The test ability of fish Tawes to leachate garbage dump (TPA) Benowo

N R Juliardi AR1  R I Wiyanti 2
1 Environmental Engineering Department UPN"Veteran"East Java
2 Environmental Engineering Department UPN"Veteran"East Java
1naniktulpn@yahoo.com, ririkindahwiyanti.ri@gmail.com

Abstract. Leachate is a liquid from waste containing elements of dissolved and suspended elements. Garbage collected at the landfill site contains organic, inorganic and heavy metal substances. If the rains will produce leachate with mineral content, organic and heavy metals. When the condition or leachate flow in let to the soil surface can cause negative effects to the surrounding environment including for humans. Toxicity test it was conducted to determine the level of leachate toxicity of the test animals living in surface water located around of the “TPA Benowo”. In this study using Tawes fish with length between 4-6 cm. In this toxicity test is done in 2 stages, namely: range finding test, the search for this range is obtained 0% concentrations (as control) 0,3%; 0,6%; 0,9%; 0,12% and 0,15%. The next stage of toxicity acute test, at this stage of toxicity concentration do smaller again that is: 0,18%; 0,36%; 0,54%; 0,72% and 0,9%. The results obtained LC50 value of 0,385%, while eyes, brown stomach skin.

1. Introduction
The amount of waste production that raise especially in urban areas triggered by the process of modernization or development in all areas that ultimately extend the waste accumulation all over the time. For example, in the city of Surabaya in 2013 as much as 1,200 tons / day, in 2014 as much as 1,200-1,300 tons / day, 2015 as much as 1,300-1,400 tons / day and in 2016 as many as 1,500-1,600 tons / day [1]. Along with the increasing amount of garbage volume every year in the city of Surabaya is not followed by an appropriate waste management system that causes incompatibility with the rate of waste pile. Garbage is a waste of human activity that is not used anymore. Its existence cannot be avoided but must be managed. Leachate is water degradation from waste and can cause pollution if there is no processing done before it is discharged into the environment. Leachate is generally toxic because it contains many microorganisms in high amounts, containing heavy metals that are dangerous if exposed towards environment directly. In addition, the level of leachate degradation ability immature is very low, it is indicated by the low BOD / COD ratio [2]. Characteristics of leachate vary greatly depending on the processes occurring within the landfill which includes physical, chemical and biological processes. While the factors that influence the processes, which occur in landfills include: type of waste, landfill location, hydrogeology and location of operations, biological activities and processes that occur in the pile of waste both aerobically and anaerobically [3]. Here are the characteristics of leachate: COD, BOD, Cd, Mg, Na, K, Cl, Fe, Cu, Cr, Hg, Zn, As, Pb, Ni [4] [9] [10]. The aquatic toxicity test is representative enough for estimating the magnitude of the hazard set by the substance existence in the waste material. The most common thing that is used to indicate waste toxicity is LC50 (median lethal concentration) or acute toxicity [5]. The organism that is commonly used to test the toxicity of a contaminant which will enter a water body is a fish. Fish that is
used for this toxicity test should have high sensitivity, age, weight and length required in accordance with fish which is living in contaminated environments. Choosing *tawes* fish is a type of fish that has high economic value and has a wide spread, and has a high resistance / resistance to pollutants.

2. Method

2.1. Acclimatization

Acclimatization is the stage of self-adaptation of organisms with leachate in conditions which will be processed. The water medium is always conditioned having temperatures between 24°C - 30°C, pH 6.0-8.5 DO between 5-6 mg / L based on Organization for Economic Cooperation and Development [6]. This stage is aimed for Test biota adaptation which will be used with water diluent. This acclimatization stage is done for at least 7 days.

2.2. Range finding test

At this stage is the initial stage in starting the research. Range finding test is the step to determine the smallest concentration of toxicity causing 100% of test biota to die in 96 hours exposure.[7]. Because in this stage is a rough search range, it can be variation of toxic concentration with a considerable interval distance. At this stage repetition is done twice for each level.

2.3. Acute Toxicity Test

The objective at this stage of the test is to determine the level of toxicity which can provide death to the test biota in a relatively short time. It is repeated three times at this stage each toxicant level. In each container provided 10 given test biota, with the test variables obtained from the results of Range Finding Test [8].

2.4. Calculation of LC50

The value of LC50 is the value where at that concentration there is 50% of test biota in dead study. This LC50 value is treated in the analysis and discussion of this study. The method used in determining this LC50 value uses the Litchfield-Wilcoxon method, since this method takes into account the 95% confidence limits of the LC50 result.

