International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Feasibility Study of Phytoremediation in Wastewater Treatment

Sheena K.N[1], Harsha P[2]

[1]A P J Abdul Kalam Technological University, Department of Civil Engineering, Faculty of Civil Engineering, M-DIT Ulliyeri, Calicut

[2]A P J Abdul Kalam Technological University, Department of Civil Engineering, PG Student in Environmental Engineering, M-DIT Ulliyeri, Calicut

Abstract: ***Surface and subsurface water resources are polluted due to rapid urbanization and industrialization, population exploitation etc. Now the water consumption is more and the clean water demand is also high. Recycle and reuse of wastewater is the solution to solve these problems. Phytoremediation is an emerging natural green technology that removes the contaminants from water, soil and sediments by using natural properties of wetland plants. Grey water and industrial wastewater such as dairy effluent are treated with different commonly available wetland plants to analyze the feasibility of phytoremediation in wastewater treatment by constructing the simple wetland based technology (popularly known as phytorid technology). In the present study comparative assessment of the efficiency of different available natural wetland plants are analyzed. These plants are planted in the 3 small scale phytoremediation chambers (cannas plant & umbrella palm in first chamber, water hyacinths & fern type vascular plants in second chamber, combination of both of these and marigold, pea plant, hibiscus are planted in third chamber). The physicochemical characteristics such as turbidity, pH, TSS, TDS, BOD, COD, iron, chloride were done before and after treatment. The results are compared with CPCB standards. Result shows promising reduction in BOD, COD, turbidity, TSS, and also irons and chloride contents are reduced. The result also reveals the effect of microbial action in rhizosphere which promote plant growth have considerable effect on phytoremediation.***

Keywords: Grey Water, Dairy waste water, Phytoremediation, BOD, COD, TSS, TDS, DO etc

1. Introduction

Water is an essential element for existence of life. Literally, it is the source of life on earth. About 70% of the earth is water but only one percent is available surface fresh water. Due to rapid population growth & industrialization water consumption is increased which leads to water scarcity & related water pollution problems. Proper treatment of waste water generated by various sectors will be necessary for safe disposal. Use any process that refits the quality of water to make it more acceptable for its reuse. Domestic or municipal wastewater, storm water discharge, agricultural runoff and industrial waste water are major sources of waste water. From the domestic supply of 135lpcd, 80% is converted into waste water. This wastewater includes 70% grey water [18]. Grey water is all waste water that is discharged from a house; excluding black water (toilet water).This include water from showers, bathtubs, sinks, kitchen dishwashers, laundry tubs, and washing machine. Typically 50-80% of the household's waste water is grey water. Industrial activities also contributes significant waste load on environment and treatment units. The dairy industry is a major source of food processing waste water in many countries. The Bio-chemical Oxygen Demand (BOD) of wholesome milk is estimated at 100,000 mg/l for cow's milk and about 1, 33,000 mg/l for buffalo's milk Thus it is clear that wastewater generated from dairies have high BOD. The other significant pollutants are Total Suspended Solids (TSS), Oil and Grease, Total Nitrogen, Total Phosphorous and it can occasionally contain pathogenic bacteria. The dairy effluent adversely affects fish and other aquatic organisms and algae so the disposal of untreated dairy water is rapidly becoming a major economic and environmental problem in many respects [20].

A natural and economic method like phytoremediation is the solution. Phytoremediation is a bioremediation process that uses various types of plants to remove, transfer, stabilize, and destroy contaminants in wastewater as well as contaminated sites [11]. In this project the grey water and dairy waste water can be recycled or treated successfully by using phytoremediation. Phytoremediation is achieved by constructing the specifically designed wetland based technology (popularly known as phytorid technology). The phytorid system is advantageous because of its cost effectiveness, minimum electricity requirements and its high efficiency to recycle and reuse water [1]. A proper functional phytorid system is present at National Environmental Engineering Institute (NEERI) unit, University of Mumbai [7]. 3 numbers of simple small scale units of phytoremediation chambers with 0.3 m deep, 0.6 m long, 0.4 m wide are constructed. Different available natural wetland plants are planted in these 3 chambers (cannas plant & umbrella palm in first chamber, water hyacinths & fern type vascular plants in second chamber, combination of both of these and marigold ,pea plant, hibiscus are planted in third chamber). In these chambers treatment is carried out. This project shows natural ecofriendly solution for waste water treatment.

