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# BOD Decreasing of Liquid Waste Tofu Using a Constructed Wetland System

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## ABSTRACT

The liquid waste of the tofu industry is the waste from the process or the remainder of an industrial activity which is liquid in nature where its presence is not desired by the environment because it does not have economic value so it tends to be disposed of. The release of tofu wastewater into the environment without meeting established quality standards will cause disruption to the environment itself and to human health. The purpose of this study was to understand the effect of water hyacinth plants in reducing BOD levels by using a Constructed Wetland system using variations of water hyacinth 1 kg, 1.5 kg and 2 kg with a detention time of 21 days. An experimental study with a quasi-experimental research design by conducting pretest-posttest group design. Sample examination was carried at the Makassar Public Health Laboratory Center. Data analysis using General Linear Model-Repeated Measure test. The results showed the value of p = 0,000 <0,05, which means that there was an effect of the difference in weight of the water hyacinth plant to the detention time of decreasing BOD of tofu waste water with a value of BOD level which had decreased on the 7th day and below the standard on day 21 on when processing. Processing of Tofu industry wastewater by system constructed wetland can be recommended as a safe, inexpensive and environmentally friendly processing technology.

***Keywords:*** Water Hyacinth, Liquid Waste, BOD, Constructed Wetland Systems

## 1. INTRODUCTION

Waste water is the remainder of a business and/or activity which is liquid. Waste water can come from households (domestic) or industry. Every production activity in an industry always produces waste water. Industrial liquid waste is the discharge from the process or the remainder of an industrial activity in liquid form where its presence at a time and place is not desired by its environment because it does not have economic value so it tends to be disposed of. [2]

Wastewater threatens the safety of both the humans and environment, due to the acceleration of industrialization resulting in an increase in the discharge of wastewater caused by the production of wastewater produced by home industries or other industries. This problem is increasingly anincentives in developing countries, especially the poor waste water treatment process. The low awareness of industrial owners is one reason of the absence of waste treatment in the industry. [3]

The release of wastewater into the environment without meeting established quality standards will cause disruption to the environment itself and to human health. The high content of Biochemical Oxygen Demand (BOD) can disrupt the ecological balance of aquatic life, while the presence of pathogenic microbes in wastewater can cause various losses. BOD is an indirect

measure of organic matter in waste. The presence of organic matter in waste naturally will decompose due to bacterial activity. This activity will consume a certain amount of oxygen, the more organic substances contained in wastewater, the higher the oxygen demand, so that the oxygen which is dissolved in the wastewater will be even lower and can be completely depleted (nol). [12]

One of the industries with the largest waste water production is the tofu industry, the tofu industry is able to produce ± 700 kg / day of tofu with the use of clean water ± 6000 L / day and produce waste water of ± 4800 L / day. Liquid waste is obtained from several processes, including washing processes, immersion processes, clumping processes, and pressing processes. In the process of clumping and pressing produces high-discharge waste water. To overcome,the waste is safely disposed of into the environment requires a liquid waste treatment, so that later it can reduce the burden of waste entering the body of water. [15]

To comply with the regulation of waste water disposal, wastewater treatment usually combines primary, secondary, and tertiary processing. [1] There are several processes that have been widely used to treat tofu wastewater so as not to pollute the environment, one of which is a constructed wetland system. The basic principle of a sewage treatment system in constructed wetland is in the process of respiration of hydrophyte plants which are able to suck oxygen from the air through leaves, stems, and roots which are then released back to the area around the roots (rhizosphere). This is possible because the type of hydrophyte plants has space between cells or air duct hole (aerenchym) as a means of transportation of oxygen from the atmosphere to the roots. Another advantage of this plant is that it can live in an anaerobic state. [9]

This study was designed to carry out an experiment in the treatment of wastewater in tofu industries with an artificial wetland processing (constructed wetland), using water hyacinth plants. Water hyacinth is widely used in waste treatment because it can reduce the levels of BOD, particle suspension biochemically and can absorb heavy metals. Water hyacinth has beneficial properties,one of which is clear water. [5]

The purpose of this study was is to look at the effectiveness of the use of water hyacinth plants in decreasing the BOD levels of tofu industry wastewater using a system of constructed wetland with differences in the weight of water hyacinth and the time of detention wastewater treatment.

## 2. DATA AND RESEARCH METHOD

### 2.1 Research Location

This research was conducted in one tofu industry in the Village of Sugiwaras, Polewali Mandar Regency West Sulawesi, in April 2019.

### 2.2 Research Design and Variables

This type of research is an experimental study with a quasi-experimental research design by conducting pretest-posttest group design. In this study, BOD levels were measured before and after processing.

### 2.3 Research Samples

The sample of this study is liquid waste produced from tofu industry as much as 50 liters of waste water taken in one tofu industries with the largest production.

