Potential for Management and Utilization of Lampung Province of Tofu Industrial Waste

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Abstract. This study purposed to examine and determine the management and utilization techniques of tofu wastewater with the right technology. The method used in this research is Literature Review. The results of the studies that have been carried out are all journals showing that the management of tofu liquid waste is to reduce the levels of BOD, COD, TSS, minerals and pH to conform to water quality standards according to the Regulation of the Minister of the Environment of the Republic of Indonesia Number 5 of 2014 concerning Wastewater Quality Standards. The management can be done naturally using materials that are around the environment including vetiver, chitosan, coconut shell charcoal, water jasmine and tamarind and modern management includes continuous electro-coagulation methods, aeration methods, batch system methods as well as a combination of aeration, precipitation and filtration methods so as to reduce environmental pollution caused by tofu waste. In addition, the common use of tofu liquid waste is as an organic liquid fertilizer that can increase the economic value of the liquid waste and the use of liquid waste into biogas as an effort to fulfill sustainable development goals (SDGs) which are expected to improve the quality of sustainable life without causing environmental pollution.

PRELIMINARY

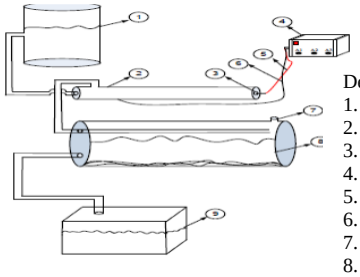
Lampung Province is one of the provinces that has more than 460 industries, both small and large industries with a high scope of work productivity. Based on research conducted by the Lampung Provincial Office, it was found that 200 industries were able to maintain their productivity level. One type of industry that is most in demand and crowded is the tofu and tempeh industry (Lampung Provincial Office, 2017). Tofu is one type of food favored by the people of Indonesia hence its production continues to increase. Tofu contains several nutritional values, such as protein, fat, carbohydrates, calories, minerals, phosphorus, and B-complex vitamins. Tofu is also often used as a low-calorie diet menu because of its low carbohydrate content (Utami, 2012). The need for tofu in Indonesia continues to increase along with the increase in population. Public awareness of the fulfillment of nutrition derived from tofu can be seen from the high consumption of tofu with the amount reaching 0.136 kg per capita in a week or equivalent to 7.02 kg/capita /year in 2014 (BPS, 2014). In the tofu production process, high amounts of waste are generated, both in the form of solid waste and liquid waste. According to Roesiani (2015) liquid waste will cause an uncomfortable odor and if it is dumped directly into the river it will cause river pollution. According to BPPT (2014), to make 80 kg of tofu, 2610 kg and 2800 liters of solid and liquid waste will be produced. Liquid waste generated from the process of washing, boiling, pressing and molding tofu, tofu liquid waste with characteristics containing high organic matter, such as BOD, COD, TSS and pH. Liquid waste has a liquid form resulting from the rest of a business or activity. The tofu industry is usually a home industry with limited capital, therefore, the majority of the tofu industry does not have a waste water treatment plant (WWTP).

According to Adack (2013), tofu waste disposed of in rivers can reduce environmental quality, especially for waters. Damage to the aquatic environment will have an impact on the ecosystems in these waters and can have a negative impact on human health. The presence of pollutants in the water will reduce the quality of water quality and its utilization. This is because the waste originating from the food processing industry is a fertile place for the proliferation of microorganisms, especially pathogenic microbes. Pathogenic bacteria that breed in polluted water can cause diseases that can be easily transmitted easily. If tofu waste pollution is not handled properly and continues continuously, it will disrupt the ecosystem in these waters. The characteristics of tofu factory waste are that it contains high BOD (Biochemical Oxygen Demand), COD (Chemical Oxygen Demand) and TSS (Total Suspended Solid), and a relatively low pH. The level of BOD (Biochemical Oxygen Demand) of tofu liquid waste reaches around 5000-10000 mg/lt. Therefore, before the waste is disposed of, the BOD level must be lowered according to the waste quality standard. Regulation of the Minister of Environment of the Republic of Indonesia Number 5 of 2014 concerning Wastewater Quality Standards. Each waste water quality standard has a stipulation in its parameter limits. The BOD level of tofu industrial wastewater that may be discharged into water bodies is 150mg/lt, COD is 300mg/lt, TSS is 200mg/lt the maximum allowable pH level is 6.0 – 9.0 mg/l.