2. Objectives

- To analyze the feasibility of phytoremediation in wastewater treatment.
- Evaluate the efficiency of phytoremediation in grey water and dairy wastewater treatment.
- Evaluate the phytoremediation efficiency in different chambers using different plant species.

- To analyze the variation of phytoremediation process in different plant species & combination of selected plants with natural pea plants for evaluating the effect of microbial action in plant growth as well as phytoremediation.
- Check the effect of different hydraulic retention time (HRT) in pollutant removal.
- Quality of treated water will compared with prescribed standards and obtains the sustainability of phytoremediation.

3. Phytoremediation

Phytoremediation is a term applied to a group of technologies that use plants to reduce, remove, degrade, or immobilize environmental toxins, primarily those of anthropogenic origin, with the aim of restoring area sites to a condition useable for private or public applications [23]. Phytoremediation is the passive wastewater treatment methods and using plants-based systems and microbiological processes to eliminate contaminants in nature. Phytoremediation is based on the physiochemical properties of the plants and associated microorganisms, such as photosynthesis, metabolism and mineral nutrition. It is a plant based on bioremediation technology [15]. The phytorid system is advantageous because of its cost effectiveness, minimum electricity requirements and its high efficiency to recycle and reuse water [1]. A proper functional phytorid system is present at National Environmental Engineering Institute (NEERI) unit, University of Mumbai [7]. The Treatment methods are usually classified as physical, chemical and biological. The Phytorid Technology is the combination of all these three processes needs in the treatment. The general concept design for the Phytorid Technology is Advanced Filter Cell (AFC), that supports a permutation of different sizes of stones and gravel wherein anaerobic digestion occurs and Phytorid Treatment Cell (PTC) made up of different layers of life supporting media (Gravel) as in AFC, planted with wetland plants and Final Collection Cell (FCC) [1]. In the phytoremediation process plants detoxifies or stabilizing the contaminants by different aspects or mechanisms. Mainly six mechanisms of contaminant removal are occurring in phytoremediation namely phytoextraction, phytodegradation, rhizosphere degradation, rhizofiltration, phytostabilization, phytovolatization [23]. The waste water treatment is dependent on both plant species and microbial consortia that specific to the used plant system. So the ultimate removal of the organic and inorganic load from the waste water is the consolidate effect of the biota [1].

4. Materials and Methodologies

4.1 Sample Collection

In this project grey water and dairy wastewater are used for determining the feasibility of phytoremediation in wastewater treatment. The grey water is collected from M-DIT College Ulliyeri. The waste water includes water from kitchen sink, floor cleaning, utensil washing etc. After collection of sampling the wastewater are poured to sedimentation tank and immediately test the parameters before treatment in the laboratory. For obtaining clarity of treatment continuous 5 week sampling is done.

Second sample is considered as an industrial effluent to analyze the efficiency of phytorid treatment to treat the industrial effluent. Dairy wastewater collected from Kozhikode dairy at Peringolam under Kunnamangalam near 15 km from Calicut. 25 litre of sample is collected in colourless bottles. The parameters are checked immediately for the waste water and 5 litre sample is kept for blank to analyze characteristic change. Alternative 2 weeks samples are taken for the analysis.

