International Research Journal of Environment Sciences ISSN 2319–1414
Vol. 2(2), 6-14, February (2013) Int. Res. J. Environment Sci.

Developing a Pilot Scale Angular Horizontal Subsurface Flow Constructed Wetland for Treatment of Sewage through Phytoremediation with *Colocasia esculenta*

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Available online at: www.isca.in
Received 30th December 2012, revised 13th January 2013, accepted 30th January 2013

Abstract

Phytoremediation is the technique based on the use of plants to remediate sites contaminated with organic and inorganic pollutants. This technology is rapidly growing as is helpful to growing industries. Colocasia esculenta is a tropical plant grown primarily for its edible corm and the root vegetables. It has many names like Taro and Eddoe. It is a wide spread emergent aquatic plant, generally grows near bogs, streams, river pools and many shallow aquatic bodies. This plant is useful for wastewater treatment by its plant-root–rhizome system. In the present study, Colocasia esculenta is used for the treatment of sewage to test its pollutant absorption capacity. The studies aim at developing and assessing sewage treatment efficiency through a Angular Horizontal Subsurface Flow Constructed wetland pilot scale plant for treatment of sewage for sewage treatment process of Solapur city to recycle and reuse. The treated and untreated samples of sewage with different dilutions viz. 10%, 20%, 30%, 40%, 50%, 60%,70%, 80%, 90% and 100% were tested and compared with a blank (without Colocasia esculenta) as a control. The results reveal that the average reduction in EC was by 23.68%, TSS by 46.15%, TDS by 50.08%, TS by 49.34%, BOD by 54.30%, COD by 58.69%, NO_3 by 59.48%, PO_4 by 46.99% and SO_4 by 39.32% against treatment of sewage in the control bed in which EC was reduced by 11.62%, TSS by 27.90%, TDS by 32.66%, TS by 29.94%, BOD by 31.26%, COD by 39.81%, NO_3 by 23.93, PO_4 by 20.89 and SO_4 by 16.48% respectively. The soil samples were analyzed at before use and after use in the constructed wetland as bedding media. Considerable reduction in pollutants using Colocasia esculenta plant bed was noticed against the bed treatment without Colocasia esculenta plant. It is concluded that Colocasia esculenta is capable for the treatment of sewage.

Keywords: Phytoremediation, Angular Horizontal Subsurface Flow, constructed wetlands, sewage treatment, Horizontal Subsurface flow, *Colocasia esculent.*

Introduction

Today, water availability is a problem all over the world in terms of both quantity and quality. This problem is getting worsened as the world population and industrialization is increasing and climate change is affecting water resources, mainly in water stressed developing countries. Wastewater discharges are causing eutrophication and water borne diseases. The situation is getting worse with rapid urbanization where adequate sanitation and wastewater treatment facilities are lacking. The treatment of wastewater using Constructed Wetland (CW) is one of the suitable treatment systems, used in many parts of the world. This system seems to have the potential to be one of the sustainable solutions in treating and then discharging the huge quantity of wastewater and getting access to safer drinking water. Constructed wetlands (CWs) are treatment systems have been designed to accomplish natural processes with wetland substrates, vegetation and the associated microbial assemblages to help in treating wastewaters and take advantage of the processes that occur in natural wetlands within the more controlled environment[1, 2].

The Constructed Wetlands (CWs) are designed to mimic natural wetlands with much high degree of treatment for pollution control. Despite recognizing CW as an alternative for conventional wastewater treatment, little has been done in developing countries. Conventional (e.g. biological) and advanced wastewater treatment technologies like activated sludge followed by membrane filtration or chemical treatment are used in many countries for wastewater treatment. However, considering their costs, contaminant removal efficiencies and operational skills required for advanced wastewater treatments, natural treatment systems might be more sustainable and appropriate for developing countries. These natural wastewater treatment systems are used to improve treatment efficiencies by using natural processes. These natural processes of treatment include physical, chemical and biological mechanisms and require less energy, reduce the use of chemicals and have a small carbon footprint in comparison with conventional systems[3]. In terms of contaminant removal efficiency, cost reduction and simplicity, CWs are more suitable. Among the different types of CWs, Horizontal Sub-surface Flow Constructed Wetlands (HSSFCWs) are most widely used and became low-impact alternatives to more conventional wastewater treatment processes[4].

