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Latex Factory Effluent Treatment Using Biomass Power Plant Fly Ash

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Abstract. This research aims to study Latex Factory Effluent Treatment Using Biomass from power plant fly ash. The purpose of the study is to compare treated latex factory effluent using fly ash from power plant with that of industrial effluent standard issued by Thailand's Pollution Control Department. The experiments used Coagulation as chemical treatment method. The experiments were carried out using fly ash with 0, 2, 3, 4, 5 and 6 grams dry weight. The agitation times were 10, 30, 45 and 60 minutes, respectively with the settling time of 30 minutes. The treated water was analysed for the following parameters: pH, turbidity, turbidity, sulfate and conductivity, respectively. The results shown that the best experimental set is Experiment 6, with 6 g fly ash, 60 minutes stirring time and settling time of 30 minutes. The treated turbidity value is 456 NTU COD equivalent to 28000 mg/L, the sulfate content is 23100 mg / L, conductivity is 19590 $\mu\text{s} / \text{cm}$, respectively. The pH value is 5.47 in the experiment 6 with the highest corrected pH possible in this study by adding 6 grams of fly ash with stirring time of 60 minutes. However, other parameters of treated effluent still not meet with industrial effluent standards. Further study and improvement are needed.

Keywords Latex Factory Effluent Treatment; Fly Ash; Biomass Power Plant

1. Introduction

Para rubber is the economic plant generally found in many countries in Asia, especially Thailand as the number two exporter of rubber products after Indonesia. In Thailand, para rubber is mainly plant in southern and east regions. Para rubber products can be used in many ways, such as medical supply, cooking equipment. However, the processing of raw Para rubber into finish goods create a lot of by-products and waste, especially wastewater from skim latex which is the by-product from transforming process. Most wastewater treatment plants in rubber processing factory in Thailand do not meet the environmental standards and usually release wastewater into nearby water sources. Wastewater effluent from rubber plants have high organic and sulfate composition but low in PH which polluted the environment. Most wastewater systems in rubber processing factories are located outdoor and after treatment process, the treated wastewater still has high sulfate contents which is the residual from sulfuric acid used during the processes. Wastewater with sulfate higher than 300 mg/L will then transform into hydrogen sulfate by biological degradation under anaerobic process with strong smell and can cause hazard to the living in high concentration [1]. Power plants in Yala province located in southern Thailand use para wood as fuel in electricity generation process. By-products from this process are bottom ash and fly ash which previously considered as waste and need to be disposed by landfilling method. After scholars have discovered high content of calcium oxide in fly ash which has ability to adsorb phosphorus solution, many follow up researchers has been drawn to attention to use fly ash as wastewater treatment media. The unique ability of fly ash to adsorb phosphorus in liquid form make it



become a high potential media in skim latex wastewater treatment with low pH and could neutral pH level and reduce sulfate concentration before release into water sources.

Research objectives

1. To treat factory effluent using biomass power plant fly ash as coagulation additive.
2. To compare treated latex factory effluent using fly ash from power plant with that of industrial effluent standards.