3. Results and Discussion

3.1. Acclimatization

In both observations, the aquariums 1 and 2 experience the difference in mortality of this is caused because at the time of purchasing fish in different sellers because the first seller the number does not reach 500 tails so people buy to another seller, this is causing differences in fish conditions where the large fish is from different ponds with different treatments to allow different conditions. Most likely the fish experienced death caused by stressful circumstances because their inability for adapting in the new environment. Because for each parameter such as temperature, DO and pH already meet the requirements required for the survival of the fish. The temperatures in the two observations that are in aquariums 1 and 2 ranged between 26°C - 29°C which is still in accordance with the temperature required for the fish for its survival. The pH in both observations also still in accordance with the pH in need of the range between 7-9, so it is not harming the survival of the fish. Meanwhile, for the DO level in both of these studies have increased and decreased at each observation time but the increase and decrease is not too significant and still ranges between 5-6 mg / l so it is still in

![Figure 1. Graph of Relation of Time Effect on Biota Death Test.](image-url)
accordance with the DO required fish to live. From the description above concludes the mortality of fish is not because of the decrease in parameters but most likely the fish experience stress.

### 3.2. Range finding test

**Figure 2.** Graph of Effect Relation Time and Toxicity Levels on Temperature Changes. Temperature effect on environmental conditions of *tawes* water from the results of the above research shows the water temperature at the *tawes* fish reactor has met the conditions that have been determined for the survival of *tawes* fish. From the results of the graphic above shows that the increase and decrease in temperature this is due to the decrease in gas solubility, but the temperature parameter amount still meets the requirements and does not cause interference because it does not exceed from the range of 30 °C in the research the amount of the highest temperature range at 28 °C and this is still in zone Safe for fish life.

**Figure 3.** Graph of Effect of Time and Level of Toxicity on Changes in pH

In the study of pH values 8-9 this fish can remain survive because vulnerable pH value required is 7-9 if passing from the value of 9 may cause abnormal disorders in fish or fish will experience stress. The gain in pH value at each toxicant level is due to the decomposition process of organic substances contained in both toxicants and those found in fish feces.

**Figure 4.** Graph of the Relationship of Time Effect and Level of Toxicity on Change of DO

From the observation, it can be seen that the average DO in this range of find test has fulfilled the optimum DO required for the survival of fish that is 5-6 mg / l, the decrease of DO caused by temperature rise, if the temperature is high then water will quickly be saturated with Oxygen and cause the oxygen solubility reduced.
If it is seen from some of factors that affect the life of the fish such as DO, pH, and temperature of movement of the fish already deal with the requirements. Which DO on range finding test is located in the range 5-6 mg/l because on every reactor placing an aerator to help supply oxygen. Temperature also does not indicate existence of influencing the death of the fish because the temperature is still according to standard that is namely ranges 25-28°C. Formation pH also does not indicate the existence of influencing although diluents of water in place of waste water but changes the value of pH is not too significant only increase 1-2 only and the range of pH values in the experiment range finding test ranges 8-9 and is also still in accordance standard to environment fish. While the space for its mobility has also been filled because of the reactor used big enough. So, the possibility of great fish experience death because kept uncontaminated by linditoxicant water.

### 3.3. Acute toxicity tests

From the graph above we able to know that the temperature on the water experiencing which the changes are good or decline but not too significant increase. These changes may be caused by several factors such as: the height from the surface of the water, the time in a day, the water flow and the water depth can also decrease because of soluble gases in water. Water temperature declines and increases the possibility of this happened because of the influence of oxygen dissolved in water (DO). If the temperature of the height of the water will be quickly saturated with oxygen compared with a low temperature, because the water temperature increase will cause solubility oxygen decreases.

**Figure 5.** Graph of Relation Effect of Time and Level of Toxicity on Test Biota Mortality

**Figure 6.** Graphs the relationship between the effects of time and the level of Toxicant Against Temperature Changes
Figure 7. Graphs the relationship between the effects of time and the level of Toxicant against changes in pH.

High or low pH value influences by some factors such as: the process decompositions on organic material that is on the water, the concentration of the gases is available on the water, water temperature and also the rays of the sun. Impacts are occurred when changes occur pH water namely: easy fish illnesses, metabolism fish disrupted and unwell of the fish growth. PH water is good for fish life that is between 6-9 when its more than 9 will not worthy and not according to the environment of the fish, pH rises due to the process of decompositions of organic good contained in toxicant or that is on the dirt fish. But from the graph above it is known that the ph on the research is still appropriate or still normal if used for the life of the fish pH level and therefore it is not an influence on the death of fish. The possibility of fish died because of the womb contaminant reduction on toxicant entered on soluble water.