In a typical HSSFCW, wastewater is maintained at a constant depth and flows horizontally below the surface of the bed[5]. It has been proven to be efficient in removing pollutants, organic matter[6,7,8] and pathogens[9]. In HSSFCWs, organic matter is decomposed by both aerobic and anaerobic processes, but an insufficient supply of oxygen in this system greatly reduces the performance of aerobic biological oxidation[5,8,10]. Moreover, nitrification is the main limiting factor for N removal due to low oxygen availability[11,12]. Artificial aeration would favor aerobic organic matter oxidation and nitrification in HSSFCW[9]. The main operational problem in CW is progressive clogging of the porous support and growth media, which diminishes the hydraulic performance, and consequently affects the pollutant removal efficiency and life span of the system[8,10,12,14,15].

The growth of biofilm and microbial activity may depend on oxygen availability in the CW and thus may affect the solid removal efficiency and clogging. The exact mechanisms of granular medium clogging are still unclear. It is believed that accumulation of organic and inorganic solids, growth of biofilm, chemical precipitation and deposition, plant debris and swelling of soil colloids are the main causes of clogging[16]. Biofilm is a collection of micro-organisms surrounded by slime they secrete. Biofilms are mainly comprised of bacteria, fungi, algae and micro-invertebrates. In subsurface flow constructed wetlands (SSFCWs), biofilm (growth of micro-organisms) in substratum pores is regarded as an important factor of causing clogging[17].

Phytoremediation is the use of plants to remediate contamination by the uptake of contaminated water by plants. The phytoremediation technology is uses certain aquatic plants to clean up the water contaminated with metals and organic contaminants. Plants are used to remove or degrade contaminants with an old process that occurs naturally in ecosystems as both inorganic and organic constituent's cycle through these plants. It is an aesthetically pleasing mechanism that can reduce remedial costs, restore habitat and cleanup contamination rather than entombing it or transporting the problem to another site[10,13,14,18,19.]

Several techniques can be applied to mitigate clogging, such as pre-treatment, wash back, partial or complete replacement of filter medium and using oxidizing agent like hydrogen peroxide [20,21,22,23]. Bioremediation processes can also be applied to reverse clogging when it is detected. This process includes the indigenous microbial activity to degrade these accumulated organic solids. It is considered to be one of the major factors of substrate clogging. Among the micro-invertebrates, ciliated protozoa and micro flagellates are the most important micro fauna groups in CW fed with effluent from wastewater treatment[24]. The grazing protozoa may indirectly stimulate the rate of in situ bioremediation by controlling bacterial clogging therefore improving permeability[25]. This study is focused on development of pilot scale Angular Horizontal Subsurface Flow Constructed Wetland for Phytoremediation of Sewage using *Colocasia esculenta* with the same treatment mechanism.

