Treatment of Urban Runoff Using Agglomerated Floating Weeds – (Phragmites australis and Persicaria amphibia.)

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Abstract - *In recent years, the lack of water crisis has been considered as a big difficulty in many countries. The natural method of refining the problem has been a suitable method in comparison to other refinery methods. Natural method is applied by means of Phragmites and Persicaria amphibia. This method has good advantages such as, easy management, low cost, low technology required, and finally yet importantly, low energy consumption. Enhancing the Phragmites refinement efficiency, other kind of weeds has been used, persicaria has unique morphological, genetic, and physiological features. Regarding to the limited information about this plant in refinement of Karanji Lake water, in this research, a comparison between the refinability of Karanji lake water by persicaria and phragmites was made. The results were based on the findings obtained from this research the removal rate of nutrients i.e phosphates and nitrates parameters for Phragmites weeds were 92% and 86% respectively, and 84% and 68% for the persicaria weeds. Phragmites has unique features such as high resistance to unsuitable environmental conditions and it has a better efficiency in comparison to the persicaria, therefore, it is recommended to be used in refinement of lake water.*

***Key Words*: Karanji lake water, Phosphates, Nitrates, *Phragmites australis and Persicaria amphibian*, Removal efficiency.**

1. INTRODUCTION

Water is the most important vital force for all life activities. Lakes act as storage resources of water from ancient times. Their commercial importance is no less than industries, as it facilitates fishing, irrigation, laundry and municipal supply of drinking water. Studies on lake water parameters have been performed by many authors, to emphasise the importance of conservation of water resources. The use of aquatic macrophytes, such as water hyacinth, duckweed, water lettuce etc., in wastewater treatment has attracted global attention in recent years. Aquatic ecosystems are used directly or indirectly as recipients of potentially toxic liquids and solids from domestic, agricultural and industrial wastes (4)

1.1 Karanji Lake

Karanji Lake, located in the heart of the Mysore city in the state of Karnataka, India. It was constructed by Maharaja of Mysore. It is one of the biggest lakes in Karnataka and spreads over an area of 90 acres with a water spread area of about 55 hectares. This lake is the site for largest walk through aviary in India. It is an abode for more than 90 species of native and migratory birds, butterflies and mammals. The lake is surrounded by a beautiful nature park (Butterfly Park). Regional museum of natural history is also located on the banks of the lake. Being a percolation lake, it started getting polluted when sewage water made its way into the lake. This if not controlled and checked properly will lead to the destruction of a wonderful tourist attraction and nature's gift to the mankind (2).

Macrophytes are the common features of an aquatic ecosystem. Accumulation of nutrients in an aquatic ecosystem leads to eutrophication resulting into massive growth of the macrophytes and weeds. Main cause of nutrient accumulation is rapid urbanization and anthropogenic pressure. Storm water runoff and discharge of sewage into the lakes are two common ways that various nutrients enter the aquatic eco-system, resulting into the death of those systems. Macrophytic vegetation plays an important role in maintaining the ecosystem of a lake. Various types of macrophytes emergent, free floating, submerged are generally observed in an aquatic ecosystem. Free-floating macrophytes leaves & roots are floating; roots are not attached in sediment. *Eichhornia crassipes* is free floating aquatic plant in which roots play important role in removing nutrients. It has tremendous capacity of absorbing nutrients and other substances from the water and hence brings the pollution load down. It is found to be most effective in removal of BOD, COD, nitrogen, phosphorus, organic carbon, suspended solids, phenols, pesticides, heavy metals etc from waste water (10).

1.2 About the weeds

Pollutants may accumulate in surface waters, groundwater, substrates and plants and can be divided into four classes: nutrients (P, N), organic contaminants (e.g. polycyclic aromatic hydrocarbons, polychlorinated biphenyls and pesticides), xenobiotics derived from the pharmaceutical industry (personal care products, hormones, etc.) and metals and metalloids (e.g. Cu, Zn, Fe, Cd, Ni, Pb, Sr, Al, Ba, Se, and As) (4).

Reed canarygrass biomass grown on contaminated land shows limited contaminant uptake when compared to MC or SRC, especially for the uptake of Zn and Cd. Although the biomass is rich in K and low in Ca, additional Si and ash content offset this, improving fuel quality for combustion. The biomass is suitable for use for commercial and industrial scale combustion, with the added advantage of alternative energy uses, such as conversion via anaerobic digestion to biogas or to bioethanol for transport fuels (5).

