AJES
ASIAN JOURNAL OF ENVIRONMENTAL SCIENCE
VOLUME 12 | ISSUE 1 | JUNE, 2017 | 31-36
DOI: 10.15740/HAS/AJES/12.1/31-36
e ISSN-0976-8947
Visit us : *www.researchjournal.co.in*

RESEARCH ARTICLE

Regenerating eutrophic aquatic ecosystem through hydrophytes

V. A. MESHRAM

Article Chronicle :
Received : *29.04.2017;*
Revised : *03.05.2017;*
Accepted : *17.05.2017*

ABSTRACT : As the world facing the problem of eutrophication and it is decreasing the life of lakes, this will produce the shortage of freshwater. 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. Water sample was analyzed for one month at one day interval. In a simulated experimental eutrophic model aquatic ecosystem, the BOD was depleted and the nutrients like phosphates, sulphates and nitrates were reduced significantly.

Key Words :
Hydrophytes, Model ecosystem, Removal of phosphate, Nitrate

HOW TO CITE THIS ARTICLE : Meshram, V.A. (2017). Regenerating eutrophic aquatic ecosystem through hydrophytes. *Asian J. Environ. Sci.*, **12**(1): 31-36, **DOI: 10.15740/HAS/AJES/12.1/31-36.**

Author for correspondence :
V. A. MESHRAM
Department of Zoology, Arts Commerce and Science College, (SGBAU), Kiran Nagar, AMRAVATI (M.S.) INDIA
Email: narnawarev@gmail.com

Today the flux of nutrients from their sources to the coast is strongly influenced by anthropogenic activities. Human population growth does not cease in the near future and in all already high agricultural production regions (such as the U.S., Central Europe, but in particular in India and China) the application of fertilizers will increase. In addition, clear-cutting trees, drainage of wetlands, fertilizing fields and meadows, intensive husbandry, building dams and towns, in essence all anthropogenic activities, contribute to the prevailing picture of cultural eutrophication. 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 *et al.* (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. Silva and Camargo (2006) carried out work on efficiency of aquatic macrophyte to treat nile Tilapia pond effluent.

The aim of this work was to evaluate the efficiency of three species of floating aquatic macrophytes (*Eichhornia crassipes*, *Pistia stratiotes* and *Salvinia molesta*) to treat effluents from Nile tilapia culture ponds.Naturally growing aquatic macrophytes can be used to remove nitrogen, phosphorus, nitrates, phosphates, and heavy metals, by consuming them in the form of plant nutrients (Agami and Reddy, 1991). 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*., 2002; Silva and Camargo, 2006). Knight *et al*. (2003) 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). 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. 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%). Ayyasamy *et al.* (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 *et al*.(2009) Water hyacinth reduced the nitrate level to 64 per cent in a synthetic medium containing 100 mg l^{-1} of nitrate. The efficiency of nitrate removal was further increased to 80 and 83 per cent 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 per cent of nitrogen removed by the planted wetland was due to vegetation uptake, and 89-96 per cent was due to denitrification. Lin *et al.* (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 per cent of nitrogen removed by the planted wetland was due to vegetation uptake and 89-96 per cent was due to denitrification. Phytoremediation techniques have been found potential to absorb effluents to maximum extent and without possibility of secondary pollution (Shah, *et al.*, 2010). Various reports are available on the purification of waste waters using different species of hydrophytes (Kumar *et al.*, 2012 and Vasanthy *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, 2009).

EXPERIMENTAL METHODOLOGY

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 lit of water. Afterwards certain species of zooplankton and phytoplankton, snails, *Chironomous larvae, Rasbora* fishes were introduced in the aquarium. Water sample was analyzed for one month at one day interval.

Physico-chemical parameters were analyzed (According to APHA (1995) and NEERI (1987) A laboratory manual on water analysis.

