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A study of palm oil mill processing and environmental assessment of palm oil mill effluent treatment

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Abstract

This work discusses the palm oil mill processing carried out at Jugra Palm Oil Mill Sdn Bhd, situated at Selangor, Malaysia with the capacity of 45-t fresh fruit bunch (FFB)/h. Typically, oil palm residues and palm oil mill effluent (POME) from FFB are generated while processing. Prior to discharge, POME should be treated to remove pollutants in the effluent. As such, the performances of anaerobic and aerobic ponds were assessed in this study to determine temperature, pH, biological oxygen demand (BOD), sludge volume index (SVI), and dissolved oxygen (DO). From the experiments, mesophilic temperature due to better process stability was applied in anaerobic ponds. The pH results displayed a fluctuating trend between lower control limit and upper control limit, and, the pH value increased from one pond to another. The final discharge BOD and SVI appeared to be lower than 100 mg/L and 10 mL/L indicating low degree of pollution and good settling ability for biomass/solid. DO was close to normal, mostly below 2 mg/L. The experimental outcomes revealed the effective treatability of POME in adherence to the standard regulation, which is the priority for environmental sustainability within this industry domain.

Keywords: Anaerobic digestion, Fresh fruit bunch, Palm oil mill effluent

1. Introduction

Palm oil being the world's most promptly growing and essential vegetable oil in tropical climate such as Indonesia and Malaysia, has made these countries to flourish in natural resources with significant economic value [1]. Several steps are incorporated in palm oil mill processing plant, to extract the palm oil from the fresh fruit, including sterilization, bunch stripping, and fresh fruit bunch (FFB), to name a few steps [2]. The total land under palm oil cultivation for year 2017 hit almost 5.77 million hectares (ha) (one hectare of oil palm produced between 10 and -35 tons FFB per year), indicating 2.23% of the arable acreage in Malaysia. The lifecycle of oil palm is over 200 y, whereas the productive life is approximately 20-25 y. The plant market is between 11 and 15 mon, while the first harvest can be carried out after 32-38 mon of planting [3]. The peak yield of palm oil takes 5-10 y, which is about 45-56% of FFB. The mesocarp of the fruit is used to generate oil. Almost 40-50% of the yield is from kernel. Both kernel and mesocarp of the fruit generate approximately 17 t/ha.y, in which 1 ton of crude palm oil (CPO) can be generated from 5.8 tons of fresh fruit bunch (FFB) [4]. The progression of this industry has vastly contributed to the economy, along with environmental pollution, mainly due to the oil extraction process that generates a significant amount of by-products, including oil palm trunks (OPT), oil palm fronds, empty fruit bunch (EFB), palm pressed fibres, palm kernel shells and palm oil mill effluent (POME) [5]. Discharge of these by-products and effluents into the environment causes adverse effects and environmental pollution. Malaysia has become a prominent producer of POME at the global arena with approximately 50 million tons of production at annual rate [6]. POME is characterised by high organic acid content, carbohydrate, minerals, and