The maximum allowable wastewater ammonia is 5mg/l (Effendi, 2003). High concentrations of ammonia in river bodies indicate pollution, one of which is caused by the discharge of domestic wastewater, both fresh (untreated) and treated. BOD levels can be reduced by draining the waste in a variety of streams. The flow variations include jumps on sudden falls and jumps on sudden expansion. The existence of different flow variations will lead to different flow characteristics. These conditions affect the process of decreasing BOD levels. Therefore, further studies are needed to reduce pollution levels in tofu liquid waste so that it is in accordance with permissible water quality standards and use tofu liquid waste to have economic value. The purpose of writing this paper is to find out the effective process of managing liquid waste produced in the tofu industry.

METHODS

Continuous Electrocoagulation Method



Description:
1. Tofu Liquid Waste Samples
2. External Electrode (Cathode)
3. Inner Electrode (Anode)
4. DC Power Supply
5. Black Cable (+)
6. Red Cable (-)
7. H2 Gas Station
8. Separator
9. Processed Wastewater

FIGURE 1. Electrocoagulation device circuit

Determination of Initial Parameter Level

Determination of TSS levels was carried out using the gravimetric method in accordance with SNI 06-6989.3-2004. Determination of COD levels was carried out by closed reflux method according to SNI 6989.2:2009. Determination of BOD levels is carried out according to SNI 6989.72:2009. Determination of the initial pH of the waste sample was measured with a pH meter.

Variable Flow Rate

5L of waste water is put into the electrocoagulation reactor, flowing tofu waste at a flow rate of 0.439 L/min, and a voltage of 8 V, 10 V, and 12 V. The electrocoagulation process is carried out continuously. Each sample was measured the value of COD, BOD, TSS and pH using a pH meter. Then the efficiency of removal of parameters COD, BOD, TSS are calculated. The previous step is repeated with a flow rate of 0.234 L/min and 0.087 L/min.

Voltage Variable

5L of wastewater is put into the electrocoagulation reactor, flowing tofu waste with a voltage of 8 V, and a flow rate of 0.439 L/minute, 0.234 L/minute and 0.087 L/minute. The electrocoagulation process is carried out continuously. Each sample was measured the value of COD, BOD, TSS and pH using a pH meter. Then the efficiency of removal of parameters COD, BOD, TSS are calculated. The previous steps is repeated again with a voltage of 10 V and 12 V.

Method Using Akar Wangi (Vetiver) and Zeliac

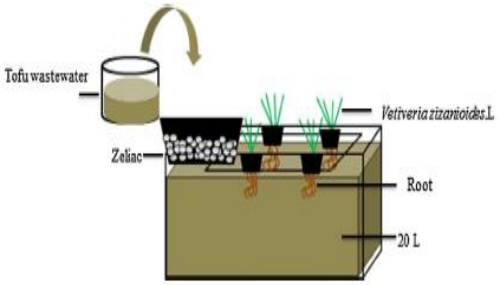


FIGURE 2. Tofu liquid waste management system with vetiver and zeliac

The response surface methodology was applied as a central composite design with two factors, namely the level of waste (20, 40, and 60%) and time (3.9, and 15 days). Response surface method is a set of mathematical and statistical techniques that are useful for analyzing problems in which there are several perfect response variables and the ultimate goal is to optimize the response.

Aeration Method

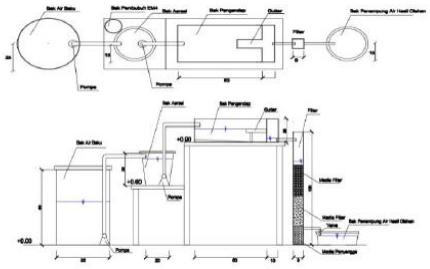


FIGURE 3. Liquid waste management aeration reactor

The reactor preparation is as follows:

1. Glass Reactor, Glass reactor is used as a filter reactor. The size used is 9 cm x 9 cm x 100 cm, with a glass thickness of 0.5 cm.
2. The raw water reservoir is used as a sample water container before it is pumped and put into the first treatment unit, namely the aeration tank.
3. Aeration Tub, The aeration tank is used for aeration with the addition of EM4.
4. Sedimentation Tub, The settling tank measures 63 cm x 18 cm x 10 cm. Equipped with a gutter as an outlet.