Keeping all these above facts in view present study is focused towards floating weeds to treat the urban runoff in a lab scale. The specific objectives are

- To study the Removal Efficiency of pollutants using *Phragmites* Weed in a single channel
- To study the Removal Efficiency of pollutants using *persicaria* weed in a single channel
- To investigate the Removal Efficiency of pollutants using *persicaria* Weed and *Phragmites* weed in Dual channel
- To investigate the effect of Flow rate in Single and Dual channel Configuration

2. Methodology

Rectangular glass channel of dimensions 1m X 0.5m X 0.5m was fabricated with top open to atmosphere as shown in Figure 2. In this study two channels were used. Polyurethane foam sheet was used for keeping the plant in floating condition. The plant is placed in the openings provided in foam such a way that root system is in contact with water and shoots system is in contact with atmosphere. The foam sheet was made in a fixed position by tying it to cleats (4no.) provided in the channel.

Phragmites and *Persicaria* i.e., Reed and Marsh Smartweed respectively, obtained from local water body is initially washed with clear water to remove the adhered dirt both on root and shoot system of the plant. In order to maintain the uniformity (to certain extent) with respect to the phragmites australis and persicaria plants having same weight were used in each channel. The weight of each aquatic plant chosen was 0.25+/-0.05kg. Each plant was weighed after washing with clear water and draining out water completely. Initially, the channel was fed with tap water and the weeds were placed in there for two days.

Two rectangular channels were employed and charged with lake water at a flow rate of 0.25, 0.695, and 0.136L/hr. The outflow water was collected and analyzed for the considered parameters (pH, DO, Total dissolved solids, Nitrate and Phosphates) to determine the efficiency of the pollutants. In order to maintain the uniformity (to certain extent) with respect to the plants having same weight were used in each channel.

The Karanji lake water was bought in cans from the lake for the experiment. About 250 to 350L of water was carried for the research work at a time. Then the water is employed to the channel where the floating weeds were implanted to it. And the analysis was done at the day to day interval of time.

The lake water samples were drawn from three points namely- Boat yard point, Surface water and Sewage Inlet (Figure 1). From these points the characterization of lake water for several parameters (pH, TDS, BOD, COD, Nitrates, Phosphates, Conductivity, DO) were made.

Later, by the analysis of the initial Characteristics only two sampling points were selected for the research work i.e. Boat Yard Point and Sewage Inlet point.

The rectangular duals channels were employed and charged with the lake water then peristaltic pump is used to regulate the required flow rate (Figure 5). The plants were kept floating by the help of polyurethane foam. The plant is placed in the openings provided in foam such a way that root system is in contact with water and shoots system is in contact with atmosphere. The outflow water were collected and analyzed for the considered parameters– pH, DO, nitrate, phosphorous, to determine the efficiency of the aquatic plants. The outflow water was collected and analyzed for the considered parameters pH, DO, Nitrate and Phosphorus) to determine the efficiency of the agglomerated floating weeds.

Fig 1: overview of the Karanji Lake at the Sampling points

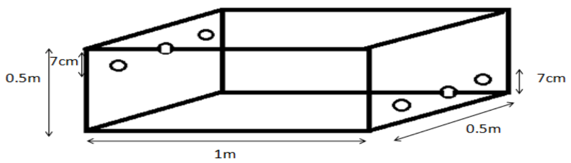

Fig 2: Dimensions of Rectangular channel

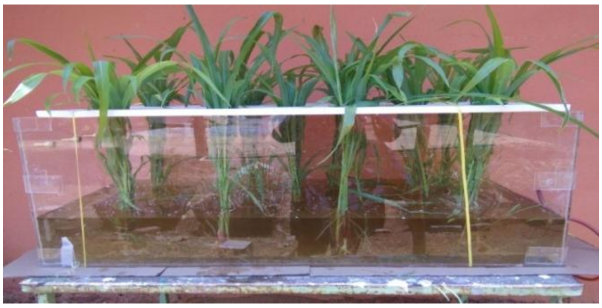

Figure 3: Floating Wetlands with Reed plant

Figure 4: Floating Wetlands with Marsh Smartweed

Figure 5: Floating Wetlands with Reed plant and Marsh Smart Weed

Table 1: Initial Characteristics of Karanji Lake water

Parameters	Values
pH	7- 9
COD(mg/L)	100 - 150
BOD(mg/L)	15 - 25
DO(mg/L)	2-3
Turbidity(NTU)	5 – 10
TDS(mg/L)	1 – 5
Phosphates(mg/L)	2- 4
Nitrates(mg/L)	1 - 3

3. RESULTS AND DISCUSSIONS

This chapter contains the complete details of the data generated out of the experimental work, the analysis of the data and the analysed data were formed in the form of tables, figures, graphs. It also contains the results obtained and interpretation of the results.

