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Tesis

**Efficiency of *Zantedeschia aethiopica* and *Nasturtium officinale* in the removal of COD and BOD5 in domestic wastewater from the Santiago Antúnez de Mayolo El Tambo Urbanization - 2021**

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# Efficiency of *Zantedeschia Aethiopica* and *Nasturtium Officinale* in the Removal of COD and BOD<sub>5</sub> in Domestic Wastewater from The Santiago Antúnez De Mayolo El Tambo Urbanization - 2021

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**Abstract.** Domestic wastewater is dumped directly into the water resource affecting it, for which it is important to implement environmental control and prevention. In this research, the aim is to determine the efficiency of *Zantedeschia aethiopica* (Water Lily) and *Nasturtium officinale* (Water cress) in the removal of COD and BOD<sub>5</sub> in the domestic wastewater of the Santiago Antúnez of Mayolo El Tambo Urbanization - 2021. To achieve the objective was to collect 36 L of domestic wastewater from the Santiago Antúnez de Mayolo El Tambo Urbanization, which were placed in three glass ponds of 35 cm x 25 cm x 25 cm, which each contained 12 liters of water ; the first pond was considered as zero treatment (T0) or control treatment, In the second pond, the *Zantedeschia aethiopica* (Water Lily) species was placed and it was considered as treatment one (T1) and in the third pond the *Nasturtium officinale* (Water Cress) species was placed and it was considered as treatment two (T2). After 31 days in the zero treatment (T0) it was obtained that the domestic wastewater from the Santiago Antúnez Urbanization of Mayolo El Tambo has a concentration of 41 mg/L of BOD<sub>5</sub> and 72.4 mg/L of COD; In treatment one (T1) with the *Zantedeschia aethiopica* species (Water lily) the final concentrations of 32.1 mg/L and 68.7 mg/L of BOD<sub>5</sub> and COD were obtained respectively; In treatment two (T2) with the species *Nasturtium officinale* (Water cress) the final concentrations of 39.79 mg/L and 56.5 mg/L of BOD<sub>5</sub> and COD were obtained respectively. It can be concluded that both species were efficient in removing BOD<sub>5</sub> and COD; the *Zantedeschia aethiopica* species (Water lily) obtained a removal percentage of 21.71% and 5.11% for BOD<sub>5</sub> and COD respectively; the species *Nasturtium officinale* (Water cress) obtained a removal percentage of 2.95% for BOD<sub>5</sub> and 21.96% for COD.

## 1. Introduction

The water resource over the years has been a problem for the world, due to the urban growth of the population, since at present most of the population is living in urban areas, for which it is specified that by 2025 it will be seen in extending reaching 60%. The evolution of industrial activity also generated pressure for the use of water in many countries, reaching a point of being able to decrease [1].

Although wastewater is transcendental and decisive in the time of water management. However, these are discharged directly to the water resource affecting it, for which it is important to implement environmental control and prevention to last and recover the natural characteristics of the receptors of the body of water [2].

In addition, the phytoremediation of aquatic plants is a main process that can be done for the treatment of wastewater, thus allowing the degradation of organic matter carried out by microorganisms that live



on and around the roots of plants. In addition, these degradation products are absorbed by plants together with nitrogen, phosphorus, and other minerals. In turn, microorganisms use part, or all of the metabolites discarded by plants through their roots as a food source. Likewise, plants have the ability to transfer oxygen from their upper parts to their roots, producing an aerobic zone favoring the different processes that occur during the treatment of domestic wastewater [3]. So, for the research, two species will be used, one that is emergent as *Zantedeschia aethiopica* and the other is submerged as *Nasturtium officinale*.

