CULTIVATION AND HARVESTING OF MICROALGAE IN PHOTOBIOREACTOR FOR BIODIESEL PRODUCTION AND SIMULTANEOUS NUTRIENT REMOVAL

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Abstract— Microalgae are recognized as a potential source of sustainable biomass feedstock for biofuel production and are capable of proliferating under versatile environmental conditions. In the current study, Chlorella vulgaris and Scenedesmus obliquus were cultivated in a small scale vertical flat-plate photobioreactor (PBR) supplemented with municipal wastewater in order to achieve simultaneous wastewater treatment and biomass production for biofuel generation. Microalgal growth and nutrient removal including total nitrogen (TN), total phosphorus (TP), total inorganic carbon (TIC) and trace elements (Ca\(^{2+}\), Na\(^{+}\), Mg\(^{2+}\) and Zn\(^{2+}\)) were monitored during microalga cultivation. C. vulgaris and S. obliquus showed optimal specific growth rates (\(\mu_{\text{opt}}\)) of 1.39 and 1.41 day\(^{-1}\), respectively, and the TN and TP were completely removed (>99%) from the wastewater within 8 days. Microalgal biomass in the PBR was harvested using a natural flocculant produced from Moringa oleifera seeds. The harvesting efficiency of M. oleifera was 81% for C. vulgaris and 92% for S. obliquus. The amounts of saturated, mono-unsaturated, and poly-unsaturated fatty acids in the harvested biomass accounted for 18.66, 71.61 and 9.75% for C. vulgaris and 28.67, 57.14 and 11.15% for S. obliquus, respectively. The accumulated fatty acids were suitable to produce high quality biodiesel with characteristics equivalent to crop seeds oil- derived biodiesel. This study demonstrates the potential of microalgal-based biodiesel production through the coupling of advanced wastewater treatment with microalga cultivation for low-cost biomass production in a PBR.