Proceedings of the
1st International Conference on Environmental Health, Socioeconomic and Technology 2022
Lamongan, Indonesia, August 10-11 2022
Vol. 1, No. 1 (https://conference.unisla.ac.id/index.php/icehst/)

POTENTIAL MICROBIAL CONSORTIUM AS AN EFFORT TO REDUCE DETERGENT WASTE IN WATERS

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ABSTRACT

Kali Otik is one of the tributaries in Lamongan which is often referred to as Kali Otik or Kali Kitchen which is indicated to be polluted. Efforts are being made to overcome the water problem by conducting bioremediation. Bioremediation is meant by using a consortium of microbes in the hope that the waste in the waters can decrease and water quality will increase. The general objective of this study was to evaluate the potential of the microbial consortium to decrease levels of LAS and other organic pollutant parameters (BOD, temperature, pH) and increase DO. The method used in this study is qualitative with a real experimental model. By making a consortium by utilizing the microbes found in organic EM4. The object being studied is that there are two points with each point being sampled on the surface and depth. The results obtained from this study showed that the microbial consortium can reduce LAS levels and improve water quality. LAS levels on water surface can be decreased 0,28% and 0,4% on the depth. DO levels on water surface can be increased 4,1% and 3,8% on the depth. BOD levels on water surface can be decreased 0,89% and 1% on the depth.

KEYWORDS: *Microbial consortium, river, LAS (Linier Alkil Sulfonat)*

1 INTRODUCTION

Water is the most important natural resource because all living organisms depend on it (Kerich & Fidelis, 2020). Daily activities cannot be separated from the use of water such as cooking, washing, bathing and drinking. In addition, household, industrial and agricultural needs also need water. One of the sources of water to meet these needs comes from rivers. Water pollution in rivers has now become a serious problem for people with population growth, the development of various industries and the use of pesticides by farmers (Wijaya et al., 2013). The quality of river water in some areas is strongly influenced by human activities, especially around rivers (Yogafanny, 2015). According to PP. No. 22 of 2021, sources of pollutants that can pollute the environment include the domestic, industrial, and agricultural sectors. Domestic wastewater is grouped into grewy water and black water. Water used for washing dishes, water for washing clothes, and water for bathing is called gray water. Wastewater containing human waste is called black water (Purwatiningrum, 2018). The existence of industry can improve the community's economy, but industry has waste that needs to be disposed of properly. If a company manages waste, it will cause cases for the environment in the future (Widiyanto et al., 2015). Agricultural waste contributes to river water pollution because it contains contaminants such as pesticides and fertilizers. The aquatic ecosystem will be disturbed because of the toxic nature of pesticides. The use of fertilizers triggers the development of aquatic plants such as water spinach and algae due to the content of phosphate, nitrate and other nutrients needed by agricultural crops that are directly dumped into rivers without processing. The rapid growth of aquatic plants can eventually cover the upper part of the river and have an adverse effect on the components of the biotic ecosystem (Idrus, 2014).