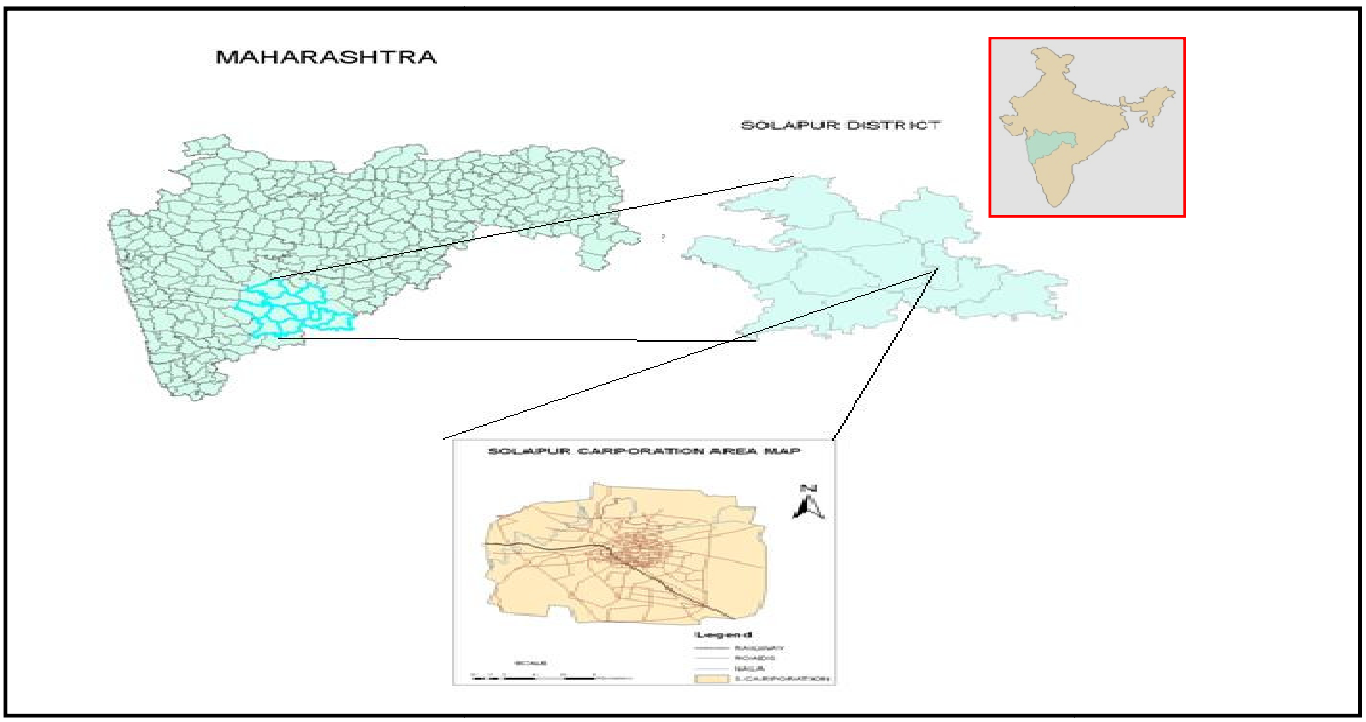

Figure-1
Study area map shows Research work carried

Material and Methods

Experimental site: Purification trials were tested and conducted at the field station of Environmental Science laboratory, located in the Solapur University, Solapur (MS) India (figure 1). Solapur city is the head quarter of Solapur district. It is situated on the south-east fringe of Maharashtra state and lies between 17^{o} 10' and 18^{o} 32' north-latitude and 74^{o} 42' and $76^{\,o}$ 15' east longitude. Solapur normally has a rain-fall of about 30 inches. However, in certain places, the rain-fall exceeds this figure. There are about 42 rainy days in a year. Even this scanty rain-fall is most unevenly distributed and uncertain leading to famine conditions now and then.

Sample collection: For the treatment of sewage, the grab samples were collected from Shelgi nala (Pune naka) located near national highway no. 9 in Solapur city (figure-2 and 3). These samples were treated studies using *Colocasia esculenta* by phytoremediation (root zone) technique after their pre-treatment characterization.

Figure-2
Shelgi Nala sewage disposal site

Figure-3
Sewage sampling on site

Treatment plant details: *Colocasia esculenta* is a tropical plant, whose many names such as Taro and Eddoe (figure- 4). Taro is closely related to *Xanthosoma* and *Caladium*, plants commonly grown as ornamentals, and like them it is sometimes loosely called elephant ear. Taro was probably first native to the lowland wetlands of Malaysia (taloes). Estimates are that taro was in cultivation in wet tropical India before 5000 BC, presumably coming from Malaysia, and from India further transported westward to ancient Egypt, where it was described by Greek and Roman historians as an important crop. In India, it is known as "arbi" or "arvi". The selected plant *Colocasia esculenta* belongs to Kingdom–plantae, Order–Alismatales, Family- Araceae, Subfamily- Aroideae, Tribe- Colocasiodeae, Genus– *Colocasia* and species- *C. esculenta* as per (L) Schott. This plant is locally known as, 'Alu' in the state of Maharashtra. Rhizomes are of plant having different sizes and shapes. Leaves grows up to 40×24.8 cm, sprouts from rhizome, dark green above and light green beneath, triangular-ovate, sub-rounded and mucronate at apex, tip of the basal lobes rounded or sub-rounded. Petiole is of 0.8 -1.2 m in hight. Spathe is up to 25 cm long. Spadix is about 3/5 as long as the spathe, flowering parts up to 8 mm in diameter. Female portion at the fertile ovaries intermixed with sterile white ones[26].