2. Theoretical Background

Previous study [1]. investigated sulfate treatment in wastewater from concentrated latex factory using fly ash from Phuket waste incinerator in the production process of skim rubber. It was found that the adsorption of sulfate with fly ash was in accordance with Freundlich Isotherm, which is a multilayer adsorption [1]. Another study investigated the utilization of fly ash from power plants to absorb hydrocarbons contaminated in water [2]. The results of the adsorption efficiency of polycyclic aromatic hydrocarbons (Polycyclic aromatic hydrocarbons, PAHs) contaminated in water with rice husk fly ash compared with coal fly ash and silica from rice husk fly ash, both passed and unprocessed by using naphthene (Naphthalene) is an agent for PAHs and is used in serum tritely ammonium bromide. (Cethyltrimethylammoniumbromide, CTAB) is a skin conditioning agent [2]. Other group of researchers also found that removal of Ethylene Glycol in the wastewater from the printing production process by using sawdust fly ash is one of the causes of water pollution from chemicals and solvents used in the production of publications [3]. The main components are ethylene glycol. And derivatives of ethylene glycol from the study of the adsorption efficiency of ethylene glycol with sawdust fly ash Sawdust fly ash that is stimulated by 1: 1 ratio of potassium hydroxide and commercial activated carbon. It is found that the adsorption capacity of ethylene glycol at 30 degrees Celsius is equal to 868, 1,058 and 963 mg of COD per gram of adsorbent, respectively Study of isotopes, adsorption and separation of ethylene glycol Can indicate that adsorption using sawdust fly ash is a physical adsorption the sawdust fly ash that has been stimulated by potassium hydroxide and commercial activated carbon is the physical and chemical adsorption [3]. Another previous study synthesized amorphous geopolymer from coal fly ash and used it as an adsorbent in the removal of Pb (II) lead from wastewater [4]. The result found that removal efficiency will increase with the amount of geopolymer that is used to touch the temperature and if the initial concentration of Pb^{2+} decreases, the best removal efficiency occurs at pH equal to 5 and the isotropic study Adsorption found that the Langmuir isotherm model is compatible with the most experimental data. It also found that the adsorption process would be better if the temperature increased as well [5]. One group of researchers used fly ash as a cationic heavy metal adsorbent for wastewater treatment using Class "F" fly ash (FA) collected from Romania's central heating and power plant. Found that fly ash is a good absorbent and can absorb heavy metal, positive electrode, Pb^{2+} , Cd^{2+} and Zn^{2+} from waste water with high efficiency This experiment can create an absorbent material called FA-Z from fly ash that is used to analyse complex adsorption processes in wastewater containing heavy metals, three types of anode, including zinc, lead and cadmium. From the study of adsorption Found that this new material has a high lead removal capability and can remove lead from waste water that contaminates both cadmium and zinc under a short period of contact and can work well in different heavy metal concentrations as well . Lastly, the study of the geopolymer adsorbent obtained from fly ash in the removal of copper charge from wastewater. The experiment was done in a shift to study the process of adsorption of copper by geopolymer derived from fly ash (FA) by observing the effect of concentration, solution and temperature on the adsorption process at a fixed particle size. It was found that the adsorption capacity of copper would increase when the initial concentration and temperature increased. The results also showed that the synthetic geopolymer from fly ash had a very good adsorption capacity and can be used as a material to effectively absorb copper [6].

3. Methods

The absorbent material is biomass power plant fly ash. Wastewater used in the experiment collected from the concentrated latex in 8 local factories. Wastewater from skim rubber production is a wastewater from rubber fermentation ponds in the process of rubber band production by pulling solid rubber from the rubber digester which will leave only the water in the fermentation ponds that will be drained into the wastewater treatment system. The chemicals used in the experiments and chemical analysis are in the laboratory quality level. The purpose of the study is to compare the treated latex factory effluent qualities using fly ash from power plant with that of industrial effluent standards. by adding fly ash in synthetic wastewater containing sulfate stir with the Jar-Test machine at a speed of 125 rpm with adjusting concentration of fly ash from 0, 2, 3, 4, 5 and 6 grams per litre and the stirring time of 10, 30, 45 and 60 minutes, respectively. The retention time and appropriate concentrations in sulfate treatment Fly ash and stirring time have been analysed to find the suitable conditions for sulfate treatment in synthetic wastewater from skim latex rubber factories. After each precipitation set, the experiment will be analysed according to the parameters as follows [7]: pH, turbidity, COD, sulfate and conductivity, then followed by the process of experimenting to determine the appropriate conditions for the treatment of sulfate in the skim latex rubber wastewater. The test will begin by adding wastewater in the container (beaker) 1 litre of wastewater. Then adding fly ash to the wastewater by adjusting concentration of fly ash as 0, 2, 3, 4, 5 and 6 grams per litre, respectively. Stirring with stirrer- Jar-test at 125 rpm with stirring time of 10, 30, 45 and 60 minutes, respectively. Leave it to precipitate for 30 minutes, analysed the parameters and recorded the results.

