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Decreasing COD and TSS levels of tofu liquid waste using Kangkungan (Ipomeacracicaulis) with phytoremediation method

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Abstract:
The tofu industry in Indonesia is growing rapidly. The development of the tofu industry is in line with the increasing number of Indonesians population. One of the impacts of the growing tofu industry is the waste produced from the tofu production process. One of the characteristics of tofu liquid waste is that it still contains a lot of organic material. The use of kangkungan plant as a tofu liquid waste processing plant with the phytoremediation method is expected to reduce COD and TSS levels of tofu liquid waste. The purpose of this study was to determine the effect of the number of kangkungan plants on reducing COD and TSS levels of tofu wastewater using the phytoremediation method. Tofu liquid waste used in the research comes from the tofu industry in the city of Malang. This research is using experimental method. The results showed a decrease in COD and TSS levels, where at the beginning COD levels of tofu waste were 5190 mg / l and TSS levels were 3625.70 mg / l. After four months of observation, it was found that COD levels decreased by 1280 mg / l and TSS levels by 487.32 mg / l.

Key Word*:kangkungan, tofu liquidwaste, COD and TSS*

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I. Introduction

The development of the tofu industry in Indonesia is growing rapidly, along with the increasing number of tofu industry in Indonesia which also contributes significantly to the Indonesian economy. But besides that, the increasing number of tofu industry in Indonesia also has an impact on the environment caused by the tofu industry waste. Given the high potential for water pollution caused by tofu industrial liquid waste, a strategy to control water pollution is needed by treating tofu liquid waste before being discharged into the environment as an effort to improve environmental health. As it is known, the current tofu industry is mostly still a home industry so that it does not yet have a waste treatment unit, where tofu liquid waste is directly disposed of into sewers or into water bodies without going through any treatment first.

One of the characteristics of tofu liquid waste is that it still contains organic material. The presence of these organic compounds causes the tofu liquid waste to contain quite high Chemical Oxygen Demand (COD) and Total Suspended Solid (TSS). High organic matter if disposed of directly into water bodies without prior treatment results in bacteria using dissolved oxygen in the water for the decomposition process so that it can cause an unpleasant odor in the water body (Mulyani, 2007). Currently, many wastewater treatment technologies are running ineffective, this is due to high operational costs and the complexity of the operating system. Organic compounds that are in the waste are compounds that can be completely decomposed through biological processes both aerobically and anaerobically. Considering the characteristics of tofu liquid waste contain a lot of organic material, one alternative to tofu liquid waste treatment that can be done is by doing biological treatment (Fachrurozi, et al. 2010).

One way of treating tofu liquid waste biologically is by using water plants to reduce the levels of organic matter in the tofu factory liquid waste. Aquatic plants have the ability to neutralize the components in the waters which are useful in the wastewater treatment process (Artiyani, 2014). The use of aquatic plants as a method of treating tofu liquid waste is called the phytoremediation process. Phytoremediation is a waste treatment system using plants where the plants together with microorganisms in the media change, stabilize and destroy contaminants to become harmless and even economically beneficial. Factors that can affect the phytoremediation process include temperature, pH, and weather / climate. The mechanism of action of phytoremediation consists of several ways, namely phyto extraction, phytovolatilization, phytodegradation, phytostabilization, and rhizofiltration (Hidayati, 2005).

Kangkungan plant (Ipomeacrassicaulis) is a plant in the tropics are characterized in the form of a bush with a height of ± 2 m, has a hibiscus-shaped green leaves, pale purple flowers have the shape of a tube or funnel. Usually this kangkungan plant grows along river banks, moist soil or roadside. Based on the results of

several previous studies, kangkungan plants can reduce the levels of pollutants in textile dyeing waste such as pH, BOD, COD, TSS, total ammonia and sulfide (Nailufari, 2008). In additionkangkungan plant has the advantage that these plants grow wild so it is easy to come by, but it is also these plants can survive in conditions of polluted environment. This study aims to determine the effect of the number of kangkungan plants on reducing COD and TSS levels of tofu liquid waste by using the phytoremediation method.

II. Material And Methods

This research is an experimental research (laboratory scale) with the research design used pre-post test with control. This research was conducted in the laboratory of the Malang Agricultural Institute from April to September 2020.

This research is divided into three stages, namely the preparation stage, the implementation stage and the data analysis stage. The preparation stage is carried out by preparing the research reactor that will be used. The reactor of this research consisted of 1 large plastic container for tofu liquid waste, four glass reactors with sewage outlet channels, four medium plastic containers as a container for tofu liquid waste from processing. In each glass reactor, kangkungan plants were given with a plant weight of 25 gr, 50 gr and 75 g kangkungan plant, while one glass reactor was used as a control.

In addition, at the preparation stage, the acclimatization process of plants is also carried out. The purpose of this acclimatization process is to adapt kangkungan plants to the climate or temperature in the new environment, with this acclimatization process kangkungan plants can get used to the conditions of the waste that will be used in the implementation process. The acclimatization process is carried out by diluting the tofu liquid waste with a concentration of 25% (one liter of tofu liquid waste is diluted with three liters of clean water). After the acclimatization process is carried out, the initial analysis is carried out on the COD and TSS content of tofu liquid waste.

