Chapter 21
Smart Microbial Sources Management for Treatment: Palm Oil Mill Effluent and Landfill Leachate

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ABSTRACT

Overpopulation and industrialization are the major sources of wastewater in human society and water resources. Food production industries and municipal solid waste are the root origin of wastewaters containing palm oil mill effluent and municipal landfill leachate. Traditional treatment method for such highly polluted wastewaters cannot meet environmental discharge. Finding an advanced and smart decontamination process for these types of polluted wastewater could be considered as a capable method for suitable adaptation with overpopulation in current condition and future coming decades. This chapter illustrates critical points through the application of traditional treatment techniques such as acclimatization in palm oil mill effluent and municipal landfill leachate as the most straightly polluted agro-industrial effluent.

INTRODUCTION

Waste and wastewater management is one of the most critical requirements of current life style of humankind (Farraji et al., 2015b). Municipal Landfill Leachate (MLL) is known as highly polluted and toxic wastewater in human civilization. This liquid effluent creates when rainwater percolate into the landfill of waste disposal and through the process of degradation of waste materials. Several factors contribute to the amount of leachate generated in a municipal landfill including evapotranspiration, precipitation,

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infiltration, surface runoff, the level of waste compaction as well as the trespass of ground water into the landfill (Costa et al., 2019). The characteristics of landfill leachate are defined by unpleasant odor, chemical oxygen demand (COD), heavy metals, biological oxygen demand (BOD), ammonium nitrogen (NH_4+- N), sulfur components and other toxic materials. As a result, landfill leachate can be considered as seriously polluted waste water that would impose major risks on the environment provided that they are treated accurately (Meky et al., 2017; Costa et al., 2019).

Based on the age of landfill, there are two sets of leachate: 1) Fresh leachate, in five years, with high concentration of COD and BOD and better biodegradability. 2) Aging leachate, over five years, with low concentration of COD and BOD as well as high degree of ammonia and also less biodegradability (Liu et al., 2017).

On the other hand, growing widespread demand of palm oil has caused critical waste rooted in the process of degradation of palm fruits. Palm oil mill effluent (POME) has a high potential of contamination with low pH and high concentration of BOD and COD. The characteristics of this liquid waste are defined by its viscous attribute, brownish color, the components of palm fruits which are water- soluble, a large amount of carbohydrates and lipids ranging from hemicellulose to simple sugars and phenolic materials and also nitrogenous components varying from amino acids to proteins as well as pathogenic bacteria (Wong et al., 2018). POME is markedly polluted which can pose detrimental effects on water bodies and terrestrial lands discharged directly from a mill. When a river or stream receive this kind of sewage, its color turns to brown, slimy and smelly and also brings about de-oxygenation which have harmful effects on aquatic species. Moreover, POME has undesirable effects on physicochemical and nutritional properties of soil and leads to increase in salinity and decline in pH (Islam et al., 2018). Consequently, MLL and POME can be considered as serious resources of contamination which need to treat by proper technologies.

Wastewater treatment even by a specific polishing post treatment method such as constructed wetland depends on the characteristics of wastewater and concentration of pollutants (Vymazal, 2009). Concentrated landfill leachate which is effluent of membrane treatment process through the landfill leachate treatment techniques of wastewater treatment highly depends on the types and concentration of pollutants in target in wastewater treatment plants(Zhang et al., 2013), required several high-tech treatment skills to providing suitable decontamination such as Electro-Ozonation (Mojiri et al., 2019) or combining with adsorbent in augmented sequencing batch reactor for achieving higher efficiencies (Mojiri et al., 2017; Zhang et al., 2013). In case of municipal landfill leachate (MLL) as a common industrial wastewater, there is no single method of treatment to meet environmental discharge regulation (Mojiri, 2014). Meanwhile, adsorbent application is a common treatment for MLL (Farraji et al., 2015c; Foo and Hameed, 2009). Most of the common treatment methods in MLL treatment contain mixing two or more spectacular and adaptive treatment methods such as soil infiltration (Liang and Liu, 2008), combined electro-Fenton oxidation and Sequencing Batch Reactor (Lin and Chang, 2000), biological method attached with growing biomass (Loukidou and Zouboulis, 2001), phytoremediation and adsorbent in microbiological method (Aziz H.A, Farraji, 2017; Mojiri et al., 2016). On the other hand, high concentration of ammonia, toxic compounds, and metallic elements found in MLL make the sludge acclimatization a proper method to treatment.

These methods would be costly and need to use chemical substances through the process of treatment. As a result, a cost-effective and eco-friendly treatment method is required (Islam et al., 2018). Microbiological treatment would be an easiest and a cheapest method with less environmental perils