4.2 Experimental Setup

In this project the grey water and dairy wastewater can be recycled or treated successfully by using phytoremediation. The treatment unit includes settling/collection tank, phytoremediation chamber & a treated water collection mechanism. 50 litre capacity plastic bucket is used as sedimentation tank in this system. ½ inch taps are provided in collection tank & three phytoremediation chambers for distribution of waste water & collection of treated water. 3 numbers of simple small scale units of phytoremediation chambers with 0.3 m deep, 0.6 m long, 0.4 m wide are constructed. The phytoremediation chamber constitutes different layers of coarse aggregate and soil. Bottom layer is filled with coarse aggregate of size 20 mm with 6cm depth and middle layer is filled with soil of 6cm depth & the top layer is filled with small size coarse aggregate (baby metal) of 6mm with 6 cm depth. cannas plant & umbrella palm in first chamber, water hyacinths & fern type vascular plants in second chamber, combination of both of these and marigold, pea plant, hibiscus are in third chamber are planted carefully. Sub-surface flow of waste water is provided from 3 cm below the top surface of aggregate level by provide a 20 mm 4cm long PVC pipe in the side of the chamber with 1 cm above the aggregate level & sufficient length of water distribution pipe (hose) is used to discharge the wastewater to the top of the PVC pipes fitted in the bed of the chamber.

Figure 1: Experimental Setup

4.3 Treatment Techniques

4.3.1Grey water treatment using phytoremediation:

The grey water is collected from canteen of M-DIT College Ulliyeri. The wastewater includes water from kitchen sink, floor cleaning, utensil washing etc. After collection of sampling the waste water are poured to collection tank or sedimentation tank and provide sufficient settling of large

particle in the waste water by gravity. Then the 5 litre of grey water is loaded to each phytoremediation chamber and treatment efficiency are checked with different HRT (6hr, 24hr, & 48hr). 5 week Continuous sampling and treatment are done to analyze effect of phytoremediation in grey water treatment by wetland based phytorid treatment.

4.3.2 Dairy Wastewater treatment using Phytoremediation

Dairy wastewater collected from Kozhikode dairy at Peringolam under Kunnamangalam near 15 km from Calicut respectively. 25 litre sample are collected and immediately transfer to collection tank and transfer to the each phytoremediation chamber. The effect of phytoremediation method was determined for reduction of various parameters over each day in a week. Alternate two week samples are taken for analysis. 5 litre sample is kept for blank to analyze characteristic change. Check the reduction of contaminants in different phytoremediation chamber. Variations of different parameters in different phytoremediation chamber are compared with the variation of parameters occurs in the blank during the treatment process.

4.4 Physico- Chemical Analysis

The various parameters are measured before and after treatment are included in analysis technique. Various parameters are pH, TSS, TDS, BOD, COD, turbidity, chloride, iron & DO etc. These are measured immediately after sampling and treatment in laboratory by using the standard methods by American Public Health Association (APHA 1985). The characterization of wastewater and treated water will be obtained by sample testing.

5. Results and Discussion

This section deals with the various test results & its discussion showing promising results of phytoremediation in wastewater treatment obtained by phytorid treatment. Efficiency of phytoremediation in grey water treatment and dairy wastewater treatment are discussed separately.

5.1 Results of Grey Water Treatment

After the 5 week continuous analysis of grey water treatment by using phytoremediation will established during the experimental study. Efficiency from removal of contaminants from grey water in different wetland plants such as cannas & umbrella palm, water hyacinth & fern type plants, combination of both including hibiscus and a pea plant are shows promising results. All chambers shows significant removal efficiency and better efficiency occurs in third chamber. Results of phytoremediation in grey water treatment are summarized & comparison of grey water treatment during 5 week with different HRT is obtained. The 5th week test results are presented in tabular column because of the treatment efficiency increased during continuous treatment.

