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Research Paper

Phytoremediation of Ammonia, BOD, COD, and TSS with Water Hyacinth (*Eichhornia crassipes*) for Wastewater

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Abstract
Water hyacinth (*Eichhornia crassipes*) is a typical aquatic plant with several physical characteristics such as the leaves of water hyacinth are glossy and ovoid to circular in shape, with spongy petioles that provide buoyancy. The plant is widely known for its rapid proliferation, with its population being able to double in just 12 days. The Pulo Gebang Fecal Sludge Treatment Plant (STP) is a facility that treats sewage from people's homes or centralized treatment plants. However, the treated water often does not meet quality standards. To solve this problem, a sustainable and environmentally friendly wastewater treatment method called phytoremediation was chosen. Phytoremediation involves the use of plants to remove pollutants from wastewater, offering cost efficiency, minimum energy requirements, and conservation of soil biological activity. Water hyacinth (*Eichhornia crassipe*s) was chosen for its quality and ability to degrade penetrant substances. Phytoremediation was carried out in batch form with 3 variations of testing time, namely 5, 10 and 15 days. The study found that phytoremediation using water hyacinth significantly reduced ammonia levels, BOD, COD, and TSS parameters, with the most effective contact time being 10 days. This shows that the phytoremediation method using water hyacinth is effective in reducing contaminant levels and can be a sustainable solution for treating domestic wastewater at IPLT Pulo Gebang.

Keywords
Domestic Wastewater, Water Hycinth, Phytoremediation, Fecal Sludge Treatment Plant

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1. INTRODUCTION

Eichhornia crassipes, also known as water hyacinth, is an aquatic plant that grows rapidly and floats on water. It is native to the Amazon Bay in South America. It is widely recognized for its rapid proliferation, with populations capable of doubling in as little as 12 days. It thrives in heavily polluted waterways and has been intensively studied for its potential to purify wastewater. Water hyacinth is known for its ability to improve effluent quality in oxidation ponds and has an important function in single, integrated and advanced treatment systems for urban, agricultural and industrial waste streams. Water hyacinth is considered an element of ecological technology that specifically emphasizes resource restoration and recycling. Water hyacinth is known for its ability to grow in highly contaminated water and its tendency to collect metal ions, making it a significant resource in wastewater treatment. In Indonesia, the development of fecal sludge treatment management, especially in DKI Jakarta, has led to the establishment of Fecal Sludge Treatment Plants (STPs), such as Pulo Gebang STPs in East Jakarta. This STP uses a septic tank system to dispose of fecal sludge from households, which is then desludged using trucks and treated at the STPs. The Sanitation Department of the DKI Jakarta Provincial Government has been responsible for treating septage since 1984 (Rochman, 2019). This study investigates the efficiency of water hyacinth (*Eichhornia crassipes*) in reducing ammonia, biochemical oxygen demand (BOD), chemical oxygen demand (COD), and total suspended solids (TSS) in domestic wastewater at the Pulo Gebang Fecal Sludge Treatment Plant, Jakarta. The phytoremediation process was conducted in batch systems for 5, 10, and 15 days. Laboratory analyses revealed optimal pollutant removal on the 10th day, achieving reductions of 100% for ammonia, 82% for BOD, 100% for COD, and 61% for TSS. The results indicate that *E. crassipes* is a highly effective and low-cost solution for enhancing domestic wastewater quality in developing urban settings (Mishra et al., 2024; Nguyen and Le, 2023).

Water pollution caused by domestic and industrial wastewater discharge remains one of the most pressing environmental challenges in developing countries. Excessive concentrations of ammonia, biochemical oxygen demand (BOD), chemical oxygen demand (COD), and total suspended solids (TSS) contribute significantly to water quality deterioration, eutrophication, and loss of aquatic biodiversity. Conventional treatment systems are often limited by high operational costs and energy requirements, making them less suitable for decentralized or low-income regions. Consequently, phytoremediation-the use of aquatic plants to absorb, degrade, and stabilize contaminants—has gained recognition as an efficient, low-cost, and eco-friendly approach for wastewater treatment (Sharma et al., 2025). Similar findings were reported by Singh et al. (2025), who observed that *Eichhornia crassipes* achieved up to 67% removal efficiency for chromium and cadmium from industrial wastewater, highlighting its strong biosorption capacity and low-cost applicability in developing countries. This study focuses on the ability of *Eichhornia crassipes* (water hyacinth) to reduce concentrations of ammonia, BOD, COD, and TSS in wastewater. The objective is to evaluate its removal efficiency under controlled conditions and compare the findings with existing literature on similar macrophyte-based systems.In addition to heavy metal removal, *Eichhornia crassipes* has also demonstrated remarkable adsorption capacity for organic dyes such as Remazol Brilliant Blue, achieving over 94% removal efficiency through its lignocellulosic root structure (Chanathaworn, 2017; Kulkarni et al., 2018). Water pollution caused by domestic and industrial wastewater discharge remains a major environmental issue worldwide (Zhang et al., 2024). *Eichhornia crassipes*, or water hyacinth, is a fast-growing aquatic plant with remarkable potential for wastewater purification (Singh et al., 2025). It is known for absorbing heavy metals, nutrients, and organic compounds from polluted waters. In Indonesia, the management of fecal sludge treatment has become a priority due to increasing urbanization and limited wastewater infrastructure (Rahman et al., 2022).