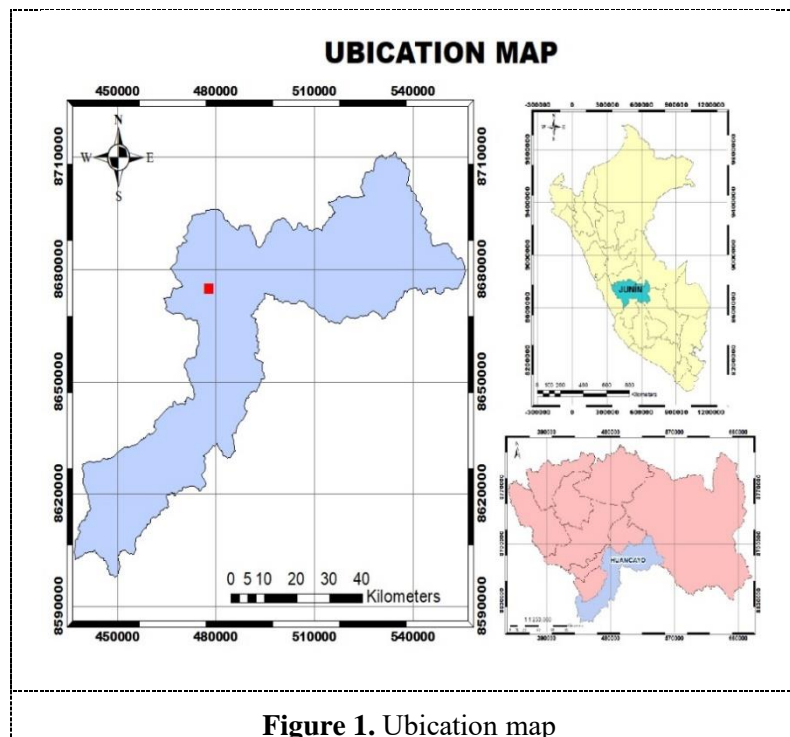
Where the *Zantedeschia aethiopica* is a plant known by the name of white cartridge or swamp cartridge, which has a height of 60 to 100 cm, the leaves of 15 to 40 cm long with 6.8 to 24.5 cm wide, also a scattered root that I was able to measure 16 cm long and this is due to its thick stem. These roots release organic compounds such as sugars and amino acids in small proportions, favoring certain microorganisms, thus generating the rhizosphere. This plant has been used to clean wastewater and prevent algae from proliferating [4].

As well as the *Nasturtium officinale* is a plant that is submerged in water, it also has a fibrous root, steep, vigorous stems that reach a height of 10 to 50 cm, its roots come from tube-shaped conduits that are submerged. It develops in the water paths in which the current and depth of the water are favorable in lotic waters with shallow depths, of insufficient flow and sandy substrate, with the upper leaves and fully emerging flowers. It has a use of being able to remove pollutants of domestic origin from wastewater [5].

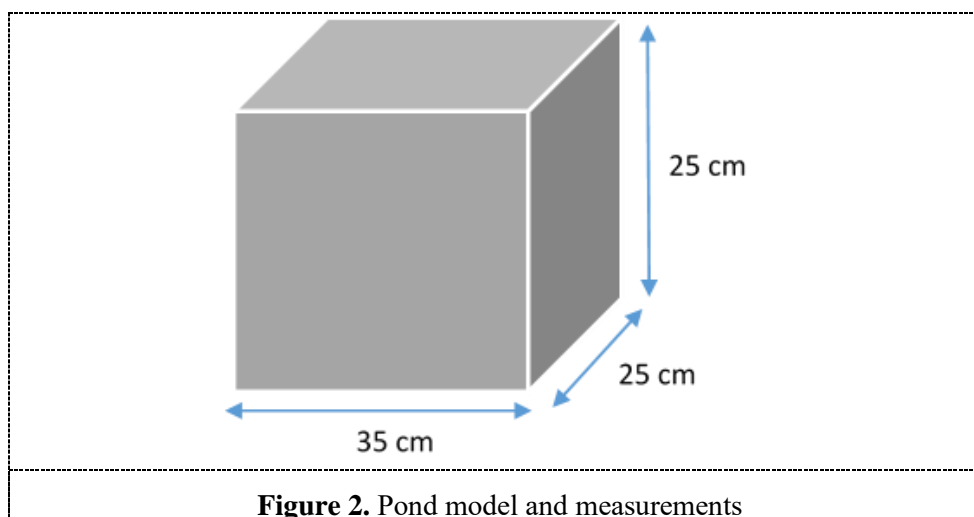
Therefore, the present study will focus on having the analysis of the removal efficiency of  $DBO_5$  and COD, carrying out the treatment in three ponds using the *Zantedeschia aethiopica* and *Nasturtium officinale* species, plus one that will serve as a control for the domestic wastewater of the Santiago Antúnez de Mayolo urbanization.

