

The Quality Of Wastewater In The Small Industrial Environment (SIE) Of Leather In Magetan Regency

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Abstract: The Small Industrial Environment (SIE) of leather in Magetan Regency is a center of leather tanning that aims to meet market needs for the leather. However, the process of leather tanning production causes various environmental problems, especially on water quality. Water quality issues affect the lives around them, hence the water must be processed at the Wastewater Treatment Plant (WWTP). This research aims to examine the quality of wastewater as the impact from SIE of leather in Magetan Regency with the level parameters of biological oxygen demand (BOD₅), chemical oxygen demand (COD), oil and fat, chromium (Cr), total suspended solid (TSS), and total ammonia (NH₃-N). This was a quantitative research and the water quality data were taken through random sampling. The results showed that the level of BOD₅ was 39.6 mg.L⁻¹, COD was 96.6 mg.L⁻¹, oil and fat was 2.1 mg.L⁻¹, Cr was 0.689 mg.L⁻¹, TSS was 169 mg.L⁻¹, and total ammonia was 107.5 mg.L⁻¹. In conclusion, some water quality parameters remained exceed the allowable environmental quality standard.

Keywords: wastewater quality, small industrial environment of leather.

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I. Introduction

Rapid industrial development is caused by the application of advanced science and technology by humans to get better quality of life. Unfortunately, it has impacts on harming human survival. These impacts must be mitigated because they can disrupt ecological and environmental balance which affects quality of living environment. One industry that is growing rapidly is leather tanning industry. Leather production aims to fulfill market needs for the leather.

The Small Industrial Environment (SIE) of leather in Magetan Regency is one of the centers of tanning owned by Indonesian Government which is located at 07°39'35.4" S - 11°19'9.9" E. In addition to be as a tourist city, Magetan Regency is also famous as leather production center from near and far. In magetan, many leather tanning activities are encountered from household to small-scale industries, as well as the leather craft production centers that produce bags, shoes and other leather products²⁰.

Leather tanning at SIE in Magetan Regency is an activity that uses large amount of chemicals and water. The tanning process starts from soaking, liming, deliming, bating, pickling, tanning, dyeing, fatliquoring, and finishing. The development of this industry is beneficial for economic growth, nevertheless it has negative impact on declining environmental quality due to the disposal of waste produced¹⁶. One of them is decreased water quality.

Decreased water quality can be seen from the main parameters, namely biological oxygen demand (BOD₅), chemical oxygen demand (COD), oil and fat, chromium (Cr), total suspended solid (TSS), and total ammonia (NH₃-N). Biological Oxygen Demand (BOD₅) is a characteristic that shows the amount of dissolved oxygen needed by microorganisms (usually bacteria) to break down or decompose organic matter in aerobic condition^{18,24}. Chemical Oxygen Demand (COD) is the amount of oxygen needed to decompose organic materials contained in water^{5,24}. Meanwhile, oil and fat are produced during the production process, especially when coloring and softening leather after tanning. Besides, Cr metal is a pollutant that is harmful to the ecosystem that can damage biodiversity^{2,4,21}. Total Suspended Solid (TSS) is a water quality parameter that is associated with light penetration and pollutant transport¹⁰ whereas total ammonia is a comprehensive picture of the environment which is a result of human activities and pollutants²⁵.

Law of The Republic of Indonesia Number 32 Year 2009 regarding Environmental Protection and Management²³ and the East Java Governor Regulation Number 52 Year 2014 regarding Wastewater Quality Standards for Industry and/or Other Business Activities for Leather Tanning Industry¹⁷ obligate environmental

maintenance to deal with the impacts caused by leather tanning activities. One of the maintenances has been processed through the Wastewater Treatment Plant (WWTP). Waste management with WWTP must be carried out sustainably and according to procedures. Sustainable waste management requires good strategies, thus businessmen and workers can understand and implement it to obtain a better quality of environment.