Figure-4
Plant of *Colocasia esculenta*

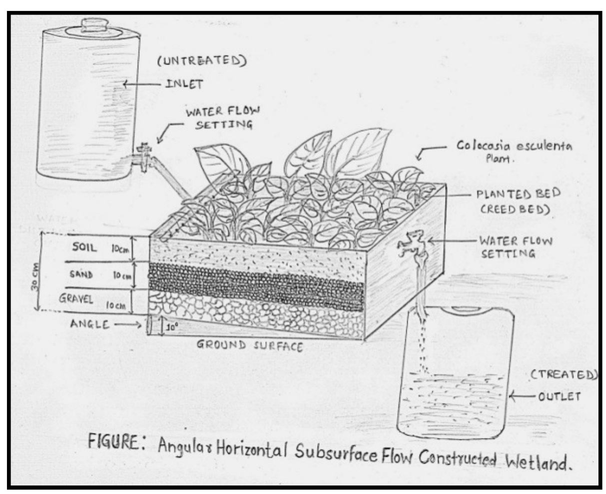

Figure-5
Experimental design of AHSSF-CW

Experimental Design and Methodological approach: Experimental procedures followed in present investigation were similar to those described elsewhere[7,8, 10, 12]. *Colocasia esculenta* is one of the prominent adaptive marshy plants in the Solapur region which was used for treatment of wastewater. It was transplanted in the designed wetland system in the Angular Horizontal Subsurface Flow process of constructed wetland (figure-5).

Three sets of buckets with different sizes and dimensions were used in each experimental set up. The vertical buckets as holding tank (Inlet) were used to hold the wastewater. The water storing capacity of tank was 30 liters each. The rectangular tub with test plant bed was used as experimental test setup in each set for preparing root zone bed of size 62 cm length and height 35 cm having suitable outlet. The vertical pipe was placed above the tub in an inverted 'T' shape for equal distribution of wastewater which was connected with the rubber pipe to the inlet of holding tank in each set. The length of plastic pipe was 40 cm and the holes were provided at the interval of 5 cm and equal flow was adjusted manually through them. Plastic cans were used for the collection of treated water after flowing out from the root zone bed through the outlets. Inlet, Root zone tub and outlet were connected to each other with taps by tubes and plastic water pipes. Treated water samples were collected and analyzed in laboratory. The Angular Horizontal Subsurface Flow constructed wetland or root zone bed for each set was prepared as follows:

Three layers were prepared with Pebbles, Sand and Garden soil. The big size pebbles accounting to 20 kg weight making bottom layer of 10 cm height followed by sharp and medium sized 15 kg sand were added to form a middle layer of 10 cm height and 6 kg small size and sieved soil forming upper layer of 10 cm height were used for construction of bed. The pebbles and sand materials were neatly washed with tap water and then arranged in different layers. Selective healthy, small, young, locally available grass saplings of *Colocasia esculenta* were transplanted which were arranged in rows & columns and covered by layer of small pebbles, sand and soil.

The rectangular tub with plant bed was provided with 10^0 slope with slight elevation at the bottom of backside of tub and kept in the slanting position. Inlet and outlet flow rates were adjusted by using bucket and timer. Inlet flow and outlet flow of wastewater were adjusted to maintain Hydraulic Retention Time (HRT) of 4 days (96 hrs). Initially, plants in bed were acclimatized for two weeks with suitable dilutions each time. As the time passed, the concentrations were increased such as 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100% of sewage through plant treatment. These samples were treated using *Colocasia esculenta* by Phytoremediation technique and other set as control (without plant) also analyzed after their pre-treatment characterization (figure-6).

(A)

(B)

Figure-6

Treatment of sewage through plant set of (A) *Colocasia esculenta* and (B) set of Control in AHSSF-CW

Test samples before and after treatment were analyzed in both sets (Plant bed and control bed) for selective parameters like pH, EC, TSS, TDS, TS, COD, BOD, NO_3, PO_4 and SO_4 using standard method[27, 28]. Soils used in before and after treatment in both beds of CWs were analyzed. Finally, pollution reduction efficiency and treatment efficiency of the test plant were calculated.

Results and Discussion

The treatment efficiency of the Angular Horizontal Subsurface Constructed Wetland unit was examined by wastewater quality parameters such as pH, EC,TSS,TDS,TS,BOD,COD, Nitrate, Phosphate and Sulphate respectively, in the inlet and outlet of wastewater at HRT of 4 (96 hrs) days. The treated and untreated samples of sewage with different dilutions viz. 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100% were tested and compared with a reference set as control (without *Colocasia esculenta*). The results in the set of *Colocasia esculenta* reveal that the maximum pollution reduction efficiency was observed in 70% sewage concentration. The characteristics of the wastewater collected from inflow and outflow of both sets of CWs are presented in the table 1 and table 3. The pollution reduction efficiencies of both CW are shown in the table 2, 4 and figure-7 and figure-8. The soil used as bed media was collected from nursery and its characteristics are studied before use as media for treatment and after treatment. The bed media is for supporting in plant *Colocasia esculenta* in bed CW and of in Control bed (table 5).