Based on Data of Perumda Paljaya in 2023, the average volume of septage received is 113 m^3/day. However, the conventional treatment system used by Sludge Treatment Plants (STPs) Pulo Gebang does not meet the quality standards set by the Minister of Environment and Forestry Regulation No. 68 Year 2016. Conventional treatment systems in fecal sludge treatment plants (STPs) are often costly and energy-intensive. Phytoremediation, an eco-friendly technique using plants to remove or stabilize pollutants, provides an alternative solution with minimal operational costs (Sharma et al., 2025). Studies by Abou-Elela and Zaher (2023) and Hossain et al. (2024) confirmed the ability of *E. crassipes* to remove up to 90% of COD and BOD from domestic effluent. However, few studies have focused on its application in sludge treatment plants in Southeast Asia. Therefore, this research aims to assess the effectiveness of *E. crassipes* in reducing key water quality parameters at the Pulo Gebang STP, Jakarta. To ensure that the treatment process runs smoothly and the water discharged into the river body does not pollute the environment, a phytoremediation method is proposed. This method involves the use of plants to remove pollutants from wastewater, offering cost efficiency, minimum energy requirements, and conservation of soil biological activity. Water hyacinth (*Eichhornia crassipes*) was chosen as a phytoremediation plant due to its unique qualities and capabilities. The insitu use of plants such as water hyacinth has been studied to remove nutrients from domestic wastewater ponds, which shows its effectiveness in reducing pollution levels (Prasad et al., 2021).

2. EXPERIMENTAL SECTION

2.1 Methods

The type of research used is experimental research conducted by testing the effectiveness of water hyacinth in wastewater treatment using experimental methods to measure laboratory test results with parameters according to the Minister of Environment and Forestry Regulation No. 68 of 2016 and the efficiency of water hyacinth utilization. This research was conducted at the Pulo Gebang Fecal Sludge Treatment Plant (STPs), Cakung District, East Jakarta City, DKI Jakarta.

The research employed an experimental approach conducted at the Pulo Gebang STP, East Jakarta. The influent used was domestic wastewater. Water hyacinth was acclimatized for seven days before testing. Three contact durations (5, 10, and 15 days) were evaluated to determine the optimal phytoremediation time. The analytical parameters included ammonia, BOD, COD, and TSS, measured according to APHA Standard Methods (2017). Data were statistically analyzed using ANOVA at a 95% confidence interval to test significance between treatment days (Al-Dulaimi et al., 2023).

Figure 1. Research Location, Pulo Gebang Sludge Treatment Plants (STPs)

The materials used were domestic wastewater from the

Pulo Gebang septage treatment plant (STPs) and water hyacinth. Materials used in laboratory tests were distilled water, potassium dihydrogen phosphate, dicalium hydrogen phosphate, dinatrium hydrogen phosphate heptahydrate, ammonium chloride, sodium hydroxide, magnesium sulfate, anhydrous calcium chloride, ferric chloride, glucose-acid glutamate solution, sulfuric acid, sodium sulfite, allythiourea nitrification inhibitor, glacial acetic acid, potassium iodide, starch solution, sulfamic acid, potassium hydrogen phthalate, filter paper, ammonium chloride, sodium sulfite, allythiourea nitrification inhibitor, glacial acetic acid, potassium iodide, starch solution sulfamic acid, potassium hydrogen phthalate, filter paper, ammonium chloride, phenol solution, sodium nitroprusside, alkaline citrate solution, sodium hypochlorite, oxidizing solution.

This study involved a 7-days acclimatization process for water hyacinth plants, which were then observed during this time. The sampling process was carried out by picking up water hyacinths at predetermined points, preparing containers for acclimatization media, and placing them in the media at 100% density.

