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The dosage variant combinations of EM-4 and fermentation time based on physics and chemicals parametersof tofu's wastewater

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Abstract

The existence of wastewater from the tofu processed waste water without processed first leads to a decrease in water quality. The objectives of the study were to analyze the combination of variation of EM-4 dose and fermentation time and combination of variation of EM-4 dose and fermentation time on physical parameters (TSS), chemical (BOD, COD, pH). The research design was using Completely Randomized Design. Types of experimental research with effluent treatment using Effective Microorganism-4 (EM4) activator with 5%, 7%, 10% and 5 days, 10 days, 15 days, repetition times. The results showed the largest decrease of waste concentration in processing of EM4 concentration 10% with a residence time of 20 days with TSS 2,938.33mg / L (85,5%), BOD 574,58mg / L (71,9%), COD 2,012, 8mg / L (71.8%) and pH 7.5 (87%). Data analysis using anova in treatment group of EM4 concentration and fermentation time was obtained p = 0,000 and α = 0,05 indicated that there was significant difference due to variation of EM4 concentration, due to combination of variation of dose em-4 and fermentation time and interaction of both. The parameters of TSS, BOD and COD have not met the standard of quality standard, and pH parameters have fulfilled the standard of quality with the index of light contamination at best treatment that is 10% dose of EM4 dose and 20 days fermentation time.

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Introduction

The increase of Industrial growth, especially the processing of Tofu indicated the development increase in Banjarbaru city. According to Department of Trade, Industry, Mining and Energy of Banjarbaru, in 2014 there were 11 Industries of Processing Tofu, both in small up to medium scale. In general, the Tofu's processing factory in Banjarbaru has no wastewater facilities. The wastewater of the tofu processing in the factory is thrown away directly to the nearby area or the nearby water source such as river etc. The result of this misconduct is the decrease of the water quality.

The characteristic of wastewater from processing tofu in general are the temperature exceeds the normal temperature of the receiving water (60-80°C), the color of the wastewater is white mixed with yellow and murky, contains organic material, the rate of pH is <7, the TSS, BOD, COD content is higher than usual. The solids partsare partly of soy skin, mucous membranes, proteins, fats, and carbohydrates. The tofu wastewater that is discharged directly to water sources other than potentially cause the smell of decay as a result of anaerobic process in the reshuffle of proteins, fats, and carbohydrates by microorganisms, also increase the risk of water pollution (Supriyanto, 2007). Tofu wastewater is an organic waste that doesn't contain heavy metals so that the processing can be done biologically.

Effective Microorganism (EM) is a mixed culture of fermentative microorganisms, consisting of: photosynthetic bacteria (*Rhodopseudomonas* sp.), Fermented fungi (*Saccharomyces* sp.), Lactic acid bacteria (*Lactobacillus*), And Actinomycetes yeast serves to reduce pollutant parameters and increase nutrients (Fitria, 2008). By doing the biological waste treatment processes using EM4 activator and oxygen supply continuously will have an effect on reducing pollutant level quickly and optimize the environmental condition, thus that condition of organic food-eating bacteria can grow well. This is because the various types of bacteria contained in EM4 is aerobic bacteria that require free oxygen in degrading organic compounds (Jasmiyanti, 2010).

This study aim is to determine the effectiveness of microorganisms (EM4) in decomposing organic waste in the manufacture of tofu industry in relation to the development of waste processing technology that is affordable, fast, easy to be applied, and the waste of the product will not damage the environment.

Materials and methods

Materials

This research was conducted in scale of laboratory using plastic holder (reactor) with 10 liters capacity, length 29,5cm, width 19cm, and height 21 cm from 15 items and three times repetition to the total of 45 reactors. The activator material (inoculum) that used to treat the waste was EM-4. Operational sample used in this research was 7 liters.