Following water quality parameters were analyzed during the study:

pH 2) Colour 3) Temperature 4) Dissolved oxygen 5) Total Hardness 6) Calcium hardness 7) Magnesium Hardness 8) Chloride 9) Alkalinity 10) Acidity 11) B.O.D. 12) Phosphate 13) Sulphate 14) Nitrate – N 15) Nitrate.

EXPERIMENTAL FINDINGS AND DISCUSSION

After adding hydrophytes to the model aquatic ecosystem the pH changed to 6.7 on day 6 (Initially it was 6.6). Further it increased to 4.54 per cent on day 20. On day 21 and thereafter it increased and on day 30

Table 1 : Physico- chemical contents in water of experimental aquatic ecosystem after addition of hydrophytes

Sr. No.	Parameters	After NO_3 and PO_4	1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	8th day	9th day	10th day
1.	pH	6.6 ± 0.25	6.6± 0.13	6.6± 0.32	6.6± 0.19	6.6± 0.13	6.6± 0.25	6.7±0.18	6.7± 0.18	6.7± 0.32	6.7± 0.32	6.7± 0.25
2.	Colour	No	No	No	No	No	No	No	No	No	No	No
3.	Temperature (^{0}C)	26± 0.04	26.8± 0.69	26.5± 0.75	26.8± 0.63	27± 0.44	27.7± 0.12	27.5± 0.18	27.5± 0.12	27.7± 0.08	29.0± 0.22	29.0± 0.03
4.	Dissolved oxygen (mg/l)	6.2± 0.31	5.6± 0.13	5.8± 0.06	5.2± 0.44	5.2± 0.50	5.0± 0.25	5.1± 0.018	5.3± 0.17	5.1± 0.26	5.0± 0.17	5.0± 0.022
5.	Total hardness (mg/l)	220± 1.26	219± 3.16	219± 2.5	218± 3.79	216± 2.52	216± 3.16	210± 1.26	208± 1.26	207± 3.16	206± 3.79	205± 3.16
6.	Calcium hardness (mg/l)	102± 3.16	101± 1.79	100± 3.79	98± 1.90	98± 1.89	98± 2.53	97± 2.53	97± 1.26	96± 1.26	96± 5.05	96± 1.26
7.	Mg hardness (mg/l)	118± 2.52	118±0.63	119± 2.53	120± 1.89	118± 1.26	118± 2.53	113± 2.53	111± 3.16	111± 3.16	112± 3.16	109± 3.16
8.	Chloride (mg/l)	65.4± 1.20	65.2±0.76	65.0± 0.57	64.7± 0.57	64.3± 0.95	64.1± 0.95	64.0± 0.95	63.7± 0.57	63.2± 0.57	63.0± 0.82	62.4± 1.58
9.	Alkalinity (mg/l)	223± 2.53	221± 1.20	219± 1.20	218± 1.58	215± 1.39	214± 1.39	212± 1.39	211± 1.83	210± 1.83	209± 1.01	207± 1.13
10.	Acidity (mg/l)	64.1 ± 1.77	63.9 ±0.95	63.8 ± 1.32	63.7 ± 1.26	62.8 ± 1.07	62.6 ± 1.07	61.9 ± 1.77	61.6 = 1.77	61.4 ± 0.57	60.8 ± 0.57	60.5 ± 0.57
11.	B.O.D. (mg/l)	3.6 ± 0.57	3.6 ± 0.57	3.5 ± 0.03	3.5 ± 0.32	3.4 ± 0.13	3.4 ± 0.32	3.4 ± 0.51	3.3 ± 0.51	3.2 ± 0.25	3.2 ± 0.38	3.1 ± 0.32
12.	Phosphate (mg/l)	1.30 ± 0.01	1.29 ± 0.03	1.29 ± 0.01	1.28 ± 0.03	1.27 ± 0.02	1.27 ± 0.03	1.26 ± 0.02	1.25 = 0.02	1.24 ± 0.01	1.22 ± 0.01	1.20 ± 0.01
13.	Sulphate (mg/l)	2.90 ± 0.57	2.87 ± 0.57	2.86 ± 0.32	2.84 ± 0.37	2.85 ± 0.13	2.83 ± 0.13	2.82 ± 0.44	2.80 = 0.38	2.79 ± 0.25	2.78 ± 0.19	2.75 ± 0.19
14.	Nitrate N (mg/l)	2.70 ± 0.25	2.68 ± 0.38	2.68 ± 0.82	2.67 ± 0.32	2.67 ± 0.32	2.65 ± 0.25	2.64 ± 0.19	2.63 = 0.19	2.62 ± 0.13	2.61 ± 0.19	2.60 ± 0.13
15.	Nitrate (mg/l)	11.96 ± 1.20	11.87 ± 0.38	11.87 ± 2.5	11.82± 1.9	11.82± 0.88	11.73± 0.57	11.69± 0.51	11.65± 0.87	11.60± 0.82	11.56± 1.26	11.51± 0.57