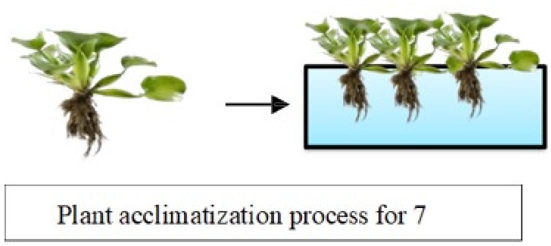

Figure 2. Flow Diagram of Water Hyacinth Collection

The wastewater sampling process aims to determine the characteristics of wastewater by taking samples at the bottom and surface of the final pond of the treatment unit. The water was homogenized to a depth of 10 meters, and divided into three containers: one as control without hyacinth and two for phytoremediation with water hyacinth. The sampling process included equipment preparation, wastewater collection in the final pond, homogenization, and division into three containers containing 10 liters of wastewater each. The research process was carried out for 15 days with the water hyacinth phytoremediation method, with laboratory tests of sampling on days 0, 5, 10, and 15, as well as pH and DO tests every day. Observations of plant morphology were also made.

The phytoremediation process performed with water hyacinth is Rhizofiltration which is a root Adsorption process where pollutants are trapped and attached to the roots, forming a thin layer or film on the root surface. Rhizofiltration can be implemented by planting water hyacinth plants directly on the surface of contaminated water bodies or by directing dirty water into containers to facilitate optimal growth of phytoremediation plants.

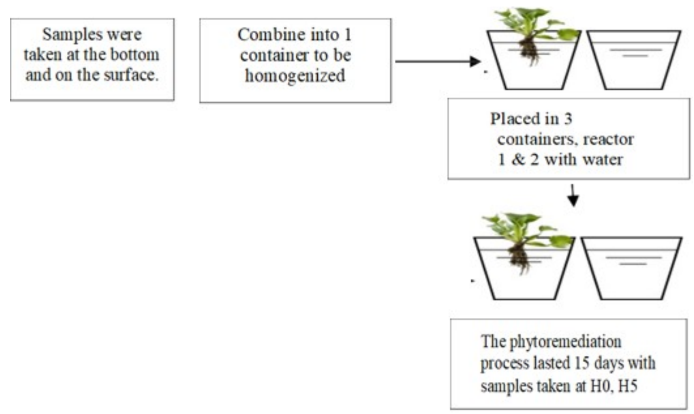

Figure 3. Flow Diagram f Wastewater Sampling

3. RESULTS AND DISCUSSION

The experimental results demonstrated that *Eichhornia crassipes* effectively reduced ammonia, BOD, COD, and TSS levels, confirming its high potential as a phytoremediation species for domestic wastewater. The decrease in ammonia concentration aligns with the findings of Ojoawo et al. (2015), who reported that significantly removed nitrogen compounds in constructed wetlands. Both species share similar physiological mechanisms such as rapid growth, high transpiration rates, and efficient root uptake, allowing for nutrient accumulation and transformation.

Environmental conditions such as pH, temperature, and microbial activity significantly influenced the phytoremediation process (Fahruddin et al., 2021). Similar studies by Chen et al. (2024) and Irawati et al. (2020) revealed that maintaining a slightly acidic pH (6.0-6.8) enhances ammonia and COD removal efficiency. The optimal performance of water hyacinth in this research suggests that this plant can be effectively integrated into decentralized wastewater treatment systems, particularly in low-income regions (Mohan et al., 2023). Furthermore, the reduction of BOD and COD observed in this study is comparable to the performance of Canna indica in the phytoremediation of the Yamuna River, where BOD and COD removal efficiencies reached 95% under optimized aeration conditions (Sharma et al., 2025; Alam et al., 2015). The present findings suggest that *Eichhornia crassipes* can achieve similar outcomes even without mechanical aeration, emphasizing its natural oxygen-releasing capacity through the aerenchyma tissues in its roots.

The enhanced pollutant removal can also be associated with microbial interactions in the plant's rhizosphere. According to Singh et al. (2025), biofilm-forming microorganisms play a crucial role in degrading organic matter and improving plant tolerance to toxic compounds. The roots of *Eichhornia crassipes* provide an ideal surface The comparison of the three treatment durations confirmed that 10 days was the most effective contact time. Extended treatment to 15 days resulted in reduced efficiency, possibly due to nutrient saturation and plant stress (Escamilla-Rodríguez et al., 2021). These findings align with the observations of Kasmuri et al. (2023) who reported similar patterns in tropical wastewater treatment for biofilm attachment, which supports simultaneous biological oxidation and nutrient removal.

