



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title: Biodegradation of polycyclic aromatic hydrocarbons in contaminated wastewater and biodiesel production using the oleaginous bacterium *Rhodococcus opacus*

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Thesis Submitted to the Department/ Center : Centre for the Environment

Date of completion of Thesis Viva-Voce Exam : 03/05/2019

Key words for description of Thesis Work : Wastewater treatment; Biodiesel production; Biochar; Bioreactors; Ceramic Membrane separation

SHORT ABSTRACT

Polycyclic aromatic hydrocarbons (PAHs) represent a unique class of ubiquitous semi-volatile organic contaminants, well-known for their persistent, bioaccumulative, toxic, carcinogenic, teratogenic and mutagenic nature. In the present study, a hydrocarbonoclastic oleaginous bacterium *Rhodococcus opacus*, was investigated for its potential to simultaneously degrade naphthalene, anthracene, phenanthrene and fluoranthene as model PAHs, in single, multi-component and cocontaminated heavy metal system. In single-component system containing minimal salt medium with all the four PAH compound as the sole source of carbon and energy and at an initial concentration in the range 50-500 mg L⁻¹, *R. opacus* was capable of degrading 58% - 83.8% of PAHs along with the lipid accumulation in the range 72.4% (w/w, CDW) within 7 days. In the multi-contaminated system, a maximum removal of 91.6%, 82.3% and 80.7% was achieved for naphthalene, phenanthrene and fluoranthene, respectively. The individual effect of PAH concentration was found to be more significant than 2-way and 3-way interaction effects on PAHs biodegradation. The biodegradation efficiency in the mixture was mainly affected by initial concentration and aromatic complexity of the PAHs. Furthermore, effect of six different heavy metals individually has depicted the following order on PAH biodegradation and lipid accumulation: Cd > Ni > Pb > Cu > Zn > Fe. In order to enhance PAH bioavailability by *R. opacus*, biochar derived cheaply from biomass gasification waste was evaluated and has shown an enhancement in PAH biodegradation in the range of 79.6% to 92.3%. The valorization of biomass gasification wastewater (BGWW) for lipids accumulation by *Rhodococcus opacus* was further examined. To further evaluate the potential of the *R. opacus* to treat BGWW, an up-flow packed bed bioreactor (UFPBBR) with nano-biochar loaded polyurethane foam as the packing material was utilized that have resulted in the potential BGWW treatment. A novel integrated biodegradation - microfiltration system for sustainable wastewater treatment and energy recovery was utilized in both batch and continuous systems and they have shown their great potential. Transesterification of the bacterial lipids to biodiesel and its properties revealed a very good potential of the strain for the production of biodiesel from PAH containing wastewater.