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TREATMENT OF POME BY FLY ASH FROM PALM OIL INDUSTRY

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ABSTRACT

Palm oil industry is the largest contribution to the main organic pollution in Malaysia. The treatment of palm oil mill effluent (POME) is crucial stage to prevent from environmental pollution. The main purpose of this project is to evaluate the efficiency of fly ash to be used as a suitable alternative coagulant for the treatment of POME in palm oil industry. Among the various coagulants, fly ash considered to be very suitable for POME treatment because of it is abundant as waste in palm oil industry. Fly ash was used to evaluate its ability to reduce the total suspended solid (TSS), biological oxygen demand (BOD) and chemical oxygen demand (COD) in POME. Sample1 was collected from Johor and sample 2 from Pahang, Malaysia. High accuracy analytical balance was used to evaluate the reduction of TSS. DO meter was used to measure dissolved oxygen for BOD. The COD procedure used multi parameter calorimeter to obtain the readings. The TSS in sample 1 was found to be 41.38% and for sample 2 was 42.06 %. Under the same experimental conditions the BOD in sample 1 was 42.87 mg/L and for sample 2 was 39.83 mg/L .The COD reading for sample 1 was 150.67 mg/L and sample 2 was 122.33 mg/L. The optimum dose for coagulant was 1g.This method was found to be efficient and cost effective compared to other coagulants.

Keywords: POME, fly ash, coagulant, suspended solid, BOD, COD

INTRODUCTION

In 2008, even though Malaysia had produced 17.7 million tonnes of palm oil based on 4,500,000 hectares of land used for its plantation, Indonesia became the world's largest producer and exporter of palm oil, replacing Malaysia as a chief producer. Palm oil has made impressive and sustained growth in the global market over the past four decades, and it is projected in the period 2016 – 2020, the average annual production of palm oil in Malaysia will reach 15.4 million tonnes. In 1999, the land area under oil palm plantation is about 3.31 million hectares, and it has been projected that Sarawak will have about one million tonnes hectares of oil palm by the year 2010 (Abdullah & Sulaim, 2013). In 2017, palm oil and palm kernel oil production recorded close to one-third (75.17 million tonnes) of world total oils and fats production from a planted area of 19.04 million hectares, mainly from Indonesia and Malaysia. Malaysian palm oil alone fetched RM 46.12 billion

export revenue from its India and European Union markets (Kushairi et al., 2018). The solid waste from palm oil mill industry has been increasing annually where it has been reported that the palm oil waste was produced 4 million tons/years in Malaysia only. Hence, the solution to overcome the problems is to reuse the waste (Zarina, Mustafa Al Bakri, Kamarudin, Nizar, & Rafiza, 2013).Incomplete combustion in the boiler and incinerator produce dark smoke resulting from burning a mixture of solid waste fuels such as shell, fibre and sometimes produce dark smoke resulting from burning a mixture of solid waste fuels such as shell, fibre and sometimes empty bunches. These boiler fly ashes are also a waste themselves and also pose problems of disposal .Since boiler fly ash is a waste and poses disposal problems, then there is huge economic advantage in the use of a boiler fly ash is a waste and poses disposal problems, then there is huge economic advantage in the use of a waste (boiler fly ash) to treat another waste (POME) from palm oil mills. Thus, using a waste to clean - up another waste (boiler fly ash) to treat another waste (POME) from palm oil mills (Igwe, Onyegbado, & Abia, 2010)

EXPERIMENTAL

SAMPLING LOCATION

The samples was collected at the different palm oil mills in Malaysia. The samples contained different organic and inorganic impurities. Figure 1 shown sample 1 were collected at Ulu Tiram, Johor and sample 2 at Jerantut, Pahang.