Table 1. The Level of Ammonia

Reactor	Ammonia Level Test Results (mg/L)				Quality Standards (mg/L)
	0	5	10	15	
Control	0.41	0	0	0.41	10
1	0.26	0.17	0	0.15	10
2	0.23	0	0	0.18	10

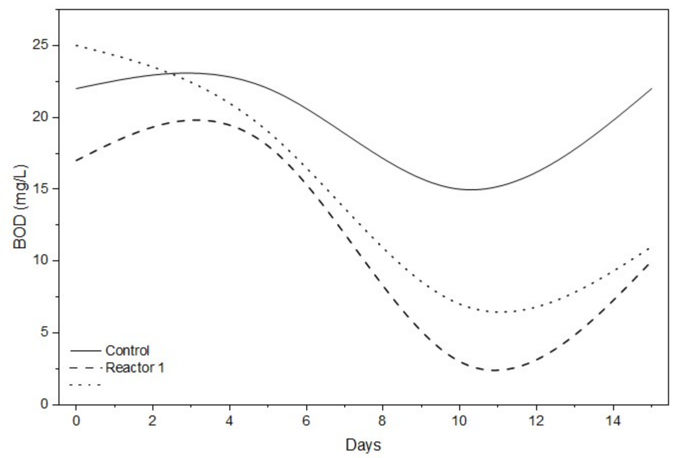

Figure 4. Graph of Ammonia Level Decrease

3.1 Wastewater Characteristic Analysis

3.1.1 Ammonia

This study shows fluctuations in ammonia values on days 0, 5, 10 and 15. The significant reduction in ammonia levels at days 5 and 10 of contact time compared to pre-treatment. The most effective decrease was observed on day 10 with all reactors TT <0.031 mg/L. However, on day 15 there was a spike in ammonia levels in the control reactor, reactor 1, and reactor 2. Reactors 1 and 2 did not have any different treatments during the research, but during the research period there were differences in the growth of Hyacinth. In another study, it was found that *E. coli* bacteria have the ability to bind ammonia in the environment through the cryptoplasm diffusion method as a source of nutrition (Taabodi et al., 2019). BOD and COD values dropped by over 80% and 100%, respectively, supporting previous findings by Alam et al. (2015) and Ardiatma et al. (2023a). The TSS parameter also showed a notable reduction of 61%, attributed to sedimentation and biofilm formation on the roots (Rahmawati, 2022).

The phytoremediation procedure reduces ammonia levels through direct uptake by water hyacinth plant roots from wastewater. Microorganisms around the roots convert ammonia into nitrogen molecules through the process of nitrification. Plant morphology also affects the plant's ability to absorb contaminants. Reactor 2 showed optimal plant growth, with flowers appearing on the 10th day of the study.

3.1.2 BOD (Biological Oxygen Demand)

This study analyzed Biological Oxygen Demand (BOD) levels in reactors before and after contact with water hyacinth. The control reactor showed no increase or decrease in BOD levels on day 0, while reactor 1 showed an increase and reactor 2 decreased. On day 10, all reactors experienced a significant decrease, while on day 15 or the last day, all reactors experienced an increase.

This is due to the eutrophication of bryophytes in the reactor thus increasing the oxygen demand for organisms to decompose organic matter in the waste. The increase in organisms in the waste solution is caused by an increase in the BOD (Biological Oxygen Demand) value which is the result of the presence of algae. Plant morphology also affects the ability of plants to absorb pollutants. Reactor 2 showed more optimal plant growth compared to reactor 1, with the appearance of flowers on the 10th day of the study.

