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Penggunaan Metode *Multi Soil Layering* (MSL) untuk Penyisihan Pencemar pada Limbah Cair Industri Pembekuan Ikan

The use of Multi Soil Layering (MSL) for Reducing Pollutans og Fish-Freezing Liquid Waste

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ABSTRAK

Metode Multi Soil Layering (MSL) adalah metode pengolahan limbah yang memanfaatkan tanah sebagai media dalam penyisihan parameter. Metode MSL sudah banyak digunakan pada berbagai pengolahan limbah cair seperti limbah cair domestik, industri dan lain sebagainya. Namun, belum pernah ditemukan publikasi pengolahan limbah cair industri pembekuan ikan dengan menggunakan metode MSL. Oleh karena itu penelitian ini bertujuan untuk mendapatkan efektivitas metode MSL dalam menurunkan parameter Chemical Oxygen Demand (COD), Total Suspended Solid (TSS) dan pH pada limbah cair industri pembekuan ikan. Variasi yang digunakan pada penelitian ini adalah variasi 1, 2 dan 3 layer SMB. Penelitian ini menggunakan variasi waktu pengolahan 24, 48 dan 72 jam. Pengolahan limbah cair industri pembekuan ikan menggunakan metode MSL dapat menurunkan kadar COD, TSS, dan menetralkan pH. Hasil dari pengolahan limbah cair industri pembekuan ikan menggunakan metode MSL pada parameter COD senilai 41 mg/l dengan efektivitas penurunannya 90,33%, parameter TSS senilai 49 mg/l dengan efektivitas penurunannya 88,94%, dan mengalami perubahan nilai pH menjadi 7,7 pada variasi 1 layer SMB dengan waktu 72 jam. Metode MSL diharapkan menjadi sebuah alternatif baru pada pengolahan limbah cair industri pembekuan ikan sehingga dijadikan metode dalam mengolah limbah cair yang dihasilkan.

Kata Kunci: Limbah cair, Multi Soil Layering (MSL) dan Soil Mixture Block (SMB), Chemical Oxygen Demand (COD) dan Total Suspended Solid (TSS)

ABSTRACT

Multi-Soil Layering (MSL) is a wastewater treatment method that uses soil for parameter removal. Domestic, industrial, and other types of liquid waste have been treated using the MSL method to a great extent. However, there has never been a publication on the MSL method for treating fish-freezing wastewater. This study aimed to determine the efficacy of the MSL method in reducing chemical oxygen demand (COD), total suspended solid (TSS), and pH parameters in industrial wastewater from fish-freezing processes. Variations of 1, 2, and 3 layers of SMB were utilized in this study. This study varied processing times between 24, 48, and 72 hours. Using the MSL method to treat wastewater from the fish-freezing industry can reduce COD, TSS and neutralize pH. The results of the treatment of fish processing industrial wastewater utilizing the MSL method on a COD parameter of 41 mg/l with a reduction effectiveness of 90.33 percent, a TSS parameter of 49 mg/l with a reduction effectiveness of 88.94 percent, and a change in pH value to 7.7 on a variation of 1 SMB layer with a time of 72 hours. The MSL method is anticipated to be a new alternative in the treatment of industrial wastewater from fisheries in order to treat the resulting liquid waste.

Keywords: Liquid waste, Multi Soil Layering, Soil Mixture Block (SMB), Chemical Oxygen Demand (COD) and Total Suspended Solid (TSS)

1. INTRODUCTION

Aceh Province has a potential annual catch of 180,000 metric tons of fish from its fisheries (Dinas Kelautan Dan Perikanan Aceh, 2019). The complete usage of Aceh's fishery production is primarily consumed as fresh fish (57.05%), traditional processed forms (30.19%), modern processed forms (10.90%), and other processed goods (1.86%). This accounts for the majority of Aceh's overall utilization (Mohammad, 2018). The washing of huge amounts of fish will generate a significant amount of liquid waste, which will be one of the by-products of the process of processing fish, which will produce waste in the form of waste products. On the other hand, there is no processing of trash from the fishing industry, which has a severe effect on the ecosystem. waste product that is liquid in nature and originates from the remnants of fish that have been frozen in water. The liquid waste that results from fish freezing has a hazy brown appearance, a fishy odor, and very little solid waste that comes behind it. These are the distinguishing qualities of the waste. The wastewater that is left behind from fish processing companies often contains organic substances. Organic waste includes blood as well as traces of the chemicals that were employed in the processing and cleaning processes (Lestari et all., 2014).