Note – All values are the mean of six replicate ± SD

Table 2 : Physico- chemical contents in water of experimental aquatic ecosystem after addition of hydrophytes

Sr. No.	Parameters	11th day	12th day	13th day	14th day	15th day	16th day	17th day	18th day	19th day	20th day
1.	pH	6.7± 0.18	6.7± 0.13	6.7± 0.32	6.8± 0.19	6.8± 0.13	6.8± 0.25	6.8±0.18	6.9± 0.18	6.9± 0.32	6.9± 0.32
2.	Colour	No	No	No	No	No	No	No	No	No	No
3.	Temperature (^{0}C)	29.9± 0.04	29.8 ± 0.04	29.6 ± 0.26	29.4 ± 0.25	29 ± 0.17	28.3 ± 0.44	28 ± 0.25	28.4± 0.22	29± 0.08	28.9± 0.26
4.	Dissolved oxygen (mg/l)	5.0 ± 0.13	4.9 ± 0.18	5.0 ± 0.12	5.2 ± 0.06	5.4 ± 0.56	5.6 ± 0.08	5.8 ± 0.31	5.6 ± 0.18	5.4 ± 0.22	5.4 ± 0.31
5.	Total hardness (mg/l)	203 ± 2.52	201 ± 3.79	200 ± 2.5	198 ± 3.16	194 ± 2.52	190 ± 3.16	186 ± 1.26	183 ± 1.26	178 ± 3.16	174 ± 3.16
6.	Calcium hardness (mg/l)	94 + 1.89	93 + 1.90	93 + 3.79	92 + 1.79	91 + 1.89	91 + 2.53	90 + 2.53	88 + 1.26	88 + 1.26	86 + 1.26
7.	Mg hardness (mg/l)	109 ± 3.16	108 ±1.89	107 ± 2.53	106 ± 0.63	103 ± 1.26	99 ± 2.53	96 ± 2.53	95 ± 3.16	90 ± 3.16	88 ± 3.16
8.	Chloride (mg/l)	62.1 ± 0.76	61.8 ±0.57	61.2 ± 0.57	60.7 ± 0.76	60.5 ± 0.95	60.1 ± 0.95	59.9 ± 0.95	59.6 ± 0.57	59.1 ± 0.57	58.6 ± 1.58
9.	Alkalinity (mg/l)	206 ± 1.58	205 ± 1.20	203 ± 1.20	202 ± 1.58	201 ± 1.39	197 ± 1.39	195 ± 1.39	194 ± 1.83	190 ± 1.83	187 ± 1.01
10.	Acidity (mg/l)	60.3 ± 0.95	59.8 ±1.26	59.5 ± 1.32	58.7 ± 0.95	57.9 ± 1.07	57.3 ± 1.07	56.7 ± 1.77	56.3 ± 1.77	56.1 ± 0.57	55.8 ± 0.57
11.	B.O.D. (mg/l)	3.0 ±0.32	2.9 ± 0.32	2.9 ± 0.03	2.8 ± 0.57	2.8 ± 0.13	2.7 ± 0.32	2.6 ± 0.51	2.6 ± 0.51	2.5 ± 0.25	2.5 ± 0.38
12.	Phosphate (mg/l)	1.19 ± 0.02	1.18 ± 0.03	1.17 ± 0.01	1.16 ± 0.03	1.15 ± 0.02	1.13 ± 0.03	1.12 ± 0.02	1.10 ± 0.02	1.09 ± 0.01	1.08 ± 0.01
13.	Sulphate (mg/l)	2.73 ± 0.57	2.68 ± 0.37	2.65 ± 0.32	2.63 ± 0.57	2.58 ± 0.13	2.54 ± 0.13	2.52 ± 0.44	2.48 ± 0.38	2.47 ± 0.25	2.36 ± 0.19
14.	Nitrate N (mg/l)	2.59 ± 0.13	2.58 ± 0.32	2.56 ± 0.82	2.54 ± 0.38	2.52 ± 0.32	2.50 ± 0.25	2.48 ± 0.19	2.47 ± 0.19	2.41 ± 0.13	2.37 ± 0.19
15.	Nitrate (mg/l)	11.47±0.57	11.42±0.63	11.34± 0.88	11.25±0.82	11.16±0.51	11.07±0.57	10.98±0.25	10.94±0.38	10.67±1.39	10.49± 1.5