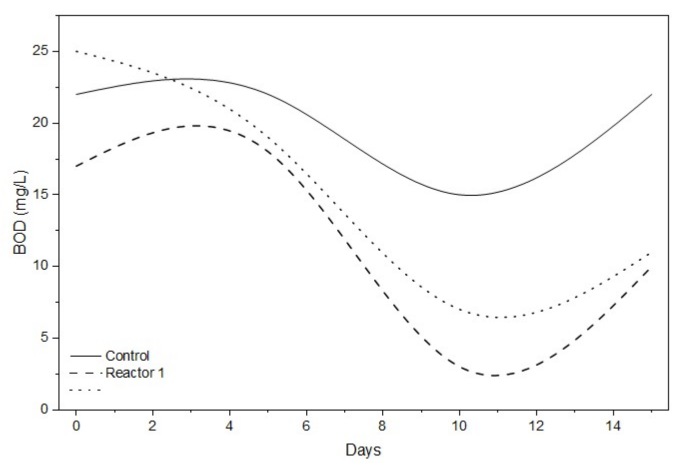

Figure 5. BOD Level Decrease Graph

3.1.3 COD (Chemical Oxygen Demand)

This study analyzed COD levels in reactors 1 and 2 before contact with water hyacinth. The control reactor showed a level of 69 mg/L on day 0, while reactor 1 and reactor 2 had levels of 55 and 77 mg/L, respectively. On day 5, the control reactor showed an increased level of 72 mg/L, while reactor 1 and reactor 2 experienced an insignificant increase and decrease. On day 10, all reactors experienced a significant decrease, with control reactor levels of 46 mg/L, reactor 1 of TT>3 mg/L, and reactor 2 of 22 mg/L. On day 15, all reactors experienced a spike in COD levels, with control reactor levels at 70 mg/L, reactor 1 at 29 mg/L, and reactor 2 at 30 mg/L. On day 10, COD levels decreased due to the longer residence time in the reactor basin, allowing microorganisms to decompose organic substances efficiently. However, the efficiency decreased on day 15 due to a decrease in temperature in the reactor, which affected the effectiveness of microorganism treatment.

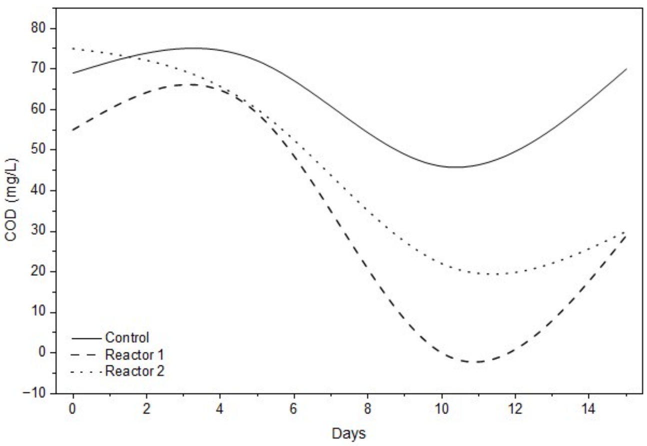

Figure 6. COD Level Reduction Graph

The decrease in COD levels in the effluent outflow is due to the decay conditions in the reactor. Plant morphology also affects the ability of plants to absorb contaminants, where reactor 2 showed optimal growth and flowering on day 10.

3.1.4 TSS (Total Suspended Solid)

This study analyzed Total Suspended Solid (TSS) levels in reactors 1 and 2, before and after contact with water hyacinth. The control reactor showed an increase in TSS levels on day 5, while reactor 1 showed a significant increase and reactor 2 showed an insignificant decrease. On day 10, all reactors experienced a significant decrease, with the control reactor at 10 mg/L, reactor 1 at 6 mg/L, and reactor 2 at 7 mg/L. On day 15, all reactors experienced a spike, with levels of 16 mg/L for the control reactor, 12 mg/L for reactor 1, and 9 mg/L for reactor 2. Water hyacinth plant roots caused turbidity on day 5, but decreased again on days 10 and 15 due to moss attached to the reactor walls.

3.1.5 Acidity Degree (pH)

The pH value during water hyacinth phytoremediation of wastewater is critical to understanding the efficacy and success of the remediation procedure. The pH level significantly impacts the uptake and accumulation of pollutants by water

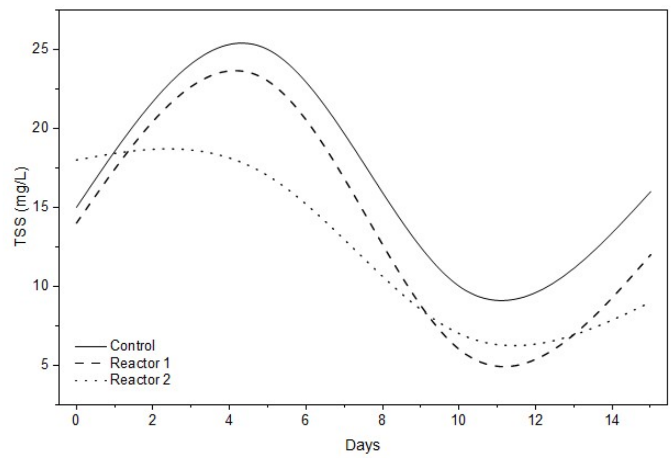

Figure 7. Graph of Decreasing TSS Levels

hyacinth plants. This study observed that the pH level during 15 days of phytoremediation fluctuated, influenced by several variables. The decomposition of organic compounds attached to plant roots and microbial respiration resulted in the production of organic acids and carbon dioxide, which contributed to the acidification of the water. The presence of standing water and pollutants such as heavy metals also affect the pH value, potentially falling below the permissible threshold.

