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INFLUENCE OF TEXTILE LIQUID WASTE TREATMENT METHODS ON CONCENTRATIONS OF ADSORBEN BOTTOM ASH

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Abstract: Liquid waste treatment must be carried out by every textile industry before being discharged into the environment, this needs to be done so as not to cause a bad impact on water resources or prevent environmental damage. This research is an experimental wastewater treatment by utilizing solid waste from coal, namely bottom ash with a comparison of two methods, which include filtration and batch. This experiment aims to become an alternative for wastewater treatment that can be used to reduce water pollution levels in the environment by utilizing waste water. This experiment was conducted by comparing two methods, namely the filtration method in which the waste flows through a cylindrical glass column in which there is foam, gravel, and bottom ash, while the batch method is to ensure even contact between the adsorbent and the adsorbate. Parameter evaluation carried out are Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), and Total Suspended Solid (TSS). Based on the results of research and testing conducted on waste treatment using bottom ash is proven to be the best results on the filtration method. The COD parameters for the Filtration method and the Batch method for COD results from the Filtration method are 268.8 mg O_2/L while the COD produced by the Batch method is 576 mg O_2/L. In this TSS test the result of the Filtration method is 20 mg/L while the Batch method is 200 mg/L. For BOD testing, the results of the Filtration method are still better than the Batch method. The result of the Filtration method is 104 mg O_2/L while the Batch method is 134 mg O_2/L.

Keywords: textile waste, bottom ash, filtration method, batch method

1. INTRODUCTION

One of the environmental problems is caused by liquid waste from industrial activities. Liquid waste that is not managed properly will have a tremendous impact on waters, especially water resources. Nature has the ability to neutralize pollution that occurs if the amount is small, but in large quantities it will have a negative impact on nature because it disrupts the balance of the environment so that environmental damage occurs. This can be prevented by treating industrial waste before being discharged into river. Waste discharged into the river must meet the quality standards that have been set, because the river is a source of clean water for the community, there for it is expected that it will not be polluted and can be used for other purposes. Provisions regarding textile industry wastewater quality standards are regulated in the Minister of Environment Regulation Number P.16/MENLHK/SETJEN/KUM.1/4/2019. In this regulation there is a change in a new parameter, namely the color parameter which was not previously listed in the MenLH Regulation N0.6 of 1999.

The results of research in the field show that almost all large and medium-scale textile companies have wastewater treatment plants (IPAL). However, in reality, only a small number of companies are able to process waste in accordance with established quality standards. Another problem is the presence of harmful heavy metals in some textile dyes, including Cu, Ni, Cr, Hg and Co in the form of functional groups. These pollutants exist in textile wastewater because in the dyeing process only part of the dye is absorbed by textile materials, the rest (20-50%) remains in textile wastewater (Theresia, 2004).

The use of chemical substances such as alkalis, starches, acids, oxidizing agents, reducing agents, electrolytes, surfactants, dyes and high heat in the textile industry process causes textile liquid waste to have a high pH, Total Suspended Solid (TSS), Biological Oxygen Demand (BOD) and high Chemical Oxygen Demand (COD), colorless, oily, hot and smelly. If this textile waste is disposed of directly into the environment, it causes environmental pollution and often creates conflicts between industry and the surrounding community.

One of the wastes produced by textile factories is the use of coal as an alternative energy source which is a fuel substitute for oil in the textile industry. Coal in the textile industry is used for boilers or water boilers in the dyeing process and is used for power generation. Total use of coal reaches 10-20% of the total coal used per day. The coal combustion waste produced consists of fly ash and bottom ash. Coal contains mineral matter in the form of inorganic compounds that do not burn and become combustion residues. If is not managed properly, it will disturb the community.

Bottom ash is a solid waste generated from burning coal in power plants. Bottom ash waste can be used as an additive in waste stabilization and as an artificial zeolite and adsorbent. Bottom ash has more pores and has more macropores (>50nm) than commercial carbon and the surface area of bottom ash is 548 m^2/g and the calorific value is 6370 cal/g. The adsorption capacity of reactive black 5 and acid red 4 dyes was 56 and 47 mg/g, respectively, and these results were better than commercial activated carbon. Microstructure analysis using SEM showed that bottom ash activated carbon has a large number of macro-pore structures on its surface. Bottom ash has good adsorption ability so that it can bind organic substances and heavy metals. Bottom ash contains silica and alumina which function as porous media that have the potential to be used as adsorbents for metal ions, as well as other content that can bind organic substances and polar and non-polar bonds in wastewater.