The implementation stage is the stage where the phytoremediation process begins. At this stage the tofu liquid waste is continuously flowed. Then every 2 weeks measuring the COD and TSS levels from the tofu liquid waste. The data obtained at the implementation stage are then analyzed to achieve the research objectives.

III. Resultand Discussion

The initial characteristics of tofu liquid waste taken directly from the tofu industry are COD of 30,200 mg / l and TSS of 4560 mg / l. Then the tofu liquid waste is diluted for the acclimatization process. After the acclimatization process, the characteristics of tofu liquid waste were COD of 5190 mg / l and TSS of 3625.70 mg / l.

COD or chemical oxygen demand is a value that indicates the amount of oxygen to oxidize organic compounds contained in one liter of solution expressed in units of mg / l (Alaerts and Santika, 1987). According to Mulia (2005), organic compounds in COD include compounds that can be processed biogically (biodegradable) and cannot be processed biologically (non-biodegradable). COD measurements were carried out every 2 weeks for 4 months. COD measurements were carried out for four reactors, where the first reactor was a control reactor. The first reactor had the largest and most stable COD value due to no processing at all, namely 5190 mg /l at the eighteenth week.

The lowest COD value at week eighteen is in the fourth reactor with a COD concentration of 980 mg / l. Reactor four is a reactor with 75 gr of kangkungan plants. The highest COD value at week eighteenth was in reactor one, which was 1280 mg / l. The first reactor is a reactor with 25 gr of kangkungan plants. This shows that the number of plants has an influence on the COD removal process from tofu liquid waste. It can be explained that COD removal is carried out by kangkungan plants. The process of photosynthesis produces oxygen which is then released into the wastewater so that it can oxidize organic compounds. The absorption process of organic compounds by kangkungan plants can reduce the content of organic compounds in tofu liquid waste. This is because the roots of kangkong plants contain rhizosphere bacteria. Based on Ulfin (2001), the bacteria found in these roots will break down the organic compounds contained in the waste aerobically into simpler compounds which are then absorbed by kangkungan plants as a source of nutrition. The reduction in COD levels can be seen in Figure 1.

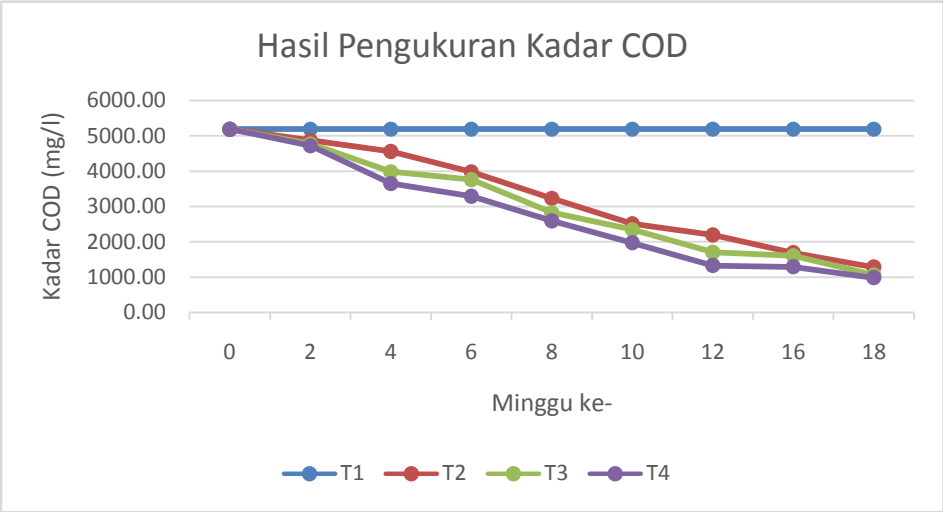

Figure 1. Decreased COD levels of tofu wastewater

From Figure 1, it can be seen that the COD level of tofu liquid waste continues to decrease every week until the eighteenth week. Microorganisms found in the roots of kangkungan plants where this phytoremediation process takes place and have an important role in absorbing organic pollutants. Plants can absorb pollutants as far as their roots grow. The more the number of kangkungan plants that are in the reactor, it will also affect the number of microorganisms present in the roots of kangkungan plants. Microorganisms that grow on the roots of kangkungan plants are more effective in reducing COD values because the number of microorganisms is increasing and these microorganisms are increasingly able to adapt to the environment.

So it can be said that the amount of biomass or plant weight greatly affects the process of reducing COD levels. The smaller the weight of the plant, the more likely it is that the plant will die, so that the process of reducing liquid waste levels will be disrupted, so that the amount of plant weight is needed to replace the dead plants.

The COD value is the amount of oxygen needed to chemically oxidize organic matter in water. If untreated organic material is disposed of into water bodies, the bacteria will use oxygen for the decomposition process. This decrease is also due to the large amount of dissolved oxygen supply, especially from plant photosynthesis, which causes the decomposition of organic matter to be more effective.