Note – All values are the mean of six replicate ± SD it became 7.1.

After adding hydrophytes to the model aquatic ecosystem the colour is found to be faint green on 21st to 23rd day. Afterwards it became transparent during the experimental work. Transparency is an important factor in the development and distribution of flora and fauna in the freshwaters. Pechlaner (1971) and Singh (1984) have used the transparency values as an index of eutrophy.

After adding hydrophytes to the model aquatic ecosystem the temperature changed to 27.5^{0}C on day 6 (Initially it was 26.0^{0}C). Further it increased to 28.9^{0}C on day 20. On day 21 and thereafter it decreased and on day 30 it became 27.4 ^{0}C .

After adding hydrophytes to the model aquatic ecosystem the dissolved oxygen changed to 5.6 mg/l on day 1 (Initially it was 6.2 mg/l). Further it decreased to 4.9 mg/l on day 12. On day 25 and thereafter it increased and on day 30 it became 7.2 mg/l .

After adding hydrophytes to the model aquatic ecosystem the total hardness changed to 219 mg/l on day 1 (Initially it was 220 mg/l). Further it decreased to 201 mg/l on day 12. On day 13 and thereafter it decreased and on day 30 it became decreased to 156 mg/l .

After adding hydrophytes to the model aquatic ecosystem the calcium hardness changed to 101mg/l on day 1 (Initially it was 102 mg/l). Further it decreased to 93 mg/l on day 12. On day 13 and thereafter, it decreased and on day 30 it became 76 mg/l .

After adding hydrophytes to the model aquatic ecosystem the magnesium hardness changed to 119 mg/l on day 1 (Initially it was 118 mg/l). Further it decreased to 109 mg/l on day 10. On day 11 and thereafter, it decreased and on day 30 it became 83 mg/l.

After adding hydrophytes to the model aquatic ecosystem the chloride concentration changed to 65.2 mg/l on day 1 (Initially it was 65.4 mg/l). Further it decreased to 61.8 mg/l on day 12. On day 13 and thereafter, it decreased by 14.53 per cent on day 30.

After addition of hydrophytes to the model aquatic ecosystem the alkalinity changed to 221 mg/l on day 1 (initially it was 223 mg/l). Further it decreased by 16.15 per cent on day 20. On day 21 and thereafter, it decreased and on day 30 it became 167 mg/l.