The karanji lake water was drawn from the lake and the characteristics were analyzed for different parameters such as pH, BOD, COD, Turbidity, Conductivity, Phosphates and Nitrates.

Initially the single channel analysis was made in batch studies at the tome interval of fifteen days. Every day the samples were drawn and analysed for the considered parameters. By taking the individual weed the removal efficiency of the pollutants were done. The effect of flow rate was also considered for the experimental work.

3.1 Results of reed plants for single channel configuration in batch studies

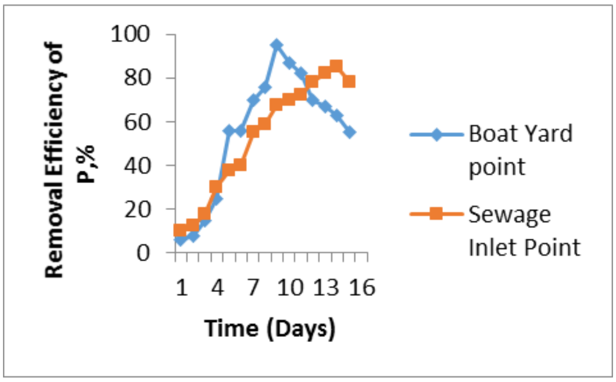

Chart 1: Uptake of Phosphate using Reed Plant

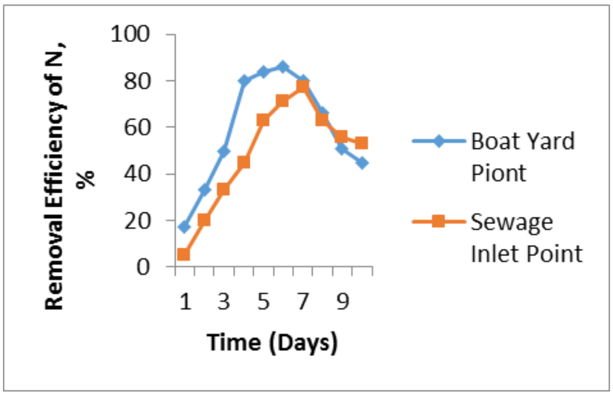

Chart 2: Uptake of Nitrate using Reed Plant

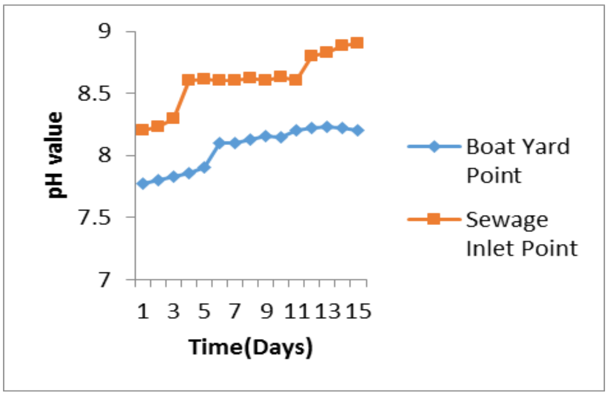

Chart 3: Variation of pH in Floating plants (Reed plant)

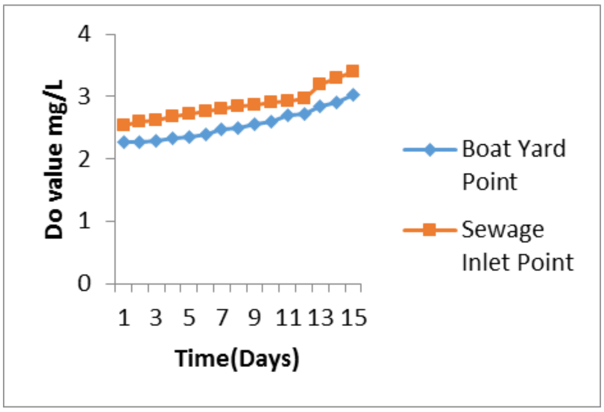

Chart 4: Variation of DO in Floating Plants (Reed plant)