Research Design

The system used in this research was batch system. In general, the principal of using the batch reactor as follows; a. the reactors are filled with the reactant and being kept for a certain period to be monitored. On the monitoring process, the researcher analyzed the changes of the quality of the EM-4.

The Effective microorganisms (EM-4) had to be activated first before being added to the tofu wastewater which is treated as a treatment with 1 liter of EM-4 plus 1-litermolasse and 20 liters of drink water (the Brand's name is Aquades) in scale of 1:20 (5%) plus 5 up to 7 days fermentation period.

The use of 5% of EM-4 on the tofu's wastewater was based on the Jasmiyati's research about the optimum dosage (2010). The purpose of the fermentation was to give more time and room to the EM-4 in order to reproduce optimally, so the microorganism could work more efficiently and optimum before being mixed to the wastewater.

Method

The type of research conducted is experimental research. The design of this study was Completely Randomized Design Factorial Pattern 3 x 5 with 3 replications, so there were 15 treatment combinations and 45 experimental units.

This process was done up to 20 days, with varieties of fermentation times such as: 0 day (W0); 5 days (W1); 10 days (W2); 15 days (W3); and 20 days (W4) on each treatment as follows:

(E1) Tofu's wastewater 7.000 ml+ 350 ml EM4 {5%}

(E2) Tofu's wastewater 7.000 ml+ 525 ml EM4 {7,5 %}

(E3) Tofu's wastewater 7.000 ml+ 700 ml EM4 {10%}

Thus, there were 15 treatments combination which have been done with three times repetitions on each treatment. The lab's temperature was also registered every single day to see how the changes of temperature may affect the result of the treatment given. Based on the treatment given, the water from the age of the 0; 5; 10; 15 and 20 days sample and their repetition will be brought to lab to be examine both with physical and chemical parameters, that is Total Suspended Solid (TSS), Biologycal Oxygen Demand (BOD), Chemical Oxygen Demand (COD), degree of acidity (pH)

Analysis of Data

The data taken from the lab will be analyzed using variety analysis (ANOVA) where the previous data firstly, will be examined using Bartlet method for the homogeneity of data. If the result of the variety analysis is true then, the progress will be using the Duncan Multiple Range Test (DMRT) according to Steel and Torrie (2004). On the other hand, the data from the lab's sampling from each treatments and repetitions will be compiled and compared with the standard of quality according to ministerial regulation of Environmental and Health no.5 year 2014.

No	Parameters	Standard (mg/L)
1	BOD	150
2	COD	300
3	TSS	100
4	pH	6,0 – 9,0

However, the status of water quality was using pollution index method (IP) based on regulation of the minister of environmental state no. 115 year 2003 about the guidelines of water quality status , using the equation:

$$PI_j = \sqrt{\frac{(C_i / L_{ij})_M^2 + (C_i / L_{ij})_R^2}{2}}$$

where Lij is mentioned the concentration of water quality parameters listed in the Water Design Standard (j), and Ci states the concentration of air quality parameters (i) generated from the airborne analysis results at a sampling site of a river flow, then PIj is the Pollution Index for esignation (j) which is a function of Ci/Lij., while M = maximum, R = average. Water quality index IP determined from result maximum value and mean value of ratio per-paramater concentration against value quality standards. The evaluation criteria will be as following:

$0 \leq Pij \leq 1,0$	=	Good
$0 \leq Pij \leq 5,0$	=	Slightly Polluted
$5,0 \leq Pij \leq 10$	=	Medium Polluted
$Pij \geq 10$	=	Heavily Polluted

Results and discussion

The results of measurement of BOD, COD and TSS levels before treatment are as follows:

Table 1. The First Measurement of Tofu's Wastewater.

No	Parameter	Units	Results	Standard
1.	BOD	mg/L	2.041,87	150
2.	COD	mg/L	7.150,00	300
3	TSS	mg/L	2.938,33	100
4	Ph	-	4,01	6,0 -9,0

Based on the above data (table 1) it is known that all inspection parameters do not meet the applicable standard of BOD (2.041,87mg/L), COD (7,150.00mg/L), TSS (2,938.33mg/L) and pH (4.01), those results indicating the need for wastewater treatment before disposing into the environment.