If pH levels consistently fall below the required quality criteria, this can impact other metrics such as ammonia, BOD, COD, and TSS. Regulations for water quality in domestic wastewater often control factors such as pH, TSS, BOD, and COD. A decrease in pH levels can affect the behavior of other factors, such as the solubility and toxicity of ammonia, which in turn affects its concentration in the water.

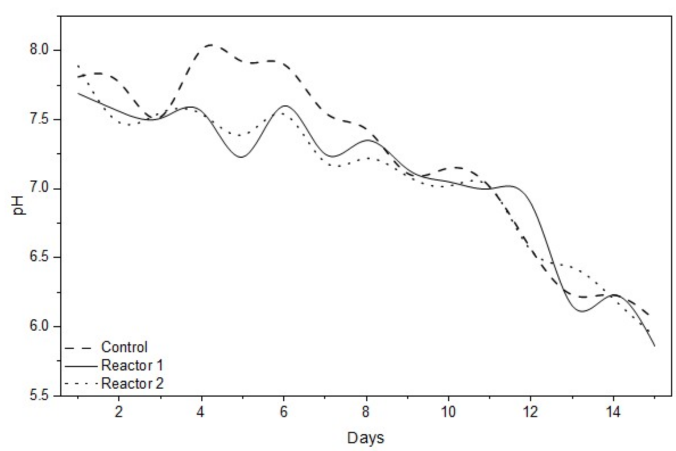

Figure 8. Results of Observations of Acidity Degree (pH)

The relationship between pH and other factors emphasizes the importance of monitoring and controlling pH levels in the phytoremediation process to ensure overall remediation efficiency. The continuous decrease in pH levels observed during wastewater phytoremediation using water hyacinth plants can be attributed to various reasons, emphasizing the interrelationship between water quality parameters in the phytoremediation process.

3.2 Effectiveness of Wastewater Concentration Reduction and Effect of Water Hyacinth Contact Time with Wastewater

This study compared the effectiveness of reducing domestic wastewater concentrations on day 0 with concentrations on days 5, 10, and 15, to determine the optimal contact time to reduce ammonia, BOD, COD, and TSS levels. To assess the success of the phytoremediation process in the reactor basin, calculations were made by comparing the concentration of substances on day 0 with the concentration on days 5, 10, and 15. The decision was made by considering the causal relationship between the various parameters and the fluctuations in each parameter. The effectiveness of phytoremediation was calculated on days 5, 10, and 15 of the study.

3.2.1 Effectiveness and Effect of Contact Time on Ammonia Levels

This study showed that water hyacinth phytoremediation was the most effective method for reducing ammonia levels, with 100% reduction achieved after 10 days of exposure. This is in line with previous research by Kasmuri et al. (2023), which showed a significant reduction of 94.29%. The graph shows the percentage reduction in ammonia levels after a 15-days process.

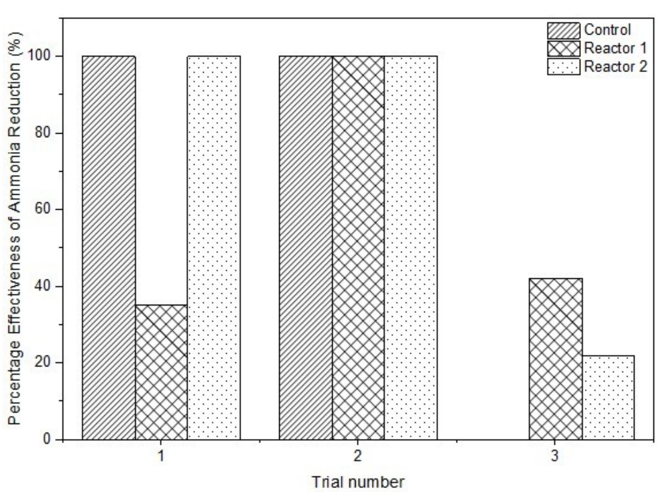

Figure 9. Percentage Effectiveness of Ammonia

3.2.2 Effectiveness & Effect of Contact Time on BOD Levels

This study analyzed the percentage decrease in BOD levels after 15 days of water hyacinth phytoremediation. The most effective decrease occurred on the 10th day, the decrease in levels in the control reactor was 32%, reactor 1 was 82%, and reactor 2 was 72%. This shows that water hyacinth is effective in treating domestic wastewater, because it has a 10-day contact time with wastewater. This is in line with previous research conducted in 2023 by Ardiatma et al. (2023b) which reduced BOD levels by 96.66%.

