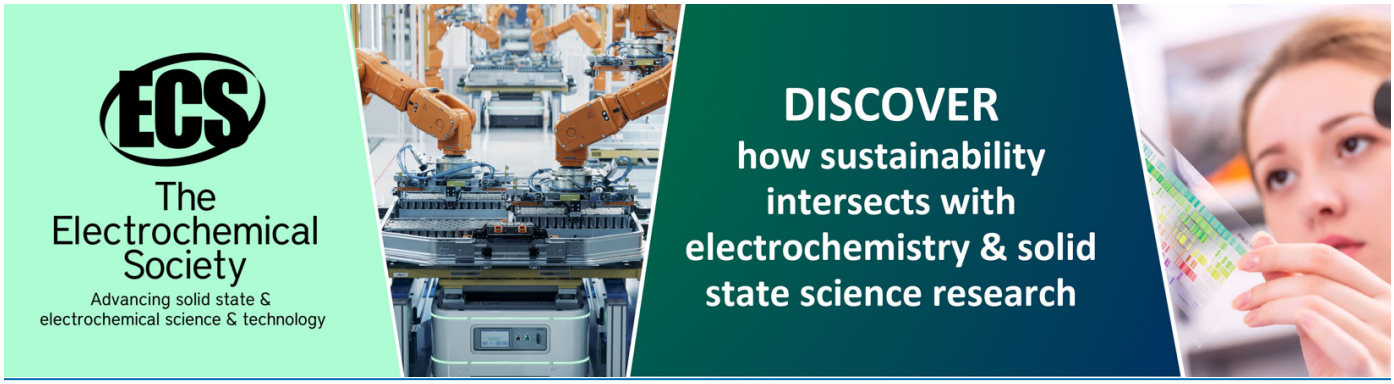
Phytoremediation of phosphate using *Typha sp.* and *Echinodorus palaefolius*



Phytoremediation of phosphate using *Typha sp*. and *Echinodorus palaefolius*

F L Fitria[1]* and Y Dhokhikah[2]

[1,2]Study Program of Environmental Engineering, Faculty of Engineering, University of Jember

E-mail: firdafitria@unej.ac.id

Abstract. Jember Regency is an agricultural area. Giving fertilizer is one of the agricultural activities. It usually contains a phosphate. If fertilizer is used too much, it will cause environmental pollution. The level of phosphate pollutants increase that can cause eutrophication. Phytoremediation is a plants utilization technology to reduce pollutants. This study aims to determine the effect of *Typha sp*. and *Echinodorus palaefolius* to reduce phosphate levels from fertilizer residues. The research reactor was a batch. The reactor used bed evapotranspiration system. Phytoremediation test analysis was carried out every two days for 8 days. *Typha* sp. and *E. palaefolius* on the day 8th observation levels phosphate were down by 90,33% and 92,86%. The most efficient in this experiment was *E. palaefolius*.

1. Introduction

Agriculture in Jember is one of its main areas. Giving macronutrient fertilizer phosphate is one of the agricultural activities to fertilize the soil. The used of fertilizers containing excess phosphate will result in environmental pollution. Phosphate is one of pollutants in aquaculture wastewater [1]. Aquaculture effluents can cause water pollution [2]. The presence of excess phosphate pollutants in water may causes eutrophication. Many conventional methods that can reduce the pollutants from the water such as biological treatments, advanced oxidation processes (AOPs) and ultraviolet irradiation. This technology requires operational, and maintenance costs are high. However, phytoremediation is green technology. The remediation technology of polluted soil and water that is currently widely used is the phytoremediation methods. The development of this technology is very rapid because its application is relatively easy with economical operational costs. If technology use plants, It do not require maintenance, costs and high skills. This technology is very suitable for use in Indonesia because it has tropical climatic conditions that have high humidity and many types of plant. Phytoremediation is a plants utilization technology to reduce pollutants. Plant utilization can reduce, degrade, move and immobilize pollutants [3]. Phytoremediation technology can be used domestic, agricultural and industrial wastewater. The challenge for the progress of phytoremediation is the factor of potential and application in the sustainable ecosystem management.