5. Water Hoses and Faucets, Water hoses are used to drain water from unit to unit. Hoses are used because of their flexible and malleable characteristics. The plastic water faucet will be used as a valve to regulate the discharge and take water samples that have been treated by filters with activated charcoal and zeolite media.
6. Effluent Reservoir from Processed Effluent, The reservoir is used as a sample water container after passing through the filter. The height of the effluent reservoir does not exceed the height of the bottom of the filter media

Batch System Method

Research on processing tofu liquid waste anaerobically using a batch system is carried out on a laboratory scale. This study is to determine the efficiency of the removal of wastewater parameters. The process used in this study is a batch process by giving contact between tofu liquid waste samples and cow dung in the reactor for 30 days so that changes in the quality of tofu liquid waste samples can be seen. This research is divided into several stages, namely:

1. Research preparation is carried out to prepare tools and materials that will be used in research. The material used in this research is tofu liquid waste. batch system as a container for wastewater samples that are conditioned without oxygen (anaerobic) and connected to a pipe in a container that serves to accommodate the gas produced from the degradation of organic matter in wastewater samples anaerobically.
2. In this study, 2 (two) types of treatment were carried out to determine the optimum condition of the process. The two types of variations were: one variation of 15 liter tofu waste water with the addition of 1.5 liter cow dung and two variations namely tofu waste water and 2.5 liter cow dung. Experiments on each variation were carried out for 30 days by measuring pH, checking Biological Oxygen Demand (BOD5), Chemical Oxygen Demand (COD), Total Suspended Solid (TSS) and C/N ratio at the beginning and end of processing. The gas composition analysis was carried out at the end of the study.
3. The final research is the results of the concentration of pollutant parameters and the calculation of the efficiency of parameter removal after processing. The processing results are compared with quality standards.

Filtration Method with Sand

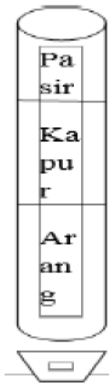


FIGURE 4. Illustration of sand filter design

1. The first test carried out by the researchers was an odor test on each sample of liquid waste that had been filtered in a jar using the sense of smell by calibrating the sense of smell using clear water this is done every time they smell each liquid waste sample and are assisted by several people other than the researchers themselves.
2. Testing the color of tofu and tempeh liquid waste using the sense of sight on each filtrate sample.
3. Measure the temperature of each filtrate using a thermometer.
4. Test the turbidity of the filtrate with the senses.

Method of Making Organic Fertilizer from Tofu Liquid Waste

The Process of Making Liquid Organic Fertilizer

1. Prepare tofu liquid waste that has been cooled using a bucket / jerry can as much as 5 liters, EM4 150ml/3 tablespoons (tbs), and 150 gr/ 5-7 tablespoons granulated sugar, 2 liters of coconut water and enough water.
2. The prepared ingredients are mixed and fermented for 14 days.

Method of Utilizing Tofu Liquid Waste into Biogas

The data sources used in this study are secondary data obtained from scientific publications such as journals, books and internet media. The data obtained were then analyzed descriptively (Rianti et al., 2018)

DISCUSSION

Tofu Liquid Waste Treatment into Clean Water by Continuous Electrocoagulation Method

Effect of Voltage and Flow Rate

Voltage has a strong current which is an electron that can move per unit area. So that the greater the voltage, the greater the electrons that move, this will cause more coagulants to be formed. This coagulant will serve to reduce the level of pollution in tofu liquid waste. The voltage used is 8V; 10V and 12V, at various flow rates, namely 0.087 L/min, 0.243 L/min and 0.439 L/min, so that for each voltage run, 9 samples will be obtained, after the electrocoagulation process is complete. Each sample was then analyzed to determine the content of COD, BOD, TSS and pH