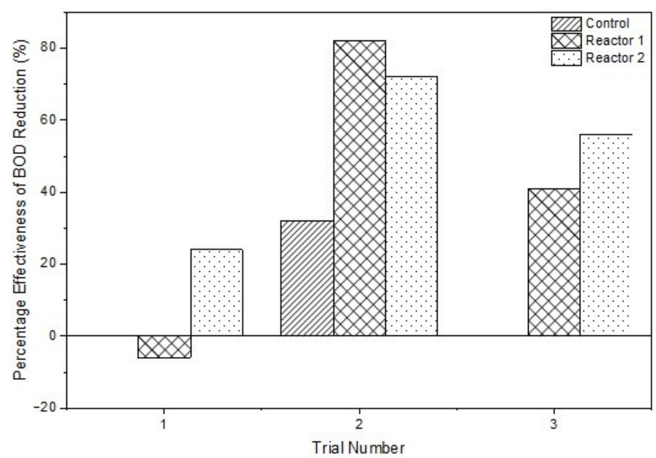

Figure 10. Percentage of Effectiveness of BOD Level Reduction

3.2.3 Effectiveness & Effect of Contact Time on COD Levels

This study analyzed the percentage decrease in COD levels after 15 days of water hyacinth phytoremediation. The most effective decrease occurred on day 10, with a decrease of 33% in the control reactor, 100% in reactor 1, and 71% in reactor 2. This shows that water hyacinth is effective in treating domestic wastewater, especially in the COD parameter, with a contact time of 10 days. This is in line with the research of Dodit Ardiatma, Agus Riyadi, and Angga Abdillah Aziz in 2022 which reduced COD levels by 96.85

3.2.4 Effectiveness & Effect of Contact Time on TSS Levels

This study analyzed the percentage decrease in total suspended solids (TSS) levels after 15 days of water hyacinth phytoremediation. The most effective decrease occurred on day 10, with a decrease of 41% in the control reactor, 57% in reactor 1, and 61% in reactor 2. Research on domestic wastewater indicates the potential for microbes to pass through a series of wastewater treatment units and be found in the environment after STP treatment (Anastasi et al., 2012). The presence of *E. coli* bacteria is related to

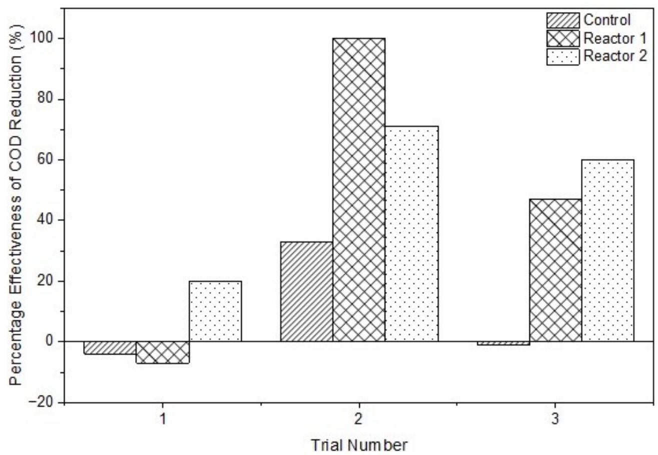

Figure 11. Percentage of COD Level Reduction Effectiveness

TSS levels. It is possible that *E. coli* that is inactive on day 5 and reactivates on day 10 can affect TSS values. This shows that water hyacinth is effective in treating domestic wastewater, especially in the TSS parameter, with a contact time of 10 days. This is in line with Anita Rahmawati's research in 2023 which showed a decrease in TSS levels by 99.46%.

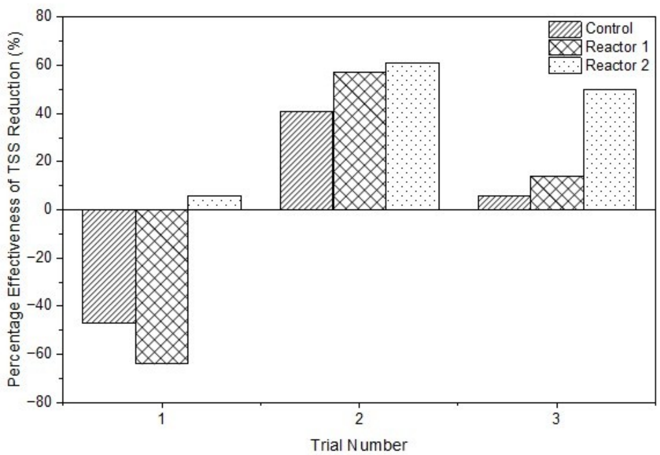

Figure 12. Percentage of Effectiveness of Reducing TSS Levels

3.2.5 The highest Existing Data Level Decrease by Percentage of Research Effectiveness

The results showed that the water hyacinth phytoremediation method significantly reduced the levels of Ammonia 100%, BOD 82%, COD 100%, and TSS 61%. With these results, it can be seen that the decrease in pollutant levels according to existing data Perumda Paljaya in 2023 can be seen in the following table:

Table 2. Highest Lab Results compared to Research Effectiveness

Parameter	Highest in 2023 (mg/L)	Research Effectiveness (%)	The final result (/L)
Ammonia	36.92	100%	0
BOD	50	82%	9
COD	130	100%	0
TSS	55	61%	21.45

The highest pollutant levels were achieved with the research effectiveness percentage, indicating that the treatment significantly reduced these pollutants and could meet the quality standards, demonstrating the effectiveness of the water hyacinth phytoremediation method.

