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Effectiveness of aluminum electrode in reducing bod, cod, ammoniac, and chromium in leather tannering waste with the electrocoagulation process

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ABSTRACT

Tanning industry skin use ingredient chemical and water in amount which so much This process produces liquid waste containing various organic substances from ingredient raw and substance chemical from additional materials used During process tanning. This study aims to determine the efficiency of the electrocoagulation method in reducing the parameters BOD, COD, ammonia, and chromium. A sample of 100 liters of leather tanning waste water used is put into a grease trap and flowed into an electrocoagulation bath in which electrodes (3 cathodes and 3 anodes) have been arranged. The electrocoagulation process lasted for 60 minutes. Parameters of wastewater quality examined include BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand), ammonia, and total chromium. The method for measuring the quality parameters of tannery wastewater uses the appropriate Indonesian National Standards. The results of the measurements will be analyzed descriptively by comparing the results with the standards of the Minister of Environment of the Republic of Indonesia Number 5 of 2014 concerning Quality Standards for Tannery Wastewater. After the electrocoagulation process is complete, then the effectiveness is calculated in percent (%). The effectiveness of the electrocoagulation process in reducing the levels of parameters from the highest percentage was total chromium (62.01%); COD (58.29%); BOD (52.52%); and ammonia (42.79%). The electrocoagulation process is quite effective in reducing the levels of tannery wastewater quality parameters.

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INTRODUCTION

The leather tanning industry is a processing industry leather into finished goods to complement human daily needs like bag, shoe, jacket, craft hand and etc. Finished skin is skin animal which experience tanning, which previously has free from hair, tendon, and meat in lower skin. Tanning

skin use ingredient chemical and water in amount which many, so that This process produces liquid waste containing various organic substances from ingredient raw and substance chemical from ingredient used During process tanning.

The Magetan Leather Industry Environment (LIK) is located in Tulung Hamlet, Ringinagung Village, Magetan District, Magetan Regency is company which move in field processing skin raw until it becomes skin ready to be processed for in the process of becoming goods so. Raw material used that is goat and sheep skins. Process Leather tanning consists of three main processes, namely the pre-tanning process (beam house), tanning (tanning) after tanning (finishing). So that produces a type of skin that is strong and resistant to environmental effects such as microbial influences, heat, sweat, or moisture etc., are processed addition sour, salt, and then tanning with chromium salts (Wahyulis et al, 2014). Types of waste generated in the activity production skin tan form waste liquid, mud and waste congested (Sugihantoro, 2016).

Negative impact The leather tanning process includes: waste liquid with high organic matter content, and various pollutants such as sulfates, chromium, synthetic tannins, oils and resins. So produce solid waste which are lumps of flesh, fur, and fat sufficient big. Only 20% from skin which can changed Becomes skin commercial. Based on the results of testing the quality of leather tanning wastewater with used by the Environmental Laboratory Technical Implementation Unit for the Environment Service, the East Java Provincial Government used the grab sampling technique in April 2020 there is parameter which exceed NAV that is parameter BOD (Biological Oxygen Demand) of 129.6 ppm; COD (Chemical Oxygen Demand) of 283.5 ppm; TSS (Total Suspended Solid) of 113.5 ppm; total ammonia (NH 3 -N) of 38.7 ppm; and chrome total (Cr) of 1.61 ppm. Results the exceed raw quality based on the Regulation of the Minister of Environment of the Republic of Indonesia Number 5 Years 2014 concerning Quality Standards for Leather Tannery Industry Wastewater, namely a BOD of 50 ppm; COD of 110 ppm; TSS of 60 ppm; ammonia of 0.5 ppm; and chromium of 0.6 ppm.

Chromium (Cr) in leather tanning industry wastewater originated from process production tanning skin, use compound chromium sulfate between 60-70% in the form of chromium sulfate solution, but on process tanning no everything could absorbed by skin so the rest issued in form waste liquid (Teak et al, 2015). The leather tanning industry produces a sufficient volume of liquid waste high content of organic and inorganic pollutants. Content substance organic which no could oxidized in tanning waste _ skin cause the value of the content of the parameters BOD and COD in waste high (Srinivan, 2010). If the BOD and COD in wastewater are high, it will disrupt the life of biota in the waters. This is due to the low oxygen levels in the waters which is caused by more oxygen being used to degrade or oxidize existing organic substances (Sulhan, 2017).

Waste treatment efforts to improve the quality of existing parameters can use chemical, physicochemical, and biochemical methods (Hoon, 2012). Electrocoagulation is one method that can be applied to improve the quality of wastewater before it is discharged into the environment (Pulka et al, 2014). Electrocoagulation has several factors that affect the process inside, including electrode material, pH of the solution, current density, processing time, pollutant concentration, anion concentration, temperature, and other factors (Vepsalainen, 2012).

RESEARCH METHOD

This type Batch system electrocoagulation technique with aluminum (Al) electrode plates with a plate thickness of 0.3 mm. The device consists of an electrocoagulation bath with a volume of 75 x 50 x 40 cm 3 which contains 6 plates (3 cathodes and 3 anodes), electrodes connected to a direct current (DC) source in the form of a power supply . The surface area of each electrode is 40 x 30 cm 2 carrying a current of 40 A, a voltage of 12 V, and a distance between the electrodes of 10.7 cm. A sample of 100 liters of leather tanning waste water used is put into a grease trap , after which it is flowed into an electrocoagulation bath in which electrodes have been arranged. The electrocoagulation process runs for 60 minutes (1 hour).

