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In vitro Study on Bio Removal of Cadmium (Cd^{2+}) by Freshwater Cyanobacterium *Oscillatoria* sp. and its Isotherm

Wijesekara W.A.M.A.[1], Wijeyaratne W.M.D.N.[2] and Manage P.M.[1*]

[1]*Center for Water quality and Algae Research, Department of Zoology, University of Sri Jayewardenepura, Sri Lanka*
[2]*Department of Zoology and Environmental Management, University of Kelaniya, Sri Lanka*
**pathmalal@sjp.ac.lk*

Abstract

Enormous quantities of heavy metals are released into the environment over a long period of time due to various industrial, manufacturing and other anthropological activities. Physical and chemical methods which are being practiced to remove metals in contaminated water were not given a sound solution for this problem so far. Also, the conventional metal removal methods have disadvantages such as low efficiency, production of toxic sludge and expensiveness. Therefore, as a better alternative bio removal methods have been identified and microorganisms have been suggested as potential green agents to remove heavy metals from contaminated sites. It is a known fact that microorganisms are capable of accumulating metal ions by absorption and bioaccumulation. Presence of Cd^{2+} in the environment is of major concern and identification of cost effective methods to remove Cd^{2+} is a major national and international research priority. Therefore, in the present study, *Oscillatoria* sp. was employed to study the Cd^{2+} removal potentiality. Batch cultures and mass cultures of *Oscillatoria* sp. were prepared prior to evaluating metal removal by living and activated dried cells. Bio removal of metals by *Oscillatoria* sp. was carried out using different concentration of cadmium solution (0.06, 0.08 and 0.10 mg/L) along with different incubation time (24 hrs for dried bio mass and 7 days for living cells). Chlorophyll-a was analyzed to detect the growth of *Oscillatoria* sp. Non absorbed metal concentration in samples were assessed by Graphite Furnace Atomic Absorption Spectroscopy (GFAAS).

The adsorption capability of functional groups in fresh dried and cadmium treated samples were analyzed by FTIR and Langmuir and Fendrich isotherm in order to calculate properties of the adsrobate. The results of the study revealed that chlorophyll-a concentration and sorption efficiency increased when initial heavy metal concentration is low. In living cells maximum sorption percentage was recorded as 86% when chlorophyll-a concentration reached to 520.01±0.02 µg/L in 0.06 mg/L cadmium concentration after 5 days of incubation. Bio sorption of dried cells with living cells, showed a significant sorption capability ($p<0.05$) within 24 hrs. The highest sorption capacity of dried cells was recorded as 87% against 0.10 mg/L of metal concentration and 67% metal ions were removed within 30 mins. The estimated Langmuir isotherm maximum sorption capacity of adsorbent was 88.45 mg/g for dried cells and 3.43 mg/L for living cells respectively. The results of the FTIR transmission spectra revealed that carboxilc acid, amide, sulphonyl and suphanate groups are present as functional groups in chemical structure of *Oscillatoria* sp. Therefore, this study identified the cyanobacterium *Oscillatoria* sp. as an effective organism and a low cost absorbate to remove Cd^{2+} from aqueous medium and future studies are recommended to identify the removal mechanism and to improve effectiveness of the method.

Keywords: Cadmium (Cd^{2+}), *Oscillatoria sp.*, FT-IR, GFAAS, Chrolophyll-a