 minutes (Kapoor *et al*., 1999). It was then washed with generous amount of deionized water as long as the pH of the washing solution became near the neutral range (7.0-7.2). After washing, the biomass was dried at 60°C for a period of 16 hr and powdered, which was further used in biosorption experiments in non-immobilised.

RESULT & DISCUSSIONS

The effluent water collected from oil refinery, Panipat was analyzed and the characterization of the effluent and control water were shown in Table1. The effluent / waste water discharged from Panipat oil refinery was found to be brownish grey in colour, turbid and odourless, and effluent was found with heavy metal such as Chromium, Nickel and Lead concentrations above than control water and CPCB (1995) standards.

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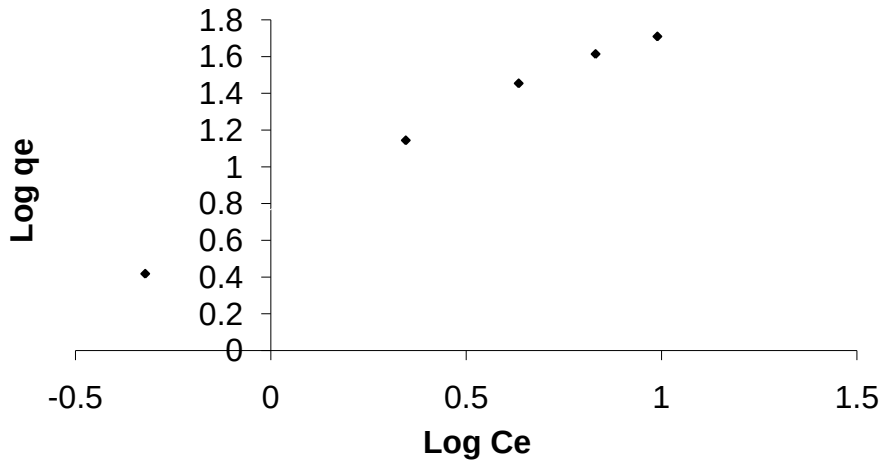
Table:1 Characterisation of refinery effluent and control water in comparison with the CPCB (1995) standards

Parameter	Effluent	Control	CPCB Standards
lour	Brownish grey	Clear	Clear
Odour	Greasy	Odourless	Odourless
Turbidity	Turbid	Transparent	Transparent
Ni^{+}(mg/L)	0.17±0.29	0.02±0.01	–
Cr^{+3}(mg/L)	0.120±0.018	–	–
Pb^{+2}(mg/L)	0.080±0.009	–	–

