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Waste Water Treatment Analysis of Soybean Industry Using Wetlands System

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A B S T R A C T

The development of agricultural product processing technology in Indonesia's steps towards food security in 2025 is increasing rapidly. This is evidenced by the increasing number of soybean processing industries. The Kaliwining Bedadung Kulon area, Rambipuji District, Jember Regency is the center of the soybean processing industry with 11 industries in the Bedadung Kulon area. From this processing in addition to producing food centers, a byproduct is produced in the form of waste water. According to PermenLHK 05 2014, the content of soybean processing industry wastewater that can affect environmental physical changes is BOD, COD, and TSS. The wetlands method is a plant-based biological wastewater treatment that can be operated and applied quite simply Basically, almost all existing plants are able to absorb and reduce pollutant levels in wastewater. The main objective of this research is as an effort to minimize the environmental impact resulting from the disposal of untreated wastewater.

Keywords: wastewater, soybean, wetlands, kaliwining bedadung kulon, papyrus

1. INTRODUCTION

The development of agricultural product processing technology in Indonesia's steps towards food security in 2025 is increasingly rapid, this is evidenced by the increasing number of home industry activities. Among the home industries, one type of home industry that is quite a lot in the area of Rambipuji Subdistrict, Jember Regency, East Java is the industrial processing of soybean seeds which is processed into food in the form of tofu. There are at least 11 cottage industries in the Kaliwining area, Bedadung Kulon, Rambipuji District, Jember Regency. The production of tofu from the soybean processing industry is so high that it basically also requires the management of industrial byproducts, which basically the activities of the soybean processing industry produce liquid and solid waste. In the home industry for soybean processing in this area, generally the solid waste is used as animal feed, while the waste water produced is currently not properly managed.

Wastewater from the soybean processing industry if not managed properly will have an impact on the environment. According to PermenLHK 05 2014 the content of soybean processing industry wastewater which has an impact including physically, namely a thick odor and changes in the color of water bodies, as well as chemical and biological impacts, namely increasing levels of BOD, COD, and TSS in large quantities.

The wetlands method is a biological wastewater treatment with the help of plants that can be operated and applied quite simply in the form of planted wetlands with several plants that digest various types of wastewater content, so this method is considered good enough in managing wastewater.

In previous research conducted by researchers (Senki, 2016) in research on hospital wastewater management using the wetlands method resulted in a reduction in the BOD wastewater content of 51.93%, COD of 61.90%, and TSS of 100%. There is a significant reduction in hospital wastewater but the effectiveness of waste water for soybean processing is not yet known. The advantage of this method of technology is that it is very easy to apply and operate and does not require large costs, you only need to prepare wetland media and plants.

Basically, almost all existing plants are able to absorb and reduce pollutant levels in wastewater, among several types of plants that are able to reduce waste water levels properly according to research conducted by Kusumawardani and Rony in 2013, namely water hyacinth, semanggi, water jasmine, Fire lotus, Lembang or swamp grass, Umbrella Leaves / Papyrus, and water bamboo / horsetail.

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The objectives of this study are: (1) Minimizing the impact of river pollution due to the disposal of soybean processing industrial wastewater, (2) Determining the effectiveness of wetlands in reducing the contaminant content of soybean processing industrial wastewater.

2. METHODOLOGY

Potential Problems

The potential problem stage aims to analyze the positive and negative impacts of the soybean processing industry operations. The potential problem stage includes two main steps, namely the results of laboratory analysis of soybean processing wastewater in the region and various literature studies related to soybean processing industrial wastewater and the wetlands method.
Researchers need to conduct a literature study in order to find information on waste water from the soybean processing industry. Literature study is useful and aims to collect all research findings or other information that has similarities with the research to be carried out. Literature study is also useful for knowing different characteristics and environments.

