# Physical Modeling of Greywater into Clean Water with Fragrant Root (Vetiveria Zizanoides) in View of pH,Turbidity

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***Abstract*-. Vetiver grass or what is locally known as vetiver grass, is a type of aquatic plant that has long grown wild so it is very easy to find. It turns out that the potential of vetiver grass can not only be used as a handicraft and ornamental plant, but can also be used as a waste water remediation agent. The method used is to plant vetiver roots in soil submerged in tilapia pond waste water with variations in discharge, number of vetiver stems and time. The results of the description of the turbidity parameters show that with a total of 150 vetiver stems and each additional water discharge at different residence time periods will be able to reduce the turbidity value and increase the pH so that the quality of the waste water discharge increases. It can be concluded that: the initial pH of 7.30 increased to 7.90 and was standard (6.5 – 8.5) with a residence time of 7 days. And the initial turbidity of 119 decreased to 5.44 NTU and standard (<3 NTU), with a remaining time of 7 days. So, the residence time must be longer in order to meet the specified standards.**

***Keywords; Clean water, Greywater, Vetiveria***

## I. INTRODUCTION

Domestic sewage is ranked as one of the largest sources of pollutants to the aquatic environment, especially rivers [1]. This pollutant load contaminates up to about 57% of river flow [2, 3]. Meanwhile, the river water itself should still be able to be used for various purposes, such as for agricultural and landscaping irrigation needs, washing vehicles and tools, and so on [4, 5, 6, 7]. Domestic waste makes the benefits of river water reduced, where river water when used can have a negative impact, such as disrupting the quality of plant growth and development if used for irrigation, and so on [8, 9, 10, 11].

Given the high production of domestic wastewater, as well as its high pollution potential, the topic of sewage treatment will always be needed as one of the solutions that can be pursued. Various previous studies have formulated various waste treatment technologies that are easy to apply and have the potential to produce optimal outcomes through various approaches [2, 3, 4, 5, 11]. One approach that is currently being developed is the utilization of aquatic plants as phytoremediators [12, 13]. Waste treatment media equipped with aquatic plants are not only able to precipitate or filter pollutants, but can also improve the treatment process because pollutants are absorbed by plant roots [14].

Vetiver grass (Vetiveria zizanioides), or locally known as fragrant root, is one type of aquatic plant that has been growing wildly so that it is easily found [15]. The potential of vetiver grass not only can be utilized as handicrafts and ornamental plants, but can also be utilized as a wastewater remediator agent [16, 17]. This potential has been proven from various research [18]. This potential can be an excellent solution for the fulfillment of clean water, especially in urban areas.

This community service-based research is simply an effort to treat household wastewater to support the availability of clean water sources in urban areas. The type of waste processed here is graywater waste, which is wastewater that comes from kitchen and bathroom sink or washing water (not feces and urine) [19]. The reason for choosing the type of graywater waste is because of its high production, which is up to 70-75% of the total liquid waste generated from domestic activities [20]. Generally, graywater wastewater is directly discharged through the drainage system and of course leads to the river [21]. So it is quite unfortunate if this high quantity is not attempted to be reprocessed so that it can be utilized for various purposes.

## II. MATERIAL AND METHODS

### A. *Conceptual Framework*

Tilapia pond wastewater treatment and its output is processed into clean water to improve water quality so that it can be reused. To provide a clear picture of how the variables in this study interact with each other, a conceptual framework of the study is made based on the background, problems and objectives of the study: background, problems and objectives of the study. The variables in this study include the following:

1. Free Variable:
   a. Stay time (2 days, 4 days, 7 days) Where each is distinguished based on the type of plant used in the wetland, that is called the Fragrant Root plant (Vetiveria zizanoides) with soil media.
   b. Variation of discharge
   c. Number of vetiver stems
2. The dependent variable consists of selected parameters, which are as follows:
   a. pH (Potential of Hydrogen)
   b. Turbidity

As for the quality standards of each parameter above referring to the Minister of Health Regulation No. 2, 2023 concerning Hygiene and sanitation (clean water), The Research Parameters are described as follows:

Table 1. Clean Water Quality Standard Research Parameters

| Parameters | Clean water standard | Unit |
|---|---|---|
| pH (*Potential of Hydrogen*) | 6,5 - 8,5 | - |
| Turbidity | < 3 | NTU |

### B. *Wetland Construction*

The building model is planned using a scale ratio of 1:1000. With a discharge scale. For wetland, a box is sized (70 x 30 x 30 cm). in this physical model using waste discharge taken from the tilapia fishpond output (figure 1).

