Development of Multi-Filtration Method in Waste Treatment of PT "X" Glasses Industry in Surabaya

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Abstract

The wastewater treatment plant (WWTP) is a vital instrument for the industrial world to treat its liquid waste, not to endanger the environment. The eyeglass lens industry has wastewater with very high turbidity due to residual sediment from the lens cutting and scrubbing process. The treatment of liquid waste with a filtration system aims to reduce the value of TSS, COD, pH, Oil, and Grease and observe BOD so that it is hoped that the treated water can be clearer to be used as raw water for the following process (Reuse). Experimental results from research with physical tests using filtration or membrane methods show the levels of TSS previously 46.033 mg/L to < 2.5 mg/L, pH previously 6.9 to 7.1, COD previously 373.3 mg/L to 265 mg/L, Oil & Grease previously 2.88 mg/L to 2.03 mg/L, and BOD5 previously 100.2 mg/L to 105.4.

Keywords: *WWTP, Liquid Waste, Filtration, TSS, Reuse*

1. INTRODUCTION

PT X is a manufacturer of lens glasses in Surabaya. Waste of PT X has TSS, pH, BOD, COD, and its oils and fats exceed the allowable threshold. Meanwhile, the waste is placed in temporary storage tanks. PT X's wastewater treatment plant in Surabaya was damaged due to improper maintenance. This Condition occurs because the personnel on duty are unavailable. After all, the company is experiencing financial difficulties during the Covid-19 pandemic. PT X was founded in 2004, closed in 2006, and reopened in 2007. The owner of PT "X" is Mr. Rudy Limsa and Subiharto, while the General Manager from 2013 until now is Mrs. Febry Yana. PT "X" will have 65 employees in 2023. This Condition is after reducing 20 personnel during the COVID-19 pandemic. The company's products are single-vision, one-focus, bifocal or two-focus, and progressive or multi-focus lenses. The composition of the stock lens and brush lens is 70: 30. The trademarks owned by PT X include: SB, CW, and NT for stock lenses, while for brushed lenses, it is brand D.

PT X's market is people in East Java and Bali. In 2022 PT X will expand to the Central Java region and the Special Region of Yogyakarta. PT "X"'s production capacity, originally 8,000 pairs of lenses per month, is predicted to reach 12,000 pairs per month this year. Peak production capacity is usually in the months leading up to Eid al-Fitr and New Year's Christmas. Quiet conditions are generally 5,000 to 6,000 orders per month. PT X lens raw materials are obtained from the parent company in Medan. The raw material in semi-finished lenses will be processed into lenses according to the order and cut according to the customer's order frame.

The glass lens-cutting machine uses two semi-automatic machines. The production of mica lenses uses 2 Essilor machines, two Delta machines, and one Berjaya machine. There are two units of automatic machines to produce double progressive lenses. The lens tinting process is carried out in 2 ways. The first is the manual method with heating and immersion systems to

get lenses with permanent coloring. In comparison, the second is by using a coating system according to the color ordered by the customer according to the lens color catalog.

The lens coating system uses a green or blue coating to block UV rays. The blue light coating is usually used on special-order lenses to counteract radiation. One example is photochromic lenses. Photochromic lenses are divided into two types, namely photochromic lenses, which come from lens materials and photochromic lenses, which are only a layer of lenses. Photochromic lenses function to block UV rays in outdoor areas so that the lenses automatically darken when exposed to direct sunlight. The density of photochromic lenses depends on whether or not the intensity of sunlight is bright. Photochromic lenses will become normal or white when they re-enter the room automatically.

Based on PT X, it produces liquid waste with a volume of approximately 1500 liters per month up to 3000 liters per day. The Condition before this research was that the liquid waste from cutting and rubbing the lens was stored in a temporary storage tank. The tub is on the bottom of the existing cutting or scrubbing machine. Then if the water in the holding tank is very cloudy, the water is filtered using a white cloth, and then the remaining solid particle deposits are put into sacks to be sent to the third party. This Condition is what happened when the WWTP at PT X was damaged. The pollutant content in the process wastewater was measured with TSS parameters of 46,033 mg/L, PH 2.03 mg/L, COD 373.3 mg/L, BOD 100.2 mg/L, and oil and fat content of 2.88 mg/L L. So far, this waste has been reused for cutting lenses' cooling and washing processes. Some of the pump equipment was damaged, as well as the quality of the cutting, which was less accurate. This waste Condition requires processing to meet the acceptable standard of wastewater.

Liquid waste treatment, in general, can be done physically, chemically, and biologically [1]. These processes remove suspended solids, colloids, and dissolved organic matter. Processing processes that include physical processing include screening, sedimentation, filtration, centrifugation, and flotation. Treatment processes that include chemical processing are coagulation, neutralization, and electrochemistry [2]. The filtration method has several advantages in waste treatment. These advantages include the fast process, low cost, scalable, and easy-to-operate equipment.

