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Effectiveness of Decreasing Cod Liquid Waste Using Constructed Wetlands Systems

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ABSTRACT

In every production activity a tofu industry can produce waste water in the form of liquid waste. The liquid waste of tofu industry has characteristics such as having a cloudy color, strong odor, foaming, and having an acid content from the production by adding vinegar. The purpose of this study was to determine the effect of water hyacinth plants in reducing COD levels using a Constructed Wetland system using variations of water hyacinth 1 kg, 1.5 kg, and 2 kg with a detention time of 7 days, 14 days and 21 days. Based on the results of the study using General Linear Model-Repeated Measure analysis shows the value of p = 0,000 <0,05, which means that there is an effect of differences in water hyacinth plant weight to detention time of decrease in liquid waste COD of tofu industry, with COD levels decreasing with a percentage of 96- 97%.

Keywords: Liquid Waste, Water Hyacinth, COD, Constructed Wetland System

INTRODUCTION

The tofu industry is a business established in the context of developing activities in the food sector that have positive and negative impacts on the environment. The positive impact is in the form of fulfilling people's needs for food sources while the negative impact of the tofu industry is in the form of waste that causes pollution problems that damage the environment. Environmental pollution is the result of disposal of solid waste (tofu waste) and liquid waste. Most of the liquid waste produced by the tofu manufacturing industry is a thick liquid which is separate from the tofu called whey.[5]

Liquid tofu industrial waste contains suspended substances, resulting in water becoming dirty or cloudy. One way to find out how far the pollution load on wastewater is by measuring Chemical Oxygen Demand (COD). COD is the amount of oxygen needed to chemically oxidize organic compounds.[5] The liquid waste contains high COD levels.[7]

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 waste water that has high pollutants. To overcome this waste so that it is safely disposed of into the environment, a liquid waste treatment is needed, so that later it can reduce the burden of waste entering the body of water.[13]

To comply with the regulation of waste water disposal, wastewater treatment usually combines primary, secondary, and tertiary processing.[1] Constructed Wetland

is an artificial land that is built by utilizing natural processes involving wetland vegetation (hydrophyte), soil, and a collection of related microbes to assist in the treatment of biological wastewater. Constructed wetlands are designed to take advantage of many of the same processes that occur in natural wetlands, but do so in a more controlled environment.[5] As well as evaluating the effective water quality of a wetland case study of the expected performance of a disinfectant procession stating that under the right conditions these two process units together can produce adequate quality.[12]

The purpose of this study was to determine the effect of using water hyacinth plants on the decrease in COD of tofu industry wastewater using constructed wetland systems with differences in the weight of water hyacinth plants and variations in the detention time of waste treatment.

MATERIALS AND METHODS

Location and Design of Research

This research was conducted in one of the largest tofu industries in Sugiwaras Village, Wonomulyo Subdistrict, Polewali Mandar District, West Sulawesi. This type of research is an experimental study with a quasi-experimental research design by conducting a pretest-posttest group design.

Research Samples

The sample taken in this study was 60 liters of tofu liquid waste produced from one tofu industry which had the largest production in Sugiwaras Village, Wonomulyo District, Polewali Mandar District, West Sulawesi.

Method of Collecting Data

The main material in this study was tofu waste water planted with water hyacinth plants as a treatment for the processing process. Tofu waste water was taken from one of the tofu industries in Sugiwaras Village, Polewali Mandar District, West Sulawesi.

This study was given treatment with three differences in the weight of water hyacinth namely 1 kg, 1.5 kg, and 2 kg as a comparison in reducing levels of COD with the detention time of sampling on the 7th day, 14th day, and 21st day. Water hyacinth plants are planted in a glass container box with a size of 30 cm x 70 cm x 43 cm using filter media namely 5 cm high gravel, 10 cm high sand, and 25% wastewater.

