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ACUTE TOXICITY TEST (LC50) TANNING LIQUID WASTE AGAINST TILAPIA MORTALITY (*Oreochromis niloticus*)

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ABSTRACT

The liquid waste of the tanning industry contains chromium metal of a toxic nature. The heavy metal chromium has high solubility and toxicity and is toxic to living things with a concentration of more than 0.05 ppm. For this reason, it is necessary to conduct a toxicity test to determine the level of danger from wastewater if it is discharged into the environment. The purpose of this study was to determine the value of LC concentration of 50 96 hours from tanning liquid waste to tilapia mortality (*Oreochromis niloticus*). The method used in this study is an experimental method. The data used is in the form of primary data and secondary data. The measured wastewater parameters are temperature, pH, BOD, COD, TSS, Cr, oil and fat, ammonia, sulfide, and nitrogen. Data analysis using probit analysis. The results of this study show that LC 50 96 hours is 261,3 ppm, so tanning wastewater needs to be treated first before being discharged into the environment.

1. Introduction

The tanning industry is an industry that uses chemicals and water in large quantities and produces liquid, solid, and gas waste [21]. In general, liquid waste resulting from tanning industry activities after processing is usually discharged into water bodies, both rivers and directly into the sea. The discharge of liquid waste into water (river or sea) can have an impact on the biotic and abiotic components in it [11], [10].

The Magetan Leather Industry Environment (LIK) is according to the Minister of Environment and Forestry of the Republic of Indonesia No. 5 of 2014 concerning Quality Standards for Tanning Waste in it is stated that every person in charge of the business must comply with the quality standards predefined wastewater. Wastewater in the tanning industry that is disposed of still has risks because in the production process the tanning industry uses chromium compounds [1]. This tanning process aims to transform raw skin that is easily damaged due to the activity of microorganisms, chemical processes, and physics into tanned skin that is more resistant to the destructive factor [13].

The aquatic toxicity test is a fairly representative way to estimate the magnitude of the harm posed by the substance present in the waste material. The most commonly used thing to show exhaust toxicity is LC_{50} (*median lethal concentration*) or acute toxicity. Organisms commonly used to test the toxicity of contamination that will enter a body of water are fish. Fish used for toxicity tests must have the required height, age, weight, and length sensitivity according to fish living in polluted waters. Tanning liquid waste toxicity test research mostly uses fish organisms such as the research of [16], [5], Insyiraah (2014), [2].

The choice of red tilapia (*Oreochromis niloticus*) as a test animal in this study, is because red tilapia is a type of fish with important economic value, widespread distribution, and is in accordance with biological testing requirements set by the *Environmental Protection Agency* [7]. The purpose of this study was to determine the value of LC concentration of $_{50\text{-}96\ hours}$ from tanning liquid waste to tilapia mortality (*Oreochromis niloticus*).

2. METHOD

The type of research used is experimental research with the materials used are tanning industry liquid waste, test animals in the form of tilapia (*Oreochromis niloticus*), and chemicals used for the examination of tanning wastewater parameters in accordance with the Minister of Environment and Forestry of the Republic of Indonesia Number 5 of 2014 concerning Wastewater Quality Standards. The tools used include test vessels, fishing nets, fish meters, aerators, thermometers, pH meters, DO meters, COD reactors, spectrophotometers, and ponds.

The test animal *Oreochromis niloticus* to be used in the study was first acclimatized in a pond made of tarpaulin filled with fresh water. The tilapia used in the study was 8-10 cm in size. The implementation of the tanning industry wastewater toxicity test against fish mortality began with a preliminary test that resulted in the death of half of the test animals in the concentration range between 240-280 ppm. Furthermore, a real test was carried out using a concentration interval of 10 ppm in very 10 liters of wastewater containing 10 fish with concentration variations: 0 ppm (control), 240 ppm, 250 ppm, 260 ppm, 270 ppm, and 280 ppm with three replications on each treatment.