Table 1: Characteristics of Grey Water Before treatment

Parametrers	Before treatment
pH	8.7
Turbidity(NTU)	309
DO (mg/l)	2.9
TSS(mg/l)	256.8
TDS(ms/ppt)	804.67
BOD(mg/l)	180
COD(mg/l)	680
Chloride(mg/l)	116.98
Iron(mg/l)	0.58

Table 2: Characteristics of Grey Water after treatment

Parameter	After treatment								
	Chamber 1			Chamber 2			Chamber 3		
	HRT			HRT			HRT		
	6 hr	24 hr	48 hr	6 hr	24 hr	48 hr	6 hr	24 hr	48 hr
pH	8.2	7.238	7.2	8.3	7.4	7.35	8.2	7.15	7.1
Turbidity (NTU	18	4	4	20	6	5	16	5	4
DO (mg/l)	2.1	4.2	5.5	2.4	4.4	5.6	2	4.6	5.6
TSS (mg/l)	89.8	64.2	36	97.5	71.9	48.7	82.1	56.4	30.8
TDS (ms/ppt)	8	8	7.98	8.04	8	7.99	8.01	8	7.98
BOD (mg/l)	135	57.6	36	136.8	54	32.4	135	52.2	28.8
COD (mg/l)	523.6	280	230	544	270	210	510	260	204
Chloride (mg/l)	101.77	90	92.8	102.9	91.24	95.21	99.43	87.73	90.39
Iron (mg/l)	0.48	0.35	0.35	0.51	0.36	0.36	0.48	0.32	0.32

Removal efficiency of each parameter in each chamber with different HRT in fifth week are shown by graphs for easy analysis of result. Considerable reduction are noticed in all 3 chambers. From the above results following graph is plotted, showing results of BOD, COD, TSS, chloride & turbidity. Characteristics graph is plotted as follows

Removal efficiency of BOD in each chamber with different HRT in fifth week is shown in figure 2.

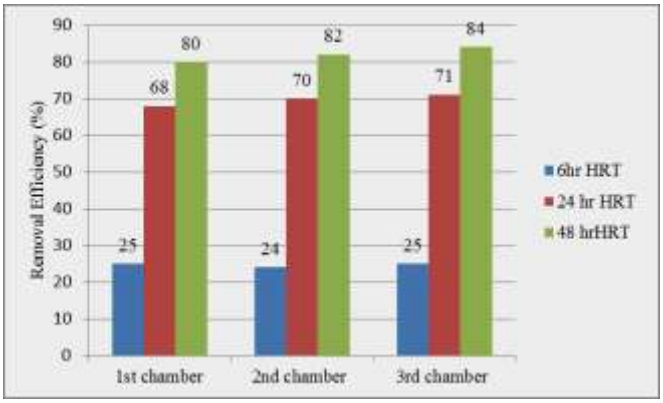

Figure 2: Removal efficiency of BOD

The removal efficiency of BOD is increased with HRT. Maximum removal efficiency is obtained in third chamber. Average removal efficiency of BOD is 70% with 24hr HRT (180 mg/l reaches to 57.6 mg/l, 54 mg/l, 52.2 mg/l in 1st, 2nd and 3rd chamber respectively) and it removed up to 82% in 48hr HRT. The treated water of 48hr HRT has BOD of 36 mg/l, 32.4 mg/l, 28.8 mg/l in each chambers.

Figure 3 shows the removal efficiency of COD in different chambers with different HRT in fifth week.

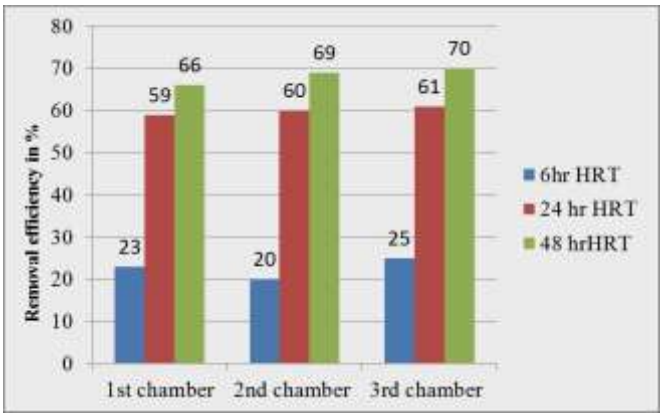

Figure 3: Removal efficiency of COD

The maximum COD removal is obtained from third chamber with 48hr HRT. 680 mg/l reduced to 230 mg/l, 210 mg/l, and 204 mg/l in 1st, 2nd & 3rd chamber respectively. Average removal efficiency of COD ranges to 65-70% in all chambers. TSS removal by phytoremediation are shown in figure below