Figure 8. Graphs the relationship between the effects of time and the level of Toxicant against changes in prayer.

Decrease the value of DO can be decreasing the ability to normal life in the environment of their life. The highest and lowest level of oxygen dissolved in water in hikes affect by temperature, partial pressure of the gases, the swiftness of the current. DO content declines because soluble water has been in the intervention by toxicant which may contain organic material that is causing the decline in DO.

Figure 9. Graphs the relationship between the effects of time and the level of Toxicant against the death of Biota Test.
On the graph above can be seen from the differences in the number of deaths of fish caused by the difference in the condition and the immune system of the fish itself, besides also absorption or the ability to sequester fish on a different Toxicant until that time and the number of his death different. Deaths of biota test can be caused by a toxic substance that affect the quality of the environment biota test. If it is reviewed from some of the factors that affect the life of the fish as the water temperature, pH water and oxygen’ needs dissolved in water (DO), on this research to the three parameters fulfill the requirements and not exceed the raw material quality. On the acute tests has checked the level of BOD because BOD greatly affects the level of DO the greater the level of BOD and the level of DO will be less, if the BOD higher so, microorganisms will also need oxygen to dissolve the organic substance so the oxygen to the biota will be reduced but at the test of BOD on each of the reactor value is very small which is between 7 mg/l - 38 mg/l with known the value of BOD that does not exceed the raw material quality and the possibility of big fish tawes experience Death or mortality as a result of kept uncontaminated by the womb substance/chemical compounds/heavy metals contained in lindi water as Cd, Mg, Na, K, Cl, Fe Cu, Cr, Hg Zn, USA, Pb, Ni likely [9], to be one of the characteristics of the heavy metal that has been poisoned and accumulated into the body of the tawes fish causing contaminated fish and death. Besides, the fish died out the mucus on his body, the color of the skin of the abdomen turned into brownish yellow such as poisoning and also the eyes turns white.

The Calculation of the LC50 with Lithfield Method - Willoxon Abbreviated Method

![Figure 10. Correlation line Equation from concentration of toxicant vs the propotional of death tawes fish.](image)

### Table 1. Calculation of the proportion of hope, the difference chi²

| Types of Biota | The level of Toxicant t % | The number of the Biota | Mortality | The proportion of the response (R) | The prop. of the response of hope (RH) | (R-RH) | Chi² |
|----------------|---------------------------|-------------------------|-----------|-----------------------------------|----------------------------------------|--------|------|
| Tawes Fish     | 0.18                      | 10                      | 10        | 0                                 | 0                                      | 0      | 0.18 |
|                | 0.36                      | 10                      | 10        | 5                                 | 40                                     | 34     | 0.002|
|                | 0.54                      | 10                      | 10        | 5                                 | 50                                     | 48     | 0.09 |
|                | 0.72                      | 10                      | 10        | 7                                 | 70                                     | 62     | 0.03 |
|                | 0.9                       | 10                      | 10        | 10                                | 100                                    | 90     | 0.12 |
| Sum variation  | = 5                       | Sum=50                  |           |                                   |                                        |        | 0.422 |

The lowest infection rate was from 0.00
Calculate LC50 96 hours with the limit - the limit of trust 95% based on correlation line parallels the proportion of hope that has been received. From the correlation line equation can be determined the value of:

\[ Y = 77.778x + 20 \]
\[ 50 = 77.778x + 20 \]
\[ X = 0.385 \]

Then in may the value of LC45, LC50, LC55 as follows:

| LC45 | LC50 | LC55 |
|------|------|------|
| = 0.321 | = 0.385 | = 0.449 |

Determine the limit - the limit of trust 95% LC50:

The upper limit = \( \frac{LC_{50} \times f}{1 - f} \)
= \( \frac{0.385 \times 0.889}{0.111} \)
= 0.342

The lower limit = \( \frac{LC_{50}}{f} \)
= \( \frac{0.385}{0.889} \)
= 0.342

So, found LC50 tawes fish on the waste lindi water is 0.385%

4. Conclusion

Based on the results of research and discussion that has been done is obtained some conclusions as follows:

1. Toxicant content in the waste lindi water big enough to deeply must use a small concentration percentage at range finding test, and perform several times in the process of the determination of the concentration range to determine the concentration of range finding test.

2. Tawes fish have high enough levels of responsiveness to toxicant because at the time the tawes fish depicted on toxicant, reconstruction is quiet turned into a demon and swim to the surface as you want to exit from the reactor. The fish that are already dead, the body of tawes will be mucus and colors become paler, eyes turned white and on the skin of the abdomen changes color to brown.

3. The value of the LC50 for tawes fish is ± 0.385%

5. References

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