4. Results and Discussion

The purpose of the study is to compare treated latex factory effluent using fly ash from power plant with that of industrial effluent standards by precipitation and coagulation methods with 6 sets of experiments. The wastewater has multiple polluted contents with chemical characteristics, therefore, the wastewater from concentrated rubber industry is most suitable to be treated by chemical precipitation and coagulation methods. From the analysis of pH in wastewater before adding fly ash, the results showed that the pH of the wastewater before adding fly ash had pH between 3.41 - 5.47 which will cause the wastewater to have a higher acid-base value than the acceptable range of wastewater effluent before discharge into water sources (neutral pH of 7-8 is preferable). After the precipitation process, the pH has become higher with time and adding fly ash improve the level of pH significantly. as shown in Figure 1, stirring time of 60 minutes have higher in pH in all sets of experiment and concentration of fly ash at 6 g/L yield highest result in improving pH level of wastewater. The studies treatment of sulfate in wastewater from concentrated latex factory using fly ash from Phuket waste incinerator in the production process of skim rubber. Have a higher pH value [1].

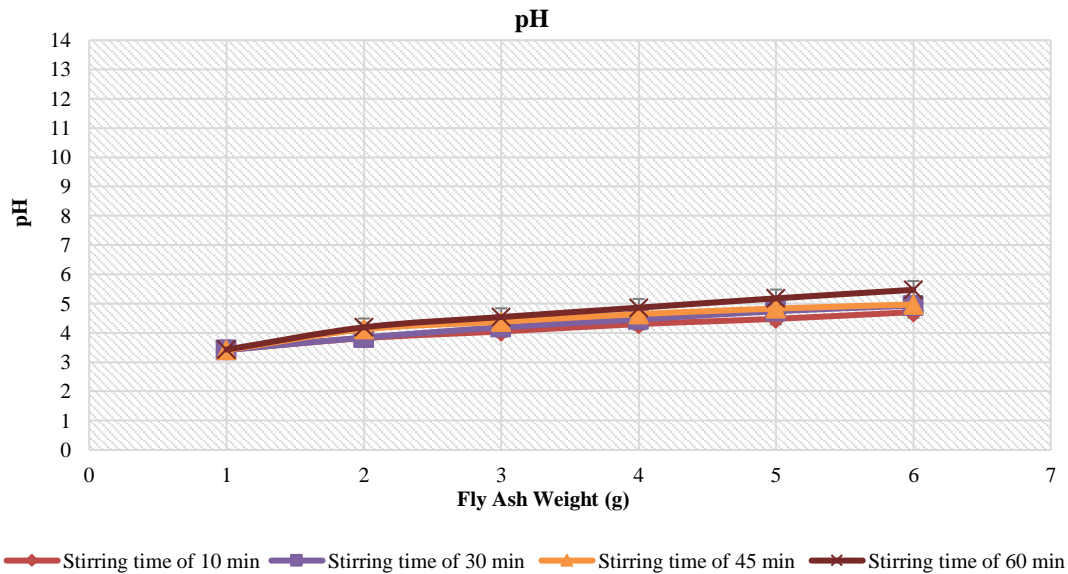


Figure 1. Graph showing pH

From turbidity analysis, it was found that the turbidity of wastewater before adding fly ash was high at 1,288 NTU at the time of stirring 10, 30, 45 and 60 minutes but the turbidity values of the wastewater after added fly ash in the amount of 2 g at a period of 10, 30, 45 and 60 minutes stirring time were reduced to 1252, 1210, 1195 and 960 NTU, respectively. The turbidity values of wastewater with fly ash in the amount of 3 g at 10, 30, 45 and 60 minutes stirring time have were reduced to 1067, 1120, 968 and 811 NTU, respectively, The turbidity values of wastewater with fly ash in the amount of 4 g, at the duration of 10, 30, 45 and 60 minutes stirring time were reduced to 1047, 967, 697 and 689 NTU, respectively. The turbidity values of wastewater with added fly ash in the amount of 5 g, at the duration of 10, 30, 45, and 60 minutes stirring time were reduced to 878, 864, 652 and 518 NTU, respectively. The turbidity values of wastewater with added fly ash in the amount of 6 g, at the duration of 10, 30, 45 and 60 minutes of stirring time were reduced to 841, 830, 582 and 496 NTU respectively, as shown in Figure 2. The studies treatment of sulfate in wastewater from concentrated latex factory using fly ash from Phuket waste incinerator in the production process of skim rubber. The reduced turbidity level [1]. The efficiency of turbidity analysis can be concluded that the higher concentration of fly ash and stirring time, the lower the turbidity of treated wastewater.