After addition of hydrophytes to the model aquatic ecosystem the acidity changed to 63.9 mg/l on day 1 (Initially it was 64.1 mg/l). Further it decreased to 57.9 mg/l on day 15. On day 16 and thereafter, it decreased

Table 3 : Physico-chemical contents in water of experimental aquatic ecosystem after addition of hydrophytes

Sr. No.	Parameters	21st day	22nd day	23rd day	24th day	25th day	26th day	27th day	28th day	29th day	30th day
1.	pH	6.9	6.9 ± 0.13	5.9 ± 0.32	6.9 ± 0.19	6.9 ± 0.13	7.0 ± 0.25	7.0 ±0.18	7.0± 0.18	7.1± 0.32	7.1*± 0.32
2.	Colour	Faint green	Faint green	Faint green	No	No	No	No	No	No	No
3.	Temperature (^{0}C)	29.7±0.22	30.0± 0.25	29.5± 0.31	29.0± 0.19	27.8± 0.18	27.0± 0.04	27.1± 0.03	27.9±0.08	27.9± 0.12	27.4*±0.06
4.	Dissolved oxygen (mg/l)	5.3± 0.69	5.3± 0.75	5.3± 0.12	5.4± 0.44	6.0± 0.18	6.6± 0.50	6.6± 1.2	7.0± 0.94	7.0± 0.82	7.2*± 0.44
5.	Total hardness (mg/l)	173± 1.26	170± 3.79	168± 2.5	167± 3.16	165± 2.52	163± 3.16	162± 1.26	160± 1.26	159± 3.16	159*± 1.26
6.	Calcium hardness (mg/l)	83± 2.53	82± 1.90	82± 3.79	81± 1.79	80± 1.89	80± 2.53	78± 2.53	77± 1.26	76± 1.26	76*± 1.26
7.	Mg hardness (mg/l)	90± 0.63	88±1.89	86± 2.53	86± 0.63	85± 1.26	83± 2.53	84± 2.53	83± 3.16	83± 3.16	83*± 3.16
8.	Chloride (mg/l)	58.4± 0.95	58.0±0.57	57.6± 0.57	57.1± 0.76	56.8± 0.95	56.6± 0.95	56.3± 0.95	56.1± 0.57	56.0± 0.57	55.9*±0.57
9.	Alkalinity (mg/l)	186± 1.01	183± 1.20	184± 1.20	183± 1.58	178± 1.39	172± 1.39	169± 1.39	168± 1.83	167± 1.83	167*± 1.01
10.	Acidity (mg/l)	54.9 ± 0.57	54.7 ±1.26	53.5 ± 1.32	53.2 ±0.95	52.9± 1.07	52.5± 1.07	52.1± 1.77	51.7± 0.57	51.4± 0.57	50.6*±1.77
11.	B.O.D. (mg/l)	2.2 ± 0.13	2.1 ± 0.32	2.0 ± 0.03	1.9 ± 0.57	1.9 ± 0.13	1.9 ± 0.32	1.8 ± 0.51	1.8 ± 0.38	1.8 ± 0.25	1.8* ± 0.51
12.	Phosphate (mg/l)	1.07 ± 0.02	1.06 ± 0.03	1.05 ± 0.01	1.04 ±0.03	1.03 ±0.02	1.01 ±0.03	1.0 ± 0.02	1.0 ± 0.01	0.9 ± 0.01	0.9* ± 0.02
13.	Sulphate (mg/l)	2.31 ± 0.32	2.25 ± 0.37	2.21 ± 0.32	2.18 ±0.57	2.15± 0.13	2.12± 0.13	2.09± 0.44	2.04± 0.19	2.02± 0.25	1.9*± 0.38
14.	Nitrate N (mg/l)	2.32±0.38	2.28± 0.32	2.25± 0.82	2.19± 0.38	2.13± 0.32	2.09± 0.25	2.04± 0.19	1.89± 0.19	1.76± 0.13	1.71*±0.19
15.	Nitrate (mg/l)	10.27± 0.32	10.10±0.75	9.96± 0.89	9.70± 0.88	9.4± 0.50	9.25± 0.32	9.03± 0.44	8.37± 0.95	7.79± 0.95	7.57*±0.38

Note – All values are the mean of six replicate ± SD (* $P < 0.5$)

and on day 30 it became 50.6 mg/l.