Research on the quality of wastewater as a result of SIE of leather in Magetan Regency is important to be implemented. In addition, it requires monitoring and policy from the Magetan Regency Government and academics, as well as cooperation and self-awareness of the tanneries in SIE of Magetan Regency to protect both industrial and non-industrial environments. Effective waste management strategies are expected to create a safe living environment from pollution of industrial activities, especially from leather tanning activities. This research aims to examine the quality of wastewater as the impact of leather production activities of SIE in Magetan Regency with BOD₅, COD, oil and fat, Cr, TSS, and total ammonia.

II. Material And Method

Time and Location of Research

The research was carried out in December 2017 in SIE of leather located at Jl. Teuku Umar, Magetan Sub-district, Magetan Regency (07°39'35.4" S - 111°19'9.9" E). Wastewater analysis was conducted in the Environmental Laboratory of East Java.

Tools and materials

The tools used were 100 mL measuring cups, water samplers, test kits for BOD, COD, oil and fat, HI Photometer, GPS, calculator, and stationery.

Meanwhile, a number of materials needed were effluent wastewater from WWTP of SIE of leather, Magetan Regency, chemical substance to test the levels of BOD₅, COD, oil and fat, Cr, TSS, and total ammonia.

Research design

This was a quantitative research. In this research, water quality data were taken through random sampling. Parameters of outlet wastewater quality observed were the levels of BOD₅, COD, oil and fat, Cr, TSS, and total ammonia.

III. Results

The results of the research on the quality of outlet wastewater as a result of the SIE of leather in Magetan Regency with the parameters of BOD₅, COD, oil and fat, Cr, TSS, and total ammonia are presented in Table 1.

Table 1: Outlet wastewater quality data.

Parameters	Test Results (mg.L ⁻¹)	Status*
BOD ₅	39.6	Not exceed
COD	96.6	Not exceed
Oil and Fat	2.1	Not exceed
Cr	0.689	Exceed
TSS	169	Exceed
Total Ammonia	107.5	Exceed

* The East Java Governor Regulation Number 52 Year 2014 regarding Wastewater Quality Standards for Industry and/or Other Business Activities for Leather Tanning Industry Activities

IV. Discussions

The BOD₅ level in the WWTP outlet wastewater of SIE of leather in Magetan Regency was 39.6 mg.L⁻¹. The observed BOD₅ level did not exceed the environmental quality standard determined on Attachment 1 of the East Java Governor Regulation Number 52 Year 2014 regarding Wastewater Quality Standards for Industry and/or Other Business Activities for Leather Tanning Industry Activities, which is 100 mg.L⁻¹. The BOD₅ level showed that the amount of oxygen needed by microorganisms to oxidize organic matter in the water was high¹³. BOD₅ parameter or biochemical oxygen demand is the amount of oxygen needed by microorganisms to decompose organic compounds in aerobic condition⁷. This biochemical oxygen demand is inversely proportional to the presence of dissolved oxygen. High BOD₅ level means oxygen needed by microorganisms in water is a lot, hence the remaining oxygen in water is a little. On the contrary, low BOD₅ level means that the oxygen needed by microorganisms in water is small, and the remaining oxygen in the water is a lot²⁶.

Then the COD level in the WWTP outlet wastewater of SIE in Magetan Regency was 96.6 mg.L⁻¹. The observed COD level also did not exceed the environmental quality standard as stated on Attachment 1 of the East Java Governor Regulation Number 52 Year 2014 regarding Wastewater Quality Standards for Industry and/or Other Business Activities for Leather Tanning Industry Activities, which is 250 mg.L⁻¹. The COD level indicated that the total amount of organic materials contained in the water, both easily biodegradable and hard to decompose⁹. COD parameter or chemical oxygen requirement is measurement of the amount of organic

compounds in water which is equivalent to the need for the amount of oxygen to oxidize organic compounds chemically⁸. COD parameter is correlated with BOD₅, indicating the presence of organic substances in water that can convert oxygen to carbon dioxide. As a result, water becomes oxygen deficient¹².