The method for measuring the quality parameters of tannery wastewater uses the Indonesian National Standard, namely SNI 6989.3:2019 for TSS; SNI 6989.2:2019 for COD; SNI 6989.72:2009 for BOD; SNI 06.6989.30:2005 for ammonia; and SNI 6989-84:2019 for total chrome. The results of the measurements will be analyzed descriptively by comparing the results with the standards of the Minister of Environment of the Republic of Indonesia Number 5 of 2014 concerning Quality Standards for Tannery Wastewater.

RESULTS AND DISCUSSIONS

Grease trap is used as a control tank equipped with inlet and outlet pipes which function to separate fat and solids and also functions as a primary processing unit to remove light components such as oil and grease. Oil and fat from leather tanning industry waste comes from the fleshing process in the form of remaining fat and meat residue from the non-chrome process of tanned rawhide. Fleshing waste in the form of devil meat contains high protein with high fat content as well. Fleshing is a solid skin waste that pollutes the environment because it decomposes easily and has a very large volume. Because the fleshing waste is obtained from the process after liming, then during the fleshing process when removing the fat and remaining meat, it is rinsed with water, then the fat and meat that is removed merges with the water and is discharged into the sewer. The content in oils and fats consists of lipid compounds, ester compounds, alcohols, and other volatile compounds (Burton, 2015).

Based on the measurement results of the tannery wastewater quality parameters, the results are the highest decrease in the concentration of water quality parameters is in the total chromium parameter. If the amount of reduction is calculated, the total chromium reduction is 573 ppm. The level of effectiveness of the electrocoagulation process for each parameter after being calculated, the percentage of effectiveness is obtained as follows:

Table 1. The effectiveness of the electrocoagulation process in reducing parameter levels Tannery Wastewater Quality

No	Parameter	Before (ppm)	After (ppm)	Decline (ppm)	Effectiveness (%)
1	Chemical Oxygen Demand (COD)	197.95	82,554	115,396	58.29553
2	Biological Oxygen Demand (BOD)	86,616	41,124	45,492	52.52147
3	Ammonia (NH3-N)	409	234	175	42.78729
4	Total Chrome (Cr-T)	924	351	573	62.01299

The high content of COD in a water can disrupt the life of biota that live in the river. This is due to low oxygen levels as a result of the oxygen contained in the river which can oxidize organic substances (Sulhan, 2017). In this study, the decrease in COD parameters after treatment with electrocoagulation was quite high, namely 58.29%, but it still did not meet the established standards.

BOD or *Biochemical Oxygen Demand* is a characteristic that shows the amount of dissolved oxygen needed by microorganisms (usually bacteria) to decompose or decompose organic matter under aerobic conditions. BOD is an illustration of the amount of biodegradable organic matter in *waters* (Erick, 2011). From the test results, it appears that the BOD content in the liquid waste has decreased sufficiently from 86.616 to 41.124 so that the decrease is more than 50%.

The test results showed that the ammonia content in the liquid waste decreased by 42.78%. This shows that after going through the electrocoagulation process, the ammonia content still does not meet the set standard (0.5 ppm) so it is still a hazardous material that can damage

health. Ammonia can be toxic to humans if the amount that enters the body exceeds the amount that can be detoxified by the body, namely not more than 100 mg/kg per day (33.7 mg ammonium ion per kg body weight per day) which can affect metabolism by changing acid-base balance in the body. In addition, ammonia with a concentration of 130-200 ppm in gas form is irritating to the skin, eyes and respiratory tract (Fawel, *et al* (1996); Azizah and Mira (2015)).

The liquid waste from the leather tanning industry has a high content of organic matter and pollutants such as sulfates, chromium, synthetic tannins, oils and resins. The presence of Cr in the ecosystem can have a negative impact on the life of aquatic organisms. Cr (VI) has high toxicity when absorbed in living organisms. Bioaccumulation of chromium metal in living things affects health, mutagenic effects on bacteria as well as mutagenic and carcinogenic effects on animals and humans. Under conditions of high doses, Cr (VI) can cause death (Lal Shah, 2010).

The contact time in the electrolysis process also affects the current strength generated. The longer the contact time, the greater the current generated. The greater the current generated, the more the formation of flocs on the electrode plate. According to Yudhistira et al, (2018) the longer the electrocoagulation process time, the better the decrease in pollution parameters, this is also in accordance with *Faraday's law* which states that the longer the process time, the more coagulant is formed. Based on research by Lestari and Agung (2014) the longer the contact time and the greater the current, the greater the decrease in COD. This is due to the process of oxidation and reduction in the electrocoagulation reactor. Oxygen and hydrogen gases are formed at the electrodes which affect the reduction of COD. Based on the double layer theory, the decrease in COD is caused by the floc formed by organic compound ions bonding with coagulant ions which are positive. The molecules in batik waste are formed into flocs, the colloidal particles in the waste are binding to the particles. Treatment for 1 hour has not been effective in reducing the Cr and COD levels of leather tanning waste, so it is necessary to add variations in contact time or modify methods in processing the waste.

CONCLUSION

Based on the research results, the electrocoagulation process is quite effective in reducing the levels of tannery wastewater quality parameters. The order of magnitude of the percentage decrease from the highest is total chromium (62.01%); COD (58.29%); BOD (52.52%); and ammonia (42.79%). The electrocoagulation method can be used for the processing of leather tanning waste and will be maximized when combined with other processing methods.

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