Kali Otik is one of the 42 rivers that flow in Lamongan with a length of 12.50 km (Department of Public Works of Water, Lamongan Regency, 2016). One of the tributaries in Lamongan which is often referred to as Kali Otik or Kali Kitchen is also one of the watersheds that are indicated to be polluted. Contaminants that enter the river body continuously without controlling the pollutant source will change and reduce the quality of the Kali Otik river waters. The Kali Otik River is starting to show signs of pollution such as an unpleasant odor and the color of the water turning black (Shaleh et al., 2021). Decomposition of fats, proteins and carbohydrates of fishery biota body tissues by decomposing bacteria causes fishery product waste to easily decompose. The amount of protein and fat causes the content of ammonia and nitrate to increase which in the end the content of Dissolved Oxygen (DO) or dissolved oxygen decreases (Pamungkas, 2016). Waste from fish markets generally produces liquids such as blood, fish skin or scales, fish internal organs and fish fins from the processing. Domestic waste (household waste, garbage, traditional market activities, etc.) has an adverse effect on water quality, causing a decrease in water quality and inhibiting the growth of aquatic plants and algae. Inorganic waste that is dumped into the river, sunlight can be blocked and inhibit the photosynthesis process of aquatic plants and algae, which produce oxygen (Windani, 2013). Increased industrial activity (large and small industries) can have an impact on rivers or affect the hydrological conditions in a watershed. The results of these industrial activities will produce waste that contributes to the decline in river water quality (Sudarno, 2012). Sources of water pollution River waste can come from domestic, industrial, agricultural and infiltration wastewater. Domestic liquid waste is generated by household activities, especially in the form of detergents (Santiari, et al. 2016). The main substance contained in the detergent is an ionic compound in the form of sodium tripolyphosphate which functions as a builder and a surfactant, an average of 75 to 80 kg of which is dumped into the river a day. 35 to 40 liters with a phosphate concentration contained in the wastewater of 7.40 mg/L (Wardhana, 2013).

2 MATERIALS AND METHODS

2.1 Materials

Initial formulations of detergents contain non-biodegradable surfactants. Detergent wastewater is a pollutant for the environment because it contains ABS (alkyl benzene sulphonate) which is classified as hard. Surfactants as the main component in detergents have chemical chains that are difficult to degrade in nature. The type of anionic surfactant is the most widely used type in laundry activities because of its easy and low cost of manufacture. Commonly used anionic surfactants are Alkyl Benzene Sulfonates (ABS) and Linear Alkyl Benzene Sulfonates (LAS) (Ge, J et al, 2008). ABS is known as a detergent because it is resistant to biological decomposition, so it is known as a toxic pollutant compound for aquatic biota (Apriyani, 2017). Its use was then replaced by LAS in 1965. LAS can reduce surface tension and emulsify fat so that it is used as a fat solvent and protein denaturation. Other types of surfactants are also used as clothing cleaners such as Nonylphenol and Sodium Lauryl Ether Sulphate from the nonionic surfactant group (Hudori, 2009). The addition of a microbial consortium in wastewater can affect BOD and COD. The microbial consortium is able to speed up the fermentation process of organic waste, speed up a literature review of no more than 1000 words by stating the state of the art in the researched field/developed technology. Sources of relevant primary literature/references and by prioritizing research results in the latest scientific journals and/or patents. waste decomposition and can reduce BOD5 and COD levels. There was a process of decomposition of organic compounds in the waste resulting in a decrease in BOD5 levels during the study with the addition of a microbial consortium (Isa, 2008). The microbial consortium contains bacteria that can affect the results of measuring BOD5 levels including photosynthetic bacteria, Lactobacillus sp, Streptomyces sp, Yeast/Yeast, Actinomycetes sp (Sucipto (2012). The presence of lactic acid bacteria (Lactobacillus sp.) activity in the microbial consortium can ferment sago liquid waste organic matter into lactic acid compounds which function to accelerate the overhaul of organic matter. The process of breaking or decomposing organic compounds into simpler compounds can indirectly reduce the COD value. Microorganisms produce gases from organic/inorganic compounds, causing pH water rose in the range of 6-8 (Febrianda, 2018).