## 2. Materials and methods

The identification of a wastewater discharge point from the Santiago Antúnez de Mayolo urbanization was carried out without any type of treatment, discharged into the Shullcas River located at coordinates -12.047051 and -75.200782 in **Figure 1**.



As well as the *Zantedeschia aethiopica* and *Nasturtium officinale* species, the improved species were collected at the farm with coordinates -12.04867 and -75.23973. Then a glass pond model was developed taking into consideration the capacity that it will receive for the storage of wastewater, making 3 main ponds, having the following measurements of 35 cm long, 25 cm wide and 25 cm high in **Figure 2**.



For the analysis of the chemical parameters in BOD<sub>5</sub> and COD of the wastewater of the Santiago Antúnez de Mayolo urbanization, after 31 days of treatment, the water samples were taken to the Environmental Laboratory “Laboratorios SAC”, which will oversee the analysis techniques to obtain the results of the investigation.

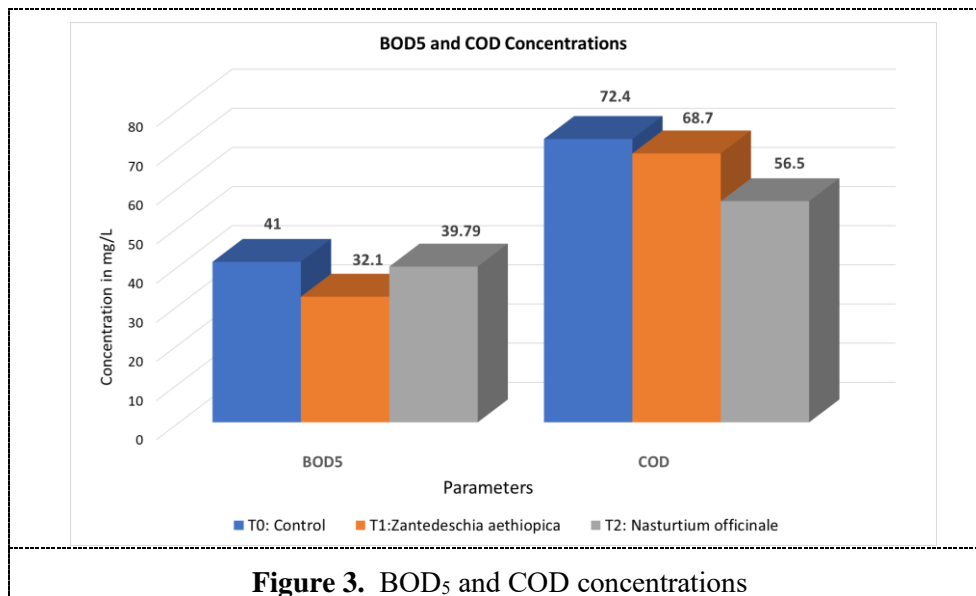
### 3. Results

The results obtained will be presented below where it can be seen that **Table 1** has the value of the concentrations of BOD<sub>5</sub> and COD in T0 which is the control treatment, in T1 which is the treatment with the *Zantedeschia aethiopica* species (Water lily) and in T2, which is the treatment with the species *Nasturtium officinale* (Water cress), these values have decreased with both the *Zantedeschia aethiopica* species (Water lily) and the *Nasturtium officinale* species (Water cress).

