



Industrial application of membrane distillation technology using palm oil mill effluent in Malaysia

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ABSTRACT

The palm oil industry plays a vital role in the nation's economy. Regardless of the high revenue generated, the main problem in the palm oil industry is its substantial amount of wastes including empty fruit bunches, oil palm trunks and in particular palm oil mill effluent (POME) which can be harmful to the environment if discharged without being treated. The objective of this work is to introduce advanced wastewater treatment technology, which is membrane distillation (MD) technology for the effluent treatment system. PVDF hollow fibre membranes were fabricated via wet spinning technique and characterized using Scanning Electron Microscope (SEM) and contact angle goniometer. The fabricated membranes were then tested in direct contact membrane distillation (DCMD) system using anaerobic POME as the feed solution. The effluent was analyzed before and after treatment with DCMD. The parameters included biological oxygen demand (BOD), chemical oxygen demand (COD), ammonia nitrogen (AN), nitrate-nitrogen (NN), total suspended solids (TSS), total dissolved solids (TDS), colour and turbidity. A preliminary test was carried out using distilled water before continuing with anaerobic POME as a feed solution. The average permeate flux obtained by the PVDF membrane is 2.509 kg/m².hr with slight flux decline that is probably due to the attachment of biological compounds on the membrane pores. It was found that at least 90% rejection was obtained for almost all water quality parameters tested with the values were all lower than that of the standard set by the local authority. In a conclusion, it can be said that MD demonstrated excellent performance in treating palm oil wastewater to produce water of high quality.

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1. Introduction

Statistics in 2020 revealed that palm oil is the most widely produced vegetable oil in the world which accounted for around 31.4% (74.02 million tons) of the total global oil production [1]. Of these, Malaysia has become the second-largest palm oil producer after Indonesia. Although the palm oil industry has greatly contributed to the nation's economic growth, this industry also becomes the main culprit for environmental degradation. The oil extraction process in the factories cannot avoid the by-products and also the discharge of the palm oil mill effluent (POME) [2]. POME is a non-toxic

waste with a viscous texture and brown appearance [3]. However, POME is high in organic content, resulting in high biological oxygen demand (BOD) and chemical oxygen demand (COD) which, if not handled properly will cause severe environmental pollution [4]. In Malaysia, POME is still being treated by a conventional open-ponding system that slowly becoming obsolete due to the system's inability to cope with increasingly stringent discharging threshold [3].

Besides conventional biological treatment (ponding system), there are several innovative technologies that have been developed for treatment of POME including physicochemical methods such as coagulation and membrane technology namely membrane filtration and membrane distillation (MD) [5]. Coagulation method transport organic pollutants from one form into another but still

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