3.2 Results of Marsh Smartweed for single channel configuration in batch studies

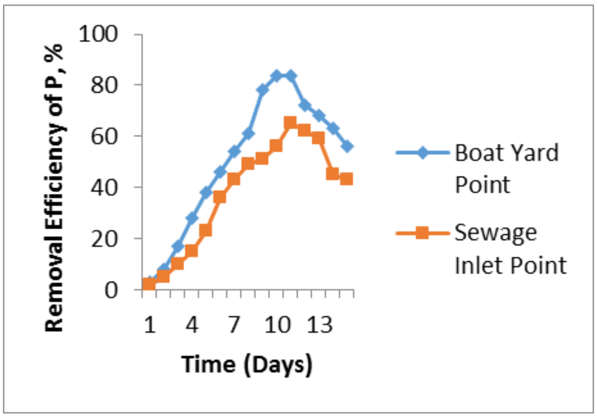

Chart 5: Uptake of Phosphate using Marsh Smart weed

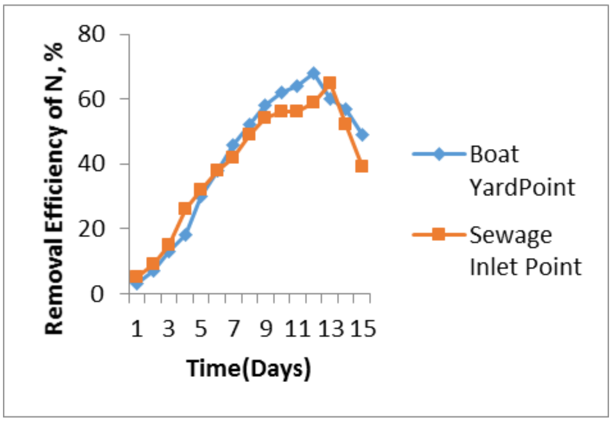

Chart 6: Uptake of Nitrate using Marsh Smart weed

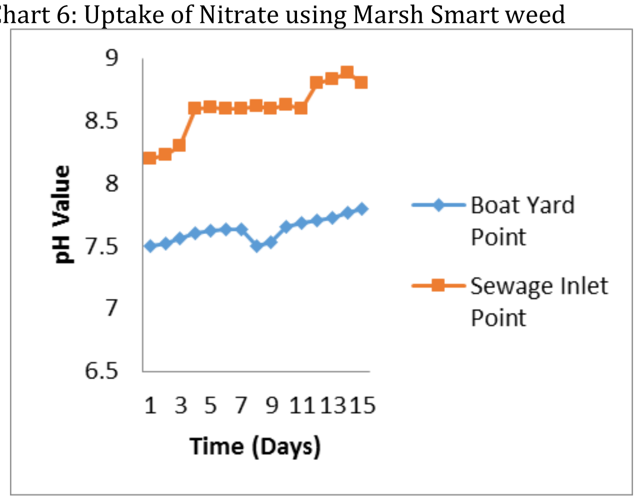

Chart 7: Variation in pH in Floating Weeds (Marsh Smart Weed)

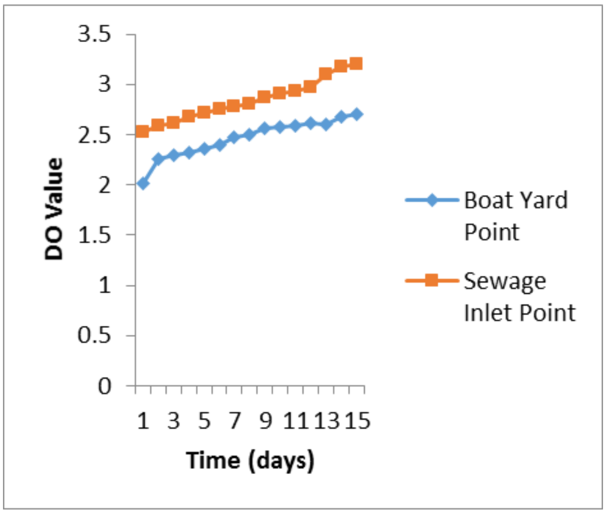

Chart 8: Variation of DO in Floating Weeds (Marsh smart weed)

3.3 Results of Reed plant and Marsh Smartweed in Dual channel configuration for continuous studies

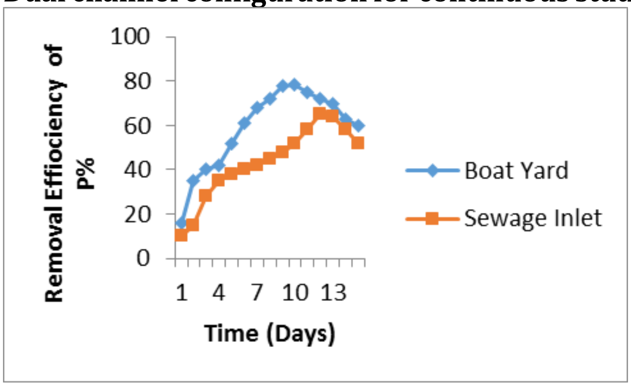

Chart 9: Uptake of Phosphate in Dual channel using Floating plants (Reed plant and Marsh Smart Weed)