The Wetlands Design Stage

The design stage is the design of the wastewater treatment system that will be operationalized. The design starts from analyzing the laboratory results data and literature studies that have been obtained, the data and information are used as a series in compiling the design. The stages in the design include: (a) analyzing laboratory results with the LHK 05 2014 regulation related to soybean processing industry wastewater; (b) analyzing literature studies on media and infrastructure of the wetlands system; (c) determine the location of the wetlands system media and (d) make a research design blueprint in the form of an autocad image of the wetlands system.

Advanced Stage

The next stage is the process of realizing the wetlands design. The next step is to apply the design that will be used as an operational facility for processing the soybean processing industry wastewater. After the design has been applied, the design will enter the trial phase, in which the design will be tested to be used to manage waste water from the soybean processing industry. The results of the trial process stage will be taken to the laboratory to be analyzed and become the final product of the application of the wetlands method in the management of soybean processing industry wastewater in the Kaliwining area, Bedadung Kulon, Rambipuji District, Jember Regency. The parameters of the feasibility of the design refer to the LHK 05 2014 regulation regarding the threshold for the quality standard of soybean processing industry wastewater which is allowed to be disposed of directly in the environment.

Research Procedure

The 4D model development research consists of four stages. The stages that must be carried out are as follows:

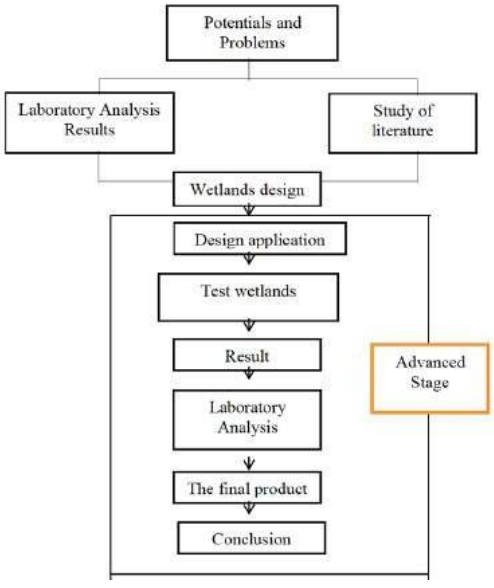

Fig. 1 - Flowchart of research topics

Type of Data

The type of data in this research is physical observation data and laboratory analysis data.

1. Physical observation data

Physical observation data were obtained from physical observations of soybean processing industry wastewater in the Kaliwining area, Bedadung Kulon, Rambipuji District, Jember Regency. From physical observation, it can be seen that the level of physical pollution is the color / turbidity of the river body and the smell of waste water.

2. Laboratory analysis data

Laboratory analysis data is obtained from samples that have been sent to the laboratory and tested with testing methods in accordance with SNI standards. The sample testing is carried out by a laboratory that has been certified by the KAN certification body (National Accreditation Committee) with optimally calibrated equipment.

Data Collection Instruments

The data collection instrument in this study was a sample of wastewater which was then sent to the laboratory for analysis. The waste water samples taken were stored in sterile bottles measuring 1.5 L, totaling 3 bottles in a sealed bottle cap condition.

Data Analysis Technique

The data obtained from the results of tests carried out by the laboratory were analyzed qualitatively and quantitatively. In the qualitative analysis, preliminary data were used in the form of the value of the wastewater content of the soybean processing industry with the quality standard of waste water according to the permitted LHK 05 2014 regulation. Meanwhile, quantitative analysis is used to determine the amount of wastewater in proportion to the area of the wetlands media.

3. RESULTS AND DISCUSSION

Analysis Results

Home industry in the form of soybean processing in the area of Bedadung Kidul Kaliwining Rambipuji Jember from physical observation at the location has a considerable impact on the environment. One of the things that underlies the assessment is that there is no wastewater treatment plant at that location. Wastewater generated from the washing and processing of soybeans is discharged directly into the river close to the home industry location which is only 12 meters from the production site. This causes the river to be polluted because the levels of BOD and COD in the wastewater from the treatment process are quite high, as evidenced by the test results either directly on site or taken to the environmental laboratory.