The breakdown of proteins in untreated waste will result in a strong odor, which is a negative consequence of the situation because it is caused by the breakdown of proteins. Waste that is produced as a byproduct of washing fish or liquid waste that is disposed of directly into rivers without first being managed will cause environmental pollution in coastal waters (Hikmah, 2012). The contamination of river water can lead to a variety of illnesses, including diarrhea, allergies in the body, and even poisoning. Monitoring of the pollution caused by the fishing industry has been going on for a long time, and it is one of the things that the government monitors. The government of Indonesia has issued stringent regulations to supervise all industries in the country that generate waste that needs to be handled or managed before it can be discharged into open waters or water bodies. These regulations cover all waterways and bodies of water. In Public Proclamation No. 82 of 2001, which addressed the management of water quality and the control of water pollution, this was regulated.

It was found through field observations that the liquid waste produced from the process of freezing fish in one of the freezing factories located at TPI Lampulo, or more precisely, PT. Confident that Pacific Tuna, has exceeded the quality standards set by the Minister of Environment Regulation No. 05 of 2014 concerning Wastewater Quality Standards. The liquid waste in question obtained a COD value of 424 mg/l, a pH value of 6.5, and a TSS value of 443 mg/l. These values were determined to According to the findings of the preliminary measurements, the liquid waste produced by the fish freezing industry needs to be processed first in order to prevent it from having a negative effect on the environment in the surrounding area, particularly the bodies of water.

The processing of liquid waste from the fish freezing industry is still being developed, with the goal of lowering the pollutant levels in this waste. The Multi-Soil-Layering (MSL) method is one of the potential treatment approaches that may be utilized in the processing. A method for the treatment of waste known as multi-soil layering, or MSL, puts the soil itself in the role of the primary agent in removing pollutant parameters and boosting soil capacity (Haribowo et al., 2019). The treatment of waste known as Multi Soil Layering (MSL) involves a number of different processes, including filtration, adsorption, absorption, decomposition, nitrification, and denitrification. The MSL method consists of constructing a tub out of alternating layers of rock and mixed soil in a brick-like arrangement. This is the core of the method's working system. In the MSL system, the primary medium is soil, and organic materials in the form of bricks are layered with a mixed layer of zeolite. These layers are separated by an intermediate layer of mixed zeolite. The MSL method has been applied to hotel wastewater (Mutia et al., 2015) in addition to palm oil wastewater (Elystia et al., 2012).

The MSL technique has a number of benefits, one of which is that it is successful in lowering both the chemical oxygen demand (COD) and the biochemical oxygen demand (BOD). In addition to this, it makes the process of washing easier, and the components that are utilized are derived from natural sources and can be utilized for an extended period of time. Because the processing step does not take as much time as it does in other methods for dealing with liquid waste, the MSL method is more

effective than those other methods in terms of treating waste.

In the MSL system, the primary medium is soil, and organic matter is stored in the form of bricks and layered with a mixture of zeolite. These bricks are separated by layers of mixed zeolite. This system has shown that it is capable of processing various types of liquid waste, such as waste from the tofu manufacturing industry and waste from peat water treatment, and it has been put into use (Zein et all., 2020). In addition, the MSL method is adequate for treating both wastewater from homes and river water (Putra and Fitri, 2019). According to the findings of research carried out by Swesty et al. (2019) in the processing of tofu industrial wastewater utilizing the MSL method, the parameters Total Suspended Solids (TSS), Biological Oxygen Demand (BOD), and Chemical Oxygen Demand (COD) were successfully reduced with high levels of efficiency. As a result, the goal of this study is to see if the MSL method can reduce the amount of pollutants found in the liquid waste produced by the fish-freezing industry and establish itself as a viable new option for wastewater treatment, particularly in the fishing industry.

Using the MSL method, the purpose of this study is to determine how the passage of time affects the reduction of pollutant parameters in the liquid waste produced by the fish freezing industry. When the MSL method is used to look at the results of this study, it is thought that they will help guide the development of technology to deal with waste from the fish-freezing industry.

2. METHOD

Multi-soil layering (MSL), an excellent approach for treating residential wastewater, is utilized in this study. This waste treatment method uses soil as the main medium and improves the soil's performance by reducing the pollutant properties of liquid waste (Hadrah et al., 2019).

Materials

In this study, 3 kg of soil, 3 kg of zeolite, 3 kg of gravel, 3 kg of sawdust, 3 kg of rice husk, 3 kg of charcoal, and 30 l of waste from processing were used.

