UAEU جامعة الإمارات العربية المتحدة United Arab Emirates University

College of Graduate Studies and College of Engineering cordially invite you to a

Master Thesis Defense

Entitled

GROWTH OF MICROALGAE FOR SIMULTANEOUS TREATMENT OF INDUSTRIAL WASTEWATER AND BIODIESEL PRODUCTION

by

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Date & Venue

08:30 AM

Monday, 18 November 2019

Room 040, F3 Building

Abstract

The treatment of industrial wastewater contaminated with phenols is among the main challenges in the chemical, and particularly the petrochemical industry. Phenols, which present in considerable amounts in industrial wastewater, are toxic even at low concentrations. Therefore, is essential to reduce their concentrations in water to harmless levels before being discharged. On the other hand, the dependence on the conventional fossil sources of energy, which is non-renewable, is not sustainable and can cause harmful environmental impacts. Therefore, in this work, the dual utilization of microalgae as a cheap and efficient means to remove phenolic compounds commonly found in refinery wastewater and as a sustainable source for oils for biodiesel production has been proposed. Most conventional bacteria used in the treatment of phenolics are pathogenic and the collected biomass after treatment is considered a secondary waste that does not have an evident commercial value. Microalgae however, are promising sustainable and renewable sources of oils that can be used for biodiesel production. In addition, they contain important compounds, such as proteins and pigments, which have large applications in the food and pharmaceutical industries. Combining the production of these valuable products with wastewater treatment renders the cultivation of microalgae very attractive and economically feasible.

In this work, two freshwater microalgae stains, namely *Chorella sp.* and *Tetraselmis sp.*, were used to remove several phenolic compounds commonly found in refinery wastewater (phenol, 4-nitrophenol and 2,4-dinitrophenol). The effect of initial concentrations of the phenols on the biomass growth and phenolic removal were evaluated and used to develop kinetics models to describe the system. The microalgae was then grown in a pilot scale open pond, and the biomass was harvested, and oils was extracted from it. The extracted oils were then converted to biodiesel using homemade heterogeneous alkaline catalyst. A parametric study was carried out to determine the effects of main reaction parameters, namely catalyst amount, methanol:oil molar ratio and reaction temperature, on the conversion after 4 h. The results showed that increasing temperature at all methanol:oil molar ratios generally resulted in decrease the FAME conversion, except at catalyst load of 7%. The experimental results were used to determine a statistical second order interactive model that was used to determine the significance of all factors and to optimize the process. The optimum conditions were found to be a catalyst wt% of 7.7, methanol:oil molar ratio of 12 and temperature of 45℃, at which the conversion after 4 h was 30.4%. The results were also used to determine a kinetic model's parameters.

The significance of this work is to use a sustainable source to treat wastewater from phenols with cheap cost. While kinetics studies of microalgae growth in water containing phenol are available in literature, as far as the investigators of this work know, this is the first work to present a kinetics study on the treatment of nitrophenols. The latter compounds are consistently found in refinery wastewater treatment, and are known to be more toxic and resistant to biotreatment. The work also presents an integration of the treatment process with biodiesel production.

Keywords: Microalgae, phenols, biodiesel.