COD Level

Voltage and flow rate that can reduce the COD value from 1017 mg/L to 283 mg/L, namely the 12V voltage variation at a flow rate of 0.087 L/min so as to produce a percent removal of 72.17%. The decrease in COD concentration in electrocoagulation was caused by oxidation and reduction processes in the electrocoagulation reactor. At the electrodes, oxygen and hydrogen gas are formed which will affect the reduction of COD. The decrease in COD was caused by the floc formed by organic compound ions bound with positive coagulant ions. The molecules in the tofu liquid waste are formed into flocs, the colloidal particles in the waste are binding on particles or other compounds in the waste, for example colloidal $Al(OH)_3$ is positively charged because its surface binds H^+ ions.

BOD Value

The BOD value in the 12V bonded wastewater sample at a flow rate of 0.087 L/min, where the initial BOD value was 513 mg/L to 146 mg/L which resulted in a removal percent of 71.53%, it can be explained that the voltage greatly affects the metal ionization process. at the anode electrode as a determinant of the reaction rate and in the electrocoagulation process to reduce the BOD concentration, where at the anode electrode the aluminum metal oxidation process produces $Al3^+$ ions which act as coagulant, the greater the voltage added to the electrocoagulation process, the greater the chemical energy produced, where the chemical energy produced is $Al3^+$ ions at the anode electrode which acts as a coagulant, so if added coagulants are formed more and more, if more coagulants are formed then many pollutants will form flocs that will settle, so that become clearer waste than before then sen the

organic compounds left in the liquid waste become more easily degraded by microorganisms (Setianingrum et al, 2016).

Total Suspended Solid (TSS)

TSS content with variations in voltage and flow rate. TSS concentration decreased. The greatest decrease in concentration occurred at a voltage of 8 Volts and a flow rate of 0.087 L/min with a final concentration of 100 mg/L. The decrease in TSS is because the particles contained in wastewater are generally negatively charged. The positive and negative ions produced by the electrode will stabilize the particles contained in the waste (Yuliato et al, 2009). The reduction efficiency or percent removal of TSS concentration is 90.90% at a voltage of 12 Volts and a flow rate of 0.087 L/min.

pH

The results of the analysis of pH content for variations in voltage and flow rate can be seen that the highest change in pH at 12V voltage variation and flow rate of 0.087 L/min is 6.7, the increase in pH in the electrocoagulation process is caused by a reduction reaction at the cathode of the aluminum electrode. This reduction reaction process will produce H^+ ions and OH^- ions which will form water. Voltage is very influential on the process of increasing the pH in electrocoagulation where if the voltage is added, the more H^+ ions and OH^- ions are formed at the cathode electrode, so that if more water is formed, the initial pH is acidic and will become neutral and vice versa initial is alkaline, then with the reduction reaction process that occurs at the cathode which produces water, the pH will become neutral (Yolanda, 2015).

Use of Natural Materials as a Reduction in BOD Levels in Tofu Liquid Waste

Chitosan

Chitosan is a derivative of chitin obtained by deacetylation which is the most abundant polysaccharide on earth after cellulose. Chitosan comes from organic materials and is a polyelectrolyte so that it can be used as a biocoagulant in the water treatment process. Chitosan application uses the principle of flocculation-coagulation with the addition of 10ppm, 20ppm, and 30ppm chitosan solutions in tofu waste. The results of research conducted by chitosan coagulant can reduce BOD levels to a predetermined quality standard, which is below 150 mg/L, with the addition of 20 ppm chitosan solution. BOD value to 7mg/L. The use of chitosan coagulant from milkfish scales in addition to being environmentally friendly can also utilize milkfish scales that have been discarded because they are considered waste as coagulant that can reduce environmental pollution.

Media of Human Hair and Coconut Shell Charcoal.

