INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	TANUSHREE PAUL
Roll Number	:	156152001
Programme of Study	:	Ph.D.

Thesis Title: Refinery wastewater treatment and value addition using *Rhodococcus opacus*- a hydrocarbonoclastic oleaginous bacterium

Name of Thesis Supervisor(s)	:	Prof. Kannan Pakshirajan and Prof. G. Pugazhenthi
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SHORT ABSTRACT

Bio-fuels for energy generation are one of the alternatives, which require integration with wastewater treatment to keep the economics of the production process low. The present study focused on treating raw refinery wastewater by *Rhodococcus opacus* for converting it into bio-oil by hydrothermal liquefaction process. For treating the raw refinery wastewater, different operating modes using a continuous stirred tank bioreactor were investigated. Continuous mode with cell recycle proved efficient in terms of complete removal of chemical oxygen demand (COD) (99%) and high lipid production (86%, *w/w*) at a hydraulic retention time (HRT) of 16 h (dilution rate of 0.06 h^{-1}). Toxicity assessment of the permeate water was carried out following different methods which established the reuse potential of the treated wastewater. Furthermore, a novel strategy involving two-stage submerged tubular membrane bioreactor (STMBR) system with the reactors connected in series was effectively employed for treating the refinery wastewater which yielded complete COD removal along with 2.98 g L^{-1} biomass growth and 2.3 g L^{-1} lipid concentration. The lipid-rich bacterial biomass obtained by treating the wastewater was converted to bio-oil by hydrothermal liquefaction (HTL) which revealed its excellent potential for bio-fuel applications. A maximum bio-oil yield of 25.53% *w/w* was obtained at the optimum HTL conditions of 215 °C temperature, 125 min treatment time, and 0.25 biomass/water ratio. Overall, this study demonstrated a sustainable zero waste strategy along with a closed loop integrated approach using the hydrocarbonoclastic oleaginous bacterium *R. opacus* for refinery wastewater treatment with provisions for resource recovery.