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Conference Paper

Reducing TSS and COD of Leachate with Constructed Wetland using Water Jasmine (*Echinodorus palaefolious*) and Spider Plant (*Chlorophytum comosum*)

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ABSTRACT

Leachate is water that comes from piles of rubbish that seeps in with dissolved or suspended material from the decomposition of rubbish. The contents of leachate include BOD, COD, pH, ammonia-nitrogen, heavy metals and suspended solids. One type of leachate treatment is a constructed wetland. A constructed wetland is a treatment that is engineered with a planned and controlled wastewater treatment system that involves the function of plants, media, and microorganism. This constructed wetland in this research uses subsurface flow with a continuous method on a laboratory scale. In this research, there were several variations such as plants, sampling times and discharge. The plants used are water jasmine (*Echinodorus palaefolius*) and spider plant (*Chlorophytum comosum*). With variations in discharge of 5L/day, 7L/day, 9L/day as well as variations in sampling time on the 6th, 8th, 10th, 12th, 14th day. The best TSS and COD reduction results in this study were at discharge of 5L/day on sampling time on the 14th day of 96,3% and 94,4% for water jasmine and 92,6% and 88,9% for spider plants. The pH and temperature in this study were observed for 14 days and it was found that the lowest pH and temperature for water jasmine and spider plant were 7,1 and 26,7°C, 7,6 and 26,7°Cfor spider plant.

Keywords: Echinodorus palaefolious, Chlorophytum comosum, Constructed Wetland, Leachate

Introduction

Leachate is water that comes from the seepage of rubbish piles which carries dissolved or suspended material originating from the decomposition of rubbish (Sudarmato, 2021). The physical characteristics of leachate are that it has an unpleasant odor and the water has a dark color. The dark color of the leachate indicates the presence of organic material in it. The darker the color of the leachate, the higher the organic material content in it (Saputra, 2021). This organized material content causes an unpleasant odor and has a darker color (Nofiyanto et al., 2019). At TPA Klotok, Kediri City, a sanitary landfill system is implemented, in this system the leachate will be collected in a leachate treatment unit before being discharged into the environment. The leachate content in it includes BOD, COD, pH, ammonia-nitrogen, heavy metals, and suspended solids (Fadhila & Purnama, 2022).

This research discusses the reduction of COD (Chemical Oxygen Demand) and TSS (Total Suspended Solid) in the processing of leachate using constructed wetlands. COD or Chemical Oxygen Demand is the amount of oxygen needed to oxidize inorganic and organic substances (Nafisah, 2020). The presence of COD in water causes various kinds of diseases to arise. If there is a high COD content in water, it causes the dissolved oxygen in the water to become low, thus causing living creatures will die (Alviomora et al., 2018). To measure COD using a slightly complex method using heating, titration, reflux, and concentrated acid. The method for measuring COD has the principle of adding a certain

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amount of potassium bicarbonate (K2Cr2O7) for the oxidizer to which concentrated acid, silver sulfate catalyst, and waste samples have been added which are then heated. The excess potassium biochromate will be measured by titration (Santoso, 2018). Total Suspended Solid (TSS) is the total suspended solid in water and is expressed in milligrams per liter. To measure TSS in wastewater samples, it is carried out using a vacuum and an oven at a temperature of 105 °C, the increase in filter paper pressure after filtering is the TSS value (Fajri et al., 2017).

There are many technologies for treating leachate from chemical, physical, and biological technologies. One of the chemical processes is coagulation-flocculation, in previous research using FeCl3 coagulant, COD levels decreased by 36,8% (Prabowo et al., 2017). There is also leachate treatment using a denitrification process and aerobic and anaerobic biofilters which can remove 97% of COD, 97,6% of ammonia, and 86,4% of nitrate (Said & Hartaja, 2018). Apart from coagulation-flocculation and denitrification-nitrification, there is leachate processing, namely constructed wetlands, constructed wetlands processing is engineered with a planned and controlled wastewater treatment system that involves the function of plants, media, and microorganisms in the construction of the treatment systems. The advantage of a processing system using constructed wetlands is that it can minimize management, maintenance, and construction costs (Fajariyah, 2017).