According to research by Pradana, et al (2018), the results obtained are the average BOD levels at repetitions 1,2,3,4,5, and 6 before treatment, which is 180.21 mg/l. After going through the aeration process it became 144.14 mg/l, hair medium became 99.66mg/l, coconut shell charcoal medium 40.39 mg/l. The average percentage decrease is 77.59%. Thus, aeration and filtration with the media of human hair and coconut shell charcoal can be applied in the tofu home industry. Coconut shell charcoal has the ability to reduce wastewater with a large capacity and absorption capacity. The ability to adsorb organic matter depends on the polar chain and the pollutant. The more organic a substance, the easier the pollutant chain will be to break down. (Alimsyah, 2013).

Echinodorus palaefolius or Water Jasmine

The use of jasmine water can function to reduce the pollutants contained in tofu liquid waste using a combination system of constructed wetland and filtration. Based on research by Kasman et al (2018), the BOD level of tofu liquid waste with the use of water jasmine on the 15th day produces a BOD value of 97 mg/lt, this already meets the wastewater quality standards. This combined constructed and filtration system has proven to be very effective in reducing BOD levels in tofu liquid waste. This method is able to reduce BOD levels to below the predetermined quality standard. In applying the combined constructed and filtration system method, tofu producers require more

costs to build a constructed and filtration system and also a fairly long waste treatment time of 15 days to produce BOD levels in accordance with quality standards.

Tamarind Seeds *(Tamarindus Indica L)* are Processed into Biocoagulants

The results of Ulwia's research (2017) biocoagulants from tamarind seeds can reduce BOD in tofu waste to below the quality standard that has been set. By using tamarind seeds at a dose of 600gr with a stirring time of 30 minutes the BOD levels decreased by 7 mg/l, from 36mg/lt to 29mg/lt. Treatment with tamarind seed powder 700gr with a stirring time of 40 minutes decreased by 10 mg/lt from 36mg/lt to 26 mg/lt. Treatment with tamarind seed powder 800gr decreased 15mg/lt from 36mg/lt to 21mg/lt. This shows that the more doses of tamarind powder used, the greater the decrease in BOD levels in tofu liquid waste. Tamarind seeds can be used as a coagulant in the coagulation process because the protein content in the seeds acts as a polyelectrolyte. Dissolved protein from tamarind seeds contains -NH3+ groups which can bind negatively charged particles so that these particles are destabilized to form particle sizes that can eventually be deposited. This group is the active side of the coagulant (Hendrawati et al, 2013).

Tofu Wastewater Treatment Using Vetiver Grass *(Vetiveria zizanioides)* and Zeliac

Use of Zeliac

COD reduction response value. The percentage of COD removal increased from 22.90% (3 days and 40% waste) to 89.33% (15 days and 40% waste). While the percentage of BOD removal increased from 16.66% (3 days and 40% waste) to 86.73% (15 days and 40% waste), TSS increased from 23.28% in 3 days and 20% waste to 82.30 % in 15 days and 60% waste. In this study, zeliac contains activated carbon, rice husk ash, lime, cement, and zeolite. These materials can effectively remove COD (Klimiuk and Kulikowska 2006). Zeliac is able to optimally remove COD. Ferric chloride in combination with a synthetic cationic polymer (Oxyfoc FL-11) with a ratio of 250: 20 mg L (−1) removed good COD, BOD, and TSS of 75.4, 79.8, and 96.0%, respectively, by eliminating odors, color and turbidity of the waste making soy milk and tofu.

Vetiver *(Vetiveria zizanioides)*

The percentage of removal of COD, BOD and TSS increased most likely due to the decomposition of organic matter and the photosynthetic process of plants which resulted in a sufficient supply of oxygen for microorganisms, more effective degradation of the rhizosphere. The process of photosynthesis in *V. zizanioides* allows the release of oxygen into the air and then diffusion into the water around the roots (rhizosphere). The condition of the oxygen-rich rhizosphere zone causes the development of aerobic bacteria to decompose organic compounds, thereby reducing the concentration of COD, BOD and TSS. Some organic compounds have been broken down into other simpler compounds, which are then absorbed by plants for metabolic processes. The pH of unprocessed tofu liquid waste is 4.45. This value is below the quality standard (6-9).