It is necessary to select processing units and effective media to reduce pollutant substances to the large number of types and concentrations of pollutants in textile wastewater. To obtain optimal results, waste treatment must be carried out in an integrated manner, namely by combining physical, chemical and biological treatment based on the nature of textile wastewater. One of the physical waste treatment processes is the filtration process. Bottom ash can also be used as a raw material for the manufacture of synthetic zeolite to absorb heavy metals and also as a filtration medium (Deperindag Bandung, 2006).

The results of previous studies have informed that coal bottom ash has a capacity of good adsorption to absorb heavy metal ions and organic substances. The major components of bottom ash are silica (SiO_2) and alumina (Al_2O_3), while the other components are iron (III) oxide (Fe_2O_3), calcium oxide (CaO), magnesium oxide (MgO), sodium oxide (NaO) and potassium oxide. (K_2O). From these data it can be seen that coal bottom ash has the potential to be used as an adsorbent.

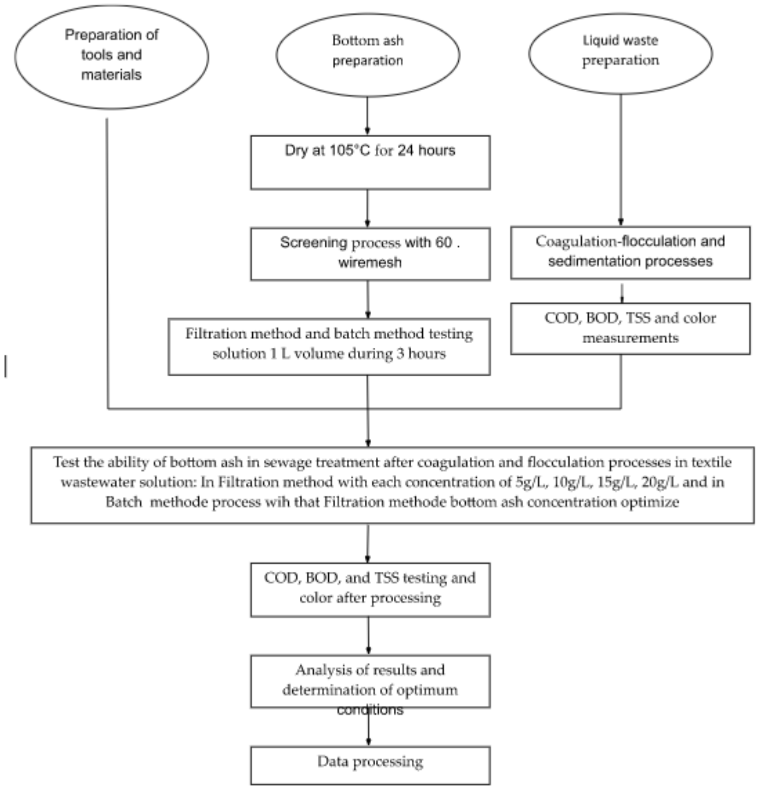
2. MATERIALS AND METHODS

a. Materials used

The materials used in this research include: Gravel, Foam, Fabric, Polyfloc, Poly Aluminum Chloride (PAC), Bottom Ash from PT.X, Wastewater from PT.X, $K_2Cr_2O_7$, H_2SO_4, Ag_2SO_4, ferroin indicator, Phosphate Buffer, $MgSO_4$, $CaCl_2$, $FeCl_3.6H_20$, $MnSO_4$, $Na_2S_2O_3$.

b. Method

The research method used



Picture. 2.1 Research flow chart

3. TEST RESULTS

3.1 Characteristics of textile wastewater used

The used of liquid wastewater is obtained from the waste produced by the textile wet production unit at PT. X in Bandung Regency area with characteristics that can be seen in the following table.

Table 3. 1 Results Characteristics of the wastewater used

Wastewater Color	**Grey**
pH	7,2
Smell	sulfur
Initial COD	1536 mgO_2/l
Initial BOD	530,4 mgO_2/L
Early TSS	201 mg/L
Color	81,27 ppm

3.2 Coagulation Test Results – flocculation in the filtration method

The results of textile wastewater testing after the coagulation and flocculation processes using the filtration method can be seen in the following table.

Table 3.2 Coagulation Test Results – flocculation in the filtration method

COD	456,96 mg O_2/L
BOD	201 mg O_2/L
TSS	56 mg/L
Color	40,42 ppm
pH	3,9

3.3 Result of textile wastewater characterization using bottom ash concentration of 5 g/L filtration method

The results of the characterization of textile wastewater using a bottom ash concentration of 5 g/L with the filtration method can be seen in the following table.