The difference in level between COD and BOD₅ gives an illustration of the amount of organic matter that is difficult to decompose in water. BOD₅ can approach the level of COD, but BOD₅ level cannot be greater than that of COD. Therefore, COD level describes the total amount of organic materials available²⁴.

The oil and fat level in the WWTP outlet wastewater of SIE of leather in Magetan Regency was 2 mg.L⁻¹. This level did not exceed the environmental quality standard based on Attachment 1 of the East Java Governor Regulation Number 52 Year 2014 regarding Wastewater Quality Standards for Industry and/or Other Business Activities for Leather Tanning Industry Activities, which is 5 mg.L⁻¹. Oil and fat are produced during the process of coloring and softening the leather after tanning process. They are component of plants or animals consisting of triglyceride ester from fatty acids³. Fat waste can be reused as soap, and oil can be used in tanning²². The petroleum ingredient (fatliquor) which is put into the skin functions as lubricant and helps the fibers to push/bind to one another which can improve the mechanical and physical properties of leather¹⁵.

Besides, the Cr level in the WWTP outlet wastewater of SIE of leather in Magetan Regency was 0.689 mg.L⁻¹. The observed metal level exceeded the environmental quality standard as declared on Attachment 1 of the East Java Governor Regulation Number 52 Year 2014 regarding Wastewater Quality Standards for Industry and/or Other Business Activities for the Leather Tanning Industry Activities, which is 0.5 mg.L⁻¹. In a free environment, Cr is usually found in the forms of Cr (VI) ions and Cr (III) ions¹⁴. Cr (VI) ions are soluble, highly mobile, have strong oxidizing ability, highly toxic, carcinogenic, dermatotoxic, teratogenic, mutagenic, and can result in death in humans, animals and microorganisms^{2,19}. Meanwhile, excessive Cr (III) ions can enter cells and cause damage to DNA⁶.

In addition, the TSS level in the wastewater was 169 mg.L⁻¹. The level exceeded the environmental quality standard as stated on Attachment 1 of the East Java Governor Regulation Number 52 Year 2014 regarding Wastewater Quality Standards for Industry and/or Other Business Activities for Leather Tanning Industry Activities, which is 100 mg.L⁻¹. The TSS level indicates the number of suspended solids in the water in the forms of organic and inorganic materials which have negative impact on water quality because they reduce the intensity of light entering water for phytoplankton photosynthesis that reduces oxygen production¹¹.

Last, the level of total ammonia in the wastewater was 107.5 mg.L⁻¹. This total ammonia level exceeded the environmental quality standard based on Attachment 1 of the East Java Governor Regulation Number 52 Year 2014 regarding Wastewater Quality Standards for Industry and/or Other Business Activities for Leather Tanning Industry Activities, which is 10mg.L⁻¹. Total ammonia is toxic to water, therefore when polluting free water it can reduce the water quality²⁶. Total ammonia is produced by decomposition of organic matter in industrial activities¹.

Based on the Law of the Republic of Indonesia Number 32 Year 2009 regarding Environmental Protection and Management, it is an obligation to maintain environment to deal with the impacts caused by leather tanning activities. One of the maintenances that has been processed is through WWTP. Waste management through WWTP must be sustainable and be carried out according to procedures. Sustainable waste management requires good strategies, hence businessmen and workers can understand and implement the management to obtain a better quality of environment.

V. Conclusion

The research results showed that the level of BOD₅ was 39.6 mg.L⁻¹, COD was 96.6 mg.L⁻¹, oil and fat was 2.1 mg.L⁻¹, Cr was 0.689 mg.L⁻¹, TSS was 169 mg.L⁻¹, and total ammonia was 107.5 mg.L⁻¹. Based on the East Java Governor Regulation No. 52 Year 2014 regarding Wastewater Quality Standards for Industry and/or Other Business Activities for Leather Tanning Industry Activities, the quality of the outlet wastewater did not meet the allowable quality standards of liquid waste.

One suggestion drawn from this research is that academics, bureaucrats, and communities together should supervise and give inputs to developers and entrepreneurs in carrying out waste management. It is also recommended to implement processing system, monitoring and professionalism strategies.

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