*Combination of Dose Variation of EM-4 and Fermentation Time Against Physical Parameters (Total Suspended Solid/TSS) of Tofu Liquid Waste***.**

The average TSS of wastewater of tofu at dose variation and fermentation time during the study can be seen in the following table.

Based on the results of the analysis of variance (Anova) showed that the combination treatment of dosage variation and fermentation time variation significantly affect the decrease of TSS (α <0,05). The highest (highest) TSS was produced by treatment

E2W0 (EM4 7,5%, 0 days) 2,868,00mg/L, while the lowest (best) TSS was produced by E3W4 (EM4 10%, 20 days) treatment of 420,33mg/L with a reduction efficiency of TSS level of 71.8%.

Table 2. Average TSS of wastewater on dose variation and fermentation time.

Treatments	Average of TSS (mg/L)		efficiency (%)
E1W0 (EM4 5%, 0 Day)	2.737,00	f	6,9
E1W1 (EM4 5%, 5 Days)	1.642,67	de	44,1
E1W2 (EM4 5%, 10 Days)	749,00	de	74,5
E1W3 (EM4 5%, 15 Days)	770,00	bc	73,3
E1W4 (EM4 5%, 20 Days)	500,00	a	83,0
E2W0 (EM4 7,5%, 0 Days)	2.868,00	g	2,4
E2W1 (EM4 7,5%, 5 Days)	1.822,67	de	38,0
E2W2 (EM4 7,5%, 10 Days)	907,00	abc	69,1
E2W3 (EM4 7,5%, 15 Days)	825,00	a	71,9
E2W4 (EM4 7,5%, 20 Days)	474,33	a	83,9
E3W0 (EM4 10%, 0 Days)	2.234,00	ef	24,0
E3W1 (EM4 10%, 5 Days)	1.425,67	cd	51,5
E3W2 (EM4 10%, 10 Days)	872,67	abc	70,3
E3W3 (EM4 10%, 15 Days)	671,67	a	77,1
E3W4 (EM4 10%, 20 Days)	420,33	a	85,5
Standard	100		

Note: The numbers followed by different superscript on the same column show significantly different (α <0.05).

The test of difference of median value/advanced test using Duncan test (DMRT) in Table 1 showed the best treatment of E3W4 (EM4 10%, 20 days) of 420.33mg/L was not significantly different with E3W3 treatment (EM4 10%, 15 days) E2W4 (EM4 7,5%, 20 days), E2W3 (EM4 7,5%, 15 day) and E1W4 (EM4 5%, 20 days), but significantly different from other treatment.

The suspected factors to cause decreased TSS levels due to increased time or length of fermentation were as follows: (1) the longer time to stay causes the compounds have been absorbed into suspended materials so that it settles in the bottom of the waters. (2) Microorganisms in the phase of growth / logarithmic phase where in this phase of bacterial growth occurs rapidly, so that in the growth microorganism require nutrients and will directly affect the decrease in TSS.

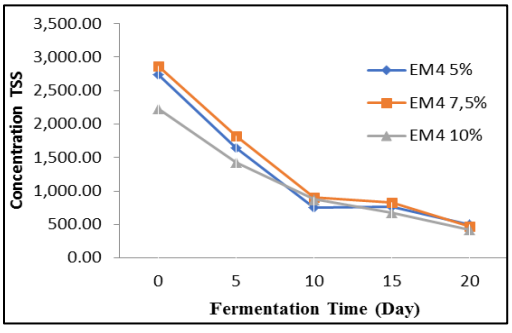

Fig. 1. The average % of EM4 combination and fermentation time in the TSS analysis on the tofu's wastewater.

In Fig. 1, the TSS parameter decreased significantly on the 1st day until the 10th day, and the decrease was relatively stable on the 15th day until the 20th day.