The plants used in this research were water jasmine (*Echinodorus palaefolius*) and spider plant (*Chlorophytum comosum*). Water jasmine is an aquatic plant that is green except for its roots and flowers. Stem length is around 50-100 cm with a diameter of 1-3 cm. The leaf surface is rough and the leaf edges are flat and round like an egg. The flower color is white. In previous research, water jasmine plants could reduce COD by up to 94% for 15 days in industrial liquid waste (Riyanti et al., 2019). Meanwhile, the spider plant has thin, elongated leaves and a smooth surface. This plant belongs to the Liliaceae family with green leaves with a combination of white on the edges. This plant has narrow leaves ranging from 20-45 cm width of 3-30 cm. In previous research using floating beds, spider plants could reduce COD by up to 88% during the summer (Sun & Fan, 2019).

The research aims to find out and compare the percentage of TSS and COD removal from the Klotok landfill leachate in Kediri City with water jasmine and spider plants for 14 days with subsurface flow. In this study, a continuously constructed wetland method was used. Apart from TSS and COD, researchers also examined temperature and pH during the research to see whether they were effective for processing constructed wetland methods.

Material and Methods

In this study, waste wastewater came from leachate from the Klotok landfill, in Kediri City. The tools were needed in this research a plastic container measuring 54x36x29 cm or a tank with a volume of 45L, an initial waste storage tank of 100L, an equalization tank of 50L with a total of 2 tubs, a pump and infusion hose that functions to regulate discharge for each reactor. The media used in the reactor include gravel measuring 4-5 cm with a height of 6 cm and soil with a height of 3 cm. The outlet on this reactor is 2 cm from the bottom of the reactor so it is called subsurface flow. The plants used in this research were water jasmine which is 2.5 months old and spider plant with 3 months old. These two plants are considered optimal for constructed wetland processing. There is a pre-research process in this research, namely the Range Finding Test process which functions to determine the ability of plants to survive in leachate water which is used for parameter selection. In the Range Finding Test Process, it refers to USEPA Guideline part 850.4500 with concentrations used including 0% (control), 20%, 40%, 60%, and 80% (Raissa, 2017).

Before entering the main research, the plants must first be acclimatized for 7 days by watering the plants using ground water or PDAM water. In this study, debit variations were used 5L/day, 7L/day, and 9L/day with variations in sampling times 5 times. This research uses a continuous process, temperature and pH will be observed during the research in 14 days.

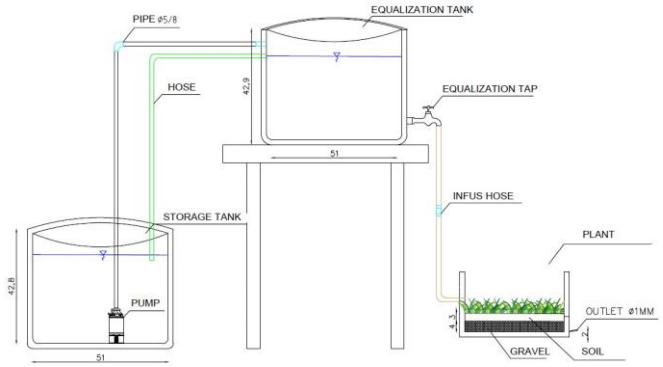

Figure 1. Reactor water jasmine and spider plant with subsurface flow

Results and Discussion

Leachate characteristics after the range-finding test process

During the Range Finding Test process, it was found that the plants did not die or not wilted at a concentration of 20% leachate. The characteristics of the leachate that will be used in the main research are in Table 1.

Table 1. Characteristics of 80% concentration leachate water

Concentration	Unit	Analysis Results	Quality Standards
TSS	mg/L	108	100
COD	mg/L	662,4	300

Based on Table 1., the TSS and COD values in leachate have not yet fulfilled the quality standards by Minister of Environment and Forestry Regulation Number 59 of 2016 concerning Leachate Quality Standards for Businesses and/or Activities at Waste Final Processing Sites.

Reduction TSS in water jasmine and spider plant

In this study, samples were taken on the 6th day, 8th day,10th day, 12th day, and 14th day. The results of reducing TSS in water jasmine and spider plants can be seen in Figure 2.