### 2.4 Data Collection

Water hyacinth plants are planted in three glass container boxes with a size of 30 cm x 70 cm x 43 cm using medium of skidding which is 5 cm high, sand with the height of 10 cm of tofu waste with concentration 25% (10 liters of waste water knows the appeal of 30 liters well bore water) for 21 days. Each box was planted with water hyacinth weighing 1 kg, 1.5 kg, and 2 kg as a comparison of research. The wastewater inlet samples were first measured BOD levels before the treatment processwas carried out, then the BOD levels of the tofu wastewater outlet samples were taken on the 7th day, 14th day, and 21st day.

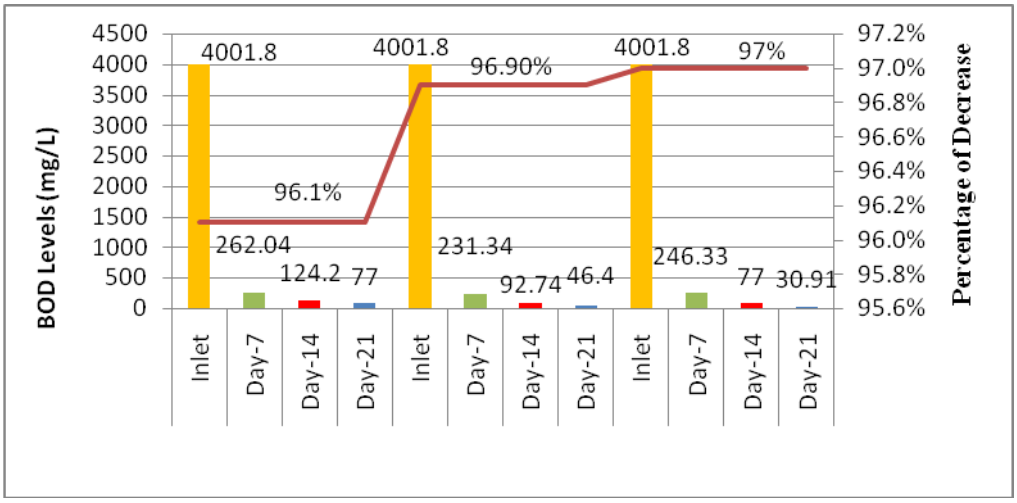
### 2.5 Data Analysis

Examination of tofu industry wastewater samples was carried out at the Makassar Health Laboratory Center which was examined by laboratory experts to determine the BOD levels before and after treatment. Data from BOD levels were analyzed using SPSS for Windows Version 24 using the General Linear Model - Repeated Measure method.

## 3. RESULTS

**Table 1 BOD Levels of Tofu Industry Waste in the Processing Process with a Constructed Wetland System**

| Water Hyacinth (kg) | Inlet (mg/L) | Outlet (mg/L) | | | Standard (mg/L) |
|---|---|---|---|---|---|
| | | Day-7 | Day-14 | Day-21 | |
| 1 | 4001,8 | 262,04 | 124,2 | 77 | 150 |
| 1,5 | 4001,8 | 231,34 | 92,74 | 46,4 | |
| 2 | 4001,8 | 246,33 | 77 | 30,91 | |




**Graph 1 Percentage of Decrease in BOD Level of Tofu Industry Waste in the Processing Process with a Constructed Wetland System**

**Table 2 Results of Normality Test of Inlets and Outlets of BOD Parameters for Tofu Industry Liquid Waste Processing**

| Research Parameters | | Shapiro-Wilk | |
|---|---|---|---|
| | | df | p |
| Level Day -7 | BOD | 3 | .974 |
| Level Day-14 | BOD | 3 | .637 |
| Level Day -21 | BOD | 3 | .643 |

*inlet BOD is constan

**Table 3 Tests of Within-Subject Effect General Linear Model - Repeated Measure BOD Parameters of Tofu Industry Liquid Waste**

| | | p |
|---|---|---|
| Week | Sphericity Assumed | .000 |
| | Greenhouse-Geisser | .000 |
| | Huynh-Feldt | .000 |
| | Lower-bound | .000 |
| Week* Parameters | Sphericity Assumed | .000 |
| | Greenhouse-Geisser | .000 |
| | Huynh-Feldt | .000 |
| | Lower-bound | .000 |

## 4. DISCUSSION

Table 1 begins to show a decrease in BOD levels from the seventh day even the BOD level on the twenty-first day for each weight of water hyacinth are ready below the quality standards of the Republic of Indonesia Minister of Environment Regulation No. 5 of 2014 regarding the quality standard of waste for BOD parameters, namely150 mg/l.