**Table 1.** BOD<sub>5</sub> and COD concentrations

|                                | <b>T0</b><br><b>Control</b> | <b>T1</b><br><i>Zantedeschia aethiopica</i><br><b>(Water lily)</b> | <b>T2</b><br><i>Nasturtium officinale</i><br><b>(Water cress)</b> |
|--------------------------------|-----------------------------|--|---|
| <b>DBO<sub>5</sub>(mg / L)</b> | 41                          | 32.1   | 39.79   |
| <b>COD (mg / L)</b>            | 72.4                        | 68.7   | 56.5  |

In **Figure 3**, it can be seen that the BOD<sub>5</sub> concentration in T0 is 41 mg/L, in T1 it is 32.1 mg/L and in T2 it is 39.79 mg/L, there was a better removal of BOD<sub>5</sub> with T1 which is treatment with the species *Zantedeschia aethiopica* (Water lily); the COD concentration in T0 is 72.4 mg/L, in T1 it is 68.7 mg/L and in T2 it is 56.5 mg/L, there was a better removal of COD with T2, which is the treatment with the species *Nasturtium officinale* (Water cress).

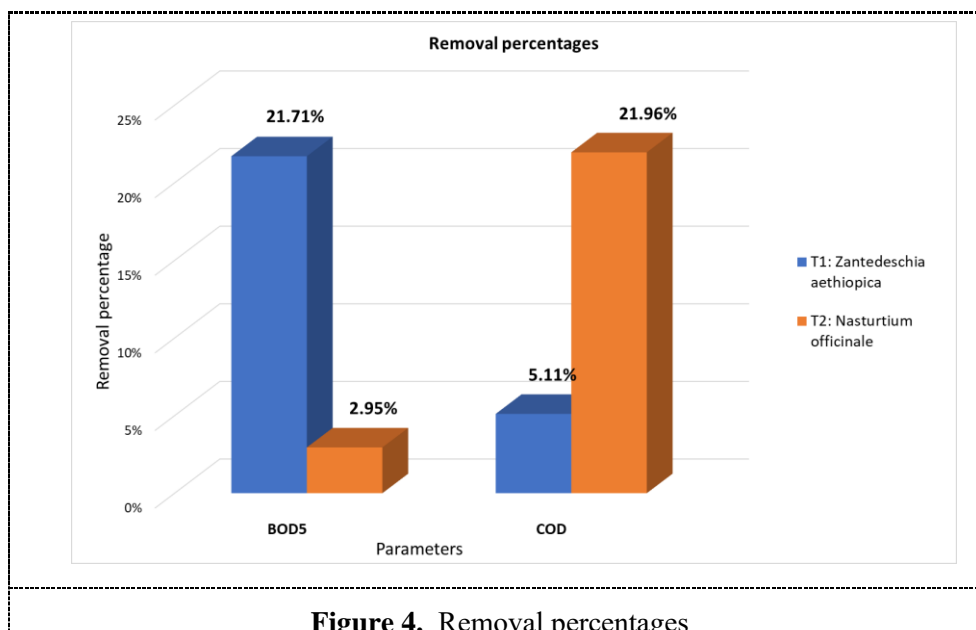


**Figure 3.** BOD<sub>5</sub> and COD concentrations

Regarding the removal percentages in **Table 2** and **Figure 4** , the removal percentage values can be observed both with Treatment 1 (T1) with the *Zantedeschia aethiopica* species (Water lily) and with Treatment 2 (T2) with the species *Nasturtium officinale* (Water cress). Both species were efficient in removing BOD<sub>5</sub> and COD; the *Zantedeschia aethiopica* species (Water lily) obtained a removal percentage of 21.71% and 5.11% for BOD<sub>5</sub> and COD respectively; the species *Nasturtium officinale* (Water cress) obtained a removal percentage of 2.95% for BOD<sub>5</sub> and 21.96% for COD.