After addition of hydrophytes to the model aquatic ecosystem the BOD changed to 3.5 mg/l on day 2 (Initially it was 3.6 mg/l). Further it decreased to 2.8 mg/l on day 15. On day 16 and thereafter, it decreased and on day 30 it became decreased to 1.8 mg/l.

After addition of hydrophytes to the model aquatic ecosystem the phosphate concentration of water changed to 1.29 mg/l on day 1 (Initially it was 1.30 mg/l). Further it decreased to 1.15 mg/l on day 15. On day 16 and thereafter, it decreased and on day 30 it became 0.9 mg/l .

After addition of hydrophytes to the model aquatic ecosystem the sulphate concentration of water changed to 2.87 mg/l on day 1 (Initially it was 2.90 mg/l). Further it decreased to 2.36 mg/l on day 20. On day 21 and thereafter, it decreased to 1.9 mg/l on day 30.

After addition of hydrophytes to the model aquatic ecosystem the nitrate - N concentration of water changed to 2.68 mg/l on day 1 (Initially it was 2.70 mg/l). Further it decreased to 12.23 per cent on day 20. On day 21 and thereafter, it decreased and on day 30 it became 1.71 mg/l.

After addition of hydrophytes to the model aquatic ecosystem the nitrate concentration of water changed to 11.87 mg/l on day 1 (Initially it was 11.96 mg/l). Further it decreased to 10.49 mg/l on day 20. On day 21 and thereafter, it decreased and on day 30 it became 7.57 mg/l.

After addition of hydrophytes to the model aquatic ecosystem the nitrate concentration of water changed to 11.87 mg/l on day 1 (Initially it was 11.96 mg/l). Further it decreased to 10.49 mg/l on day 20. On day 21 and thereafter, it decreased and on day 30 it became 7.57 mg/l.

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 BOD was depleted and the nutrients like phosphates, sulphates and nitrates were reduced significantly.

REFERENCES

Agami, M. and Reddy, K. R. (1991). Interrelationships between *Eichhornia crassipes* (Mart.) Solms and *Hydrocotyle umbellate* L. *Aquatic Botany*, **39** : 147-157.

Anandha, Varun R. and Kalpana, S. (2015). Performane analysis of nutrient removal in pond water using water hyacinth and *Azolla* with papaya stem. Internat. *Res. J. Engg. & Technol.* **2** (1) *www.irjet.net p-ISSN: 2395-0072.*

Andrew, N. Shilton, Nicola, Powell and Benoit, Guieysse (2012). Plant based phosphorus recovery from wastewater via algae and macrophytes. *Curr. Opinion Biotechnol.*, **23** : 884–889.

APHA (1995). *American public health association* / American water works Association: Standard Methods for the Examination of water and wastewater, 19th Ed., APHA AWWA, Washington, D.C., U.S.A.

Ayyasamy, P.M., Rajakumar, S., Sathishkumar, M., Swaminathan, K., Shanthid, K., Lakshmanaperumalsamye and Leea, P. S. (2009). Nitrate removal from synthetic medium and groundwater with aquatic macrophytes. *Desalination*, **242** : 286 – 296.

Farahbakhshazad, N., Morison, G.M. and Salati, E.F. (2000). Nutrient removal in a vertical up flow wetland in Piracicaba. Brazil. *Ambio V.*, **29** :74-77.

Gu, Binhe (2005). Environmental conditions and phosphorus removal in Florida lakes and wetlands inhabited by hydrilla vertiallata (Royle), Implications for invasion species management, *Biological Invasions*, **8** (7) : 1569-1578.