Acclimatization of water hyacinth plants was carried out for 7 days, the concentration was obtained from the dilution of tofu wastewater during pre-research on water hyacinth plants grown in dilution with a concentration of 100%, 50% and 25% tofu water. During the observation, water hyacinth plants which were planted in the concentration of 100% and 50% tofu wastewater died in less than three days, while at a concentration of 25% the water hyacinth plants lived more than five days. Therefore, a concentration of 25% was chosen as the main research in the treatment process.

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 COD levels before and after processing. Data from COD levels were analyzed using SPSS for Windows Version 24 using the General Linear Model - Repeated Measure method.

RESULT

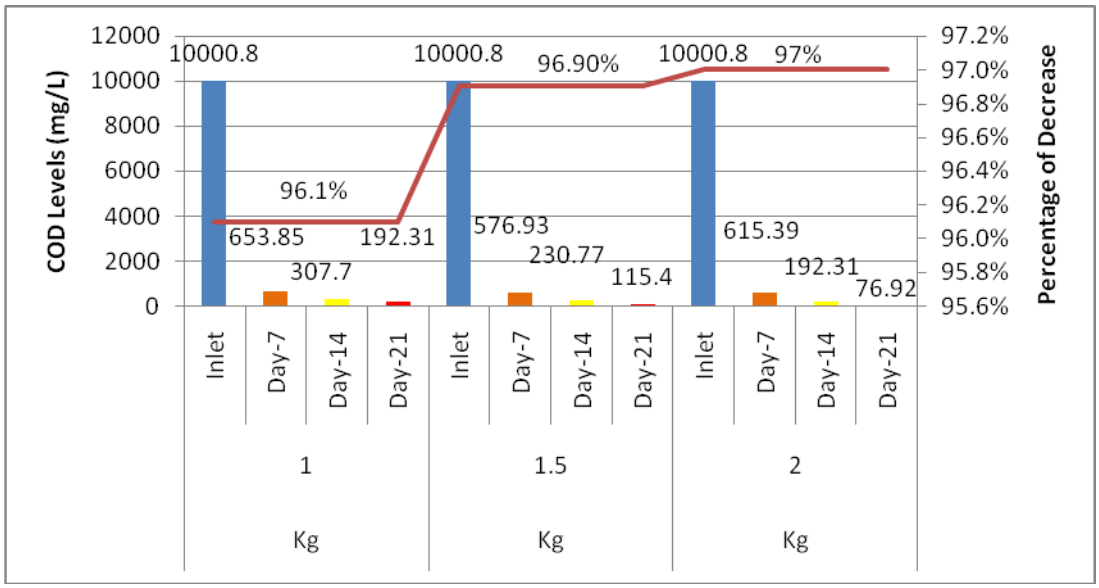
Decreasing the COD content of tofu industry wastewater using system constructed wetland can be seen in table 1.

Table 1 shows a decrease in COD levels from the seventh day even though it is still above the quality standard, and a very large decrease is shown on the twenty-first day for each weight of water hyacinth below the quality standard of the Republic of Indonesia Minister of Environment Regulation No. 5 of 2014 concerning standards the quality of tofu wastewater for COD parameters is 300 mg/l.[9]

Table 1 COD 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	10000,8	653,85	307,7	192,31	300
1,5	10000,8	576,93	230,77	115,4	
2	10000,8	615,39	192,31	76,92	

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



The average decrease in COD content with a weight of 1 kg was 384.62 mg/l with a decrease in percentage of 96.1%, the average decrease in COD with a weight of 1.5 kg was 307.7 mg/l with a percentage of 96.9%, and the average reduction in COD with a weight of 2 kg water hyacinth was 294.8 mg/l with a percentage of 97.0%. Terms in using the General Linear Model - Repeated Measure test will require normality of normally distributed data, the normality test for this data is seen in the Shapiro-Wilk test results, if the sig value or p-value > a = 0.05 then the data value is normally distributed.