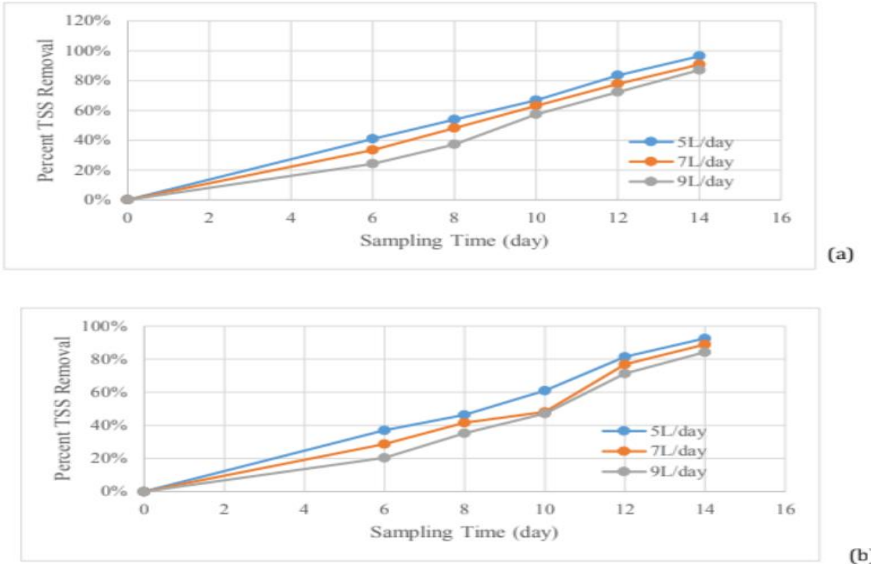

Figure 2. Graph of percent TTS removal for water jasmine (a) Graph of percent TSS removal for spider plant (b)

The percentage of TSS removal in water jasmine can be seen in Figure 2. Point (a) was highest with a discharge of 5L/day on the 14th day 96,3%. For the range of 5L/day discharge, it is 40,7% - 96,3%. The percentage of TSS removal at a discharge of 7L/day has a range of 33.3% - 90.7%. The lowest percentage of TSS removal at a discharge of 9L/day has a range of 24.1% - 87%. In spider plants according to Figure 1. the highest percentage of TSS removal was also found at a discharge of 5L/day with a range of 37% - 92.6%. The highest percentage of removal was on the 14th day at 92,6%. At a discharge of 7L/day, the TSS removal percentage has a range of 28.7% - 88.9%. The TSS removal percentage of 9L/day is the lowest, 20,3% - 84,2%.

This decrease in TSS is due to the role of plant roots in restraining the flow rate so that it can facilitate the solid sedimentation process and help the filtration process (Akhmad et al., 2022). The filtration process occurs in plant roots because plant roots can form filters so that they can retain solid particles in waste. Apart from the filtration process, there is also a sedimentation process. The filtration and sedimentation processes are also influenced by the presence of media such as soil and gravel (Nasrullah et al., 2017). In this study, water jasmine plants were able to reduce more TSS compared to spider plants, this is because water jasmine plants have long, fibrous root characteristics. The long and fibrous roots of water jasmine will allow more colloids to stick to the roots compared to the roots of spider plants (Kasman et al., 2018).

In this research, it can be seen in Figure 1. It shows that discharge and sampling time influence this research. The smaller the incoming discharge, the greater the TSS removal percentage, as well as the sampling time. The longer the sampling time, the greater the TSS removal in both plants.

Reduction COD in water jasmine and spider plant

Sampling for COD was carried out 5 times, in the 6th day, 8th day, 10th day, 12th day, and 14th day. The results of COD reduction in water jasmine and spider plants can be seen in Figure 3.