The growth of vetiver can be seen from the specific growth rate (SGR) of roots and stems. Vetiver has the potential as a biofilter to absorb organic matter. Each treatment experienced an increase in root length, stem and specific growth rate (SGR) of *V. zizanioides*. The root system grows well with a length of 12, 25 – 19.25 cm. Longer roots will provide an opportunity to absorb nutrients (Efendi et al. 2017). *V. zizanioides* can also grow well. When plants grow rapidly, greater nutrient uptake is required. Nutrients in tofu wastewater come from the decomposition of organic matter by living microorganisms which are naturally absorbed by *V. zizanioides* and serve as a source of new tissue formation. Nutritional needs are met from the decomposition of organic matter contained in water, which will be used by autotrophic organisms, such as aquatic plants and phytoplankton (Efendi et al. 2015). The application of *V. zizanioides* in wastewater purification with a foating system showed normal growth in rivers contaminated with domestic waste for 4 weeks (Chunrong et al. 1998). Xuhui et al. (2002) also showed *that V. zizanioides* can survive for 10-12 months in wastewater with COD > 400 mg/L and BOD > 150 mg/L.

Natural Reduction of Ammonia Levels in Tofu Liquid Waste

Reduction of Ammonia, Nitrite, and Nitrate Levels of Tofu Industrial Liquid Waste Using Activated Charcoal From Coffee Grounds

Weakness:

- Coffee grounds soaking time takes a long time 48 hours
- 3 hours of oven, with a temperature of 150 degrees and ingredients in the oven 2 grams, this is too long so that it wastes electricity in the oven.
- At the contact time of 60 minutes there was a decrease in the adsorption value. This is because the pores of the activated charcoal have been saturated or have closed.

Advantages:

- The absorption by activated charcoal with a particle size of 100 mesh reached the optimum at a contact time of 30 minutes.
- Effective because the materials used are environmentally friendly
- Efficient because the price of coffee is relatively cheap
- The decrease in ammonia levels using coffee grounds at the contact time and the optimum pH was 64.69% ammonia levels, this made the effect quite high.

Study on the Use of Various Activated Clays as Adsorbents to Reduce Ammonia, Nitrate and Nitrite Levels From Industrial Tofu Waste

Weakness:

- Not all types of clay can be used depending on the content in the clay
- The activation process is quite long because it is carried out for 24 hours

Advantages:

- Clay is a good adsorbent because it has high chemical and mechanical stability and has varied surface and structural properties.
- Effective because in addition to being environmentally friendly, clay from Beka Village activated by 0.1 M HCl is the best adsorbent in reducing ammonia, nitrate and nitrite levels, which is 47.52%

Use of Coconut Shell Activated Charcoal Adsorbent to Reduce Ammonia Levels in Tofu Industrial Liquid Waste

Weakness:

- The charcoal making process takes quite a long time.
- In the combustion process, side effects arise such as a reduction in air oxygen levels

Advantages:

- The optimum contact time between activated charcoal and tofu liquid waste samples was 40 minutes with a very satisfactory result of 93.693%.
- Coconut shell charcoal has a large pore cavity making it easier to absorb pollutants.
- Effective because in addition to being environmentally friendly, coconut shells are easy to obtain because many have not been utilized.
- Efficient because it is a waste from the market that is easy to find and the price is relatively cheap.

Utilization of Corn Cob Waste (Zea Mays L.) as Activated Charcoal in Reducing Ammonia, Nitrite and Nitrate Levels in Tofu Industrial Liquid Waste Using Dip Technique

Weakness:

- This type of adsorption is not site specific, where the adsorbed molecules are free to cover the entire solid surface.
- The process of making activated charcoal is calculated to take a long time, because in this study only a few samples were used. However, if it will be applied as a whole it will take a lot of time in the process of making activated charcoal

Advantages:

- Corn cobs as activated charcoal which is then wrapped in tea bags in order to reduce environmental pollution by the tofu industry
- It is quite effective because it has a lowering effect on ammonia levels by 51.29%, although it is not maximized and the materials used are environmentally friendly
- Efficient because of the costs in spending for this tofu waste treatment using cheap materials
- The adsorption event on activated charcoal occurs because of the Van der Walls force, namely the intermolecular attraction between the solid molecules and the adsorbed solute is greater than the attraction between the solutes themselves in the solution, so the solute will be concentrated on the solid surface.