The highest decrease was shown in the addition of EM-4 treatment as much as 5% where on day 10 the content of TSS live 749mg/L with a decrease efficiency of 74.5% Low TSS value can increase the value of water clarity and facilitate the penetration of sunlight into the water and ultimately affect the increase of photosynthesis process in the water.

Up to the 20th day the value of TSS of tofu's wastewater hasn't reached the required quality standard based on the Ministerial Regulation of Environment and Health No.5, 2014 that is equal to 100mg/l. The lowest decrease in TSS was found in 20th day treatment with EM-4 dose of 10% with 420.33mg/L with efficiency decrease 85,5%.

Combination of Dose Variation of EM-4 and Fermentation Time Against Chemical Parameters of Liquid Waste Tofu.

BOD (Biologycal Oxygen Demand)

The Average of BOD wastewater from tofu at dose variation and fermentation time during the study can be seen in the following table:

Tabel 7. The Average of BOD wastewater from tofu at dose variation and fermentation time.

Treatment	Average of BOD (mg/L)		Efficiency (%)
E1W0 (EM4 5%, 0 Day)	2.148,41	e	0
E1W1 (EM4 5%, 5 Days)	1.093,45	d	46,4
E1W2 (EM4 5%, 10 Days)	1.013,04	cd	50,4
E1W3 (EM4 5%, 15 Days)	722,22	ab	64,6
E1W4 (EM4 5%, 20 Days)	565,13	a	72,3
E2W0 (EM4 7,5%, 0 Days)	2.113,72	e	0
E2W1 (EM4 7,5%, 5 Days)	1.146,99	d	43,8
E2W2 (EM4 7,5%, 10 Days)	1.139,60	d	44,2
E2W3 (EM4 7,5%, 15 Days)	1.201.38	d	63,2
E2W4 (EM4 7,5%, 20 Days)	666,14	a	67,4
E3W0 (EM4 10%, 0 Days)	2.040,70	e	0
E3W1 (EM4 10%, 5 Days)	1.116,30	d	45,3
E3W2 (EM4 10%, 10 Days)	1.083,34	cd	45,7
E3W3 (EM4 10%, 15 Days)	878,59	bc	57,0
E3W4 (EM4 10%, 20 Days)	574,58	a	71,9
Standard	150		

Note: The numbers followed by different superscript on the same column show significantly different (α <0.05).

Based on the results of the analysis of variance (Anova), it showed that the combination treatment of dosage variation and fermentation time variation significantly affected the decrease in BOD (α <0,05). The highest BOD content was produced by E1W0 treatment (EM4 5%, 0 days) for 2,148,41mg/L, while the lowest BOD (best) was produced by treatment E1W4 (EM4 5%, 20 days) of 565,13mg/L with an efficiency reduction of BOD content of 72.3%. The test of difference of median value/advanced test using Duncan test (DMRT) in Table 7 showed the best treatment of E1W4 (EM4 5%, 20 days) of 565,13mg/L, not significantly different with E2W4 treatment (EM4 7,5%, 20 day) and E3W4 (EM4 10%, 20 days), but significantly different from E3W, E3W3, E3W2, E3W0, E2W3, E2W2, E2W1, E2W0, E1W3, E1W2, E1W1 and E1W0. Factors which were suspected to cause decreased BOD levels due to increased of the time or the duration of fermentation include as follows: (1) The aid of oxygen will be much faster in reducing levels of pollutants, which the organic food-eating bacteria can grow optimally, because the bacteria present in EM4 aerobic bacteria that require free oxygen in degrading organic compounds, based on Jasmiyanti (2010), (2) The Activity of lactic acid bacteria (*Lactobacillus* sp) contained in EM4. The bacteria fermented organic ingredients of wastewater into lactic acid compounds that helps to accelerate the reconstruction of organic matter (Isa, 2008), (3) The cooperation between lactic acid bacteria with fermented fungi (*Saccharomyces* sp) in fermenting organic materials into organic compounds that more simple, so that the decomposition of organic compounds faster than natural processes. Decomposition of organic compounds into simpler compounds indirectly can lower levels of BOD (Avlenda, 2009). According Fardiaz, *et al.* (1974), the reduce of oxygen is generally used for the oxidation of organic matter, cell synthesis and cell oxidation of microorganisms. Sketchily all the reactions that consume oxygen are as following:

Oxidation of organic matter: $(CH_2O)\ n + nO_2 \rightarrow nCO_2 + nH_2O$ + heat

Cell synthesis: $(CH_2O)\ n + NH_3 + O_2 \rightarrow$ Cell + CO_2 + H_2O + heat

Cell oxidation: Cell + $O_2 \rightarrow CO_2 + H_2O + NH_3$ + heat

According to Hanifah *et al.* (2004), microorganisms EM are able to degrade waste pollutant quickly. Microorganisms in pollutants substance is continuously performing the metabolic processes as long as their energy is fulfilled.

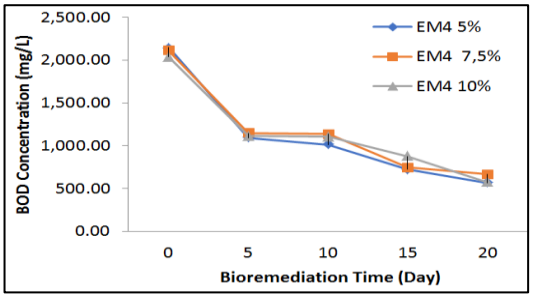

Fig. 2. The average % of EM4 combination and fermentation time into BOD analysis in tofu wastewater.

The smaller the decrease of BOD in a waste treatment process indicating that the smaller degradation process may occurs. The significant decrease in BOD value on the first day up to fifth day (see on Fig. 2) with an efficiency decrease of 67,4% up to 72.3%. The increase of the bioremediation process time (days) cause a decrease in the BOD concentration to increase because the place between the microorganisms and tofu wastewater can be found (available) is quite a lot. Under these conditions, the interaction between EM-4 with the tofu waste water was quite good.

The decrease of BOD was stable on the fifth day up to tenth day, bioremediation process was relatively static and did not show a BOD concentration changes as shown in Fig. 2. The ability of microorganisms in degrading the reduced waste was estimated along with the reduced nutrient derived from the wastewater. Up to the 20th days, the value of tofu wastewater has not reached the required standard quality which has been regulated by The Ministry of Environment No. 5 year 2014 about the standard quality of wastewater for business and/or soy processing activity for about 150mg/L.

COD (Chemical Oxygen Demand)

The COD number shows the amount of oxygen which is required for organic material that was found in the wastewater can be chemically oxidized either that can be degraded by microorganisms or the one which is hard to be degraded.

The mechanism of decomposition from chemically organic material which can be degraded by microorganism or hard to be degraded (Takwayana, 2012) is:

$CxHyOz + Cr2O72- + H+ = CO2 + H2O + Cr3+$

Based on the reaction above, the left over organic material is oxidized by potassium bicarbonate into CO_2 and H_2O gas and number of chromium ion. Potassium bicarbonate ($K_2Cr_2O_7$) is used asan oxygen supply (oxidizing agent). The amount of the oxygen is needed for oxidation reaction for the organic waste is equal with amount of potassium bicarbonate used in the oxidation reaction (Takwayana, 2012). The average of COD wastewater on dose variation and fermentation time during the study can be seen in the following table.

Table 3. The average of COD tofu wastewater on dose variationand fermentation time.

