# REGENERATING SOIL OF SIMULATED ECOSYSTEM THROUGH HYDROPHYTES

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***Abstract*:** The study is carried out for removal of nutrients from soil with the help of hydrophytes. Hydrophytes are one of the cheaper and best options for regenerating eutrophic lake. Model eutrophic aquatic ecosystems was designed for bioremediation purpose, for use of hydrophytes, a freshwater static model ecosystem was established. Glass aquarium measuring 180 x 45x 45 cm was used as an ecosystem chamber. Fifteen kg of black soil from Wadali Lake was added to make a 4 cm bed in the aquarium. Different hydrophytic plants like *ecchornia, pistia, chara, vallisneria, hydrilla, naja* were introduced in the aquarium. Then it was filled with 200 L of water. Afterwards certain species of zooplankton and phytoplankton, snails, *Chironomous larvae, Rasbora* fishes were introduced in the aquarium. Soil sample was analyzed for one month at five days interval. In a simulated experimental eutrophic model aquatic ecosystem, the nutrients like phosphates, sulphates and nitrates were reduced significantly.

***Keywords: Hydrophytes, simulated ecosystem, Removal of nutrients from soil.***

**Introduction**

Remediation and management of industrial wastewater using hydrophytes act as one of the cost effective and environmentally friendly technology (Ayaz 2020) *et.al.* Macrophytes play important roles in balancing Lake Ecosystem. For the first time, they were recognised during 1960s and 1970s in water quality improvement (Wooten and Dood 1976). Gu Binhe (2005) investigated in several *Hydrilla*-dominated lakes; mean total P concentration (126 µg/lit) at inflow was reduced to 106 µg/lit at outflow. The maximum inflow total P concentration in a lake with positive nutrient reduction was 148 µg/lit. Zimmels (2007) investigated the capacity to reach lower bounds for extraction of pollutants from wastewater by four floating aquatic macrophytes-water hyacinth *(Eichhornia crassipes*), water lettuce (*Pistia stratiotes*), salvinia (*Salvinia rotundifolia*), and water primroses (*Ludvigia palustris*). It is shown that the following lower bounds can be established for wastewater purification with water hyacinth. Macrophyte based wastewater treatment systems are relatively inexpensive to construct and operate, easy to maintain and provide effective and reliable wastewater treatments (Farahbakhshazad *et al*., 2000; Lin *et al*., 2005; Silva and Camargo, 2006). Knight *et al*. (2002) noticed long-term phosphorus removal in Florida aquatic systems dominated by submerged aquatic vegetation. Shardendu *et.al* (2012) Aquatic plants with their high relative growth rates efficiently absorb nutrients from their surrounding media, thereby providing a simple and inexpensive solution for nutrient-polluted aquifers. Phosphate recovery by macrophytes Shifting to larger aquatic plant species, floating macrophytes such as water hyacinth (Eichhornia crassipes) and duckweed (Lemnaceae minor) grow on the surface of ponds whereas emergent macrophytes are grown in what are commonly referred to as constructed wetlands. Most common is the use of emergent macrophytes Andrew *et.al.* (2012).Piyush Gupta *et.al.* (2012) Phytoremediation techniques for the treatment of different types of wastewater have been used by several researchers. These techniques are reported to be cost effective compared to other methods. Kun Li *et.al*. (2016) three species of aquatic plants (Scirpus validus, Phragmites australis and Acorus calamus) were used as experimental materials to study their capacity to purify contaminated water and their effects on water pH and dissolved oxygen (DO). Anandha and Kalpana (2015) reported that various nutrients such as ammonia, nitrate and phosphate were analyzed throughout the study. Water hyacinth with papaya stem showed greater removal of nitrate (74%) and ammonia (67%). Ayyasamyy (2009) the quality of the physico-chemical parameters in the groundwater samples were found to be low in water treated with water hyacinth compared to untreated water. Shanthi (2009) Water hyacinth reduced the nitrate level to 64% in a synthetic medium containing 100 mg l–1 of nitrate. The efficiency of nitrate removal was further increased to 80 and 83% with initial nitrate concentrations of 200 and 300 mg l–1, respectively but was decreased with 400 and 500 mg l–1. According to the harvest result, 4-11% of nitrogen removed by the planted wetland was due to vegetation uptake, and 89-96% was due to denitrification. Lin YF (2002) Planting a wetland with macrophytes with high productivity may be an economic way for removing nitrate from groundwater. According to the harvest result, 4-11% of nitrogen removed by the planted wetland was due to vegetation uptake, and 89-96% was due to denitrification. Phytoremediation techniques have been found potential to absorb effluents to maximum extent and without possibility of secondary pollution (Rouf *et al.*, 2010). Various reports are available on the purification of waste waters using different species of hydrophytes (Padhi Susant Kumar *et al.*, 2012:Vasanthy M *et al.*, 2011). Impressive removal rates of inorganic nitrogen nitrate ($NO_3$-N), ammonium ($NH_4$-N), and total N) and phosphorus ($PO_4$-P and total P) have been reported using aquatic plants especially when water hyacinth were utilized in nutrient or metal-rich wastewaters(Lu, Q., 2009).