Gupta, Piyush, Roy, Surendra and Mahindrakar, Amit B. (2012). Treatment of water using water hyacinth, water lettuce and vetiver grass. *Resourc. & Environ.*, **2**(5) : 202-215, doi: 10.5923/j.re.20120205.04.

Knight, Robert L., Binhe, G.U., Ronald, A., Clarke and Jana, M. Newman (2003). Long term phosphorus removal in florida aquatic systems dominated by submerged aquatic vegetation. *Ecological Engg.*, **20** : 45-63.

Kumar, Padhi Susant, Kumar, Sahu Sanjat, Kumari, Anuradha, Bharathi, Sudha and Ansari, Shahbaj (2012). Phytoremediation as an alternative treatment of paper industry effluents by using water Hyacinth (*Eichhornia crassipes*), *Internat. J. Res. Chemist. & Environ.*, **2** (3) : 95-99.

Kun, Li, Lili, Liu, Huanxiang, Yang, Caihong, Zhang, Huicheng, Xie and Chuanrong, Li (2016). Phytoremediation potential of three species of macrophytes for nitrate in contaminated water. *American J. Plant Sci.*, **7** : 1259-1267.

Lin, Y.F., Jing, S.R., Wang, T.W. and Lee, D.Y. (2002). Effects of macrophytes and external carbon sources on nitrate removal from groundwater in constructed wetlands. *Environ Pollut.*, **119** (3) : 413 - 420.

Lu, Q. (2009). Evaluation of aquatic plants for phytoremediation of eutrophic stormwaters., Ph.D. Thesis, University of Florida, Florida.

NEERI (1987). A laboratory manual on water analysis.

Pechlaner, R. (1971). Factors that control the production rates and biomass of phytoplankton in high mountain lakes. *Nit. Int. Ver. Limnol,* **19** : 125-145.

Shah, Rouf Ahmad, Kumawat, D.M., Singh, Nihal and Wani, Khursheed Ahmad (2010). Water hyacinth (*Eichhornia crassipes*) as a remediation tool for dye effluent pollution. *Internat. J. Sci. & Nat.,* **1** (2) : 172-178.

Shanthi, K., Swaminathan, K., Sathishkumar, M., Lakshmanaperumalsamy, P., Ayyasamy, P.M., Lee, S. and Rajakumar, S. (2009). Nitrate removal from synthetic medium and groundwater with aquatic macrophytes.*Desalination,* **242** : 286-296.

Shardendu, Shardendu D. Sayantan, Sharma, Deepti and Sufia Irfan (2012). Luxury uptake and removal of phosphorus from water column by representative aquatic plants and its implication for wetland management, ISRN Soil Science, vol. 2012, Article ID 516947, 9 p., 2012. doi:10.5402/2012/516947.

Silva, Gustavo Gonzaga Henry and Camargo, Antonio Fernando Monteiro (2006). Efficiency of aquatic macrophytes to treat Nile tilapia pond effluents. *Scientia Agricola,* **63** (5) : 433-438, ISSN 0103-9016. http://dx.doi.org/10.1590/S0103-901. 62006000500003.

Singh, R.K. (1984). Fluctuations in the composition of zooplankton population in relation to hydrobiological condition of a reservoir. *J. Hydrobiol,* **2** (3) : 37-42.

Vasanthy, Muthunarayanan, Santhiya, M., Swabna, V. and Geetha, A. (2011). Phytodegradation of textile dyes by water Hyacinth from aqueous dye solutions. *Internat. J. Environ. Sci.,* **1** (7) : 1702-1713.

Wooten, J.W. and Dodd, J.D. (1976). Growth of water hyacinths in treated sewage effluent., *Econ. Bot.,* **30** : 29-37.

Zimmels, Y., Kirzhner, F. and Malkovskaia, A. (2007). Advanced extraction and lower bounds for removal of pollutants from wastewater by water plants. *Water Environ. Res.,* **79** : 287.