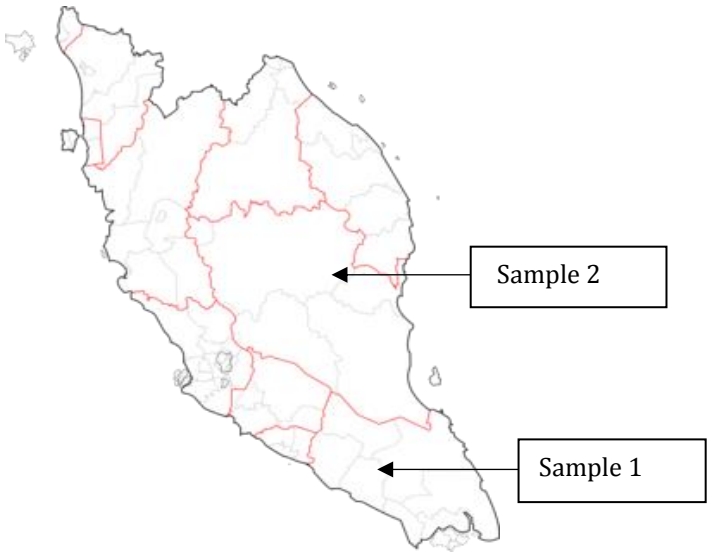

Figure 1. Sampling location

TOTAL SUSPENDED SOLID REMOVAL PROCEDURE

The boiler fly ash and samples of effluent with different concentrations collected from a palm oil mill. Firstly, the experiments will be performed by preparing different dosage of fly ash coagulant in the 200ml of pome. The fly ash-effluent mixtures were stirred in a beaker using jar tester at 200 rpm for 3 minutes. This process called coagulation and flocculation process. The suspended solid was then removed by filtration with Whatman grade 41 filter paper. The experiments were carried out in replications. Experiments carried out by treating about various amount of fly ash into the various amount of effluent to obtain optimum dosage. The mixtures were stirred and filtered by filter funnel with Whatman grade 41 filter paper at various intervals. For the total suspended solid weighted the filter paper use for filtration and put the suspended solid and dry it in over for 7 hours at 100°C.The weight of the suspended solid measure by weighting the final product after drying.

BIOLOGICAL OXYGEN DEMAND AND CHEMICAL OXYGEN DEMAND

The filtrates were analysed for BOD and COD. The treated clear solution of POME with different dosage collected into 100 ml each into the bottle and wrapped up with aluminium foil. The dissolve oxygen meter used to determine the reading for five days. The COD analysis tested using multi parameter portable calorimeter after the 1 ml samples heated with COD reagents in COD reactor for two hours at 150°C.

RESULT AND DISCUSSION

REMOVAL OF TOTAL SUSPENDED SOLIDS (TSS) BY USING OPTIMUM COAGULANT DOSAGE

Figure 2 showed that the removal of suspended solid increased from sample 1 is 41.38% meanwhile for sample 2 is 42.06 % for optimum coagulant dosage of 1.0 g respectively. The removal of total suspended solid reach at equilibrium when the coagulant dosage is1g.This was expected as with the higher dosage of coagulant, the higher suspended solid will be remove at 1g coagulant and started to decline. This is because when coagulant added to the diluted POME to help the colloidal particles to clump together however at 1g coagulant it reached the saturation point where the fly ash disable to clump more suspended solids.

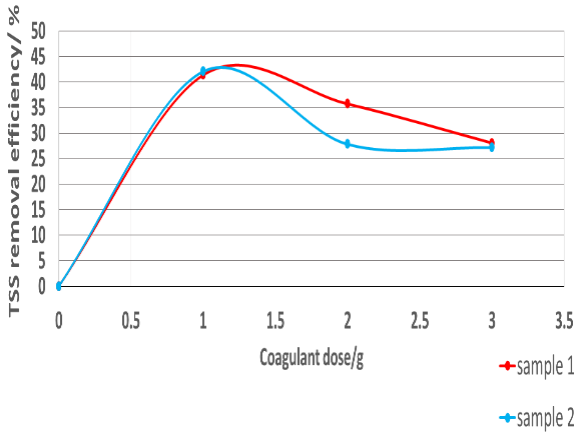

Figure 2 Relationship between coagulant dose and total suspended solid removal efficiency with experimental condition: TSS in stock: 4.54 ppm, pH: 8.5, temperature: 25 °C and dilution factor: 3