Total suspended solids are suspended solids found in waste with a size of less than 0.45 microns (Mulia, 2005). This suspended material can cause turbidity which results in blocking sunlight entering the water (Purnawati, 2015). TSS measurements were also carried out every two weeks for four months. The largest TSS concentration is found in reactor one, which is 3625.70 mg / l, this is because reactor one does not get any treatment. Meanwhile, the lowest TSS concentration in the eighteenth week was in reactor four, which was 487.32 mg / l. The amount of TSS value in tofu liquid waste comes from the remaining solid soybean which has not been completely filtered because it still uses simple technology.

The reduction in TSS value is due to the particles with a heavy enough mass contained in the waste will settle in the reactor part, while those that are light enough will stick to the roots (Fachrurozi, et al. 2010). The decrease in TSS levels occurs due to the absorption process by plants, the decomposition of organic matter and the deposition of the decomposition of organic matter. The decrease in TSS levels in tofu liquid waste can be seen in Figure 2.

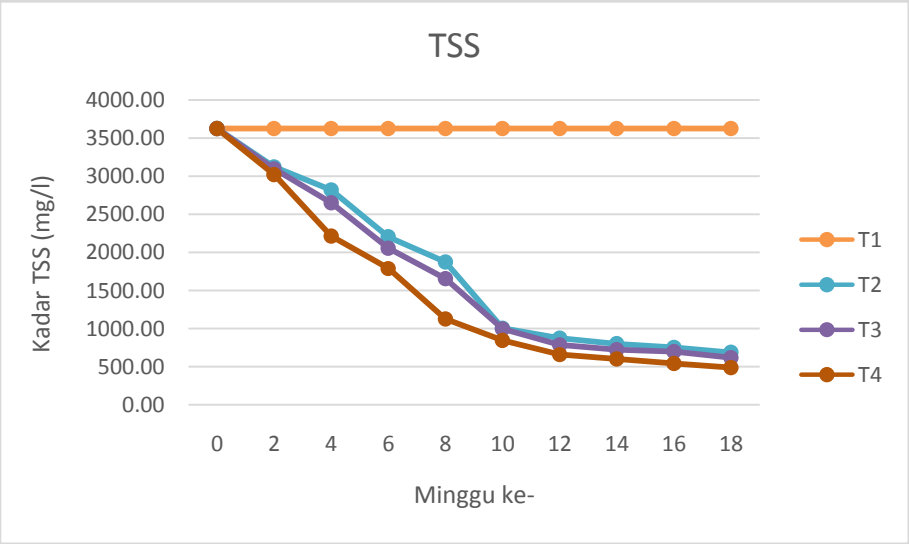

Figure 2. Decreased TSS levels of tofu liquid waste

The mechanism of water plants in reducing TSS levels of tofu liquid waste is through a phytodegradation process. In the process of phytodegradation, contaminants are decomposed in water by microbial activity on the roots of kangkungan plants. Microbes can survive on the supply of organic carbon sources of plants. Contaminants that are absorbed by kangkong plants are passed on and distributed to various plant organs. The process of absorbing contaminants contained in tofu wastewater takes place in line with the transpiration flow. The absorption of organic matter in kangkungan plants is also influenced by the presence of rhizosphere microbes found in the roots of kangkungan plants which are able to decompose organic and inorganic materials.

The decrease in TSS levels in the triple reactor is influenced by the ability of kangkungan plant roots to hold suspended solids through the roots and stems of kangkungan plants. Suspended solids are very influential with turbidity, because the higher the level of suspended solids, an increase in turbidity will also be followed. Turbidity not only endangers the biota in the waters but also causes the water to be unproductive because it blocks the entry of sunlight for the photosynthesis process.

Kangkungan plant roots, which are fiber roots, also have an effect on reducing TSS levels of tofu liquid waste, this is because the fiber roots can hold colloids floating in the water. The higher the plant biomass, the more fiber roots will be, so that more colloids will stick to the fiber roots. Sediment and colloids as well as dissolved materials originating from solid waste materials will settle to the bottom if they cannot dissolve and some will become colloidal when they dissolve. Kangkungan plant's long and dense roots can reach a deeper and wider area so that it can absorb more nutrients such as organic compounds and transfer oxygen to the base of the media and allow microorganisms to grow around the roots so that the oxidation of organic substances takes place better.

Not all aquatic plants can be used in the phytoremediation process, because not all plants can carry out the metabolic processes, volatilization and accumulation of all pollutants with the same mechanism. Plants that can be used in the phytoremediation process must have fast growing properties, be able to consume large amounts of water in a short time, be able to remediate more than one pollutant. In addition to the types of plants, environmental factors also have an influence on the plant growth process that will be used for the phytoremediation method, because with good plant growth, the accumulation of pollutants using the phytoremediation method will run optimally (Siregar and Anwar, 2010).

IV. Conclusion

Based on the results of the research conducted, there was a significant effect on decreasing COD and TSS levels from tofu liquid waste by kangkungan plants using the phytoremediation method. The amount of biomass also has a significant effect on reducing COD and TSS levels of tofu liquid waste. The greater the plant biomass, the greater the influence of the plant to reduce COD and TSS levels in tofu liquid waste.

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