Table 1 – Laboratory analysis results before using wetlands

No	Parameter	Method	Unit	Results
1	BODs	SNI 6989.72-2009	mg/L	1195
2	CODs	SNI 6989.2-2009	mg/L	2883
3	TDS	Direct test	mg/L	1033

Fig. 2 – Wetland design

After analyzing the results of laboratory tests and direct tests, a mini model of wetlands was designed in the research location which functions as a waste water treatment plant from the soybean processing industry. This design is a development of various literature studies that have been carried out, including

literature study of research results on the wetlands (Suswati & Wibisono, 2013); (Hardanu et al., 2015); and (Siswoyo et al., 2020). As well as a literature study in the form of developing the development of the author's own wetlands method which has previously been successfully carried out in the Jember General Hospital, Clinics and Slaughterhouses.

The location of this design placement is right next to the industrial site, 3 meters from the location, the processing results in the form of waste water are flowed to the previous wetlands so that they go through a treatment process before then flow to the river (Fig. 2).

The design that has been made is immediately applied by constructing a supporting building for the mini media facility for wetlands (wetlands) which functions as a facility for wastewater treatment plants in industrial sites. The supporting building is in the form of a small tub made of masonry as a raw material and cast the floor with the size and volume according to the design drawing. In the supporting building, it is filled with filtration media in the form of soil, sand, and papyrus water plants as the main media for wetland filtering (Fig. 3).

Fig. 3 – Papyrus water as the main medium for wetland filtering

Discussion

First, the main medium of papyrus was planted (Fig. 4). After the media has been made, a waiting period is carried out to get the papyrus plants accustomed to adapting to new environmental conditions. At this stage, 14 days (2 weeks) are given before the filtration test process is carried out on the media. The method used during the test is to drain waste water from soybean processing into the wetlands, hold it for 1 hour before then flow it back.

Fig. 4 – Planting Papyrus water as the main medium for wetland filtering

There are 2 methods used to determine the level of wastewater after processing, including the direct test method with a TDS meter and laboratory test methods to determine the content of BODs and CODs. The test results can be seen in the following Table. 2 :

Table 2 – Laboratory analysis results after using wetlands

No	Parameter	Method	Unit	Results
1	BODs	SNI 6989.72-2009	mg/L	31,8
2	CODs	SNI 6989.2-2009	mg/L	64,4
3	TDS	Direct test	mg/L	393

Based on the results of the environmental laboratory analysis belonging to the UPTD Mojokerto, with the SNI 6989.72-2009 testing method, the BODs results obtained 31.8 mg/L of BODs content, these results were considered very good because the wastewater samples before entering the wetlands were obtained from the laboratory. which equates to a value of 1195 mg/L. The CODs content also showed an equally high reduction, from the initial data before processing, the CODs value was 2883 mg/L after going through the wetlands processing, the CODs content decreased to 64.4 mg/L.

In the direct test at the location, the TDS meter was used, the test was carried out before the waste water was flowed to the wetlands media, the TDS value was 1033, after the waste water was flowed and then held for 60 minutes (1 hour) in the wetlands media, the TDS result was 393. These kinds of results, based on the quality standard requirements for soybean processing industry wastewater with soy sauce, tofu, and tempeh, wetlands media can be concluded that it is feasible to be used as a media for wastewater treatment plants in that location.

4. CONCLUSION

Wetlands media using papyrus plants is suitable for use as a media for wastewater treatment plants at that location. This is indicated by the results of laboratory analysis, namely BODs, CODs and TDS. Each of them showed a significant decrease in values, namely BODs from 1195 mg/L to 31.8 mg/L, CODs from 2883 mg/L to 64.4 mg/L and TDS 1033 to 393. Further research needs to be done using other types of plants such as : water hyacinth, clover, water jasmine, fire lotus, swamp flower or grass, and water bamboo/horsetail. This aims to be able to provide different levels of plant effectiveness according to the characteristics of the waste.

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