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Potential of Nutrient Removal from Sewage by Various Plant Weeds

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Abstract An attempt was made to investigate the aquatic weeds to remove the nitrogen and phosphorous using four aquatic plants i.e. two emergent plants (*Typha latifolia and Phragmites australis*) and two floating plants (*Eichhornia crassipes and Lamina gibba*) from primary treated sewage. This study focuses on the nutrient removal efficiency based on the coverage area and biomass based calculation from the aquatic weeds reactor. Results indicate the highest removal of the nutrients i.e. nitrogen and phosphorous was observed from the plants area based calculation since weight of the emergent plants are higher as compared to floating plants. The study indicates that the physiological characteristics of the aquatic plants greatly affect the performance of the system.

Keywords: *nutrients, aquatic plants, sewage*

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1. Introduction

Urban In the field of wastewater treatment there are several types of wetlands for nutrient removal depending on vegetation and hydraulic flow [1]. Besides constructed wetlands, other type of wetland such as natural wetlands and mangroves are also used for removal and immobilize the nutrient [2]. Being recognizing as a low cost and effective treatment systems, worldwide this wetland ecosystems are used for the treatment and disposal of wastewater [3]. Constructed wetland (CW) is considered for wastewater treatment in small communities and rural area or decentralized villages due to simple operation and friendly. This type of system is effective to reduce the large amounts of non-point source pollutants occurred by the rainfall and rain washing the village grounds and fields [4].

Researcher also reported that Constructed and natural wetlands are often used being a low cost treatment system for domestic wastewater effluent, single-residence septic tank effluent and large municipal wastewater [5].

Previous studies focuses on the performance of constructed wetlands (CWs) based on design, dimension, and substrate used.

The role of plants is equally important but a limited studied available yet. Current study investigate the four various types of plants viz. (*Typha latifolia and Phragmites australis* - emergent) and (*Eichhornia crassipes and Lamina gibba* - floating plants) for nutrient removal based on the plant mass and the area occupied by plants in reactor calculation.

The primary objective of this study was to explore the nutrient removal-capacity of four aquatic plants, two emergent plants and two floating plants from primary treated sewage.

2. Material and Methods

Following table summarizes the batch reactor configuration

Table 1. Reactor configuration

Depth of Reactor	0.60 m
Bed depth	0.45 m
Pebbles depth	0.25 m
Fine Gravels depth	0.10 m
Sand depth	0.10 m
Gross capacity	0.042 m^3
Net capacity	0.017 m^3
Retention time	14 days

The cylindrical shape batch reactors were made of plastic containers with dimensions explained in Table 1, accommodating capacity 55–60 L of volume. The reactors were replaced in three different layer having depth 0.25 m ,0.10 m, and 0.10 m with 50-80 mm pebbles size, 10-20 mm fine gravels and 0.6–2.4 mm of sand respectively. Plants *(Typha latifolia, Phragmites australis, Eichhornia crassipes, Lamina gibba)* were collected from a freshwater body and bank of Yamuna River) located vicinity of campus of the Jamia Millia Islamia, New Delhi, India. The

specimen was brought to the laboratory and inoculated in sewage for the further use.

3. Results and Discussion

Results revealed that the aquatic weeds *Typha latifolia* and *Lamina gibba* could reduce the N and P up to 75 and 55% respectively. Figure 1 shows the average per cent removal of N and P from different aquatic plants whereas Figure 2 and Figure 3 shows the average removal of N and P in 7 days respectively. The removal of N and P was calculated based on two physical parameters viz. area occupied by aquatic weeds and gain in weight of the aquatic weeds in vertical free surface flow (VFS). Results referred that the removal rates of N and P were having a significant variation calculated based on area and weight parameters. Results suggest that the average removal of N varies 48 to 76% in a reactor observed based on surface area of plant occupied. The mean removal of P was ranged 30 to 55% for the same reactor.

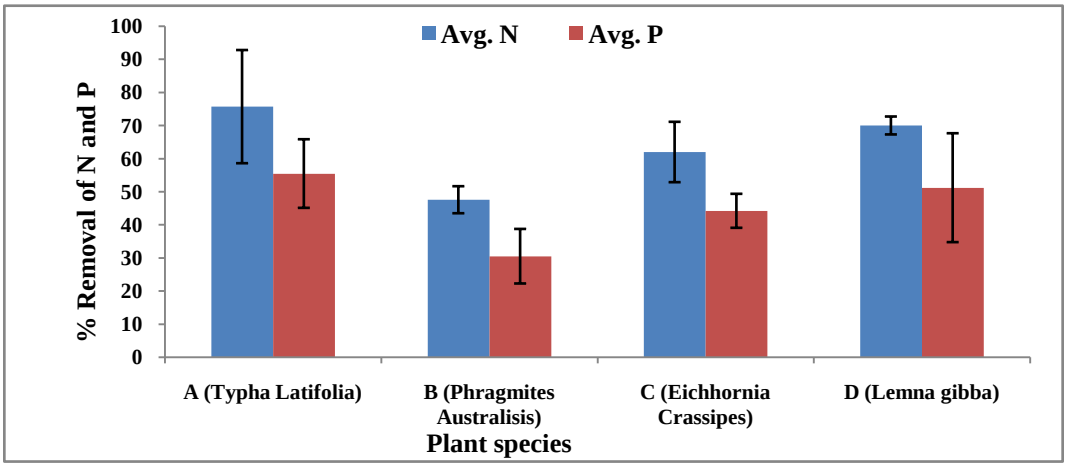

Figure 1. Nitrogen and Phosphorous removal rates (area and biomass based calculation – Mean+ SD values)