## RESEARCH METHODOLOGY

Simulated eutrophic aquatic ecosystems was designed for bioremediation purpose, for use of hydrophytes, A freshwater static model ecosystem was established. Glass aquarium measuring 180 x 45x 45 cm was used as an ecosystem chamber. Fifteen kg of black soil from Wadali Lake was added to make a 4 cm bed in the aquarium. Different hydrophytic plants like *ecchornia*, *pistia*, *chara*, *vallisneria*, *hydrilla*, *naja* were introduced in the aquarium. Then it was filled with 200 L of water of wadali lake followed by addition of nitrate and phosphate.. Afterwards certain species of zooplankton and phytoplankton, snails, *Chironomous larvae*, *Rasbora* fishes were introduced in the aquarium. Following Soil quality parameters were analyzed during the study:

1) pH 2) Chloride 3) Alkalinity 4) Calcium 5) Magnesium 6) Phosphate 7) Sulphate 8) Nitrate

## RESULT AND DISCUSSION

After addition of hydrophytes to the model aquatic ecosystem the pH of soil changed to 6.6 on day 5 (Initially it was 6.7). Further it increased to 7.1 % on day 20. On day 25 and thereafter it increased and on day 30 it became 7.2 (+ 7.46 %).

After addition of hydrophytes to the model aquatic ecosystem the chloride concentration of soil changed to 27.6 mg/100g on day 5 (Initially it was 29.1 mg/100g). Further it decreased to 24.9 mg/100g on day 20. On day 25 and thereafter it decreased and on day 30 it became 23.0 mg/100g (- 20.97 %).

After addition of hydrophytes to the model aquatic ecosystem the alkalinity of soil changed to 78.7 mg/100g on day 5 (Initially it was 80.3 mg/100g). Further it decreased to 4.86 % on day 20. On day 25 and thereafter it decreased and on day 30 it became 73.9 mg/100g (- 7.98 %).

After addition of hydrophytes to the model aquatic ecosystem the calcium concentration of soil changed to 54.2 mg/100g on day 5 (Initially it was 58.7 mg/100g). Further it decreased to 17.04 % on day 20. On day 25 and thereafter it decreased and on day 30 it became 45.5 mg/100g (- 22.49 %).

After addition of hydrophytes to the model aquatic ecosystem the magnesium concentration of soil changed to 22.7 mg/100g on day 5 (Initially it was 23.2 mg/100g). Further it decreased to 8.19 % on day 20. On day 25 and thereafter it decreased and on day 30 it became 19.1 mg/100g (- 17.68 %).