3.2.6 Factors Affecting Water Hyacinth Effectiveness

The process of water phytoremediation with water hyacinth plants involves the use of various environmental conditions and plant-related factors to increase ammonia levels. Heavy metals, such as lead (Pb), can affect the proliferation of ammonia-degrading bacteria and cause physical changes in water hyacinth plants (Fahruddin et al., 2021). The interaction between heavy metals and bacteria can affect the decomposition of ammonia in the water, potentially increasing ammonia levels.

The pH level of water is very important in determining the effectiveness of the phytoremediation process. Research shows that the level of pH reduction is greater in treatments that use water hyacinth compared to other plants (Kasmuri et al., 2023). Variations in pH can affect the function of microorganisms responsible for decomposing ammonia, which in turn affects the amount of ammonia in the water. Environmental conditions such as temperature, salinity, and nutrient availability also affect the effectiveness of phytoremediation processes involving water hyacinth plants.

The increase in Biochemical Oxygen Demand (BOD) levels during the phytoremediation process with water hyacinth plants can be influenced by various factors. The presence of heavy metals in water can affect the proliferation of ammonia-degrading bacteria, thus causing noticeable changes in water hyacinth plants and potentially disrupting the decomposition of organic matter and resulting in increased levels of biochemical oxygen demand (BOD) (Noerhayati et al., 2023).

The metabolic activity of water hyacinth plants can also be affected by environmental factors such as pH levels and nutrient availability (Nayar and Patel, 2021). This can affect their ability to decompose organic matter and impact the level of biological oxygen demand (BOD).

In summary, factors that contribute to the increase in BOD levels during the process of water phytoremediation using water hyacinth plants include the presence of heavy metals, the ability of plants to remove organic pollutants, and environmental conditions such as pH. The presence of copper and other heavy metals can inhibit the proliferation and function of bacteria responsible for decomposing ammonia, BOD, COD, and TSS during the process of wastewater phytoremediation using water hyacinth plants (Escamilla-Rodríguez et al., 2021). Heavy metals have the ability to disrupt crucial microbiological processes, resulting in decreased effectiveness of wastewater treatment procedures. Monitoring heavy metal levels and their effect on bacterial populations is essential to ensure the effectiveness of phytoremediation activities (Irawati et al., 2020).

3.2.7 Factors Causing Different Results of Two Reactors

The effectiveness of two reactors assessing the capacity of water hyacinth to reduce ammonia, biochemical oxygen demand (BOD), chemical oxygen demand (COD), and total suspended solids (TSS) may vary regardless of factors such as reactor design, wastewater attributes, environmental conditions, and biological interactions. Intrinsic biological variability of water hyacinth may explain these differences, as the physiological reactions of the plant may vary based on genetic variation, developmental stage, or health condition (Sharma et al., 2011). Different water hyacinth species exhibit different efficiencies in nutrient uptake and pollutant decomposition, resulting in variations in treatment efficacy. Changes in the microenvironment within each reactor may also contribute to differences in reactor performance, as regional variations in parameters such as light penetration, water flow dynamics, and nutrient distribution may arise. The interaction between the water hyacinth and the microbial ecosystem within the reactor significantly affects treatment efficacy (Powley et al., 2016), as certain microbial populations can enhance the plant's phytoremediation efficacy, ultimately affecting total treatment efficiency. Understanding these complications is critical to improving the utilization of water hyacinth in wastewater treatment applications.

4. CONCLUSIONS

The results showed that phytoremediation using water hyacinth significantly reduced ammonia, BOD, COD, and TSS levels in wastewater at IPLT Pulo Gebang. The effectiveness of water hyacinth was highest in reactor 1 (82%), reactor 2 (72%), and reactor 1 (57%). The most effective contact time for water hyacinth to degrade pollutants is 10 days, as shown on the 10th day of the study. The highest levels of ammonia, BOD, COD, and TSS in 2023 can be reduced if the effectiveness of water hyacinth in the phytoremediation process is considered.

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