3. RESULTS AND DISCUSSION

The results of the observation of the number of deaths of test fish during the 96-hour toxicity test were as follows:

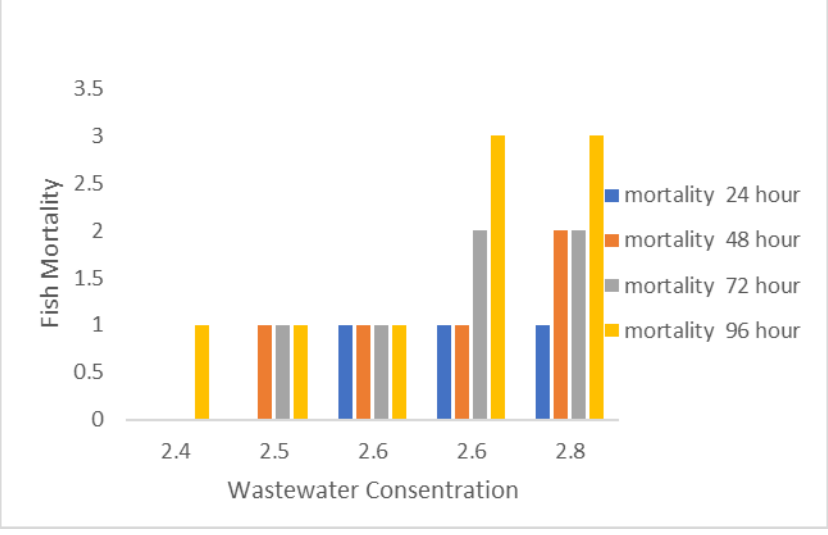

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Figure 1.

From the data obtained the order of the number of deaths of fish is 1, 3, 5, 9, and 9 heads. The highest number of deaths occurred after four days (96 hours of exposure) of 9. This acute toxicity test aims to observe the toxic effects of tanning wastewater that still contains toxic chemical compounds so that the mortality rate is relatively short after administration with a certain dose. At least four recommended dose ratings in acute toxicity testing, those doses range from low doses that are not or nearly lethal to the highest doses that can kill all or almost all test animals.

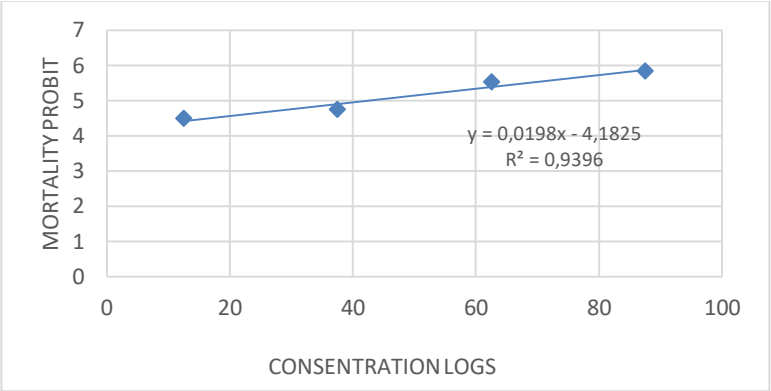

Figure 2.

After probit analysis, the equation y = 0.0194x + 4.1775 was obtained so that the LC50 value of 96 hours could be calculated at 261.3 ml of wastewater in every ten liters of solution. During the toxicity test, temperature parameters, pH, and TDS (Total Dissolved Solid) measurements were carried out with the following results:

Table 1. Temperature, pH, and TDS measurements

Dose	Replication	24 Hours			48 Hours			72 Hours			96 Hours		
		T	Ph	TDS	T	Ph	TDS	T	Ph	TDS	T	Ph	TDS
0	**1**	25,8	7,97	0,36	25,6	7,93	0,37	25,4	7,97	0,37	26,6	8,01	0,36
	2	25,6	7,96	0,36	25,3	7,81	0,37	2,51	7,8	0,37	26	8,03	0,37
	3	25,6	7,97	0,34	25,4	7,9	0,37	24,8	7,91	0,36	25,7	8,03	0,35
240	**1**	25,9	7,93	121	25	7,77	124	25,3	7,69	121	25,9	7,94	122
	2	25,6	7,92	123	25,4	7,86	123	24,9	7,46	123	25,6	7,98	126
	3	25,5	7,93	124	25,4	7,84	122	24,5	7,75	124	25,4	7,92	124
250	**1**	25,6	7,96	126	25,4	7,87	127	2,53	7,81	128	25,7	8,01	129
	2	25,5	7,76	128	25,1	7,81	130	24,6	7,78	128	25,5	7,95	128
	3	25,4	7,77	127	25	7,8	128	24,5	7,77	127	25,4	8	128
	1	25,6	7,76	131	25,1	7,77	132	25,3	7,82	132	25,6	7,98	134
260	**2**	25,4	7,72	132	25,2	7,79	134	24,5	7,84	134	25,4	7,91	135
	3	25,4	7,74	135	24,9	7,76	136	24,4	7,84	137	25,4	7,82	137
270	**1**	25,8	7,76	135	25,3	7,8	135	24,9	7,87	137	25,6	8,04	136
	2	25,6	7,78	135	25,1	7,77	134	24,5	7,79	135	25,5	7,96	135
	3	25,4	7,74	133	24,9	7,8	135	24,4	7,74	134	25,4	7,93	135

