National Institute of Technology Rourkela

Registration Seminar

Seminar Title	: Interaction of metal binding biomacromolecules with multimetal ions for bioremediation by biofilm forming marine bacteria
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Venue	: Life Science Meeting Room
Date and Time	: 01 Aug 2025 (04:30 PM)

Abstract

: **Heavy metal contamination in marine environments represents a critical ecological concern, largely attributed to the unregulated discharge of industrial effluents lacking proper treatment. Bacterial biofilms have emerged as potential agents for heavy metal bioremediation, offering an eco-sustainable approach for mitigating metal pollution. This study investigates the bioremediation potential of a marine biofilm-forming bacterial isolate, *Pseudomonas aeruginosa* CSA06P, isolated from metal-contaminated sediments of Chilika Lake, Odisha, India. The strain demonstrated robust biofilm formation in the presence of up to 100 ppm of Pb(II) and Cr(VI), and 15 ppm of Hg(II) in a multimetal system. Confocal laser scanning microscopy and phase contrast microscopy delineated the stages of biofilm development, revealing that maximum biofilm thickness (16.21±0.4521µm) and highest cell sizes (inner cells- 0.707µm outer cells- 0.97µm) were observed at 48 h. Extracellular polymeric substances (EPS) were found to play a key role in mediating bacterial cell aggregation, with peak EPS yield observed under optimal conditions of pH 7, 0% NaCl, 37°C, and incubation at 48 h. Scanning Electron Microscopy (SEM) of multi-metal treated samples revealed irregular, rod-shaped cells forming loosely packed aggregates encased in a dense EPS matrix. Field Emission SEM coupled with Energy dispersive X-ray spectroscopy (FESEM-EDS) confirmed metal sequestration by EPS, while Fourier transform infrared (FTIR) spectroscopy indicated the interaction of functional groups &ndashC&equivC, C=O (in COO^-), and N&ndashH with metal ions. Proton nuclear magnetic resonance (^{1}H NMR) analysis further demonstrated interactions between metal ions and ring protons of EPS carbohydrate moieties, alongside increased EPS crystallinity post metal adsorption (CI_{xrd} = 0.179). Metal-specific transmittance peaks and increased mean particle size, along with reduced surface electronegativity, supported EPS&ndashmetal interactions. These initial findings highlight the EPS-metal interaction and potential of *P. aeruginosa* CSA06P for effective biofilm-based multi-metal remediation in contaminated marine environments. The present study would lead to the further exploration into the potential of marine bacterium *P. aeruginosa* CSA06P in developing biofilm-based multi-metal bioremediation strategies for sustainable management of marine pollution.**