According to PP No. 22 of 2021, the water quality standard is a measure of the limit or level of living things, substances, energy, or components that exist or must exist and/or pollutant elements whose presence in the water is tolerated. According to the Minister of Health of the Republic of Indonesia Number 32 of 2017. The physical, chemical and microbiological parameters in the environmental health quality standards for water media for sanitation hygiene purposes have three parameters, namely physics, chemistry and microbiology. Sulistiono (2021) explained that the physical parameters measured included shoulder, color, taste, temperature, turbidity and TDS. Water with good quality is odorless, clear, tasteless, temperature ± 30C, and turbidity limit of 25 NTU. Chemical parameters measured included pH, iron, fluoride, hardness, manganese, nitrate, nitrite, cyanide, detergent, cyanide, pesticides, DO, BOD, COD. In accordance with (Permenkes, 2017), good water quality in terms of chemical parameters does not exceed the threshold for pH 6.5-8.5, iron 1 mg/l, fluoride 1.5 mg/l, hardness 500 mg/l , manganese 0.5 mg/l, nitrate 10 mg/l, nitrite 1 mg/l, cyanide 0.1 mg/l, detergent 0.05 mg/l, cyanide 0.1 mg/l, pesticides 6 mg/l , DO 300 mg/l, BOD 100 mg/l, COD 100 mg/l. Microbiological parameters measured included fecal coliform and total coliform. In good waters the maximum limit of fecal colifom is 100/100 ml sample, while the total colifom is 1000/100 ml sample. This review and research is in line with the road map of the researcher and partner researchers.

2.2 Methods

Making a microbial consortium carried out in vitro in the Unisla Kesling lab. Ingredients: 1 kg of sugar, 3 pineapples, 20 liters of water, 50 grams of kale, 25 grams of banana midrib, 1 clove of banana. These materials produce 25 liters of microbial consortium. Tools: microscope, 1 blender, 2 knives, 2 micro sieves, 2 cuttings, 5 1000 ml glass beakers, 5 spatulas, 1 jurygen 30 liters. The work procedure carried out is that the existing ingredients are cut into pieces and then blended until smooth, fermented for 2 weeks, filtered and then put back in a closed place. The microbial consortium is ready for harvest and 1 liter of blue algae is added. The results of the consortium were observed under a microscope to identify the microbes formed.

Microbial consortium trial on LAS This test was carried out in vitro at the Unisla FIKES laboratory. The steps taken are as follows: Tools: 5 pieces of 500 ml glass beakers, 5 spatulas, 10 dropper pipettes, 2 measuring cups, 1 pH meter, 1 TSS meter, 1 DO meter, 1 TDS meter, COD Test Tube Heater/ COD reactor 1 piece, Multiprameter Photometer 1 piece, BOD sensor 1 piece, BOD incubator 1 package. Ingredients: 1000 ml Aquades, 500 g LAS, 150 ml nitrate reagent, 50 ml Fe reagent, 5 liter microbial consortium. Working procedure: - Make 1%, 5%, 10% LAS solution and add 1 ml of microbial consortium. Waited for one week then measured the water quality which includes chemical and physical parameters. - Make 1%, 5%, 10% LAS solution and add 5 ml of microbial consortium. Waited for one week then measured the water quality which includes chemical and physical parameters. - Make 1%, 5%, 10% LAS solution and add 10 ml of microbial consortium. Waited for one week then measured the water quality which includes chemical and physical parameters. Stage 2. Trial of the microbial consortium on river water containing LAS This test was carried out in vitro at the Kesling Unisla laboratory.

Methods or ways to achieve the goals that have been set should not exceed 600 words. This section is accompanied by a flowchart of research that will be carried out during the proposed time. The research chart must be made in its entirety with clear stages, all stages to achieve the outputs along with the targeted achievement indicators. This section should also explain the duties of each member of the proposer according to the stages of the proposed research. Tools: 5 pieces of 500 ml glass beakers, 5 spatulas, 10 dropper pipettes, 2 measuring cups, 1 pH meter, 1 TSS meter, 1 DO meter, 1 TDS meter, COD Test Tube Heater/ COD reactor 1 piece, Multiprameter Photometer 1 piece, BOD sensor 1 piece, BOD incubator 1 package. Ingredients: River water containing LAS, 150 ml of nitrate reagent, 50 ml of Fe reagent, 5 liters of microbial consortium. Working procedure: - Take 1 liter of river water and add 1 ml of microbial consortium. Waited for one week and then measured the water quality. Parameters tested chemistry and physics. - Take 1 liter of river water and add 5 ml of microbial consortium. Waited for one week and then measured the water quality. Parameters tested chemistry and physics. - Take 1 liter of river water and add 10 ml of microbial consortium. Waited for one week and then measured the water quality. Chemical and physical tested parameters.