**Figure 1** Constructed Wetland

## III. RESULT AND DISCUSSION

This section presents the results of the description of water quality parameters including pH, color, turbidity, TDS, nitrate, nitrite, Fe, odor, and fecal coli. The effect on water quality is influenced by water discharge, number of vetiver stems, and residence time. The test results are presented using a line graph with the following results.

### *pH Parameter*

Table 1 Results of *Greywater* waste treatment with submerged soil media pH (6.5 - 8.5)

| Number of AW stem | Water Discharge (liters/day) | Greywater | Time | | |
|---|---|---|---|---|---|
| | | | 2 days | 4 days | 7 days |
| 50 | 1000 liters/day | 7,30 | 7,50 | 7,70 | 7,80 |
| | 1500 liters/day | 7,30 | 7,49 | 7,68 | 7,81 |
| | 2000 liters/day | 7,30 | 7,46 | 7,72 | 7,80 |
| 100 | 1000 liters/day | 7,30 | 7,55 | 7,76 | 7,87 |
| | 1500 liters/day | 7,30 | 7,55 | 7,73 | 7,83 |
| | 2000 liters/day | 7,30 | 7,57 | 7,73 | 7,85 |
| 150 | 1000 liters/day | 7,30 | 7,60 | 7,84 | 7,93 |
| | 1500 liters/day | 7,30 | 7,63 | 7,82 | 7,97 |
| | 2000 liters/day | 7,30 | 7,58 | 7,88 | 7,90 |

Source: Calculation Results

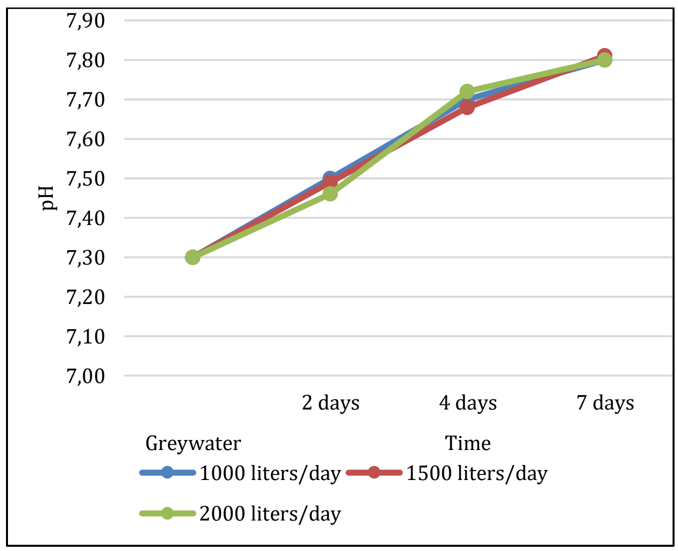


**Figure 2** Graph of pH Based on Water Discharge and Residence Time with 50 Number of Stems

The results of the description of the pH parameter show that with the number of vetiver stems as many as 50 stems and each addition of water discharge at different residence time periods will be able to increase the pH value (Figure 2).