The filtration method in waste treatment is waste treatment by separating solids from liquids using porous media. Solids can be in the form of suspended matter and colloids. The filtration process aims to remove suspended and colloidal particles through filtering and filtering media from waste or liquid [3]. Filtration can also separate precipitated chemical phosphorus [4]. Some researchers use several filters with different pore sizes to lighten the filter load. This method is often called multi-filtration. Various filter sizes can facilitate the process of cleaning and maintaining the tool.

This study aims to treat wastewater using a physical method using a multi-filtration system to reduce the value of TSS, COD, pH, oil, and fat content. Processing products are expected to be reused as processed raw water.

2. METHOD

This research method was experimental in one PT X Surabaya's Eyewear Lens Industry population. Wastewater treatment research is carried out by providing filters arranged in series. The sample wastes the lens cutting and polishing and observation sheet data. Data collection in this study used the TSS observation sheet instrument, pH, BOD, COD, and oils and fats.

The waste treatment method is carried out using a multi-filtration process. Waste containing microplastics and other suspended matter is pumped into a multi-filtration system to produce raw water for the following production process. This process is shown in Figure 1.

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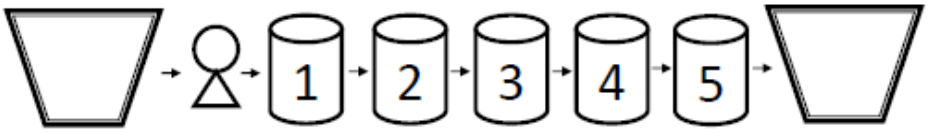

Figure 1. Multi-filtration process

Experiment with processing waste by filtering through stages. In the first stage, the wastewater from scrubbing and cutting the lens enters the grease trap. In this tool, fat and oil are retained, and waste with solid particles proceeds to the next stage. The second stage is pumping waste to the first filter. The first filter size, 10 microns, is a bag filter type. In the third stage, the product of stage 2 flows into filter II and then into the 2nd storage tank called the intermediate tank. In the fourth stage, the liquid in the middle tank flows with the help of a pump into the filter cartridge with a dimension of 0.5 microns. The fluid flows into a filter cartridge with a smaller size of 0.3 microns and then into a third filter cartridge with a dimension of 0.1 microns. In the fifth stage, the product liquid from the 0.1-micron filter cartridge enters the filter tank. Furthermore, the quality of the product is analyzed.

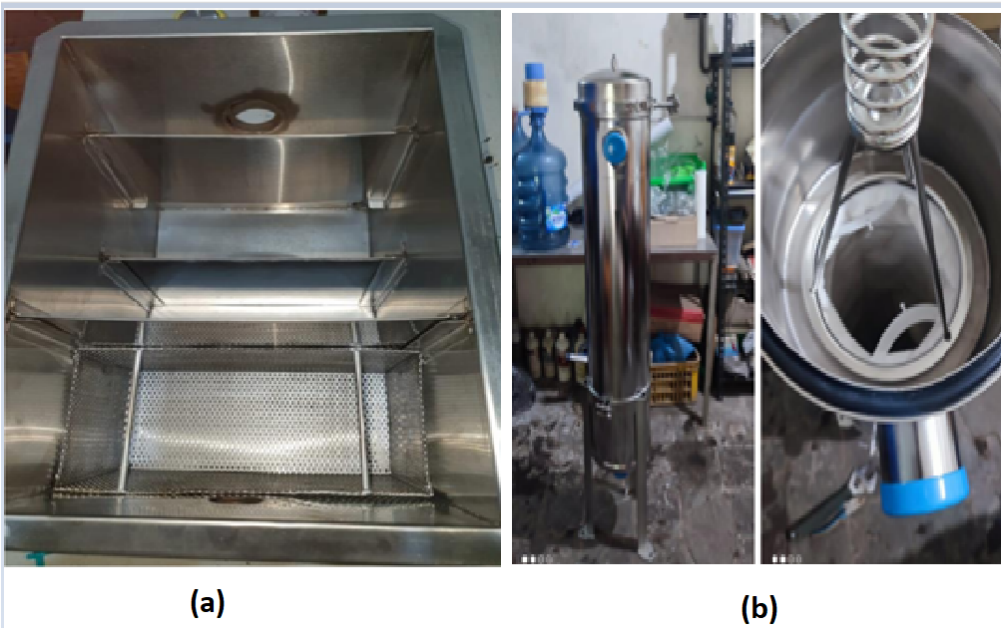

Figure 2. (a) Oil and grease trap; (b) Bag filter

3. RESULTS AND DISCUSSION

3.1. The quality of wastewater from the manufacture of eyeglass lenses

The waste generated is the remaining water from cutting and polishing the lens. The wastewater was from the PT X eyeglass lens industry in Jalan Dukuh Kupang, Surabaya. This laboratory permit determines the wastewater content left over from the lens-cutting and polishing process. The following is the quality of the spectacle lens industry wastewater compared to the Threshold Value according to East Java Governor Regulation No. 72 of 2013 concerning wastewater quality standards for the spectacle lens industry and business activities, as shown in Table 1.