Table-1
Sewage treatment performance (Before and after treatment) in the Angular Horizontal Subsurface Flow Constructed Wetland using *Colocasia esculenta* after 4 days (96 hrs) HRTs.

Concentration %	pH		EC (µMohs/cm)		TSS (mg /L)		TDS (mg /L)		TS (mg /L)		BOD (mg /L)		COD (mg /L)		NO_3 (mg /L)		PO_4 (mg /L)		SO_4 (mg /L)	
	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A
10	7.91	7.8	1.02	0.94	113	102	603	468	716	570	4.60	3.62	14.8	11.12	5.4	4.1	3.60	2.90	28.0	23.0
20	7.68	7.5	1.08	0.98	152	137	660	467	812	604	5.80	4.38	17.4	12.31	6.0	4.3	5.12	3.98	39.0	31.0
30	7.52	7.4	1.16	1.01	157	140	770	512	927	652	6.60	4.78	19.3	12.76	9.5	6.1	8.66	6.32	53.0	39.0
40	7.47	7.3	1.23	1.04	167	131	845	531	1012	662	7.10	4.92	21.8	13.66	11.7	7.12	9.86	6.86	66.0	46.0
50	7.18	7.2	1.29	1.09	172	121	950	560	1122	681	8.07	5.71	24.4	14.32	13.2	7.22	12.41	7.90	78.0	51.0
60	6.09	7.1	1.33	1.06	236	148	998	550	1234	698	9.50	5.65	27.7	14.62	17.0	7.71	14.66	8.86	84.0	53.0
70	6.81	7.14	1.52	1.16	260	140	1122	560	1382	700	13.07	6.26	36.9	15.24	19.6	7.94	16.83	8.92	89.0	54.0
80	6.87	7.17	1.67	1.30	308	188	1220	702	1528	890	21.04	9.86	41.6	18.12	21.4	9.94	17.92	9.86	94.0	59.0
90	6.76	7.23	1.98	1.59	347	227	1320	766	1667	993	36.04	18.31	92.8	40.63	24.6	12.69	18.81	11.23	97.0	64.0
100	6.79	7.26	2.63	2.12	392	298	1360	798	1752	1096	42.0	21.56	118	51.83	26.8	14.34	21.60	13.76	107.0	78.0

'B' means Before Treatment and 'A' means After Treatment.

Table-2
Percentage reduction in various parameters using *Colocasia esculenta* after the sewage treatment

Sewage Concentrations (%)	E.C. in %	TSS in %	TDS in %	TS in %	BOD in %	COD in %	NO_3 in %	PO_4 in %	SO_4 in %
10	7.84	9.73	22.38	20.39	21.30	24.86	24.07	19.44	17.85
20	9.25	9.86	29.24	25.61	24.48	29.25	28.33	22.26	20.51
30	12.93	10.82	33.50	29.66	27.57	33.88	35.78	27.02	26.41
40	15.44	21.55	37.15	34.58	30.70	37.33	39.14	32.86	30.30
50	17.82	29.65	41.05	39.30	34.36	41.31	45.30	36.34	34.61
60	20.30	37.28	44.88	43.43	40.52	47.22	54.64	39.56	36.90
70	23.68	46.15	50.08	49.34	54.30	58.69	59.48	46.99	39.32
80	22.15	38.96	42.45	41.75	53.92	56.44	53.55	44.97	37.23
90	19.69	34.58	41.96	40.43	49.69	56.21	48.41	40.29	34.02
100	19.39	23.97	41.32	37.44	48.66	56.07	46.49	36.29	27.10

Table-3
Sewage treatment performance (Before and after treatment) in the Control (Without *Colocasia esculenta*) after 4 days (96 hrs) HRTs