The instruments used in this study were three glass containers. Tub I is 31 cm × 22.5 cm × 20 cm, Tub II is 31 cm × 22.5 cm × 40 cm, and Tub III is 31 cm × 22.5 cm × 60 cm, with four 10 cm × 10 cm × 5 cm brick molds. The tub design is shown on Figure 1.

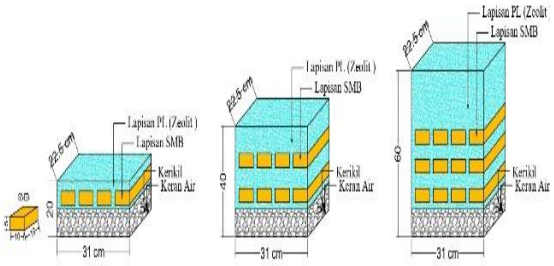

Figure 1. Multi soil layering (MSL) tub design

Experiment

This study's work procedures, including the instruments and materials used to design fish waste treatment tanks. The filtration media are stacked with a 5 cm thickness per block. Through 7 liters of Soil Mixture Block (SMB) and Permeable Layer (PL), liquid waste from the fish-freezing industry is introduced into a tub (PL). The waste from the SMB and PL layers is collected in a holding tank. The collected waste is then evaluated for its pH, COD, and TSS values. The processing time is determined by 24, 48, and 72 hours.

The pH measurement is performed with a Hanna pH meter that has been calibrated with a buffer solution. After drying with a tissue, the electrodes are rinsed with distilled water. The sample of waste is placed in a 25 ml beaker glass. The electrode is dipped into the waste sample. Wait for the pH meter's reading to stabilize before proceeding. The results of reading the numbers are displayed on the pH meter's display. After measuring, rinse the electrode again with distilled water. The pH measurement method was executed in accordance with SNI 6989.11: 2019.

The COD measurement employs a Hanna brand COD meter. 2.5 ml of the sample was placed in a test tube, followed by the addition of K2Cr2O7 and 3.5 ml of H2SO4 solution. The test tube was then sealed. Place the tube on a heater that has been heated to 105 degrees Celsius, and allow it to reflux for two hours. After bringing the sample and the refluxed working solution to room temperature, COD analyzer measurements are performed on the sample. The COD measurement method is based on SNI 6989.2: 2009.

Measurement of TSS via vacuum filtration. Filter paper that has been moistened with mineral-free water. The test sample is stirred until homogeneous, and then a 100 ml waste sample is quantitatively collected and placed on filter media. The vacuum system needs to be activated. Rinse the filter media three times with 10 mL of de-mineralized water each time, and then vacuum the filter until all of the water has been extracted. After removing the fiberglass

filter from the filter kit, carefully insert it into the weighing media. Before weighing, dry the weighing media or the cup containing the filter media in an oven at 103°C to 105°C for at least one hour, then cool in a desiccator. The TSS was computed, and the calculated results were reported. 2019 TSS measurement method based on SNI 6989.3: 2019.

3. RESULTS AND DISCUSSION

Based on experimental results, MSL can reduce COD and TSS levels in fish-frozen industrial wastewater to levels below those adjusted for Minister of Environment Regulation No. 5 of 2014. This demonstrates that the microorganisms in the soil and the zeolite in the MSL system are effective at decomposing the organic compounds present in the fish freezing industry's liquid waste (Haribowo et al., 2019). The decrease in COD and TSS concentrations in the liquid waste of the fish freezing industry using the MSL method indicates the degradation of fish washing wastewater by the soil media contained in the MSL system. Additionally, the MSL method can raise the pH level. Before treatment, the pH of fish-freezing industrial wastewater was 6.5, but it rose to 7.4 after treatment.

The decrease in COD value after processing is caused by several processes, namely filtration, adsorption, and decomposition. The filtration process occurs due to the entry of water into the layer through the inlet, then toward the SMB and gravel layers. Furthermore, the SMB and zeolite layers underwent an absorption process, while the top SMB and gravel layers underwent a decomposition process. Due to fine zeolite pore filtration, this lowers the TSS levels and can increase the absorption surface area, which makes it easier to get rid of organic and suspended matter (Ivontianti et al., 2021).