Table 1. Specifications for wastewater from the eyeglass lens industry compared to Threshold Value

Spesification	Value	Threshold Value	Unit
TSS	46.03	150	mg/L
COD	373.30	150	mg/L
pH	6.90	6-9	mg/L
Oil adn Fast Content	2.88	15	mg/L
BOD	100.20	60	mg/L

The results of measurements of the specifications for the content of wastewater before treatment were: pH 6.9, COD 373.3 mg/L, BOD 100.2 mg/L, TSS 46,033 mg/L, and Oil and Fat 2.88 mg/L. TSS, COD, and BOD wastewater values do not meet the waste quality standards in East Java, Indonesia. Processing with multiple filtrations produces product specifications from wastewater shown in Table 2. Table 2 shows that all parameters TSS, COD, pH, and oil and fat content have met the threshold value; only BOD has not met.

Table 2. Specifications for wastewater treatment products using multi-filtration compared to threshold values

Spesification	Value	Threshold Value	Unit
TSS	<2.5	150	mg/L
COD	265	150	mg/L
pH	7.1	6-9	mg/L
Oil adn Fast Content	2.03	15	mg/L
BOD	105.4	60	mg/L

Product specifications for wastewater treatment using the filtration method are pH 7.1 mg/L, COD 265 mg/L, BOD 105.4 mg/L, TSS < 2.5 mg/L, and Oil and Fat content 2.03 mg/L.

Table 2 shows a decrease in TSS wastewater from 46,033 mg/L to less than 2.5 mg/L. The percentage of TSS removal was 99.995%. This data shows that the multi-filtration process was successful in reducing TSS levels. This Condition happens because the multi-filtration process retains the suspended matter as microplastics and glass powder grains. The results of this study are under the results of the research by Anik Agustine et al., 2016. The results of research with a multi-filtration system in this study were better, with a removal percentage of 99.995% compared to previous studies using a tracking filter which only achieved a removal percentage of 88.56%.

The product wastewater treatment showed that the COD value decreased by 29.011%, the Oil and Fat values decreased by 29.51%, while the pH and BOD required further processing. The source of the results of wastewater measurements from the Laboratory of PDAM Surya Sembada City of Surabaya after being processed using physical tests with the filtration method shows safe results for processed raw water that is free from pollutant content, be it TSS, pH, COD, BOD, Oil, and Grease content.

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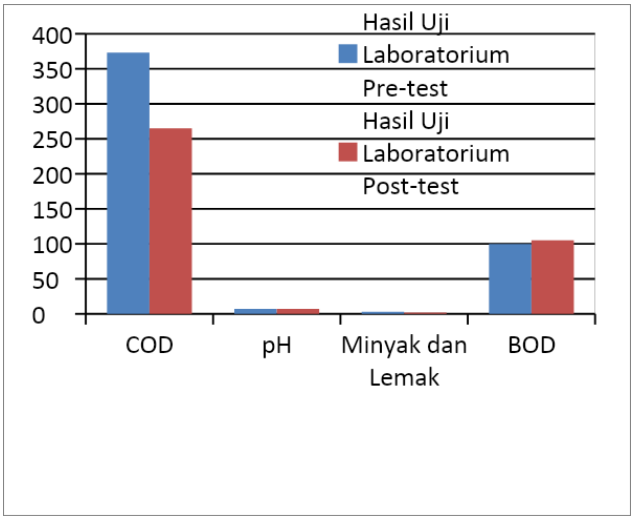

Figure 3. Comparison of laboratory test results for COD, pH, Oil, Fat, and BOD values during the pre-test and post-test

4. CONCLUSION

Based on all the steps carried out in the thesis entitled "Installation of Wastewater Treatment (WWTP) with Physical Methods Using a Filtration System to Reduce TSS Values and Observing COD, pH, Oil and Grease and BOD Values in the Glasses Lens Industry PT "X" Surabaya" has the conclusions obtained are (1) with the remaining wastewater treatment using the filtration method, researchers can find out how to treat the residual wastewater from the lens cutting and polishing process using physical tests using the filtration method. The filtration method can reduce the TSS level of dispensing liquid waste in the PT "X" Surabaya eyewear lens industry from Total Suspended Solid (TSS) 46,033 mg/L to <2.5 mg/L, pH 6.9 to 7.1, Chemical Oxygen Demand (COD) previously 373.3 mg/L to 265 mg/L, Oil & Grease (OG) previously 2.88 mg/L to 2.03 mg/L, and Biochemical Oxygen Demand (BOD5) previously 100.2 mg/L to 105.4. So that it can be used again as raw water for lens-cutting or polishing activities, and (2) with this research, researchers can find out that PT "X" Surabaya's eyeglass lens industry during the pandemic did not treat its waste because its wastewater treatment installation was damaged due to a lack of personnel maintaining the WWTP, so the temporary storage tanks have a very heavy wastewater load. And with this research, researchers can solve problems regarding liquid waste in cutting and rubbing lenses with physical tests using the filtration method.

THANK-YOU NOTE

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