Concentration %	pH		EC (µMohs/ Cm)		TSS (mg /L)		TDS (mg /L)		TS (mg /L)		BOD (mg /L)		COD (mg /L)		NO_3 (mg /L)		PO_4 (mg /L)		SO_4 (mg /L)	
	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A
10	7.91	7.62	1.02	0.96	113	106	603	472	716	578	4.60	3.68	14.8	11.36	5.4	4.6	3.60	3.12	28.0	24.7
20	7.68	7.58	1.08	0.99	152	137	660	473	812	610	5.80	4.44	17.4	12.65	6.0	4.9	5.12	4.34	39.0	33.12
30	7.52	7.48	1.16	1.03	157	137	770	529	927	666	6.60	4.86	19.3	12.86	9.5	7.2	8.66	6.87	53.0	42.0
40	7.47	7.42	1.23	1.09	167	140	845	569	1012	709	7.10	4.88	21.8	12.92	11.7	8.9	9.86	7.08	66.0	55.12
50	7.18	7.20	1.29	1.14	172	124	950	672	1122	796	8.07	6.32	24.4	15.76	13.2	10.4	12.41	10.56	78.0	68.0
60	6.09	7.12	1.33	1.19	236	174	998	702	1234	876	9.50	7.56	27.7	18.56	17.0	13.6	14.66	12.78	84.0	74.0
70	6.81	7.14	1.52	1.36	260	198	1122	790	1382	988	13.07	10.56	36.9	25.12	19.6	15.8	16.83	14.08	89.0	79.46
80	6.87	7.21	1.67	1.50	308	266	1220	910	1528	1176	21.04	17.56	41.6	29.46	21.4	18.2	17.92	15.96	94.0	84.12
90	6.76	7.27	1.98	1.79	347	300	1320	996	1667	1296	36.04	31.32	92.8	78.56	24.6	21.2	18.81	16.96	97.0	88.12
100	6.79	7.22	2.63	2.38	392	341	1360	1045	1752	1386	42.0	36.45	118	102	26.8	23.4	21.60	19.84	107.0	99.86

Table-4
Percentage reduction in various parameters in the Control Bed (Without plant) after the sewage treatment

Sewage Concentrations (%)	E.C. in %	TSS in %	TDS in %	TS in %	BOD in %	COD in %	NO_3 in %	PO_4 in %	SO_4 in %
10	5.88	6.19	21.72	19.27	20.00	23.24	14.81	13.33	11.78
20	8.33	9.86	28.33	24.87	23.44	27.29	18.33	15.23	15.07
30	11.20	12.73	31.29	28.15	26.36	33.36	24.21	20.66	20.75
40	11.38	16.16	32.66	29.94	31.26	39.81	23.93	20.89	16.48
50	11.62	27.90	29.26	29.05	21.68	35.40	21.02	14.90	12.82
60	10.52	26.27	29.65	29.01	20.42	32.99	20.00	12.82	11.90
70	10.52	23.84	29.59	28.50	19.20	31.92	19.38	12.06	10.71
80	10.17	13.63	25.40	23.03	16.53	29.18	14.95	10.93	10.51
90	9.59	13.54	24.54	22.25	13.09	15.34	13.82	09.83	09.15
100	9.50	13.01	23.16	20.89	13.21	13.55	12.68	09.35	06.67

Table-5
Analysis of soil used in the treatment set up before and after treatment of different beds.

Sr. No.	Parameters	Nursery Soil Before treatment	*Colocasia esculenta* (After treatment)	Control bed Or Without plant (After treatment)
1	Nitrate (Kg/Hectare)	264	270	96
2	Phosphorous (Kg/Hectare)	7	12	11
3	Potassium (Kg/Hectare)	531	439	454
4	Calcium (Meq)	1.62	1.63	1.60
5	Magnesium (Meq)	0.48	0.47	0.51
6	Sodium (Meq)	0.35	0.73	0.71
7	pH	7.90	7.70	7.80
8	Salinity (Total Soluble Salts)	0.84	1.32	1.00
9	Free Lime (%)	2.64	2.34	3.33
10	Density of Soil (g /cm^3)	1.09	1.31	1.16
11	Organic Carbon (%)	0.44	0.45	0.16