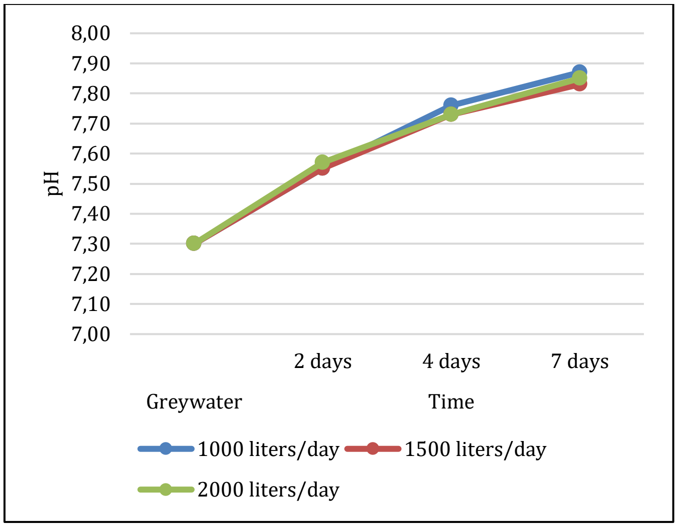


**Figure 3** Graph of pH Based on Water Discharge and Residence Time with 100 Number of Stems

The results of the description of the pH parameter show that with the number of vetiver stems as many as 100 stems and each addition of water discharge at different residence time periods will be able to increase the pH value ( Figure 3).

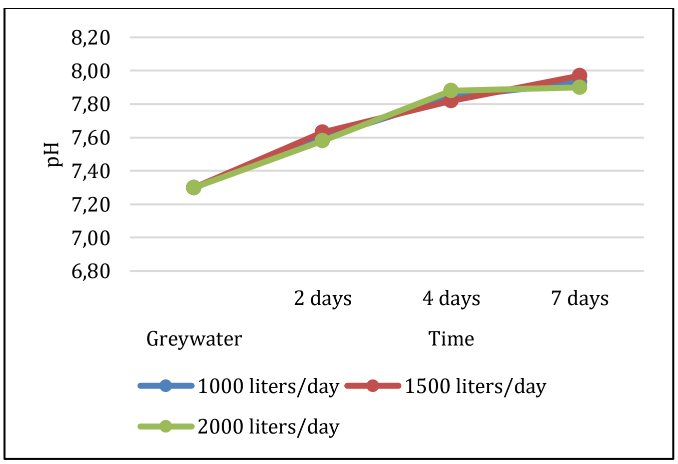


**Figure 4** Graph of pH Based on Water Discharge and Residence Time with 150 Stems

The results of the description of the pH parameter show that with the number of vetiver stems as many as 150 stems and each addition of water discharge at different residence time periods will be able to increase the pH value (Figure 4).

*Turbidity Parameters*

Table 2 Results of *Greywater* waste treatment with submerged soil media Turbidity

| Number of AW Stems | Water Discharge (liters/day) | Greywater | Time | | |
|---|---|---|---|---|---|
| | | | 2 days | 4 days | 7 days |
| 50 | 1000 liters/day | 119 | 67,00 | 20,00 | 6,36 |
| | 1500 liters/day | 119 | 69,68 | 20,20 | 6,30 |
| | 2000 liters/day | 119 | 63,65 | 20,40 | 6,42 |
| 100 | 1000 liters/day | 119 | 60,30 | 19,00 | 5,85 |
| | 1500 liters/day | 119 | 61,51 | 18,81 | 5,91 |
| | 2000 liters/day | 119 | 60,30 | 18,43 | 5,68 |
| 150 | 1000 liters/day | 119 | 54,27 | 17,48 | 5,38 |
| | 1500 liters/day | 119 | 53,73 | 17,65 | 5,11 |
| | 2000 liters/day | 119 | 54,27 | 18,00 | 5,44 |

Source: Calculation Results

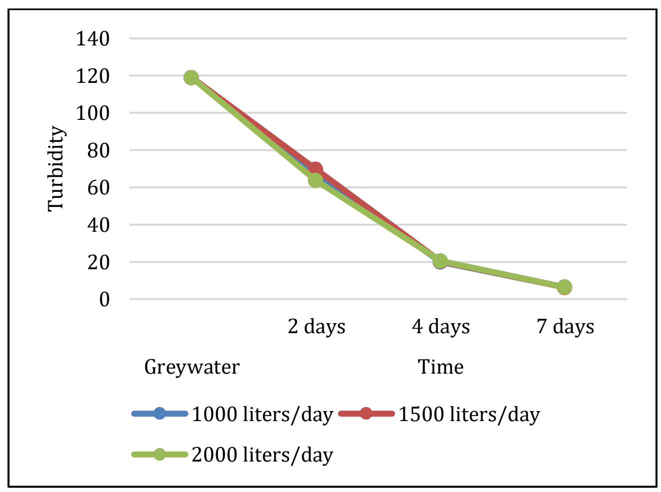


**Figure 5** Turbidity Graph Based on Water Discharge and Residence Time with 50 Number of Bars

The results of the description of the turbidity parameter show that with the number of vetiver stems as many as 50 stems and each addition of water discharge at different residence time periods will be able to reduce the turbidity value (Figure 4).