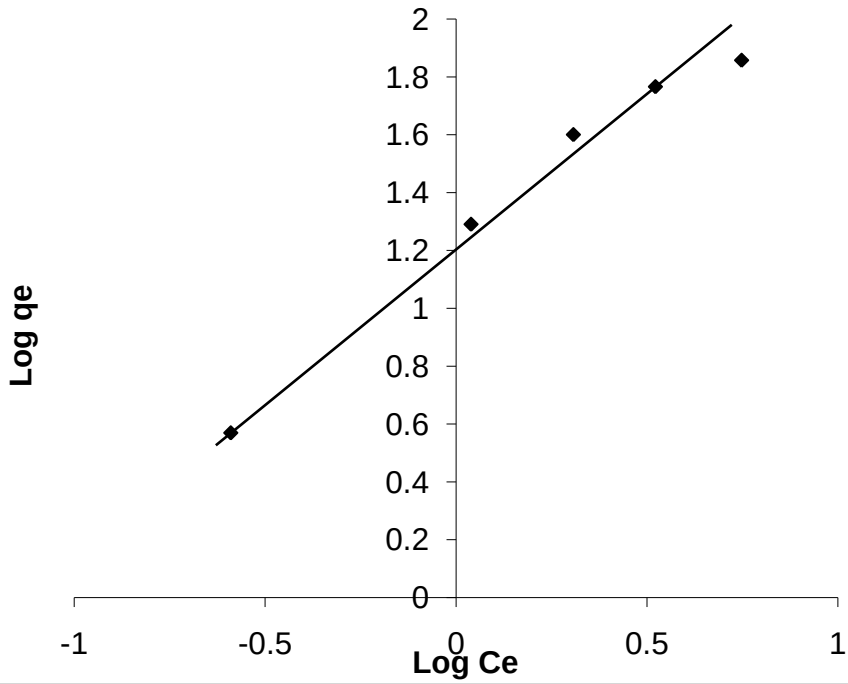
Mean values ±SD

Removal of toxicants by biosorbent developed from *Aspergillus sydowi* was studied at different initial concentrations of toxicants (1 ppm – 20 ppm) at fixed dose of biosorbent (2 g on k) and contact time. The results were shown in Figures 1, 2 and 3 found that removal percentage of lead, chromium and nickel by *Aspergillus sydowi* biosorbents was found to increase with increase in initial concentrations of toxicants but at high concentration, removal percentage decrease slightly supported by finding of Bahadir *et al.* (2007) and Pan *et al.* (2009). Irrespective of the initial concentration toxicant removal efficiency of biosorbents was found to be of increasing order: nickel, lead and chromium. Of all these toxicants, chromium was noted to be effectively removed by *Aspergillus sydowi* biosorbents in non-immobilized form.

Figure 1: Freundlch adsorption isotherm for nickel removal by *Aspergillus sydowi*



Freundlich adsorption isotherm for chromium by *Aspergillus sydowi*



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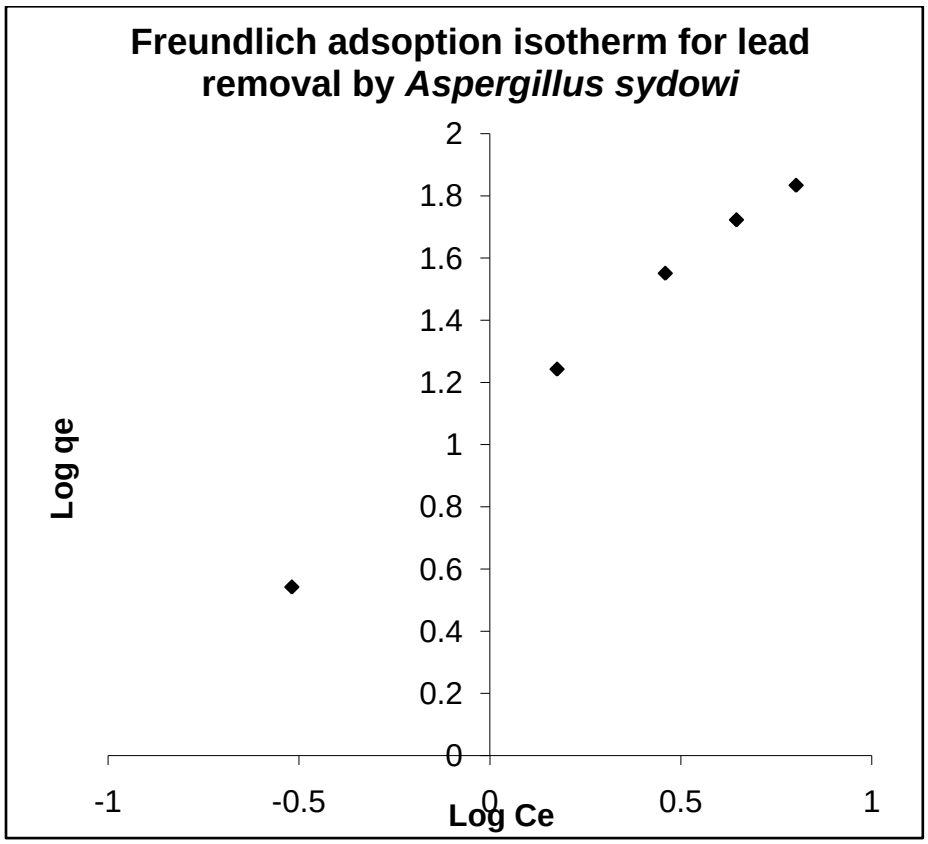

CONCLUSION

Refinery effluent at disposal site was found with heavy metals which should be removed before its use in irrigation otherwise bio-accumation of heavy metals will pose serious disadvantages for human and animal health. Removal of heavy metals can be done by various physic-chemical techniques but bioadsorption by adsorbents developed from biological origin such as bioadsorbent developed from *Aspergillus sydowi* is specific and reliable technique for heavy metal removal from secondary/partially treated refinery effluent.

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