After addition of hydrophytes to the model aquatic ecosystem the phosphate concentration of soil changed to 2.46 mg/100g on day 5 (Initially it was 2.50 mg/100g). Further it decreased to 4.4 % on day 20. On day 25 and thereafter it decreased and on day 30 it became 2.25 mg/100g (- 10.0 %).

After addition of hydrophytes to the model aquatic ecosystem the sulphate concentration of soil changed to 3.64 mg/100g on day 5(Initially it was 3.78 mg/100g). Further it decreased to 3.50 mg/100g on day 15. On day 20 and thereafter it decreased and on day 30 it became 3.30 mg/100g (- 12.7 %).

After addition of hydrophytes to the model aquatic ecosystem the nitrate concentration of soil changed to 3.67 mg/100g on day 5 (Initially it was 3.89 mg/100g). Further it decreased to 11.83 % on day 20. On day 25 and thereafter it decreased and on day 30 it became 3.34 mg/100g (-14.14 %).

Fig1: Alteration in pH of soil after remedial treatment for 30 days

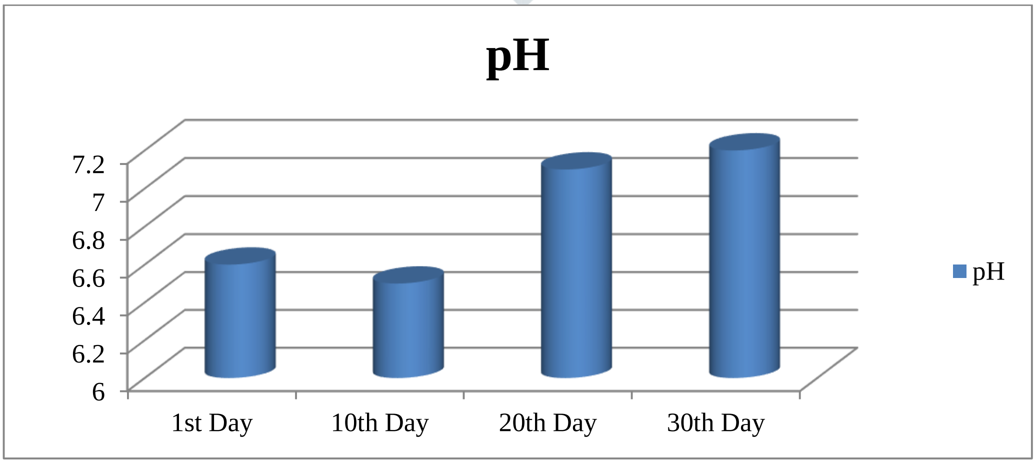


Fig: Alteration in Chloride of soil after remedial treatment for 30 days

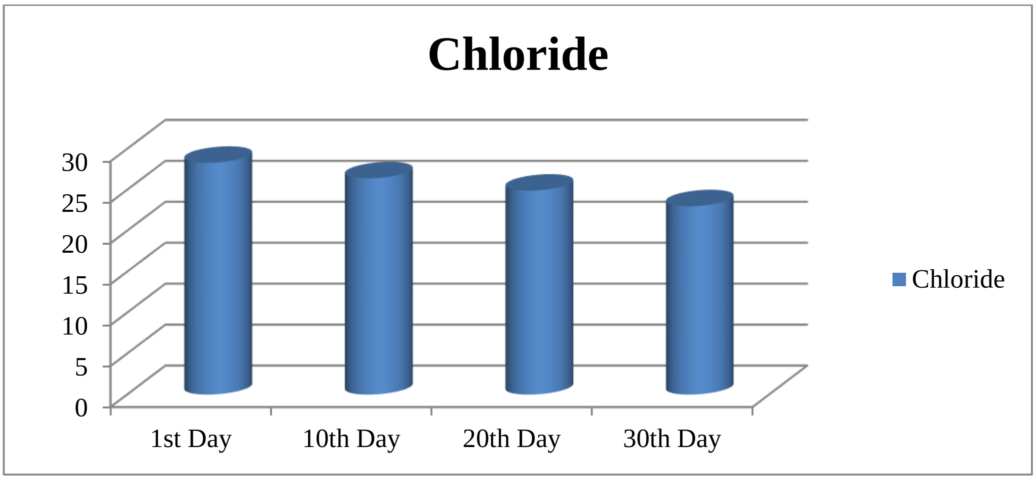