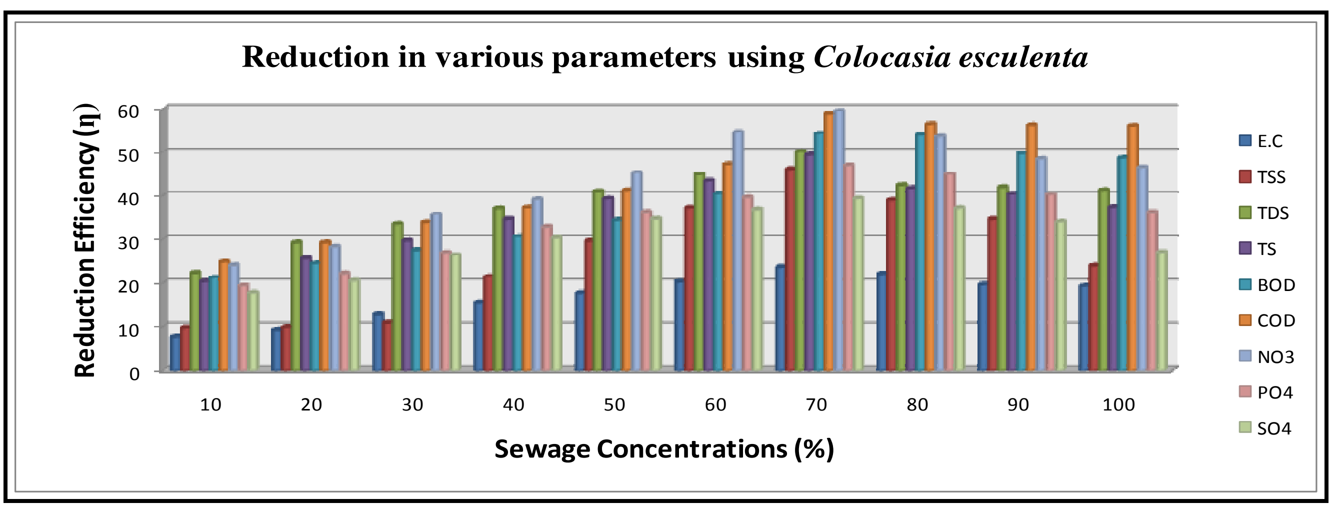

Figure-7
Reduction in various parameters using *Colocasia esculenta*

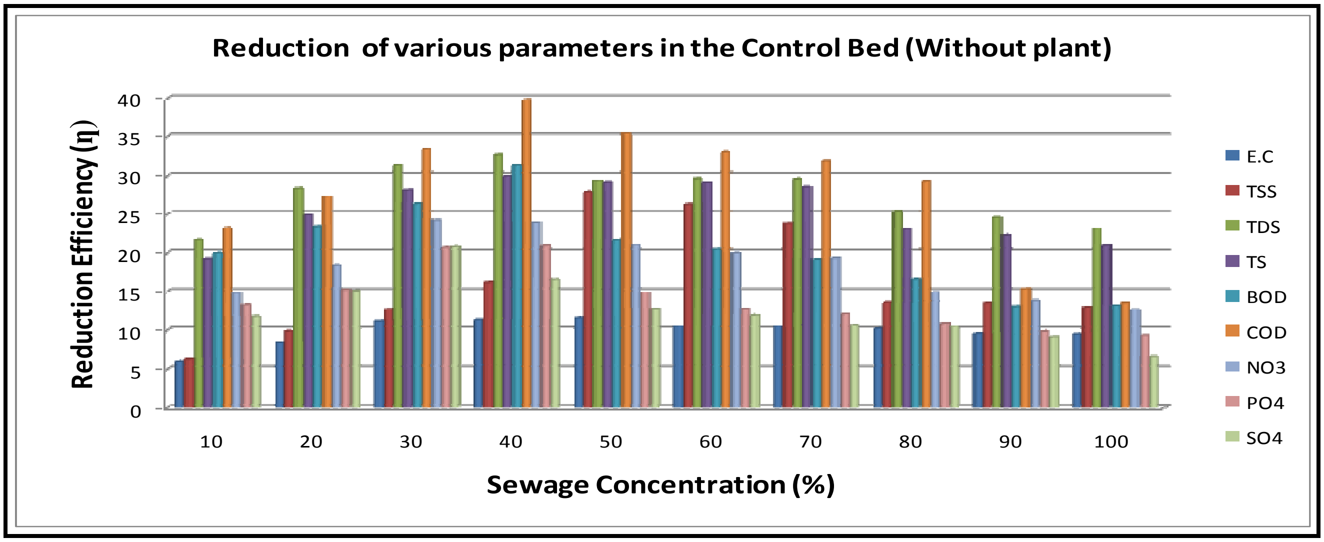

Figure-8
Reduction Efficiency of various parameters in the Control Bed (Without plant).