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

Research Parameters		Shapiro-Wilk	
		df	p
Level Day-7	COD	3	.885
Level Day-14	COD	3	.637
Level Day-21	COD	3	.637

***inlet COD is constant**

The output results in Table 2 obtained a value of p > 0.05 on COD parameters for each week, it can be concluded that the inlet normality test and COD parameter outlet of tofu industry wastewater treatment is normally distributed. After the normality test is done, the General Linear Model - Repeated Measure test can be done with the results of the Tests of Within-Subject Effect table.

Table 3 Tests of Within-Subject Effect General Linear Model - Repeated Measure COD 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

Output of Table 3 Tests of Within-Subject Effect on the results of inlet and outlet analysis of COD parameters in tofu industry wastewater treatment obtained p = 0.000 <0.05, it can be concluded that there is an effect of differences in water hyacinth plant weight to detention time of liquid waste COD in tofu industry.

DISCUSSION

COD is the amount of oxygen needed to chemically oxidize organic matter in water. If unprocessed organic material is discharged into the water body, the bacteria will use oxygen for the decay process. The COD value is usually higher than the BOD value because more waste material can be oxidized through a chemical process than the waste material that can be oxidized through biological processes. COD obtained from the coagulation process cannot meet the quality standards due to the high content of organic and inorganic substances contained in the tofu industry wastewater.[3]
Table 1 shows a decrease in COD levels from the initial results or inlet wastewater of 10000.8 mg/l on the seventh day even though it is still above the quality standard, and a very large decrease is shown on the twenty-first day already below the wastewater quality standard for the COD parameter. The percentage decrease in COD levels was 96-97% with a detention time of twenty one days with a heavy weight of different water hyacinths. The decrease in COD value was due to solids having begun to settle so that the waste material in waste water was also reduced. In addition, some of the waste material has been oxidized and some of it has also been absorbed by the plants so that it also reduces the COD value. This decrease is also due to the considerable supply of dissolved oxygen, especially from the results of plant photosynthesis, which causes the decomposition of organic matter to be more effective.[3] This research is in line with the results of other studies using water hyacinth plants including a decrease in COD and TSS levels after treatment using the Subsurface Flow Wetland using water hyacinth with a COD reduction of 92.47%.[4] The experimental results showed a decrease in COD to the permissible threshold, which was a decrease from 768 ppm to 208 ppm and in replications carried out from 672 ppm to 160 ppm which was below the quality standard.[11]
In addition to water hyacinth plants, other types of plants can also be used for other wastewater treatment, such as several studies that obtained optimum reduction in COD of
tofu wastewater with coagulant of 7% moringa seed powder measuring 70 mesh at doses of 5000 mg/200 ml with deposition time 60 minutes can reduce COD by 63.26%.[2] The next research showed that the lowest COD and BOD values were obtained from the addition of 25 ml microbial wastewater was 33.0026 ± 1.4926 mg/l and 9.8656±0.2630 mg/l with a percentage of effectiveness of 38.09% and 60.93% , respectively.[8] The highest COD removal was 90.59% resulting from variations in detention time of 1 day and organic load of 500 mg / l.[10]
The percentage of decreasing levels of COD is probably due to decomposition of organic substances and photosynthetic processes of plants that produce enough oxygen supply for microorganisms, photosynthesis allows the release of oxygen into the air and then spread into the water around the roots (rhizosphere).[13]

CONCLUSION

The conclusion of this study is that the average decrease in COD content with a weight of 1 kg was 384.62 mg/l with a decrease in percentage of 96.1%, the average decrease in COD with a weight of 1.5 kg was 307.7 mg/l with a percentage of 96.9%, and the average decrease in COD with a weight of 2 kg water hyacinth was 294.8 mg/l with a percentage of 97.0%.

SUGGESTION

The wastewater treatment system using constructed wetland method is very effective in decreasing the levels of COD of tofu wastewater, so it is recommended for tofu industry owners to treat tofu wastewater before being discharged into water bodies.

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