3 SIMULATION RESULTS AND DISCUSSION

3.1 Simulation results

This research was conducted in the Kali Otik Lamongan river. Sampling was carried out at two points, where each point was taken two parts, namely on the surface and bottom of the waters. based on the results of observations of the data obtained are presented in table 1 below.

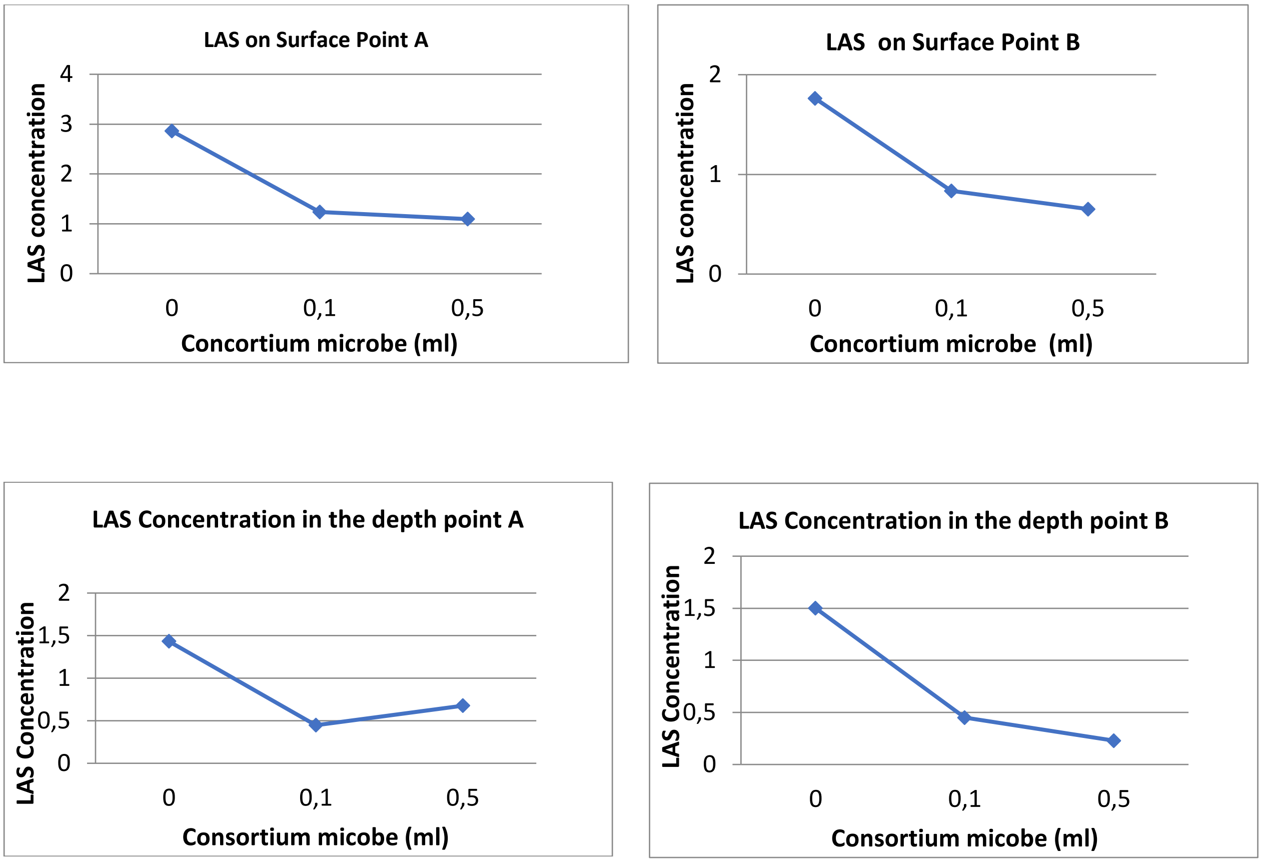
Table 1. Table of LAS Concentration

Control				Treatment							
Before		After		Permukaan				Kedalaman			
Surface		Depth		A		B		A		B	
A	B	A	B	0,1 ml	0,5 ml	0,1 ml	0,5 ml	0,1 ml	0,5 ml	0,1 ml	0,5 ml
2.862	1.764	1.432	1.501	1.240	1.094	0.836	0.652	0.447	0.675	0.451	0.229

Based on the data and graphs above, it shows that 4 samples taken at different points, namely 2 sample points A and B on the surface of the river and sample points A and B in the depth of the river that have not been treated show different results. The highest LAS level is found in the sample at point A River surface. Meanwhile, the results of water samples that have been treated in the form of the addition of 0.1 ml and 0.5 ml microbial consortia indicate a decrease in LAS levels in water samples taken at the surface and depth of the Kali Otik river compared to the levels of water samples before being treated. It is shown in the surface water sample data