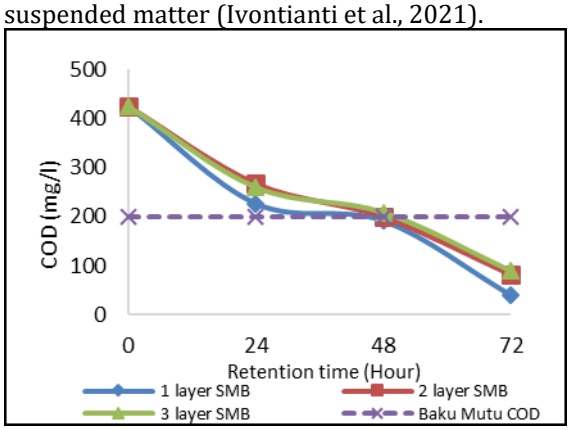

Figure 2. Graph of reduction in COD levels for variations of 1 layer of SMB, 2 layers of SMB and 3 layers of SMB with a time of 24, 48 and 72 hours

Figure 2 depicts the decrease in COD levels in fish-frozen industrial wastewater due to the addition of 1, 2, or 3 layers of SMB after 24, 48, or 72 hours. Based on the experimental findings, it is known that 1 layer of SMB with a time of 72 hours yields the best processing results, namely 41 mg/l and a reduction percentage of 90.33 percent. In accordance with the findings of Zein's (2020) study on the processing of industrial tofu waste using the MSL method, the COD levels were reduced by 95.13 percent.

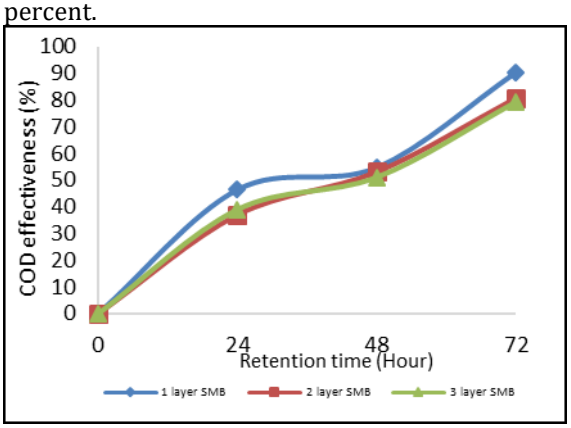

Figure 3. Graph of the percentage reduction in COD levels for variations of 1 layer SMB, 2 layers of SMB and 3 layers of SMB with a time of 24, 48 and 72 hours

Using liquid waste from the fish-freezing industry, the MSL method was able to reduce the percentage of COD in one layer of SMB in 72 hours (Figure 2). According to Salmariza dan Sofyan (2011), the organic load concentration in wastewater influences the rate of organic parameter decomposition. COD in fish-freezing industrial wastewater is reduced both aerobically and anaerobically. There are aerobic processes in the zeolite and soil layers. Different detention times also result in variations in the effectiveness of reducing COD with MSL tubs, particularly with regard to the contact between SMB and wastewater. The SMB pores will absorb wastewater that flows into the MSL tub, thereby reducing the COD results of the wastewater (Nadya and Nur, 2022).

Gravel as a large molecular filter and zeolite as an adsorbent, as well as filtration in the SMB layer, decrease the TSS concentration (Haribowo et al., 2019). This is because of the high absorption capacity of sawdust, charcoal, and rice husks, which serve as filters for waterborne dirt.

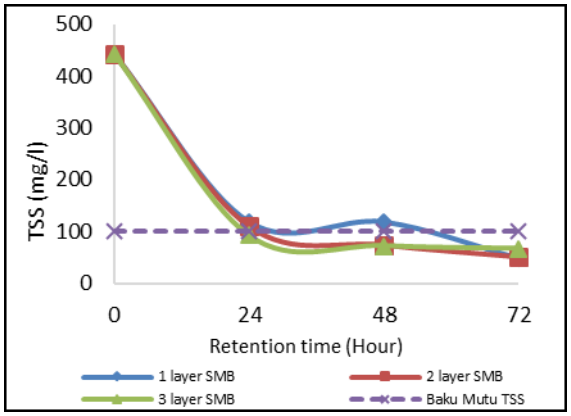

Figure 4. Graph of the decrease in TSS levels for variations of 1 layer SMB, 2 layers of SMB and 3 layers of SMB with a time of 24, 48 and 72 hours

Figure 4 depicts a decrease in TSS levels in fish-frozen industrial wastewater after treatment with 1, 2, and 3 layers of SMB for 24, 48, and 72 hours. On the basis of the obtained experimental results, it is known that the 1-layer variation with a time of 72 hours produced the best processing results, namely 49 mg/l with a reduction percentage of 88.94%. This is supported by the findings of Hadrah et al. (2019) regarding the processing of laundry liquid waste using the MSL method, which demonstrated an 88% reduction in TSS content.