Domestic Wastewater Treatment Using Aeration, Precipitation, and Filtration Process of Zeolite-Activated Charcoal

a) The largest decrease in content or removal of organic substances was found in the C2-A2 variable, namely with a 50% zeolith and 50% activated charcoal media variation, and an additional dose of EM4 which was 5%. The average removal of organic matter content reached 93.14%.

b) The largest decrease in the content or removal of TDS values was found in the C2-A2 variable, namely with a 50% zeolith and 50% activated charcoal media variation, as well as an additional dose of EM4 which was 5%. The average allowance for the BOD value reached 84.76%.

Anaerobic Tofu Liquid Waste Treatment using Batch System

Anaerobic treatment using a batch feeding system can reduce the parameters of tofu liquid waste. Based on the results of the study, the most optimum treatment in this study was treatment 3, namely 15 liters of tofu liquid waste and 2.5 liters of cow dung. The most optimum processing was determined based on the processing efficiency which was higher than the three treatments. The removal efficiency of the treatment that has been carried out with the pollutant parameter BOD5 reaches 73%, while the removal efficiency for the COD parameter is 78% and the TSS parameter is 50%.

Parameters BOD5, COD, pH and TSS after processing still do not meet the quality standards of the Decree of the Minister of the Environment No. 51 of 1995 concerning the quality standard of liquid waste for industrial activities. The most optimum gas production rate is in the second variation where the weight of biogas produced is 0.840 gram/day. However, the production rate does not affect the results of the analysis of gas composition that has been carried out, where the results of the analysis of gas content using gas chromatography show that the highest methane gas content of 0.399% is produced from the 3rd treatment which has a slower gas production rate.

Tofu Waste Treatment with Appropriate Technology Methods Sand Filters as a Study of Environmental Knowledge Courses

Color

The color of the tofu liquid waste after being filtered looks clear. After doing several repetitions, the resulting filtrate still has the same color or does not cause saturation in the sand filter and rice husk charcoal supplements used. Changes in color after filtering as an indicator of reduced organic and inorganic particles dissolved in the sample. The reduction of these particles is due to partly being absorbed and/or retained by the filter particles. Sand with a size of 0.0001-0.0003 mm, rice husk and lime can hold large particles. In addition, rice husk charcoal, which is an amorphous and alkaline structure carbon, can absorb dyes and metal ions. Likewise for lime, it can neutralize acids and absorb dyes and certain ions.

Temperature

The temperature of the tofu liquid waste and before being filtered ranged from 21ºC-22ºC. Tofu liquid waste after filtering ranges from 21ºC-25ºC. This means that the temperature range of 21ºC-25ºC is a temperature at which the life of microorganisms can still occur because from a temperature of 10ºC-85ºC pathogenic microorganisms can still grow. An increase in temperature can be an indicator of chemical and biological activity by microorganisms. From the discussion of the previous indicators (smell, color), the researcher concluded that the particles in the filtered sample were reduced. Although the temperature is caused by the heat released from the chemical activity of the decomposition or decomposition of organic compounds by microorganisms, according to the researchers, this temperature increase is not caused by the chemical or biological activity of the dissolved particles. This is based on the reduced odor and gas pressure and the color becomes clear indicating less dissolved particles. Therefore, according to researchers, this temperature increase is caused by filter particles. It is known that the solid particles (filter particles) have a higher temperature than the liquid (waste) temperature. In addition, the lime particles when dissolved in water will react to produce $Ca(OH)_2$ base and release heat. So the increase in temperature is a result of the solid particles or from the lime In addition, lime particles when dissolved in water will react to produce $Ca(OH)_2$ base and release heat. So the increase in temperature is a result of the solid particles or from the lime In addition, lime particles when dissolved in water will react to produce $Ca(OH)_2$ base and release heat. So, the increase in temperature is a result of the solid particles or from the lime

Thickness

Observations showed that the liquid waste was not thick but watery like ordinary water because the organic matter suspended in the liquid waste was successfully filtered and settled on the surface of the sand. Viscosity consists of organic and inorganic solids that are soluble, precipitated or suspended. This material will settle to the bottom of the water which over time causes siltation at the bottom of the receiving body. Another consequence of this viscosity causes the growth of certain aquatic plants and can be toxic to other creatures. Viscosity indicates the amount of sludge contained in wastewater.