at point A that the LAS content is 2.862, after being treated in the form of adding 0.1 ml of a microbial consortium, the LAS content is 1.240, and the results for the addition of 0.5 ml of a microbial consortium in the same sample. showed a reduction in LAS levels in it.

Likewise for other samples, the LAS levels also decreased after being treated in the form of adding a microbial consortium. The data and graphs above also show that the more consortium given in the water sample containing LAS, the LAS content will decrease, except in the 3rd graph where the water sample at the depth at point A shows an increase in LAS when given the microbial consortium as much as 0.5 ml. In the 3rd graph, which was originally given 0.1 ml of the microbial consortium, the LAS level of 0.447 increased to 0.675.

The following is a graphic description of the decrease parameters of LAS being treated according to graph 1 below.



Graph 1. LAS concentration after and before treatment

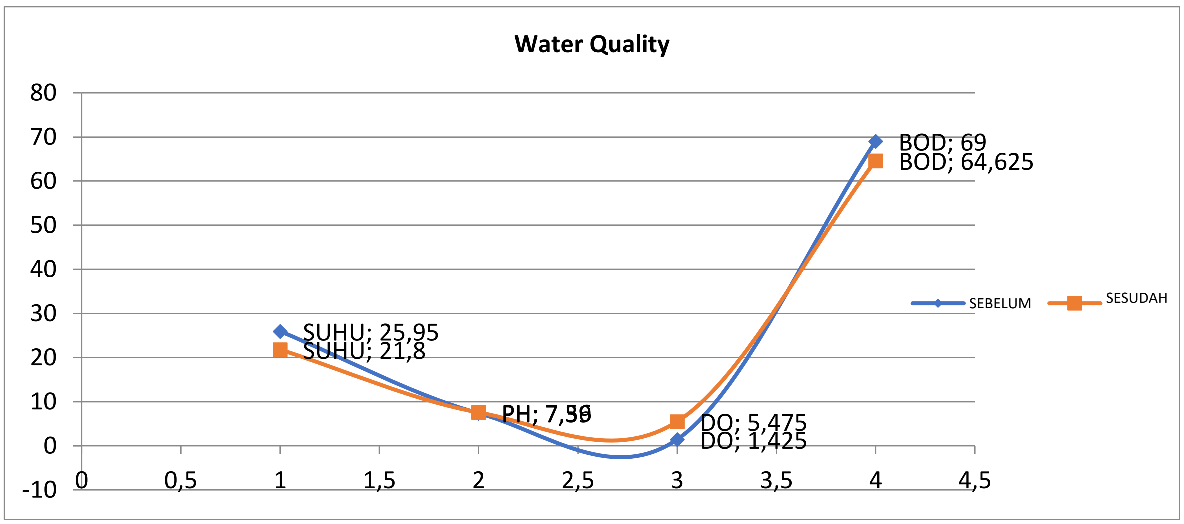
In addition to the LAS content of the waters, this study was also conducted to measure water quality. This is done with the aim of knowing the relationship between the levels of LAS on the quality of the river water. The results of the water quality measurements are poured in table 2 below.