Constructed wetlands (CWs) use plant in the wastewater treatment. CWs are effective treatment for removal of pollutan. State of the art of constructed wetlands is used wastewater management in Brazil [4]. The studied of Kenaf plants had been conducted using constructed wetlands that used Horizontal Subsurface Flow in the bed evapotranspiration system reactor [5]. Aquatic plants effectively removed nitrogen and phosphate that is suitable for phytoremediation [6]. *Thypa sp*. and *E. palaefolius* are aquatic plants. *Typha sp*. Is a family of Typhaceae which is an upright rhizomatous plant, a perennial plant. *E. palaefolius* or also called water jasmine is an aquatic plant that is used for ornamental flowers. The flower is white. This aquatic plant often flowers all the time. *Typha sp.* and *E. palaefolius* research for phosphate levels from fertilizer residues in the water is needed.

2. Methodology

The research used reactor with evapotranspiration bed system. This study used constructed wetlands. The experiment conducted using Horizontal Subsurface Flow and composite sampling. The materials were reactors, plastic tanks, rulers, plastic pots, and parameter analysis equipment. This research used plants (*Thypa sp*. and *E. palaefolius*), sand, gravel, and water.

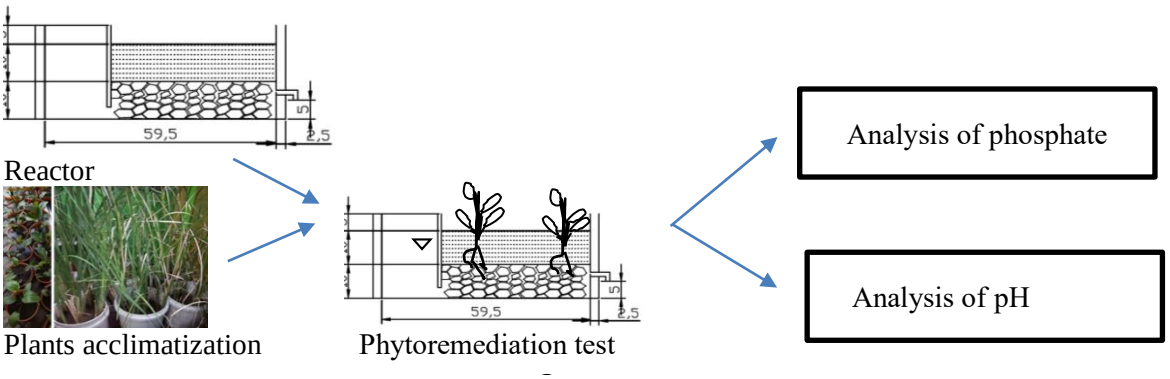


Figure 1. Diagram of phytoremediation test

The first step was acclimatization that was carried out in the greenhouse. The plants were watered using water for a week every day. Analyze of phytoremediation test conducted for 8 days. The analysis of levels of phosphate and pH were measured every two days for 8 days. Analysis of phosphate levels used spectrophotometer.

3. Result

Phytoremediation test of *Typha sp.* and *E. palaefolius* decreased amount of phosphate levels. The results showed that plants can reduce phosphate levels. Removal of phosphate levels were showed in Figure 2.

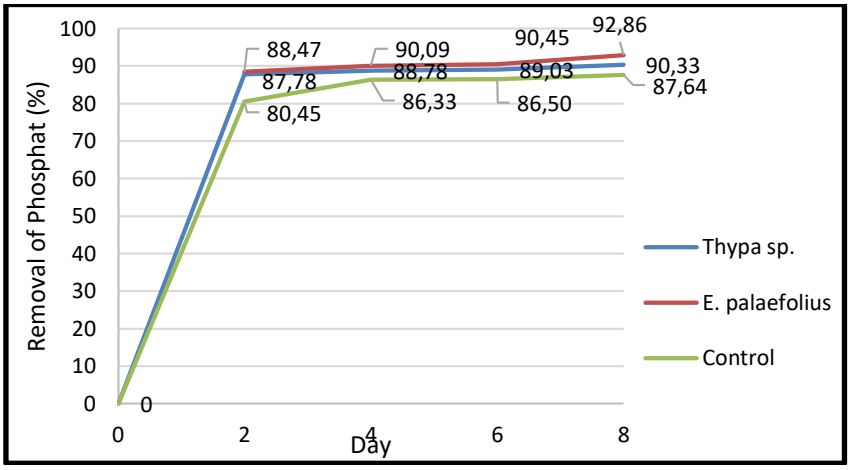


Figure 2. Removal of phosphate levels

The phytoremediation test showed more efficient to decrease number of phosphate levels than control (without plant). Based on the graph of the phosphate level, *Typha sp.* and *E. palaefolius* were consistent and removed the pollutant. The levels of phosphate decreased at days 2, 4, 6, and 8. *E. palaefolius* had the most consistent to uptake phosphate that was a maximum removal concentration on the 8th day. Observation phytoremediation test showed that pH increased (Figure 3). pH changed in wastewater indicated the activity of microorganisms.