Treatment	Average COD (mg/L)		Efficiency (%)
E1W0 (EM4 5%, 0 day)	12.320,00	a	0
E1W1 (EM4 5%, 5 days)	8.680,00	a	0
E1W2 (EM4 5%, 10 days)	2.442,00	de	65,8
E1W3 (EM4 5%, 15 days)	2.012,80	bc	71,8
E1W4 (EM4 5%, 20 days)	2.379,84	d	66,7
E2W0 (EM4 7,5%, 0 day)	13.640,00	a	0
E2W1 (EM4 7,5%, 5 days)	6.710,00	a	6,2
E2W2 (EM4 7,5%, 10 days)	2.835,25	ef	60,3
E2W3 (EM4 7,5%, 15 days)	2.506,13	de	64,9
E2W4 (EM4 7,5%, 20 days)	3.011,31	f	57,9
E3W0 (EM4 10%, 0 days)	11.715,00	a	0
E3W1 (EM4 10%, 5 days)	8.250,00	a	0
E3W2 (EM4 10%, 10 days)	2.997,50	f	58,1
E3W3 (EM4 10%, 15 days)	2.858,88	b	60,0
E3W4 (EM4 10%, 20 days)	2.328,53	cd	67,4
Standard	300		

Note: The numbers are followed bydifferent superscript on the same column show significantly different ($\alpha < 0,05$).

Based on the result of the variant analysis (Anova) showed that the combination treatment of dosage variation and fermentation time variation significantly influence the decrease of COD ($\alpha < 0,05$). The highest COD (the worst) was produced by E2W0 treatment (EM4 7,5%, 0 day) amount 13.640,00mg/L, while the lowest COD (the best) was produced by E1W3 treatment (EM4 5%, 10 days) amount 2.012,8mg/L with the efficiency decrease of COD is equal to 71,8%. The different in mean or advance experiment using Duncan (DMRT) in table 8 showed the best treatment E1W3 (EM4 5%, 10 days) was equal to 2.012,8mg/L, it is significantly different from other treatments.

Based on the table 3, it is known that on 0 day and 5th day of the treatment, the COD value was still very high with 0 (zero) efficiency value. The highest COD value occurs because of environment factors which influence such as oxygen content that dissolved into sufficient reactor to help bacteria to compose the pollutant compounds in the reactor. Tofu contains high protein, so the tofu wastewater will contain high organic materials as well. It is proved that the pollutant concentration in the tofu waste still high. The factors which are identified to cause decreased the COD levels as the effect of increasing the time or fermentation period such as: (1) Microorganisms contained in EM4 are able to decompose the wastewater rapidly (2) The protease enzyme in wastewater which produced by various types of microbes contained in EM4 activator to break the protein into ammonia, nitrit, nitrat, CO2, H2O.

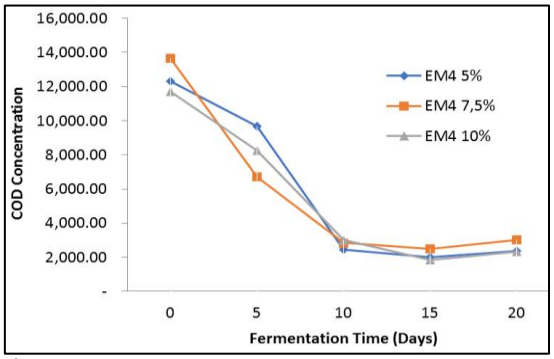

Fig. 3. The average (%) of EM4 combination and fermentation time into COD analysis in tofu waste.

In the 1st day up to 10th day there was a very significant decrease in COD number. The decline is relatively stable on the 15th day. While on the 20th day the COD value has increased. The increasing of COD value on the 20th day can occur due to taking sample every 5 days without being followed by volume replacement with (Aquades) in reactor. As the sample volume was decrease, the sample becomes more concentrate.

Up to the 20th day the COD value of tofu wastewater has not reached the required standard quality of The Ministry of Environment No. 5 year 2014 about the standard quality of wastewater for business and/or soy processing activity that is 300mg/L

pH

The average pH of tofu wastewater in dose variation and fermentation time during the research can be seen in following table.