Table 3. 3 Characterization results of effluent after filtration

Test	Test Parameter Value	
	After Coagulation - Flocculation	After Filtration
BOD	201 mg O_2/L	104 mg O_2/L
COD	456,96 mg O_2/L	268,8 mg O_2/L
TSS	56 mg/L	20 mg/L

3.4 Characterization results of textile wastewater using a bottom ash concentration of 5 g/L batch method

The results of the characterization of textile wastewater using a bottom ash concentration of 5 g/L with the batch method can be seen in the following table

Table 3. 4 Characterization results of effluent after filtration

Test	Test parameter value
BOD	134 mg O_2/L
COD	576 mg O_2/L
TSS	200 mg/L

4. DISCUSSION

4.1 The effect of using bottom ash on the COD value

In its own working principle, COD is a parameter that tests the content of organic and inorganic compounds, especially organic, in the test sample being oxidized by $Cr_2O_7^{2-}$ in closed reflux for 2 hours to produce Cr^{3+}. Excess potassium dichromate that is not reduced is titrated with a solution of Ferro Ammonium Sulfate (FAS) using a ferroin indicator. The required amount of oxidant is expressed in oxygen equivalents (O2 mg/L). COD itself is a parameter to determine the amount of oxygen needed to chemically oxidize organic and inorganic substances in wastewater using a strong oxidizing agent.

In the batch method, the activated carbon adsorbent is contacted with the wastewater for a certain period of time. Carbon is able to adsorb these solutes into the cracks on its surface. When a solution is in contact with porous activated carbon grains, the solute molecules are attracted to the pore surface and are held in the pores by weak forces. With the presence of very large number of micro pores on activated carbon bottom ash, it will cause capillary symptoms that effect absorption. In this COD parameter the results from the comparison of the Filtration method and the Batch method for COD results from the filtration method get much better results than the Batch method, which is 268.8 mg O_2/L while the COD produced by the batch method is larger, namely 576 mg O_2/L.

4.2 The effect of using bottom ash on the BOD value

In principle, the more bottom ash used, the lower the BOD value. In a test wastewater sample the more bottom ash used, the more carbon content. This shows that this liquid waste treatment tool is quite effective in reducing the high BOD value in liquid waste. Bottom ash itself functions well in absorbing and degrading liquid waste so that the BOD value decreases quite significantly. This is due to the activity of microorganisms in wastewater treatment that work optimally in degrading organic materials. The activity of microorganisms that function as decomposers can only work if there is a sufficient amount of oxygen (PUSPARPEDAL, 1996).

In the BOD test, the results of the filtration method are still better than the batch method. The result of the filtration method is 104 mg O_2/L while the batch method is 134 mg O_2/L. In these two methods, the filtration and batch method, each has its own advantages and disadvantages, the filtration method has a disadvantage that we have to adjust the speed of the water discharge, while the disadvantage of the batch method is that wastewater quickly becomes saturated which requires more adsorbent time. Another disadvantage of the batch method is that it takes quite a long time than the filtration method, but even so the filtration method must go through a coagulation-flocculation process in which the batch method does not need to do it, fortunately the coagulation-flocculation process the wastewater becomes clearer even though the results have not been through the filtration method. which makes the results of the comparison of the wastewater treatment process between filtration and batch different. The results are quite significant.

4.3 The effect of using bottom ash on the TSS value

In principle, the test sample that has been homogeneous is filtered using filter paper that has been weighed. The residue retained on the sieve was dried to a constant weight at 105°C. The increase in sieve weight represents the total suspended solids. If suspended solids obstruct the sieve and prolong filtration, it is necessary to increase the diameter of the pores of the sieve or reduce the volume of the test sample. To obtain the TSS estimate, the difference between total dissolved solids and total solids was calculated. The decrease in TSS value before and after processing can be seen visually, as evidenced by the clearer waste that has been treated than before it is processed. This is because bottom ash acts as sedimentation, so the filtrate that comes out is clearer.

In this TSS test the results from the filtration method are 20 mg/L while the batch method results are 200 mg/L. It can also be seen in the graph above that the results of the filtration method filter more particles or waste impurities; it looks like the batch method wastewater is cloudier in the water compared to filtration method.

5. CONCLUSION

From the discussion of the experimental results, it can be concluded that bottom ash is able to absorb textile factory wastewater well and between the two methods, the filtration and batch methods, the results show that the filtration method is better than the batch method.

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