**Table 2.** Removal percentages

|                  | T1<br><i>Zantedeschia aethiopica</i><br>(Water lily) | T2<br><i>Nasturtium officinale</i><br>(Water cress) |
|------------------|--|---|
| DBO <sub>5</sub> | 21.71%   | 2.95%   |
| COD              | 5.11%  | 21.96%  |



**Figure 4.** Removal percentages

#### 4. Discussion of results

The results present in the investigation determined the removal of BOD<sub>5</sub> and COD from the wastewater of the Antúnez de Mayolo Urbanization using two types of treatment, which were *Zantedeschia aethiopica* (Water lily) and *Nasturtium officinale* (Water cress) and taking as reference to a control treatment that only contained the wastewater.

Regarding the *Zantedeschia aethiopica* species (Water lily), it showed efficient results for the Biochemical Oxygen Demand (BOD<sub>5</sub>) parameter, managing to remove 32.1 mg/L from the concentration of the control treatment, with a removal percentage of 21.71% and for the Chemical Oxygen Demand (COD) parameter removed 68.7 mg/L from the concentration of the control treatment, showing a removal percentage of 5.11%. These results obtained are supported by the thesis of Córdova Menéndez Leonardo entitled "Use of *Zantedeschia aethiopica* and *Canna indica* in the removal of organic matter from the wastewater of the population of Santa María, Huachipa 2018" where he stated in his results with de la *Zantedeschia aethiopica* species (Alcatraz) achieving up to a concentration of 21 mg/L for BOD<sub>5</sub>, 36.5 mg/L for COD, also presented an efficiency in the percentage of removal being these of 85.51% for BOD<sub>5</sub>, 89.51% for COD [6].

For the species *Nasturtium officinale* (Water cress) efficient results were seen in the Chemical Oxygen Demand (COD) parameter, acquiring remove 56.5 mg/L from the control concentration, having a removal percentage of 21.96% and for the Biochemical Demand parameter of Oxygen (BOD<sub>5</sub>) removed 39.9 mg/L from the concentration of the control treatment, showing a removal percentage of 2.95%. Therefore, these results can be corroborated with the research work by César Valdivia Rodríguez entitled "Efficiency of *Eichhornia crassipes* (Mart.) Solms Laub - *Pontederiaceae* and *Nasturtium officinale* WT Aiton - *Brassicaceae* in the removal of BOD<sub>5</sub> and COD from the effluent of the wastewater treatment plant of Celendín" in which he demonstrated in his results with the species *Nasturtium officinale* (Water cress) reaching a concentration of 127.8 mg/L for COD, 21.2 mg/L for BOD<sub>5</sub>, it also had a removal efficiency of 30.62 % of BOD<sub>5</sub> and for COD a removal efficiency of 35.44 % [5].

#### 5. Conclusions

After evaluating the results obtained by the treatments, it can be concluded that the *Zantedeschia aethiopica* (Water Lily) efficiency was achieved more for BOD<sub>5</sub> with 32.1 mg/L and less for *Nasturtium officinale* (Water cress) with 39.79 mg/L for BOD<sub>5</sub>, with respect to the control treatment that has 41 mg/L BOD<sub>5</sub>.

However, in terms of efficiency, *Nasturtium officinale* (Water Cress) achieved more for COD with 56.5 mg/L and less for *Zantedeschia aethiopica* (Water Lily), which has 68.7 mg/L of COD, with respect to treatment control that has a 72.4 mg/L of COD.

The removal percentages for *Zantedeschia aethiopica* (Water Lily) are 21.71% for BOD<sub>5</sub> and 5.11% for COD. Likewise, for the removal percentage of *Nasturtium officinale* (Water cress), 2.95% was achieved in BOD<sub>5</sub> and 21.96% for COD.

#### 6. References

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