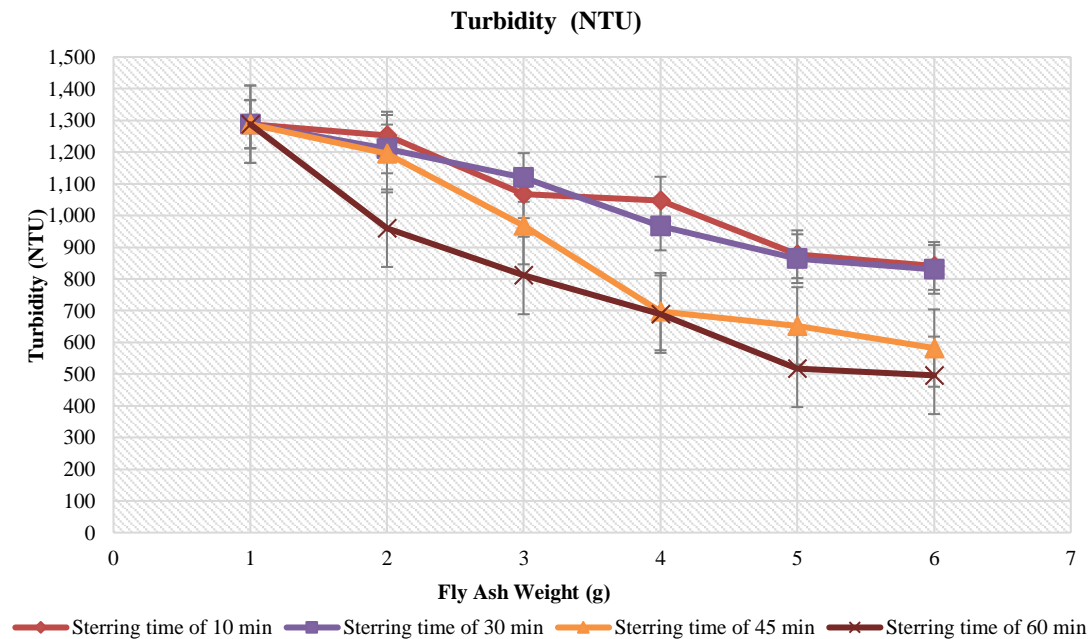


Figure 2. Graph showing turbidity values

From COD analysis showed that COD values of wastewater before adding fly ash were high at 36800 mg/l at 10, 30, 45, and 60 minutes of stirring times but the COD levels in the wastewater after added fly ash in the amount of 2 g at the duration of 10, 30, 45 and 60 minutes of stirring time were reduced to 35200, 35200, 33600 and 32000 mg/l, respectively. COD levels of wastewater with fly ash at 3 g at 10, 30, 45 and 60 minutes stirring time were at 33600, 35200, 33600 and 30400 mg/l, respectively. COD levels in the wastewater with fly ash in the amount of 4 g at a period of 10, 30, 45, and 60 minutes stirring time were at 32000, 33400, 32000 and 27200 mg/l, respectively. The COD levels in wastewater with added fly ash in 5 g volume at 10, 30, 45 and 60 minutes stirring time were at 30400, 33400, 32000 and 28000 mg/l, respectively. The COD levels in wastewater with added fly ash in volume of 6 g at 10, 30, 45 and 60 minutes stirring time were at 30400, 33400, 32000 and 28000 mg/l, respectively, as shown in Figure 3. The results of COD efficiency analysis can be concluded that the experiment with fly ash 6 g, and stirring time at 60 minutes, has the highest efficiency. Therefore, when adding fly ash, the COD value decreased slightly.