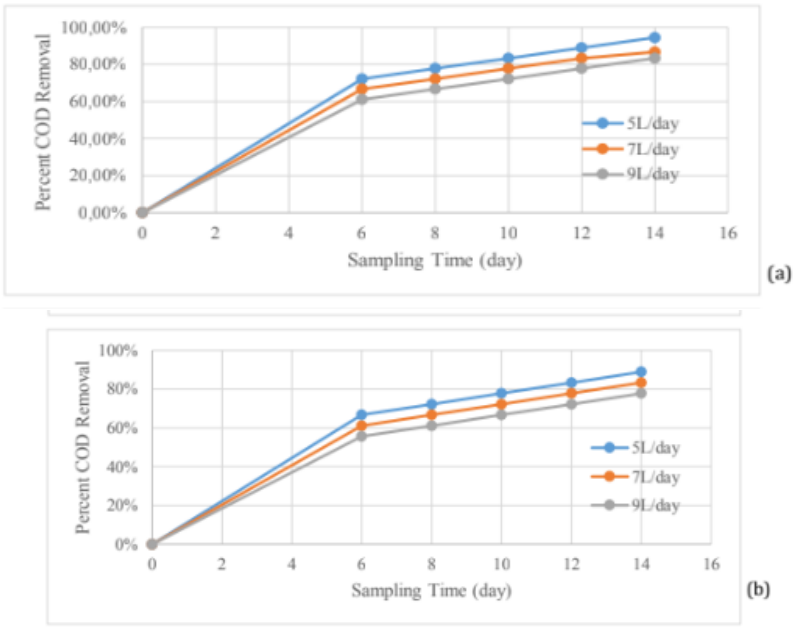

Figure 3. Grap of percent COD removal for water jasmine (a) Graph of percent COD removal for spider plant (b)

The COD removal percentage in water jasmine with a flow rate of 5L/day ranged from 72.2% - 94.4% and had the highest removal percentage on the 14th day, 94.4%. At a discharge of 7L/day, it has a range of 66.7% - 86.7%, and at a discharge of 9L/day, it has a range of 61.1% -83.3%. Meanwhile, the percentage of removal of spider plant can be seen in Figure 3. (b) The percentage of COD removal was

highest at a discharge of 5L/day with a range of 66.7% - 88.9%. The highest COD removal percentage was on the 14th day at 88.9%. At a discharge of 7L/day, the lowest COD removal percentage was on the 6th day at 61.1% and the 14th day at 83.3%. The percentage of COD removal for spider plants at a debit of 9L/day has a range of 55.6% - 77.8%.

This decrease in COD occurs due to the symbiosis of plants with microbes in the plant root system. Microbes will help process and break down organic materials in wastewater into simpler compounds that can be used as nutrients (Roliya, 2021). The highest reduction in COD in water jasmine plants is because the root tissue is very influential, where the deeper the root tissue, the wider the rhizosphere zone is created. Water jasmine also has long, spreading roots which cause more microorganisms to stick to the roots so that the microorganisms can degrade more pollutants (Hadi & Pungut, 2022). Another characteristic of water jasmine roots is that the roots of water jasmine have holes so they can release organic substances as food for microorganisms which causes strong biological activity. Because an increase in biological activity means the decomposition of organic matter will also increase (Sejati, 2016).

pH and temperature during the research process

In this study, pH and temperature samples were also taken in 14 days. The lowest pH and temperature in water jasmines are 7.1 and 26.7°C. The highest pH and temperature for 14 days in water jasmine plant are 8.4 and 26.9°C. In spider plants, the lowest pH and temperature for 14 days are 7.6 and 26.7°Cand the highest pH and temperature of spider plants for 14 days are 8 and 28°C. At both plants, pH, and temperature were within acceptable pH and temperature ranges for the constructed wetland. The optimal pH for this processing is pH 6-9 (Ningrum et al., 2022). The temperature of both plants is also considered effective because in the range of 25-33°C bacteria can live and develop and in this study, temperature was still in that range (Ningrum et al., 2022).

Conclusion

The conclusion of this research is that water jasmine is more effective in reducing TSS and COD compared to spider plants. However, both plants are still considered effective for treating leachate using the constructed wetland process. Water jasmine is effective in reducing TSS and COD at a discharge of 5L/day on the 14th day, 96.3% and 94.4%. Meanwhile, spider plants can reduce TSS and COD most effectively on the 14th day with a discharge of 5L/day of 92.6% and 88.9%. Water jasmine is more effective than spider plants because the characteristics of water jasmine roots are long and fibrous, making it easier to reduce TSS and COD. The pH and temperature in this study were still within the optimal range in constructed wetland management, the lowest pH and temperature for water jasmine were 7.1 and 26.7°C, while the lowest pH and temperature for spider plants were 7.6 and 26.7°C. The pH and temperature in this research were considered optimal for processing constructed wetlands amounting to 6-9 and 25-33°C.

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