Then graph 1 shows the average decrease in BOD levels in 1 kg of water hyacinth by 154.41 mg/l with a percentage of 96.1%, the average decrease in BOD levels in the weight of 1.5 kg water hyacinth is 123.49 mg/l with a percentage of 96,9%, while the average decrease in BOD levels in the weight of 2 kg water hyacinth was 118.08 mg/l with a percentage of 97%. Requirements in using the General Linear Model - Repeated Measure analysis will require normality of normally distributed data, the nomination test for this data can be seen in the Shapiro-Wilk test results, if the sig value or p-value> a = 0.05 then the value data is normally distributed. The output results in Table 2 obtained a value of p > 0.05 on BOD parameters for each week, it

can be concluded that the inlet normality test and BOD parameter outlet of the tofu industrial wastewater treatment are normally distributed. After the normality test is carried out, the General Linear Model - Repeated Measure is done by looking at the results of table 3 of the Tests of Within-Subject Effect on the result of inlet and outlet analysis of BOD parameters in tofu industrial waste water treatment obtained p = 0.000 < 0.05. The difference in the weight of the water hyacinth plant to the detention time of liquid BOD waste in tofu industry.

The liquid waste of tofu industry when decaying can spread foul odor and pollute the surrounding waters, tofu industrial waste water if channeled in to river or water bodies will pollute the water body and if the water is used it will cause health problems in the form of itching, diarrhea, cholera, inflammation of the intestine, and other diseases especially those that are closely related to dirty water and can cause bad environmental sanitation. [13]

Table 1 shows a very significant decrease in changes in BOD levels before and after processing. BOD levels before processing or used as research inlet samples showed values of 4001.8 mg/l experienced a 96-97% reduction in percentage of water hyacinth weight in a few days of detention time, high BOD levels indicating the amount of organic matter sometime in wastewater. The use of organic substances is a natural event, the higher the contamination in the body of water, the bacteria will spend dissolved oxygen in water which can cause a foul odor in the water. To reduce contamination of water, it is necessary to use plants that can reduce pollutant loads such as water hyacinth plants. The longer the contact time between tofu wastewater industry and the processing using water hyacinth plants, the greater the decrease in the BOD level of tofu industrial wastewater. [7]

The process of accumulation and absorption of organic matter by plants is divided into three processes, namely root absorption, translocation and localization. The first, absorption mechanism of organic matter must go through around the roots (rhizosphere), this absorption mechanism occurs chelate substances formation (phytosidorophore), phytosidorophore molecules will bind organic matter or heavy metals and bring them into cells through active transport events. The second is the translocation of organic matter from the roots to other parts of the plant. After organic matter penetrates the root, other foreign compounds will flow to the top of the plant through xylem and phloem tissue of other plant parts. Third, the localization of organic matter in cells and tissues, from this localization to maintain organic zarso as not to inhibit plant metabolism and prevent cell poisoning. In addition, the results of photosynthesis carried out by plants can also supply the need for oxygen to be used to decompose organic matter contained in waste water. This is indicated by the lower BOD decrease. [6]

The BOD value is also affected by the presence of plants that cover the surface of waste water. The existence of these plants can absorb organic substances contained in waste water. The more plants, the more organic material is absorbed and organic matter must be degraded by fewer microorganisms. The less organic matter that must be degraded by microbes, the higher the oxygen content in wastewater. Dissolved oxygen in waste water is also increasing because of the supply of oxygen from plant photosynthesis. So the more plants, the smaller the BOD value, which means the better the quality of the wastewater. [4]

The results of this study are in line with several studies including those showed a decrease in using water hyacinth plants on the 6th day was 1131.38 mg/l, the 12th day was 52.72 mg/l, and the $18^{th}$ day was 33.68 mg/l. [11] Water hyacinth (*Eichhornia sp*.) gives the best results in reducing organic matter of tofu waste to become 195 ± 48.61 mg/l with leaves still appear green and the colour of clear brown water. [8]

There are several studies that examined decreasing in BOD levels by using different plants, including Moringa seed powder and aluminum sulfate (alum) at a dose of 2000 mg/l capable of reducing the BOD value in optimum tofu industrial wastewater at a fast stirring speed of 100 mg/l and 120 mg/l, where it can be said that when looking at the BOD value of waste water in the initial tofu industry, it can be said that with the coagulation process of flocculation, it can reduce BOD levels by 91.67% and 90.00% respectively. [14] While other studies showed the highest percentage reduction in BOD levels occurred in *Pistia stratiotes L.* 200 gram biomass which was 2966.67 mg/l (92,70%). [4]

## 5. CONCLUSION

The conclusions of this study is that the average decrease in BOD levels in the weight of 1 kg of water hyacinth was 154.41 mg/l with a percentage of 96.1%, the average decrease in BOD levels in the weight of 1.5 kg water hyacinth was 123.49 mg/l with 96,9%, while the average decrease in BOD levels in the weight of 2 kg water hyacinth was 118.08 mg/l with a percentage of 97%.

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