280	**1**	25,6	7,73	140	25,1	7,7	141	24,7	7,87	141	25,6	7,86	140
	2	25,6	7,78	142	25,1	7,7	142	24,6	7,74	142	25,4	7,96	142
	3	25,5	7,78	142	25	7,8	142	24,8	7,81	143	25,4	7,97	143

The results of measuring temperature, pH, and TDS parameters obtained temperature conditions during relatively normal observation in the temperature range of 25.4-26.6. The lowest pH during the test was 7.7, and the highest pH was 8. The content of dissolved solids was the lowest in control, while in the highest treatment at a dose of 280 ppm, the TDS level was 143 ppm. Parameter levels during observation remained relatively unchanged so that the influence on fish mortality due to temperature, pH, and TDS could be minimized.

The quality of the tanning wastewater used in this toxicity test was also measured. The results of measurements of tanning wastewater quality parameters including temperature, pH, BOD5, COD, TSS, Cr, oil and fat, ammonia, sulfide, and nitrogen obtained the following results:

Table 2. Content of wastewater parameters

No	**Parameter (mg/L)**	unit	Parameter Content
1	Temperature		28,6
2	Ph		8,28
3	BOD_5	Ppm	129,6
4	COD	Ppm	283,5
5	TSS	Ppm	113,5
6	Total Chrome (Cr)*	Ppm	1,61
7	Oils & Fats	Ppm	<0.59
8	NH 3-N (Total Ammonia)	Ppm	38,7
9	Sulfides (H_2S)	Ppm	0,03
10	Total-N	Ppm	41,4

From the results of tanning wastewater quality measurements, there are still parameters that exceed the standards of the Ministry of Environment Regulation Number 5 of 2014, namely BOD_5, COD, TSS, Cr, ammonia, and total N. This suggests the organic content in tanning is difficult for organisms to decompose [28]. The causative factor is the high concentration of ions of toxic compounds used in the production process. The toxicity of each the production process is different in value. The liming process produces waste with a toxicity of 76%, while tanning has a toxicity of 24%.

The largest contributors to BOD and COD came from the liming process with values of 70% and 55% respectively [8]. This high concentration of waste will also affect the poor quality of the water [26]. Therefore, the waste that comes out must still be treated so that if it is discharged into the environment, it will not pollute the surrounding environment [3]. High levels of BOD and COD in a river cause disruption of the life of biota living in the river. This is due to low oxygen levels as a result of oxygen contained in the river which can oxidize organic substances [25]. The BOD and COD levels in tanning liquid waste come

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from the tanning process with the addition of acid, salt, and then tanning with chromium salts. In the tanning industry, chrome compounds are widely used tanning materials. If the remaining solution is discharged into the environment, it means increasing the number of metal ions in the water environment [27].

The principle of the TSS reducing work process needs to be carried out, although in general the growth of the particle mass so that the specific gravity of the particles becomes large and can eventually precipitate. The reduction of TSS is also affected by time. The longer the settling time, the less TSS in wastewater [14].

The presence of chromium in wastewater is harmful to the environment. The toxicity possessed by chromium metal is determined by the valence of its ions. Ions are the most studied chromium metal with toxic properties compared to ions. The toxic properties carried by this metal can also result in the occurrence of acute poisoning and chronic poisoning. Acute poisoning caused by the compound K2Cr2O2 in humans is characterized by a tendency to swelling of the liver. The degree of chromium poisoning in humans is measured through the level or content of chromium in the urine, chromic acid crystals that are often used as a remedy for the skin, but the use of these compounds often results in fatal poisoning. A large amount of chromium with the slow process of removing chromium from the lungs became the basis for a hypothesis that chromium is one of the ingredients that can cause lung cancer. chromium is classified as a carcinogenic material [24]. High chromium content in the waste can be processed by using activated carbon [18], [9], bioreduction [17], [29], electro-coagulation [23], [22], [4], as well as phytoremediation [1], [15], [20].

4. CONCLUSION

The results of this study show that LC_{50} 96 hours is 261,3 ppm, so tanning wastewater needs to be treated first before being discharged into the environment

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