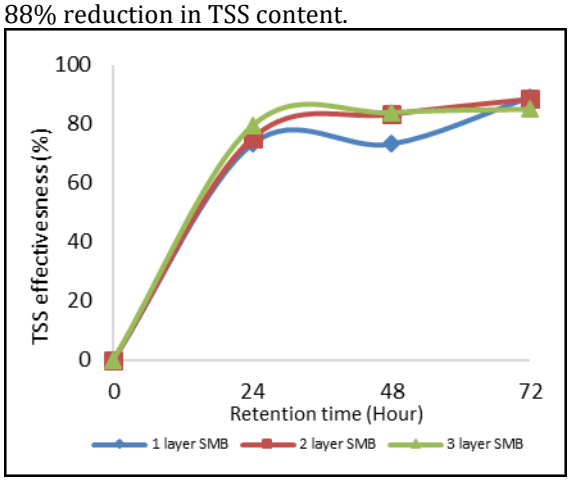

Figure 5. Graph of the percentage reduction in TSS levels for variations of 1 layer SMB, 2 layers of SMB and 3 layers of SMB with a time of 24, 48 and 72 hours

The processing of wastewater from the fish-freezing industry using the MSL method was able to reduce the TSS concentration by 88.94%, as shown in Figure 5. Because suspended substances in wastewater are heavier and will stay in the permeable layer of the MSL tubs, the optimal reduction of TSS concentration can happen when waste is treated with MSL tubs (Salmariza and Sofyan, 2011).

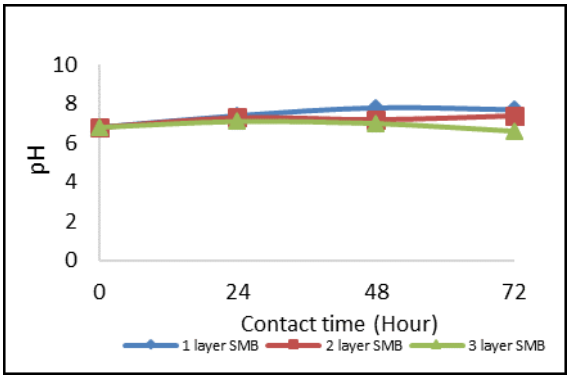

Figure 6. Graph of changes in pH values for variations of 1 layer of SMB, 2 layers of SMB and 3 layers of SMB with a time of 24, 48 and 72 hours

Figure 5 depicts the results of measuring the pH level after administering the experimental treatment, demonstrating that the MSL method is capable of adjusting the pH level. As with the 1-layer variation over 72 hours, the optimal pH was 7.7. According to Environment Minister Regulation No. 5 of 2014, these results have met the quality standard. The change in pH from pH 6.5 to pH 7.7 was caused by the presence of a soil layer in the MSL container. The soil has the capacity to neutralize pH because it can hold acidic cations. There will be an exchange of acidic cations for basic cations and vice versa if the soil is acidic (Salmariza and Sofyan, 2011)

The MSL method is effectively applied to the treatment of fish-freezing industry wastewater. On the basis of the MSL method's capacity to reduce the parameters COD, TSS, and pH value, it is hoped that this method can serve as a processing alternative and be considered by the fishing industry. In future studies, this method will make it possible to test domestic and other industrial wastewater in a variety of tanks in order to obtain the most accurate results.

4. CONCLUCIONS

According to the results of multiple linear regression tests each hour of processing can reduce the COD value by 4,631 mg/l, reduce the TSS value by 4,919 mg/l, and increase the pH by 0.005. The variation of the SMB layer in the MSL method has no effect on the variation of pollutant levels in the fish freezing industry's liquid waste. Based on the outcomes of multiple linear regression tests in SPSS software, the addition of one SMB layer to the tub can increase the COD by 12,000 mg/l, the TSS by 7,000 mg/l, and the pH by 0.250. The MSL method is able to reduce the levels of pollutants found in the fish freezing industry's liquid waste. With a reduction rate of 90.33 percent for COD and 88.94 percent for TSS, the final processing result met the quality

standard limit set by Minister of Environment Regulation No. 5 of 2014 concerning Wastewater Quality Standards for the 1 layer variation after 72 hours.

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