Fig: Alteration in Alkalinity of soil after remedial treatment for 30 days

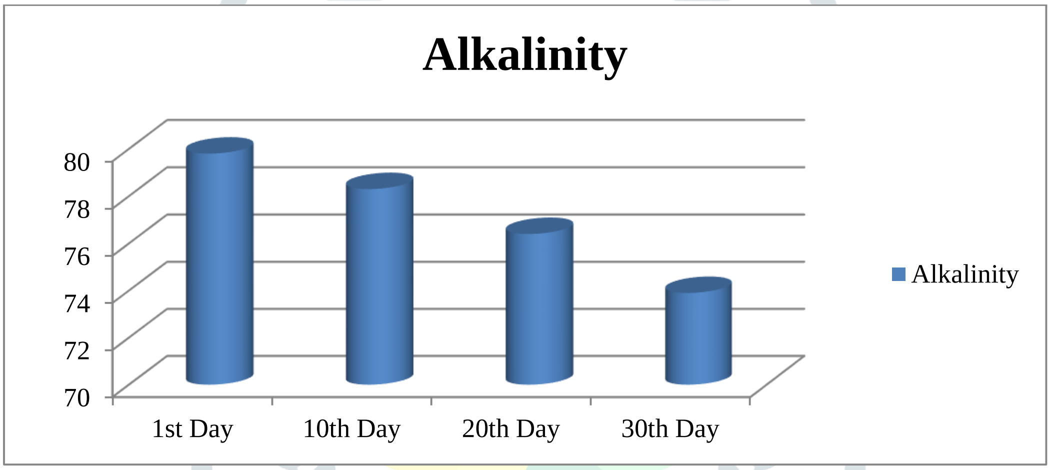



Fig: Alteration in calcium of soil after remedial treatment for 30 days

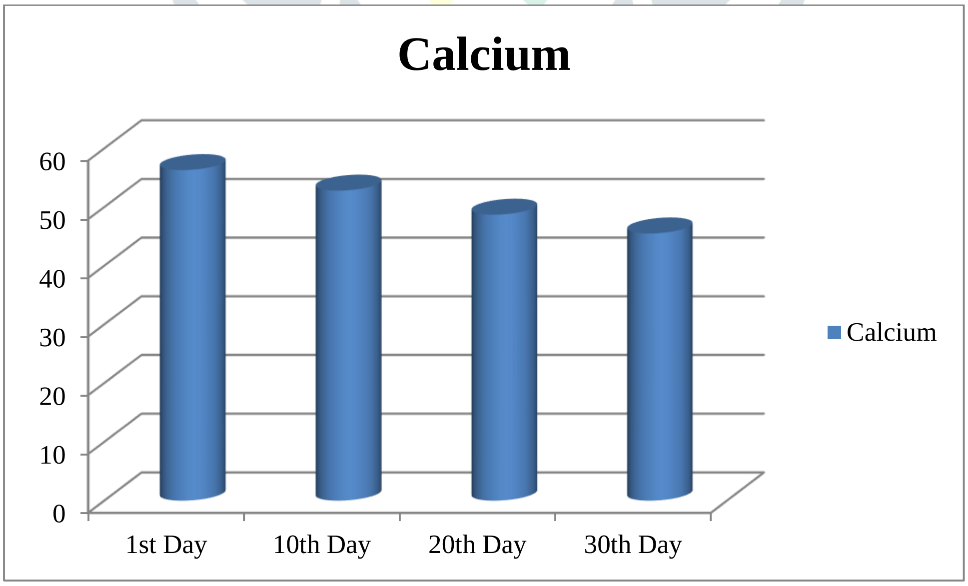


Fig: Alteration in magnesium of soil after remedial treatment for 30 days

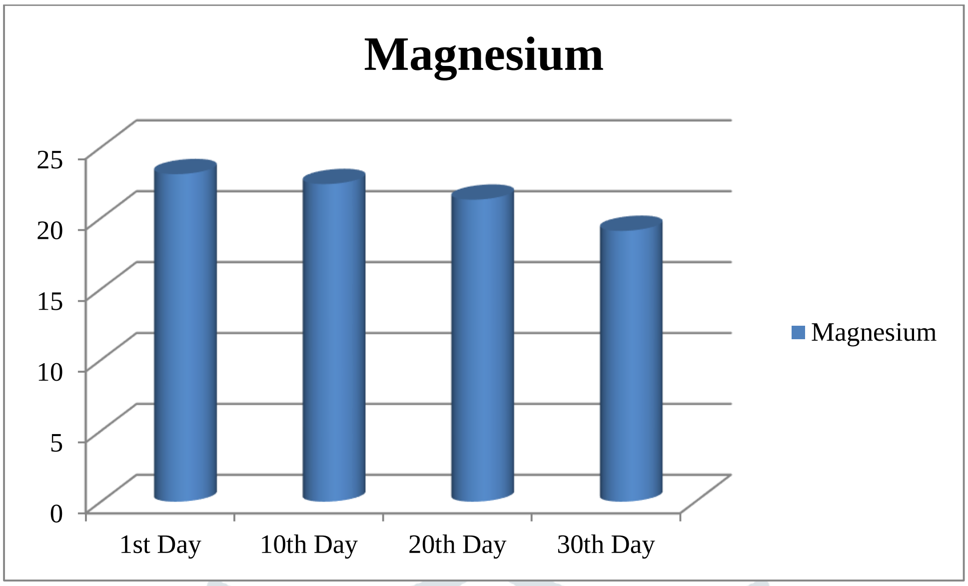



Fig: Alteration in phosphate of soil after remedial treatment for 30 days

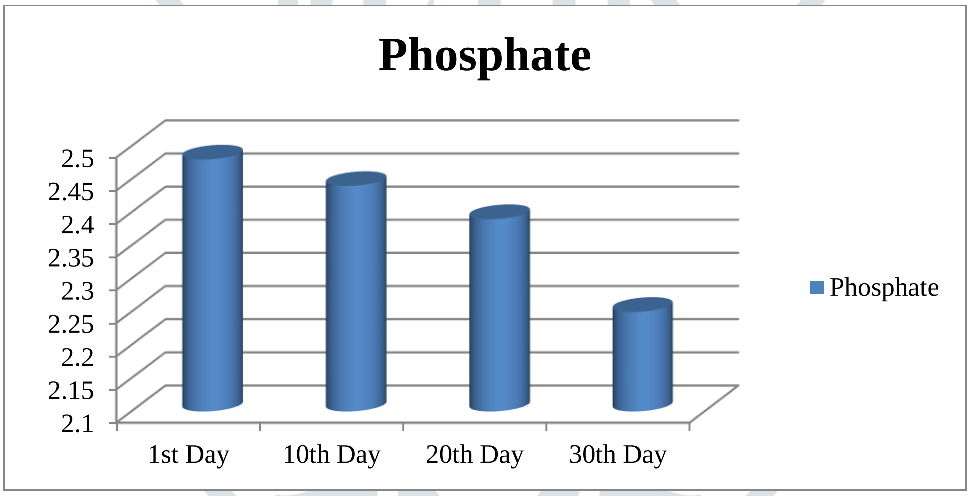



Fig: Alteration in sulphate of soil after remedial treatment for 30 days

