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Photosynthetic Microbial Desalination Cell to Treat Oily Wastewater Using Microalgae *Chlorella Vulgaris*

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Abstract

Microbial desalination cell (MDC) offers a new and sustainable approach to desalinate saltwater by directly utilizing the electrical power generated by bacteria during organic matter oxidation. In this study, we used microalgae *Chlorella Vulgaris* in the cathode chamber to produce oxygen as an electron accepter by photosynthesis process for generate bioelectricity power and treat oil refinery wastewater by microorganisms in both anode and cathode.

The power density generated by this Photosynthetic Microbial Desalination Cell (PMDC) with 1KΩ external resistance at the first 4th hr. of operation period was 0.678 W/m^3 of anode volume and 0.63 W/m^3 of cathode volume. It increased after one day to a peak value of (4.32 W/m^3 of anode volume and 4.013 W/m^3 of cathode volume). The microalgae growth in the biocathode chamber followed in terms of optical density. The optical density increased from 0.546 at the beginning of the system operation to 1.71 after 24 days of operation period. The percentage removal of chemical oxygen demand (COD) of oil refinery wastewater was 97.33% and 79.22% in anode and cathode chamber, respectively. The microalgae in the biocathode were able to remove volatile compounds causing odor from the influent wastewater. TDS removal rate 159.722 ppm/h with initial TDS in desalination chamber of 35000 ppm.

Keywords: PMDC; Oil Refinery; *Chlorella Vulgaris.*

1. Introduction

Industrial wastewater generated from the oil industry generally characterized by its high concentration of pollutants such as organic compounds, heavy metals, and chemicals, which may cause adverse public health and environmental problems [1]. Conventional techniques (chemical precipitation, membrane filtration, electrolytic processes, and adsorption) have widely used for the treatment of such wastewater. However, these techniques present many disadvantages, such as high cost, intensive energy requirements, and considerable sludge generation [2]. Moreover, wastewater treatment and reuse have become an essential issue with the increasing population and depletion of freshwater resources in many regions of the world.

Microbial fuel cell (MFC) is a promising technology that has obtained a significant interest in recent years. This technology offers the possibility of treating a wide range of wastewaters with soluble organic pollutants and gaining electrical current simultaneously [3]. MFC technology based on the electrogenic nature of specific bacteria that use electrode (anode) as an electron acceptor instead of dissolved oxygen while treating wastewater anaerobically. The electron transferred to the cathode through an external electric circuit at which the reduction reaction occurs [4].

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