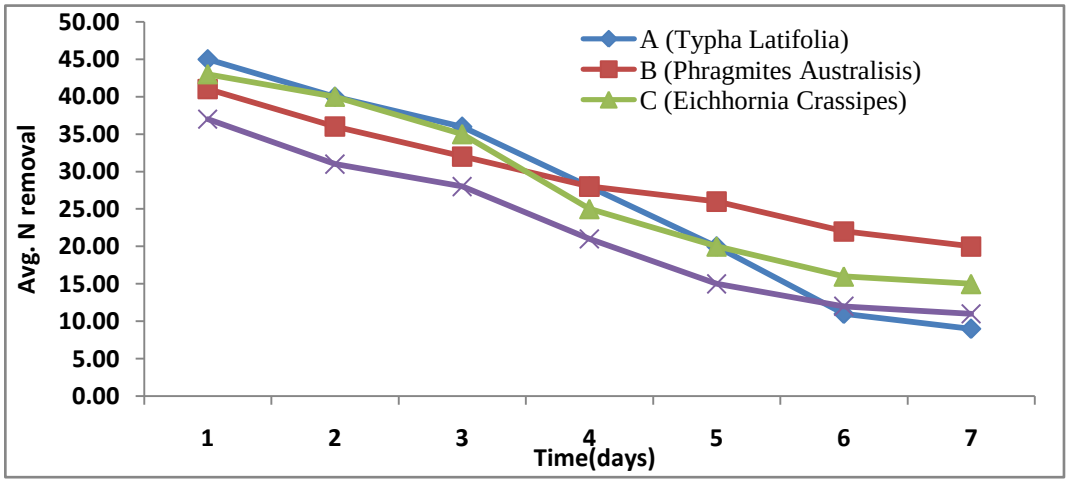

Figure 2. Average removal of N

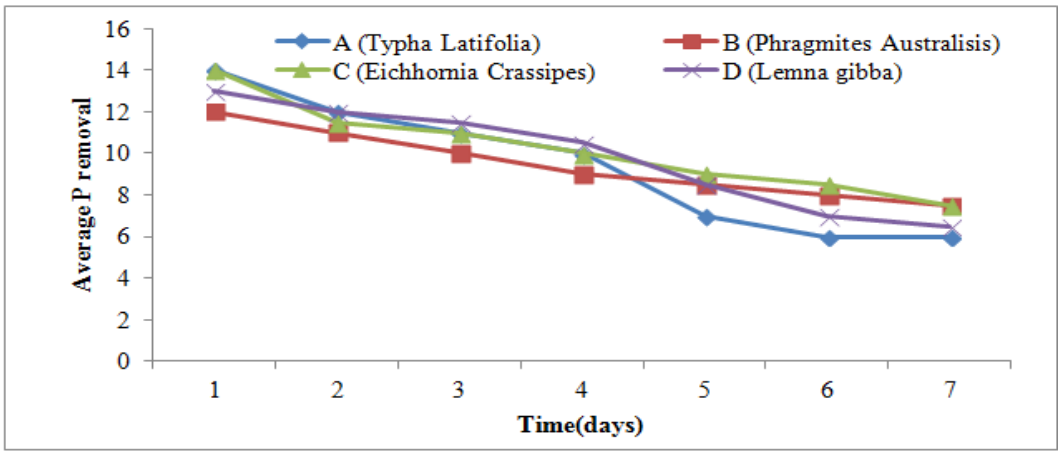

Figure 3. Average removal of P

When removal of N and P compared with the reactor analysed based on weight of plants gain calculations, the removal efficiency differed significantly.

The variation in pH and alkalinity was insignificant throughout the test period. The dissolved oxygen was varied significantly from 2 - 6 mg/L in both type of reactor under investigation.

4. Conclusions

Following conclusions were drawn from the present study:

- Aquatic weeds based natural treatment system resulted in the significant amount of dissolved oxygen and insignificant change in pH, compared with unplanted natural system. Species of the weeds were observed an influence on dissolved oxygen and pH in planted system.
- Different types of aquatic weeds have shown significant effect on nutrient removal rates in the VFS-natural system. Highest removal of nutrients was observed in VFS-natural system planted with aquatic weeds as compared to the non-planted VFS – natural system.
- The N and P removal rates by weeds treatment was observed in ranges of 15 – 45 mg N–P m^{-2} d^{-1} in area based treatment system as compared to 2 – 12 mg N-P kg^{-1} d^{-1} in weight based calculations.
- Results have demonstrated that *T. latifolia* is represented as the most efficient plant for removing nutrients in the VFS - natural system compared to the nutrient removals in terms of plant weight calculations.

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