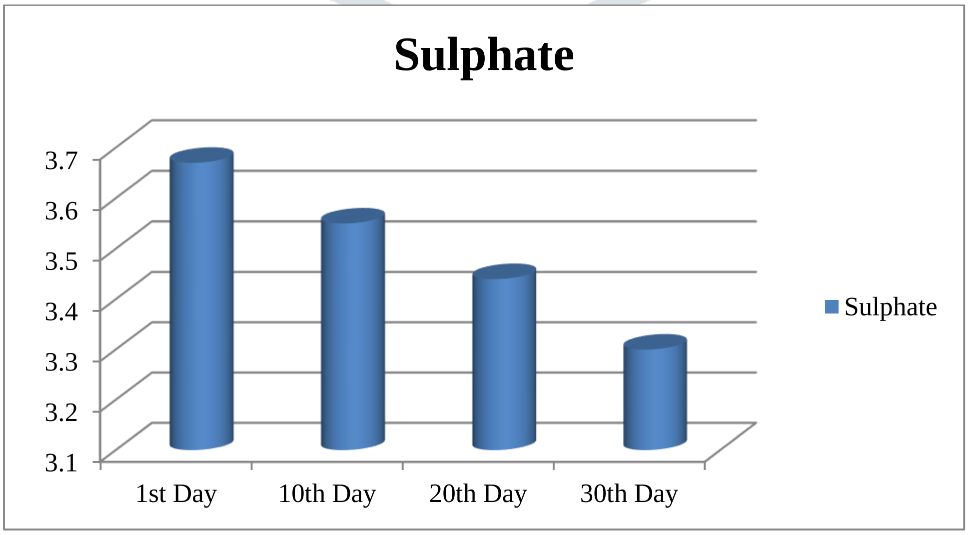
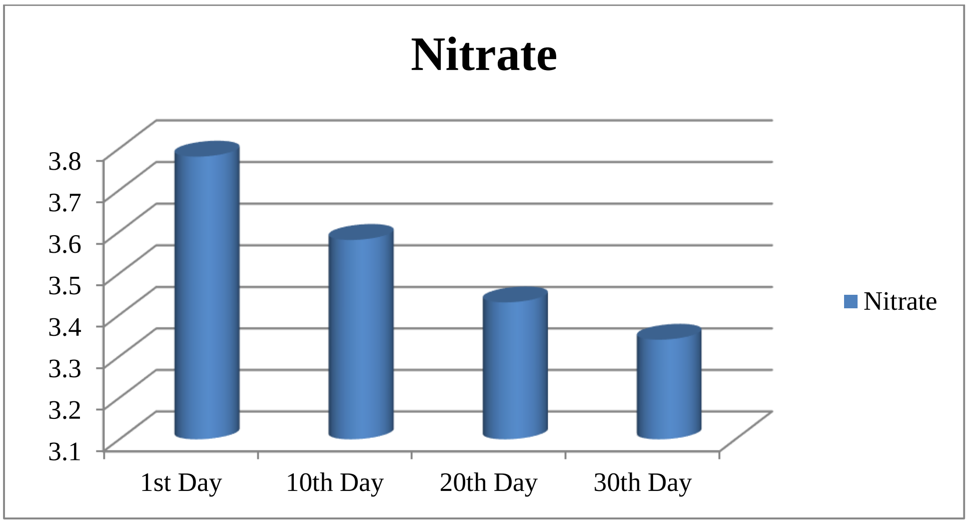


Fig: Alteration in Nitrate of soil after remedial treatment for 30 days




**Conclusion:**

In a simulated experimental eutrophic model aquatic ecosystem, when rooted hydrophytes like *Ecchornia*, *Pistia*, *Chara*, *Vallesneria* and *Hydrilla* were introduced for 30 days, the nutrients from soil like phosphates, sulphates and nitrates were reduced significantly and soil quality is improved to much extend.

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