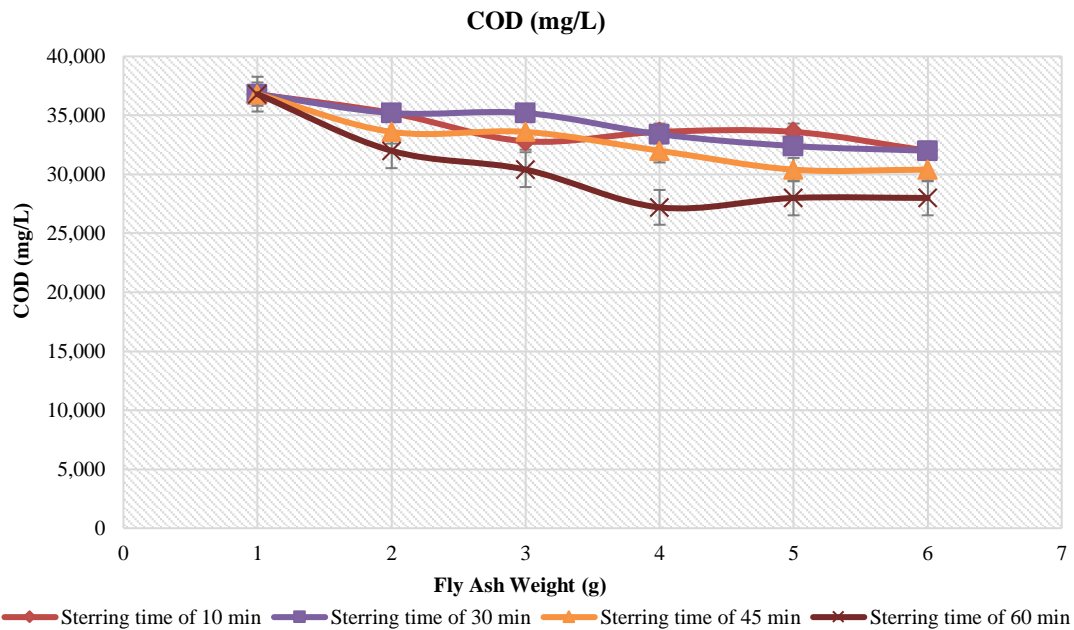


Figure 3. Graph showing COD values

From sulfate analysis, it was found that the sulfate values of wastewater before adding fly ash were at 24400 mg/l at 10, 30, 45 and 60 minutes stirring time and the sulfate value of wastewater with added fly ash in volume of 2 g at 10, 30, 45 and 60 minutes stirring time were at 21000, 20300, 18700 and 21600 respectively. The sulfate values in wastewater with 3 g of fly ash at 10, 30, 45 and 60 minutes stirring time were at 22500, 17800, 17900 and 19300, respectively. The sulfate value in wastewater with added fly ash in the amount of 4 g at 10, 30, 45, and 60 minutes stirring time were at 17300, 17300, 19800 and 22000, respectively. The sulfate values in wastewater with added fly ash in the amount of 5 g at 10, 30, 45, and 60 minutes stirring time were at 16700, 16900, 22400 and 19800, respectively. The sulfate values in wastewater with added fly ash of 6 g at 10, 30, 45, and 60 minutes stirring time were reduced to 21000, 19600, 21500 and 23100, respectively. Therefore, as shown in Figure 4, the results of the sulfate efficiency analysis can be concluded that the experiment with fly ash 5 g at 10 minutes stirring time has the highest sulfate removal. We can conclude that adding more fly ash can only slightly increase sulfate removal efficiency from wastewater.