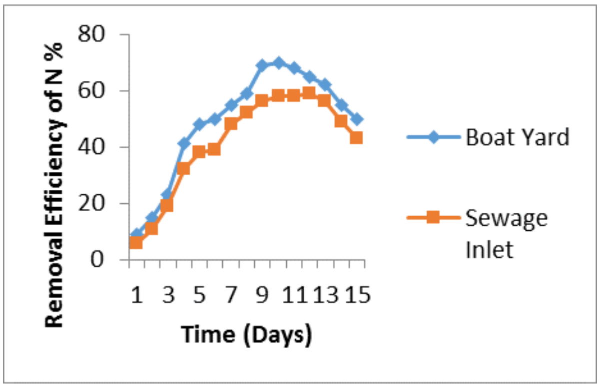

Chart 10: Uptake of Nitrate in Dual channel using Floating plants (Reed plant and Marsh Smart Weed)

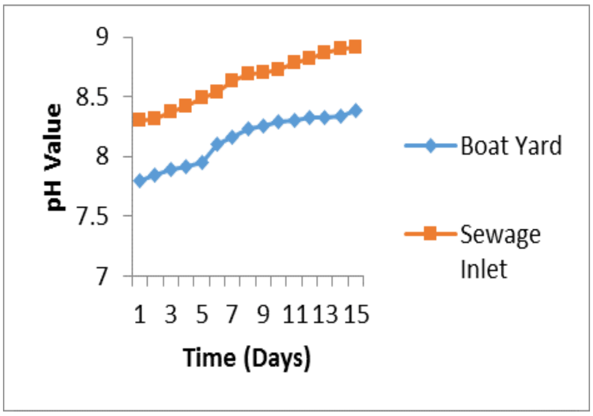

Chart 11: Variation of pH in Dual channel using Floating plants (Reed plant and Marsh Smart Weed)

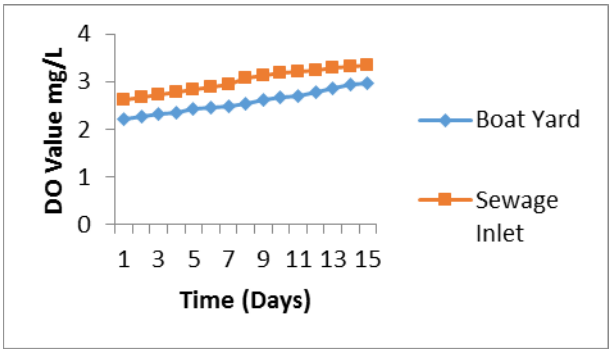

Chart 12: Variation of DO in Dual Channel Using Floating Plants (Reed plant and Marsh Smart Weed)

4. CONCLUSIONS

Regarding to the fact that the cost for making wetlands is almost one third of the cost for constructing a typical system based on activated sludge process, and the results obtained from this research that showed a high efficiency of *phragmites* in removing nutrients; it could be an appropriate plant to establish a green atmosphere for these regions. Among other reasons for using this plant are the facts that removing the organic materials is more important than other parameters in refining the lake water.
The plant of vetiver has the potential and because of its special features, the application of vetiver system (VS) in order to refine the wastewater is a new technology to refine the wastewater by plants which has an extraordinary potential. Vetiver as a natural, green, simple, and economical solution. This plant could grow in dry and hot climate so it is good for making green places because vetiver has very beautiful light-purple leaves and flowers. Its unique morphological, physiological, economical, and genetic features makes its introduction, identification, and use more important in our country, of course, like any other method, the method of artificial reed with sub-surface flows can be

problematic if it is not correctly installed and maintained. Moreover, some ideas such as pre-refinement, loading shock, reaping the reeds, washing the wastewater distributing network, blocking the holes, etc. should be considered for its maintenance (2).

The average removal efficiency of colloidal particles from the synthetic runoff by the coated sand was 88.7%. The performance of the column to remove turbidity was improved over time. The removal efficiency of lead and zinc were 64% and 81%, respectively. Previous studies reported an average removal efficiency of 54% and 29% for lead and zinc, respectively. It is evidence that sand coated with manganese oxide has improved the adsorption of heavy metals. Results of this study indicated that MOCS has a significant efficiency in improving urban runoff quality. Furthermore, magnetic field increased removal efficiencies of pollutant from runoff (4)

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