Based on the result of analyst variance (Anova) showed that the combination treatment of dosage variation and fermentation time variation significantly influence the increasing of pH (α <0,05). The lowest pH (the worst) was produced by E0W1 treatment (EM4 5%, 0 day) amount 4,1 while the best pH was produced by E1W2 treatment (EM4 5%, 10 days) amount 7,5 with an increase efficiency of pH is equal to 87%.

Table 4. The average pH of tofu wastewater in dose variation and fermentation time.

Treatment	Average pH		Efficiency (%)
E1W0 (EM4 5%, 0 day)	4,10	a	2,2
E1W1 (EM4 5%, 5 days)	5,58	d	39,7
E1W2 (EM4 5%, 10 days)	7,50	f	87,0
E1W3 (EM4 5%, 15 days)	8,86	h	121,9
E1W4 (EM4 5%, 20 days)	9,46	i	136,9
E2W0 (EM4 7,5%, 0 days)	4,61	b	14,7
E2W1 (EM4 7,5%, 5 days)	5,82	e	44,6
E2W2 (EM4 7,5%, 10 days)	7,88	g	97,0
E2W3 (EM4 7,5%, 15 days)	8,72	h	117,0
E2W4 (EM4 7,5%, 20 days)	9,48	i	136,9
E3W0 (EM4 10%, 0 day)	4,53	b	12,2
E3W1 (EM4 10%, 5 days)	5,32	c	32,2
E3W2 (EM4 10%, 10 days)	7,74	g	92,0
E3W3 (EM4 10%, 15 days)	8,71	h	117,0
E3W4 (EM4 10%, 20 days)	9,41	i	136,9
Standard quality	6,0 -9,0		

Note: The numbers are followed by different superscript on the same column show significantly different (α <0,05)

The effect of the long fermentation gives a greater influence on the increasing pH compared with the influence of EM-4 dosage variation. The longer the fermentation time from 0 to 20th days of fermentation, the pH level improve (the pH level raises). This indicates the possibility of improving the pH level with a long day of fermentation for 20 days. The different in mean or advance experiment using Duncan (DMRT) in table 4 showed the best treatment E1W2 (EM4 5%, 10 days) is significantly different from other treatments. The factors which are suspected to cause increased the pH levels as the effect of increasing the time or the length of fermentation such as the microorganisms' activity in EM-4 remodel the organic material remnant from the tofu wastewater to produces ammoniac and carbon dioxide which automatically can increase the pH. Based on the table 4 pH value in each treatment of tofu wastewater has increased during the processing. The increasing of pH from acid to neutral in tofu waste occurs by microorganisms' activity both founded in tofu waste and bacteria in EM-4. In line with Isa's research study (2008) bacteria contained in waste produces ammoniac that can increase pH value. Lactic acid bacteria change carbohydrate into lactic acid. Lactic acid is used by yeast and fungi in form alcohol or ester, so the pH rises.

Meanwhile, according to Jasmiyati, *et al.* (2010), the increasing of pH occurs in tofu wastewater that was given EM4 due to the existence of microorganisms in the EM4 remodeled the organic remnant from the tofu wastewater.

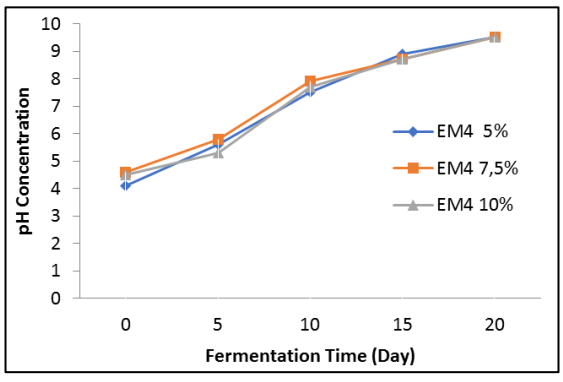

Fig. 4. The average % EM4 combination andinto pH analysis in tofu wastewater.