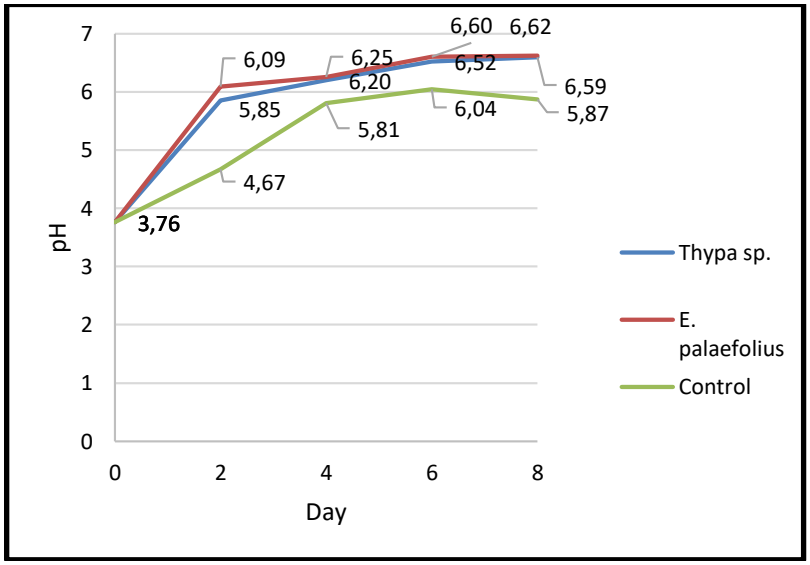


Figure 3. Analysis of pH

4. Discussion

Phytoremediation test on the day 8th observation levels phosphate decreased. *Typha sp.* and *E. palaefolius* removed phosphate levels up to 90,33% and 92,86%. The phytoremediation test showed that plants reduced phosphate levels. The efficiency removal of pollutant can be look at the presence of plants in CWs because it can improve the wastewater treatment. This can be verified by compared to the control treatment. This control did not used plants. The plants can absorb pollutants from the soil and water. Thi research used material such as sand and gravel. Using gravel can achieve good results for the removal of pollutants. The studies, gravel is the most applied in CWs then followed sand.

E. palaefolius was the most consistent phosphate removal rate. The most efficient plant in this experiment was *E. palaefolius* because had more roots to uptake phosphate than *Typha sp*. The root system showed that the ability of root to absorb phosphate was increased. The other research, *E. palaefolius* can reduce phosphate pollutants in wastewater [7]. Plants can use to solve the problem of wastewater and environmental pollution problems. Plant is an agent phytoremediation to reduce, replace, and immobilize pollutants [8]. This study indicated the ability of *Typha sp.* and *E. palaefolius* reduce phosphate. Phosphate is one of pollutant from aquaculture wastewater. Some plants need phosphate for their growth but depend on requirements, the plants type, and environment [9]. *Typha sp.* and *E. palaefolius* can need phosphate for their growth.

Phytoremediation is remediation technology that It uses plant for treating wastewater. This technology are low maintenance and low cost [9]. Ideal phytoremediation agent is a plant that has a good root system. Plant can grow easily and fast that It can be ideal agent of phytoremediation. *Typha sp.* and *E. palaefolius* can be ideal phytoremediation because the plants can grow easily and fast. *E. palaefolius* has good root system than *Typha sp*. Plant need high biomass to reduce pollutant [10]. This require for sustainable remediation systems. The graph showed that pH increased from acid to almost neutral. Changes in pH values on observations can be caused by the presence of microorganism activity. The increase of pH is caused due to the hydrolysis process.

5. Conclusion

Phosphate is one of pollutants from aquaculture wastewater that can causes eutrophication. Phytoremediation are technology using plant that are low maintenance and low cost. The results showed phytoremediation can reduce pollutant. *Typha sp.* and *E. palaefolius* decreased phosphate levels. This plant can be used as a phytoremediation agent in agricultural wastewater because the plant can grow easily and fast. *Typha sp*. and *E. palaefolius* removed phosphate levels up to 90.33% and 92.86% on the 8th day. *E. palaefolius* has more root than *Typha sp*. The study found *E. palaefolius* was better removal of phosphate and the most efficient.

Acknowledgments

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