The colour and odour were removed and hence treated samples were observed clear and odorless. The average wastewater pH values obtained in the plant bed for the inlet and outlet of Angular- HSSF- CW were 6.79 to 7.26 and in the control bed 6.79 to 7.22 respectively. This increase of pH value may be due to formation of some acidic components in the bioremediation process. In our earlier study, a similar trend in pH value was observed at same rate of HRT[14]. Other authors also have reported the decreasing trend in pH in the lake water by using various aquatic macrophytes[29, 30, 31] and also noticed the average colour removal from pulp and paper mill wastewater through HSSF-CW. It was by 97% and the change in pH at decreasing mode while some of them reported the change in pH in decreasing mode in his field scale study of domestic wastewater using *Phragmites karka*[32].

The maximum EC reduced was by 23.68%, TSS were reduced by 46.15%, TDS were reduced by 50.08%, TS were reduced by 49.34%, BOD was reduced by 54.30%, and COD was reduced by 58.69%. The COD removal is believed to occur rapidly through settling and entrapment of particulate organic matter in the void spaces of the substrate[33]. The substrate is the main supporting material for plants and microbial growth. Fine gravel promotes higher growth of plants and therefore increases the quantity of contaminant removal[34]. The microorganisms attached to the root zone of the plants play a very important role in the degradation of organic matter. They play crucial role in the conversion of organic carbon to carbon dioxide. In this process, the oxygen is supplied by the roots of the plants[35]. Soluble organic matter may also be removed by number of separation processes including absorption and adsorption. The degree of sorption and its rate are dependent on the characteristics of both organic and the solid surface[36]. The maximum NO_3 was reduced by 59.48%, PO_4 was reduced by 46.99% and SO_4 was reduced by 39.32% respectively in present study. These pollutants were reduced due to reed bed of *Colocasia esculenta.* In addition to this, phyto-volatilization is also an important phenomenon for the removal of pollutants from the CW. Some wetland plants also take up pollutants directly through the root transport system and transfer them to the atmosphere via their transpiration system [37, 38, 39]..

In the reference or control set (without plant), the maximum pollution reduction efficiency was observed at 40% and 50% sewage concentration. The maximum EC reduced was by 11.62%, TSS were reduced by 27.90%, TDS were reduced by 29.65%, TS were reduced by 29.94%, BOD was reduced by 31.26%, COD was reduced by 39.81%, NO_3 was reduced by 24.21%, PO_4 was reduced by 20.89% and SO_4 was reduced by 20.75% respectively. These pollutants were reduced in the reference set due to trickling process and biofilm of aerobic and anaerobic microorganism. The difference in the efficiency of each parameter in both sets indicates that the use of *Colocasia esculenta* is helpful for better treatment of sewage at almost all concentrations studied as compared to reference set. As a result, the treatment efficiency is higher at 70% concentration of sewage, in experimental test set with *Colocasia esculenta* over the reference or control set without *Colocasia esculenta.*

The results obtained by the analysis of soil indicate that the concentration of macro and micro nutrients were maximum in treated sets over the control bed (without plant) than nursery soil of before treatment and *Colocasia esculenta* treated bed of CW. This increase of nutrients levels in the soil was due to continuous addition of concentration of sewage for the pollution reduction efficiency study.

Conclusion

Angular Horizontal Subsurface Flow Constructed wetland through phytoremediation is an effective green technology for the treatment of sewage. The proper selection of locally adaptive aquatic plant is more trust worthy and insured technology for better treatment of sewage in local environment. The difference in the efficiency of each parameter in both sets indicated that the use of *Colocasia esculenta* is helpful for better treatment of sewage at almost all concentrations as compared to reference or control set of CW. The pollution reduction efficiency is higher up to 70% dilution factor in experimental test set with *Colocasia esculenta* than the reference or control set (without plant). It is concluded that *Colocasia esculenta* is capable and suitable plant for the treatment of city sewage. This plant is a mostly adaptive in western region of India. It has considerable capacity of pollution reduction and generating treated water which is useful for some common uses like gardening, washing, irrigation and general uses like toilet flushing, cooling, floor washing and cleaning applications in both, households and industries.

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