Table 2. Table of Water Quality

Parameter	Control				Treatment							
	Before		After		Surface				Depth			
	Surface		Depth		A		B		A		B	
	A	B	A	B	0,1 ml	0,5 ml	0,1 ml	0,5 ml	0,1 ml	0,5 ml	0,1 ml	0,5 ml
Temperature	25.7	26.0	26.0	26.1	22.7	21.8	21.9	21.5	21.7	21.5	21.8	21.5
pH	7.5	7.4	7.2	7.46	7.77	7.52	7.72	7.71	7.45	7.42	7.46	7.37
DO	1.9	0.9	2.2	0.7	5.9	3.6	6.7	6.8	5.9	5.0	4.3	5.6
BOD	80	84	59	53	75	72	78	67	69	52	56	48

Based on the data from table 1. The results of the water quality test indicate that there is a decrease and increase in physical parameters and chemical parameters after being given treatment. This is evidenced by the average decrease in temperature after treatment, from which initially had an average of 25.95 after being treated to 21.8, as well as chemical parameters such as BOD which initially had an average of 69 changed to 64, 625. after being treated. In addition to a decrease, the addition of a microbial consortium in the water sample also resulted in an increase in several parameters. As for some meters that have an increase after being given treatment including pH and DO. The pH which initially had an average of 7.39 after being treated became 7.56 as well as DO which initially had an average of 1.425 to 5.9.

The following is a graphic description of the decrease and increase in the parameters of temperature, pH, DO, and BOD after being treated shows on graph 2 below.



Graph 2. Water quality after and before treatment

3.2 Discussion

Based on the research on the Kali Otik river water sample, the water sample was given two different treatments by giving a microbial consortium and not being given a microbial consortium. The results of the LAS level test showed that there was a decrease in LAS levels in water samples treated with the addition of a microbial consortium, both water samples taken from the surface and those taken from depth. Likewise in research in the form of testing water quality, where several parameters have decreased due to treatment on water samples. This shows that the activity of the microbial consortium in the water sample is able to reduce the levels of LAS in the water. This is due to the activity of the bacteria present in the water sample to ferment the liquid waste organic matter into lactic acid compounds which have the function of accelerating the overhaul of organic matter (Isa, Y. 2008). In addition, the microbial consortium can also reduce the level of laundry liquid waste (LAS) so that aquatic organisms can survive (Prahasantika, M. et al. 2020) so that some parameters that should be high and do not match the normal threshold can decrease due to microbial activity. inside it. In addition, the Department of Gas and Petrochemical Engineering, University of Indonesia also investigated the durability and effectiveness of the bacterial consortium in degrading LAS. Thus, LAS can degrade well under aerobic conditions, but it is still questionable if under anaerobic conditions although many types of bacteria have been found that are able to degrade LAS, such as Pseudomonas, Clostridium, Corynebacterium, Alcaligenes, Achromobacter, Bacillus, Flavobacterium, Nocardia, and Clasdosporium. Therefore, the microbial consortium is able to play a role in biological wastewater treatment. In decomposing organic matter contained in water, microorganisms are very dependent on environmental conditions.

4 CONCLUSION

The conclusion from the research that has been done is that the microbial consortium made consists of lactic acid bacteria, photosynthetic bacteria, actinomycetes and fermented fungi. The microbial consortium that was made was able to reduce the LAS level of the waters, this was indicated by the percentage of LAS levels on water surface can be decreased 0,28%and 0,4% on the depth. DO levels on water surface can be increased 4,1%and 3,8% on the depth. BOD levels on water surface can be decreased 0,89%and 1% on the depth.

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