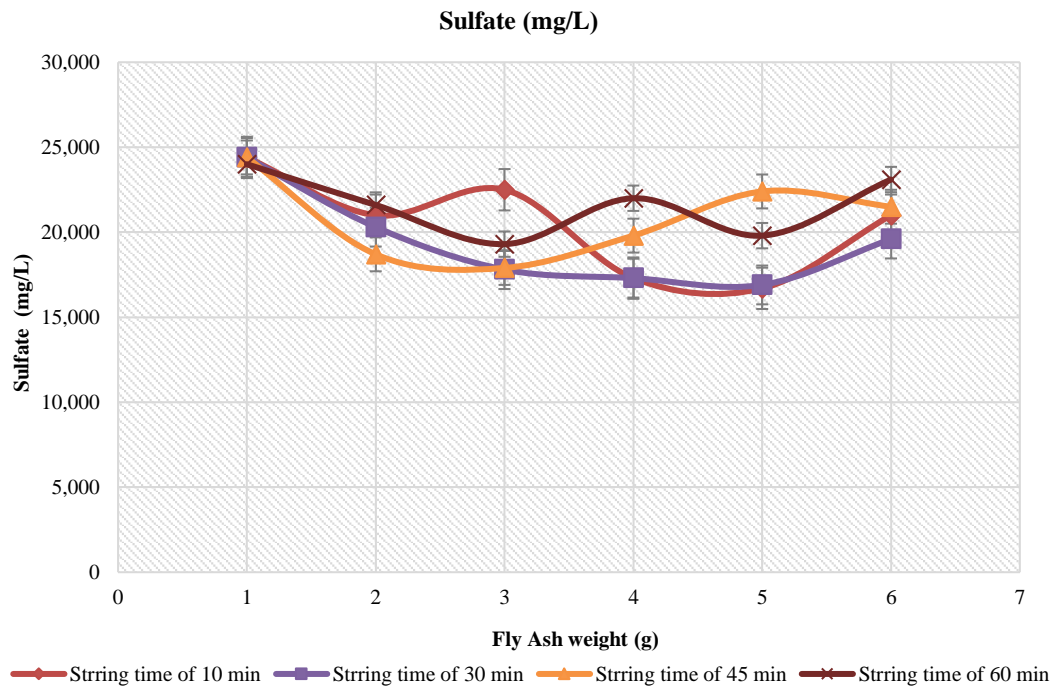


Figure 4. Graph showing sulfate values

Discussion of the results following the second objective

This study has 2 Objectives 1) To treat factory effluent using biomass power plant fly ash as coagulation additional media. 2) To compare treated latex factory effluent using fly ash from power plant with that of industrial effluent standards. The experiment employed the chemical treatment process using sedimentation by mean of coagulation method with 6 sets of experiments using fly ash at concentration of 0, 2, 3, 4, 5, and 6 g/L, with stirring time at 10, 30, 45 and 60 minutes, respectively. The following parameters; pH, COD, turbidity, sulfate and conductivity has been analysed. The pH of the wastewater before adding fly ash were 3.41-5.47. The result after the treatment found that at the fly ash concentration of 6 g, with stirring time of 60 minutes yielded the highest efficiency in increasing pH values, removal of COD and sulfate, and improving turbidity and conductivity conditions of treated wastewater. The results obtained from this study are consistent with the results [1]. The results showed that adding fly ash can reduce wastewater turbidity. Since fly ash can absorb the colour of wastewater, so the turbidity can be reduced. Electrical conductivity also reduced after adding fly ash, since it was known that inorganic compounds dissolved in water are sulfates, which contain anion with a negative charge and higher sulfate resulting in higher conductivity. Increasing fly ash concentration and stirring times also make the COD values slightly reduced. This is because fly ash can only absorb a small amount of organic matters in wastewater and fly ash itself also contain organic matter. The analysis of sulfate removal found that when the fly ash concentration and the stirring time increased, the amount of sulfate values will be decreased slightly. This is because fly ash was unable to absorb too much amount of sulfate. The results shown that the best experimental set is Experiment 6, with 6 g fly ash, with 60 minutes stirring time and settling time at 30 minutes. The treated turbidity value is 456 NTU COD equivalent to 28000 mg/L, the sulfate content is 23100 mg /L, conductivity is 19590 $\mu\text{s/cm}$, respectively. The pH value is corrected to 5.47 and it's the highest value received by adding 6 grams of fly ash with

stirring time of 60 minutes. However, other parameters in treated wastewater are still not meet with that of industrial effluent standards.

5. conclusion

From the results of the experiment, it was found that Experiment 6, with 6 g fly ash, with 60 minutes stirring time and settling time at 30 minutes has the best results in treating latex factory effluent with the treated turbidity value of 456 NTU COD equivalent to 28000 mg/L, the sulphate content of 23100 mg / L, and conductivity of 19590 ($\mu\text{s} / \text{cm}$), respectively. The experiment 6 also give the best result for adjusting pH value to 5.47 which is in an acceptable value for treated latex factory effluent according to industrial effluent standard issued by Thailand's Pollution Control Department. However, other parameters of treated wastewater are still not meet with industrial effluent standard. Since the effluent entered the experiment was high polluted. Further study with pre-treatment is needed to decrease the concentration level of pollution in wastewater before entering the treatment process. With pre-treatment system installed, it will help decrease pollution and increase pH values of wastewater before entering the coagulation process, thus make the fly ash treatment process results more successfully and meet with all industrial effluent standards.

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