International Journal of Basic and Applied Biology
p-ISSN: 2394-5820, e-ISSN: 2349-2539, Volume 5, Issue 2; April-June, 2018, pp. 58-63

http://www.krishisanskriti.org/Publication.html

Kinetic Study of Removal of Toxic Metals by a Mixed Bacterial Culture Isolated from East Calcutta Wetlands

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Abstract—*Nowadays, one of the most prominent contributors in environmental pollution, specifically in case of soil and ground water pollution is industrial effluent which is laden with heavy metals like lead, cadmium, mercury etc. Heavy metals in hazardous waste cause serious health issues. Removal of heavy metals by chemical processes results in residual toxicity. Thus, bioremediation is much more beneficial as an economic and environment friendly method. The present study deals with lead and cadmium. Mixed bacterial cultures were obtained from the soil collected from East Calcutta Wetlands. The cultures were acclimatized in presence of lead and cadmium separately. The pure cultures capable of growing in presence of lead or cadmium were isolated from the mixed bacterial culture. After isolation, the strains were identified to be Stenotrophomonasmaltophilia (tolerating lead) and Bacillus subtilis (tolerating cadmium) by 16s rRNA sequence data analysis method. The μ_{max} (maximum specific growth rate) value, without lead inhibition, was found to be 0.321 hr^{-1} and with lead inhibition, was found to be 0.182 hr^{-1}. Growth kinetic study was done for cadmium tolerating culture as well. For the culture tolerating cadmium, μ_{max} value, without cadmium inhibition, was found to be 0.241 hr^{-1} and with cadmium inhibition, was found to be 0.187 hr^{-1}. Metal removal kinetic study of the corresponding pure cultures were done in presence of respective metals. Atomic absorption spectroscopy (AAS) was used to determine the concentration of the metals. The removal kinetics of lead by Stenotrophomonasmaltophilia was investigated. With respect to lead concentration, the order was found to be 1.63 and the rate constant was 0.01967 $mg^{-0.63}l^{0.63}h^{-1}$. By Similar experiment, the removal rate of cadmium by Bacillus subtilis with respect to cadmium concentration was determined and the order of the reaction was 1.43 and the rate constant was found to be 0.01076 $mg^{-0.43}l^{0.43}h^{-1}$.*

Keywords: *Bioremediation, East Calcutta Wetlands, Lead, Cadmium.*

1. INTRODUCTION.

Metal pollution plays a key role in environmental pollution caused by toxic heavy metal deposition in the ground or water. Toxic heavy metals are relatively dense metal or metalloid that is noted for its potential toxicity, especially in environmental contexts. There are several heavy metals like Cadmium, Lead, Arsenic, Mercury, Antimony, Thallium, Silver etc. found in the ground water due to human activities as well as found naturally in the earth. They can enter plant, animal, and human tissues via inhalation, diet, and manual handling and can bind to and interfere with the functioning of vital cellular functions [1-4].

The present study deals with removal of lead and cadmium. Cadmium (Cd), a widely dispersed metal in environment as cadmium sulfide, is refined during zinc production and occurs in association with zinc. Lead is widely dispersed in air (as smelters), water, soil, food, dust and affects human. Cd is an extremely toxic industrial and environmental pollutant classified as a human carcinogen. Acute exposure to cadmium fumes may cause flu-like symptoms including chills, fever, and muscle ache sometimes referred to as "the cadmium blues." More severe exposures can cause tracheo-bronchitis, pneumonitis, and pulmonary edema. Symptoms of inflammation may start hours after the exposure and include cough, dryness and irritation of the nose and throat, headache, dizziness, weakness, fever, chills, and chest pain [5-6]. Lead (Pb) poisoning is a type of metal poisoning caused by introduction of lead in the body. Exposure to lead can occur by contaminated air, water, dust, food, or consumer products. In acute poisoning, typical neurological signs are pain, muscle weakness, numbness and tingling, and, rarely, symptoms associated with inflammation of the brain abdominalpain, nausea, vomiting, diarrhea, and constipation are other acute symptoms [7-9].

Lead and Cadmium can be removed by chemical methods which results in byproduct or residual toxicity in most cases. There are studies where extremophils had been used for their removal but extremophilic conditions are difficult to maintain and are costly. In the present work removal kinetics study of bioremediation of lead and cadmium bymesophilic bacterial culture have been studied. The bacterial culture was isolated