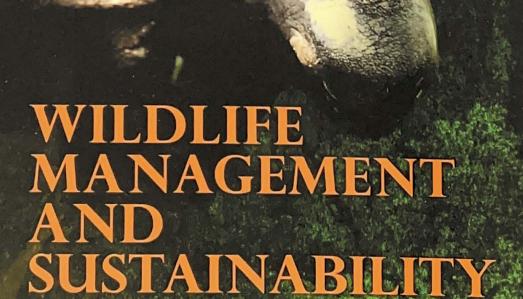


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SAGO WASTEWATER: CHARACTERIZATION AND DEGRADATION BY TIO, PHOTOCATALYSIS

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ABS IRACT

One of the major sectors which have been contributing to the deterioration of water resources as well as accumulation of solid wastes is agriculture. One of the most important crops for starch production is sago palm. It is known that more than 90% of sago-planting areas are found in the state of Sarawak. Malaysia Heavy consumption of water by sago starch production mills have resulted in large volumes of sago effluent Direct release of sago wastewater into water bodies may be inappropriate due to the high amount of organic material, and suspended solids. There are also growing concerns about the solid wastes which include sago roughage (hampos), and sago bark. Hence an effective method or protocol becomes necessary to tackle issues related to this agroindustry Titanium dioxide (TiO₂) photocatalysis is known for its potential to effective b treat various types of wastewater. However, there remains a paucity of studies on sago wastewater abatement over TiO2 photocatalysis. The objective of this study is to investigate the potential of TiO, photocatalysis for the degradation of sago wastewater Discussion pertaining to the properties of sago wastewater and solid residues. performance of T₁O photocatalysis and recommendation for future studies are outlined

Keywords: Advanced oxidation process, Effluent, Agriculture, Environment

INTRODUCTION

Many countries including Malaysia are struggling to cope with water deterioration or depletion issue Agriculture sector being the backbone in terms of economic return to our country, has inevitably contributing to water polhition as well as generation of solid wastes Amongst various crops, crops for starch production are mainly concentrated in the state of Sarawak. In Sarawak, the highest starch producing crop known as sago palm (Metroxylon segu), consume more than 90% of the total planting areas (Singhal et al. 2008, Bujang, 2015) The sago residues from sago starch processing mills are abundantly available. Wastewater effluent generated during sago debarking and sago processing is generally discharged into nearby rivers (Awg-Adeni et al., 2010) Typically, a sago mill which consumes 1,000 logs/day is known to generate approximately 400 tons of effluents (Bujang, 2008). About 94-97% of the bulk of the sago wastewater is liquid, while the remaining portion is solid waste referred as roughage or 'hampas' Sago bark (SB) is another solid waste generated during the debarking step of starch extraction process. Deposition or dumping of SB on land is the most common practice among most of the mill operators to address the disposal

problem of this solid waste. Although such practice provides a short term solution. notential chy ironmental problems could however emerge in the long term

Sago effluent which is complex, acidic and emits obnoxious odour is usually characterised by elevated chemical oxygen demand (COD), biochemical oxygen demand (BOD) and total suspended solids (TSS) ranging from 780-5130 mg.L. 910-1300 mg/L, and 19-20,000 mg/L, respectively (lbrah im et al., 2006, Rashid et al., 2010). Sago wastewater may lead to pollution mainly owing to its high organic content (Ulhiza et al., 2018). As the direct discharge of sago wastewater effluent may cause issues related to environmental deterioration, its upaiment for either re-using or improving its discharged water quality has been the main goals of the sago mill operators

Biological methods such as anaerobic fluidized beds and filters (Sarayanane et al., 2001. Parthiban et al., 2008), three-phase fluidized bed bioreactor (Rajasimman &Karthikevan, 2007), and hybrid upflow anaerobic sludge blanket reactor (Banu et al., 2006) have been commonly applied to treat sago wastewater. Given that the efficiency of biological methods to completely degrade the effluent are poor, other alternative treatments are needed to improve the water quality of sago wastewater (Sangcetha et al., 2015) Titanium dioxide (TiO₂) photocatalysis a non-biological method could be a desirable alternative to degrade organic present in the sago effluent. TiO2 photocatalysis has emerged as an effective method for the degradation of various biorecalcitrant compounds in water and wastewater (Gaya & Abdullah, 2008, Chong et al., 2010)

TiO2 photocatalysis has emerged as a promising wastewater treatment technology with key adventages including the operation at ambient conditions, low cost, lack of mass transfer hmitations and the possibility of utilising solar irradiation as a photon source (Pekakis et al., 2006). Semiconductor TiO2 has been widely applied in the photocatalytic treatments to induce oxidative and reductive reactions on its surface (Chong et al., 2010. Kanakaraju et al., 2018a) Despite the established importance of TiO2 photocatalysis in wastewater purification be it natural or synthetic wastewater, there is limited evidence of whether this technique is capable to degrade sago wastewater

Study area: Sago Mill in Pusa, Sarawak

Sago palm is the species of the genus of Metrovolon which belongs to the Palmae family (Awg-Adem et al., 2010). At present, this species of sago palm is grown commercially in Malaysia. New Guinea, Philippines and Indonesia. The state of Sarawak besides being the world's biggest exporter of sago also possesses the largest sago growing areas in Malaysia. Figure 1 shows the sugo palms found in Pusa, Sarawak. About 44,700 tons of sago starch were exported to Peninsular Malaysia. Singapore, Taiwan, Hong Kong and other countries in 2007 (Awg-Adem et al., 2010). In Sarawak, the total export earnings between US\$ 3.4 million to US\$ 10.8 million were generated from annual export of pure sago starch, which typically fluctuates between 30,000 to 50,000 tons (Bujang, 2014) Five major sago planting areas in Sarawak include Mukah, Pusa-Saratok, Oya-Dalat, Igan and Balingan (Andriana & Ahdullah, 2010) Generally, the sago industries are located along rivers to ease transportation of sago logs (Figure

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