The increasing of pH from predicted treatment was caused by microorganisms' activity in EM-4 remodel the organic material remnant from tofu wastewater with the following reaction:

$C_2H_yO_zN_2S$ + Bakteri + O_2 → CO_2 + H_2O + NH_3 + $C_xH_yO_zN$ (organic compound) (new cell).

Based on the results, every dosage variation has increased from acid pH value into normal value on the 10th and 15th days with the range of values (7,5-8,9). Normal pH value in accordance with standard quality of wastewater (BMLC) based The Ministry Of Environment No. 5 year 2014 about the standard quality of wastewater for business and/or soy processing activity in range the pH values 6,0-9,0. Thus, ifit's only referring to the standard quality guideline, then based on the pH parameters obtained shown that all treatments are eligible to be disposed into water after 10 days of the research.

The status of river water quality shows the level of pollutant of water source in certain time, if it's compared to set the water standard quality. River categorized as polluted if it cannot be used in accordance normally (Azwir, 2006). In this study the parameter that is used in analyzing the status of water quality are BOD, COD, TSS and PH, which are compared with the State Environment Minister of Regulation number 5 year 2014. The analysis of the status of water quality is done based on the guidelines on determining the status of water quality was set by Ministry of Environment number 115 year 2003 by using Pollution Index (IP).

The result of calculation of the status of wastewater quality with Pollution Index method can be seen in table 10 as follows. Table 5 shows that the early condition of tofu wastewater included in the medium polluted category with IP value of 7,99. TSS value as 2938,33mg/l, this value is further than standard quality designed. The higher the TSS value the water quality will decrease. The high TSS value influences the high BOD and COD value, because in the suspended solid in the water contained organic and inorganic materials.

Table 5. Relation Value (IP) AndtheStatus of Water Qualityof Index pollution of Tofu Wastewater Quality.

Treatment	Parameter				IP (Pollution Index)	Note
	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	pH		
Awal	2041,87	7150,00	2938,33	4,01	7,99	Medium Polluted
E1W2 (EM4 5%, 10 Hari)	1013,04	2442,00	749,00	7,5	5,46	Medium Polluted
E2W2 (EM4 7,5%, 10 Hari)	1139,60	2835,25	907,00	7,88	5,78	Medium Polluted
E3W2 (EM4 10%, 10 Hari)	1083,34	2997,50	872,67	7,74	5,83	Medium Polluted
E1W4 (EM4 5%, 20 Hari)	565,13	2379,84	500,00	9,46	5,08	Medium Polluted
E3W4 (EM4 10%, 20 Hari)	547,58	2328,53	420,33	9,41	4,98	Light Polluted

In degrading the organic materials of wastewater require oxygen either biologically or chemically. Giving help of oxygen supply continuously will be faster in reducing level of pollutant the bacteria eating an organic material can grow well, because the bacteria in EM4 are aerobe bacteria that required free oxygen to degrade an organic compound (Jasmiyanti, 2010), the more bacteria grow and expand the organic material which is degraded more and more. The decrease of BOD level will be accompanied by decreasing the COD level and TSS. Based on the analysis various treatment which is conducted for 20 days, the best treatment on E3W4 (EM4 10%, 20 days) with pollution index value (IP) 4,98 with medium polluted category.

Conclusion

The dosage variation and fermentation time of EM-4 significantly influence (α <0,05) in decrease the TSS tofu wastewater level with the decrease efficiency BOD level is equal to 71,9%, COD level 71,8%, and pH is equal to 87%. Based on standard quality of Environment Minister of Regulation number 5 year 2014, the physics parameter (TSS) and chemical parameter (BOD and COD) have not fulfill the standard quality, while for chemical parameter that is pH already fulfill the standard quality with light polluted index at the best treatment that is dosage variation of EM4 10% and fermentation time 20 days.

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