BIOLOGICAL OXYGEN DEMAND (BOD)

Figure 3 shown the influence of coagulant dosage on the treatment of POME with the fly ash was investigated in the dosage of 1.0 g to 3.0 g for each samples. Maximum biological oxygen demand (BOD) for sample 1 is 42.87 mg/L meanwhile sample 2 is 39.83 mg/L. This was expected as with the higher dosage of coagulant, the higher BOD results. This is because when the treated POME put in the wrapped aluminium foil bottle it sealed tightly. The amount of the oxygen consumed by microorganisms to break down the organic matter present in the samples during the incubation period. The higher BOD levels because of the demand for oxygen by the bacteria is high and the oxygen dissolved used rapidly.

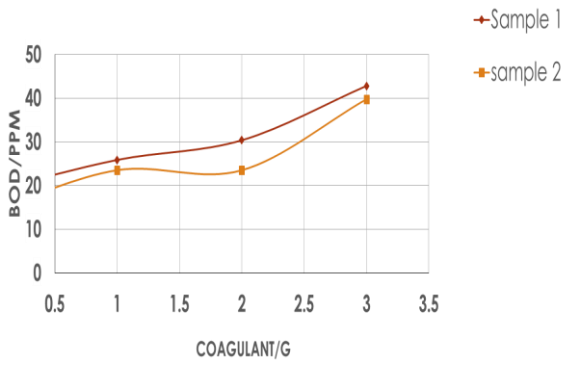

Figure 3. Relationship between coagulant dose and biological oxygen demand (BOD) with experimental condition: BOD in stock: 16.64 ppm , pH:7.6, temperature:20 °C and dilution factor: 3

CHEMICAL OXYGEN DEMAND (COD)

Figure 4 showed the relationship between coagulant dosage and COD. Sample 1 decreasing from 296 mg/L to 150.67 mg/L meanwhile sample 2 is from 382.67 mg/L to 122.33 mg/L. In this research COD decreases with increasing coagulant dosage because the bacteria in the POME grows and degrade the organic matters in POME samples.

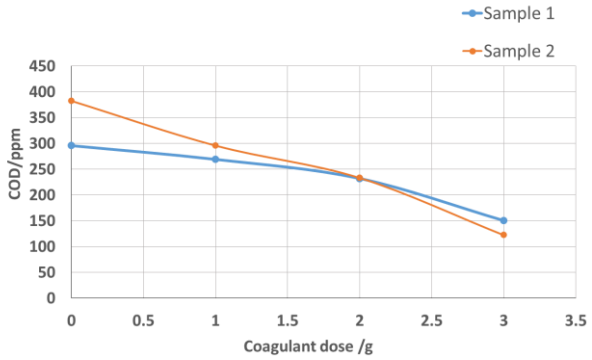

Figure 4. Relationship between coagulant dose and chemical oxygen demand (COD) with experimental condition: COD in stock: 339.34 ppm, pH: 8.5, temperature: 25 ℃ and dilution factor:3

CONCLUSION

The study in this project shows that the fly ash coagulant is a suitable substance to be used as an alternative as coagulant for pome treatment. Different parameters directly related to the preparation of the sample are manipulated to study the optimum coagulant to remove total suspended solids. Based on the results, it is proven that the 1g dose of coagulant have higher removal efficiency for total suspended solid . In this study, the highest removal efficiency obtained were for TSS in sample 1 is41.38% meanwhile for sample 2 is 42.06 %. Next, the highest BOD in sample 1 is 42.87 mg/L and for sample 2 is 39.83 mg/L and the result for COD in sample 1 is 150.67 mg/L meanwhile for sample 2 is 122.33 mg/L. Thus, non-hazardous palm oil mills waste materials like fly ash can be used to remove total suspended solid (TSS), biological oxygen demand (BOD) and reduce chemical oxygen demand (COD) for POME treatment.

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