The viscosity or the amount of sediment and colloidal and dissolved materials come from the presence of solid industrial waste materials. Solid industrial waste material if it is not completely dissolved will settle to the bottom of the river and the partially soluble will become colloidal. The sediment before reaching the riverbed will float in the water and block the entry of sunlight into the water layer. Though sunlight is needed by microorganisms to carry out photosynthesis. Because there is no sunlight, the process of photosynthesis cannot take place. As a result, the life of microorganisms is disrupted. If the precipitates and colloids that occur come from organic waste materials, the microorganisms, with the help of oxygen dissolved in the water, will degrade the organic matter so that it becomes a simpler material. In this case, the oxygen content in the water will decrease so that other organisms that need it will be disturbed as well. Therefore, the disposal of tofu waste by craftsmen is not considered properly,

as well as the lack of understanding and knowledge about environmental health, instability or damage will occur such as water pollution.

Tofu Liquid Waste Processing Into Liquid Organic Fertilizer

Nutrient content of tofu liquid waste; contains complete nutrients, both macro nutrients: N, P, K, Ca, Mg and S and micro nutrients: Fe, Cu, Mn, Mo, Zn, Cl and B. The results of Samsudin et al. (2018) showed that the P content in tofu liquid waste was low after being fermented, so it was necessary to add other ingredients in the form of coconut water. On the other hand, fermentation of tofu liquid waste can increase potassium levels from 0.042% to 0.31% (Liandari, 2017), the same thing was also obtained by Rasmito et. al (2019) the potassium content in K2O was 3.36% higher than the nitrogen content of 1.24%. The perfect mixing process will speed up the fermentation process, composting that goes well is characterized by a tape-like aroma (Kasmawan, 2018). This is important because the smell is caused by the presence of yeast (Elfarisna, 2014), Yeast will form anti-bacterial substances. Bioactive substances such as hormones and enzymes produced by yeast will increase the number of active cells (Elfarisna, et al., 2013). The duration of fermentation also has a significant effect on sugar and molasses content in the manufacture of organic liquid fertilizer (Fahruddin and Sulfahri, 2019). The storage process for 14 days aims to make the anaerobic fermentation process run well so that liquid fertilizer can be applied immediately.

Potential Utilization of Tofu Liquid Waste into Biogas

Biogas is a gas formed from the decomposition of organic matter under anaerobic conditions (Wahyuni, 2011). The composition of biogas consists of: 50-80% methane, CO2, H2S and a little water, which can be used as a substitute for kerosene or liquefied petroleum gas (LPG). In the process of making biogas, a series of tools are needed in the form of a digester (digester), an inlet of raw materials, an outlet for slurry from digestion, and a pipe to drain the biogas produced directly to the stove or for lighting.

The advantages of using biogas compared to other fuels are:

1. Help slow global warming by lowering greenhouse gas emissions such as CO_2.
2. Utilize and reduce waste such as animal waste and food industry waste.
3. Realizing the existence of environmentally friendly fuels.
4. Save the costs incurred to buy fuel for breeders or industrial owners who produce waste that can be used as biogas.

Handling tofu liquid waste into biogas can function as a producer of new renewable energy which has the benefit of reducing dependence on fossil energy and optimizing the potential of the Tofu industry which is supported by the use of biogas as a renewable energy source that can be used for the operational production of the tofu.

CONCLUSION

Based on the description above, it can be concluded that the management of tofu industrial wastewater can be carried out by several methods, namely continuous electrocoagulation, using vetiver grass (*Vetiveria zizanioides*) and zeliac, using effective and efficient natural ingredients, precipitation aeration methods, and zeolite media filtration - activated charcoal and anaerobically using a batch system. As well as the use of tofu liquid waste as liquid fertilizer and biogas which can add economic value as well as an effort to reduce the impact of environmental damage due to industrial processes

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