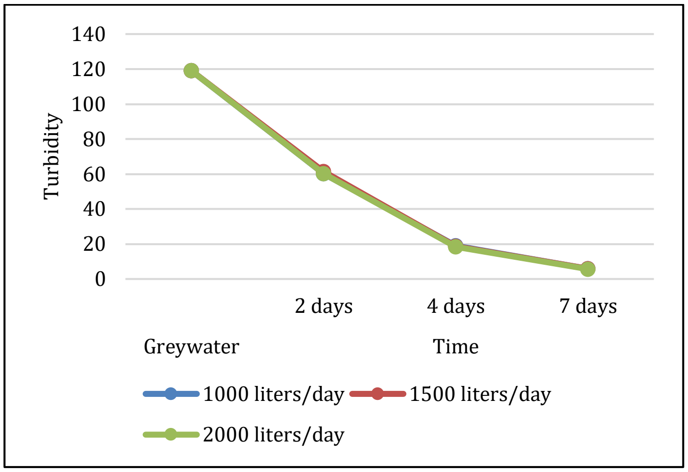


**Figure 6** Turbidity Graph Based on Water Discharge and Residence Time with 100 Number of Bars

The results of the description of the turbidity parameter show that with the number of vetiver stems as many as 100 stems and each addition of water discharge in different residence time periods will be able to reduce the turbidity value (Figure 6).

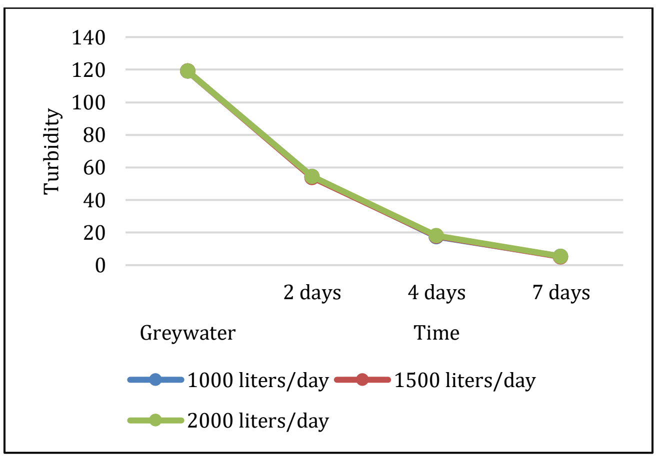


**Figure 7** Turbidity Graph Based on Water Discharge and Residence Time with 150 Number of Bars

The results of the description of the turbidity parameter show that with the number of vetiver stems as many as 150 stems and each addition of water discharge in different residence time periods will be able to reduce the turbidity value (Figure 7).

## IV. CONCLUSION

Based on the research results of the physical model of gray water waste of tilapia fish ponds, it can be concluded as follows:

1. Tilapia pond waste treatment results show that :
   a. Initial pH 7.30 rose to 7.90 and standard (6.5 - 8.5) with a residence time of 7 days
   b. The initial turbidity dropped to 5.44 NTU and the standard (<3 NTU), with a residence time of 7 days. So the residence time must be longer in order to meet the specified standards.
2. The equation in the physical model is :
   a. pH
   [ Y = 7.339 - 6.667x10-06 X1 + 0.001 X2 + 0.061 X3 + e (X1 discharge, X2 residence time, X3 number of vetiver stems)]
   b. Turbidity
   [Y = 79.479 - 0.0003 X1 - 0.054 X2 - 10.419 X3 + e (X1 discharge, X2 residence time, X3 number of vetiver stems)]

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