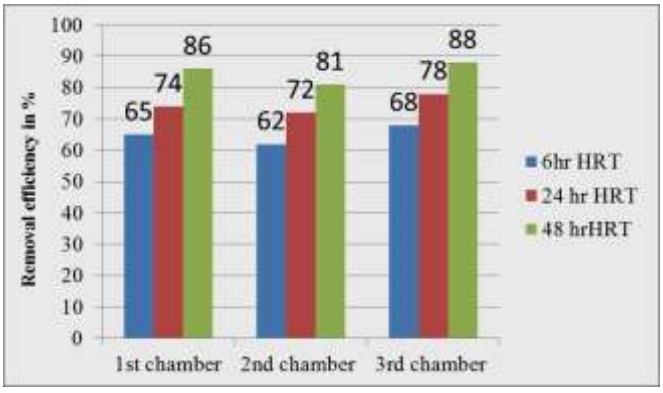

Figure 4: Removal efficiency of TSS

TSS not only contributes the load of suspended impurities, but also increases the turbidity and reduces light penetration. The reduction in TSS is found to be 74 %, 72%, 78% in different chambers with1 day HRT. Removal efficiency enhanced up to 86%, 81%, & 88% in 1st, 2nd & 3rd chamber with 48hr HRT. TSS mainly removed by physical process of sedimentation.

This graph shows removal efficiency of chloride by different phytorid plants in fifth week.

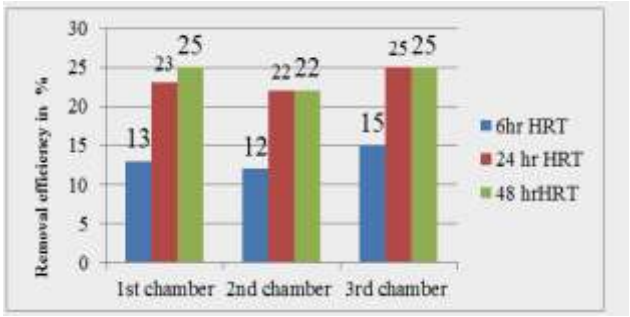

Figure 5: Removal efficiency of Chloride

Before treatment chloride ranges of grey water is 116.98 mg/l & after treatment chloride content of different chambers are reduced drastically with HRT and reaches to 92.8 mg/l, 95.21mg/l, and 90.39 mg/l in each chamber with 48hr HRT. Maximum removal efficiency is around 25%.

High removal of turbidity is achieved by phytoremediation. The removal efficiency of each chambers are shown in figure: 6.

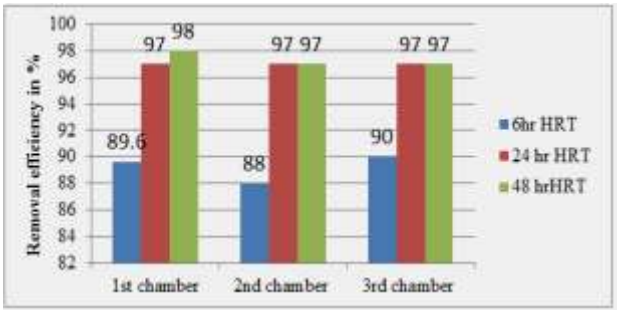

Figure 6: Removal efficiency of Turbidity

The turbidity range of grey water in before treatment is 309 mg/l and it reaches to 4 mg/l, 6 mg/l, 5 mg/l in first, second & third chamber with 24hr HRT and 4 mg/l, 5 mg/l, 4 mg/l So the turbidity removal is high in all chambers. Removal is around 97%. 88-90 % turbidity removal is achieved by 6hr HRT.

The entire chamber the removal efficiency is increased after a 2-3 week treatment due to stabilization of system and enhanced plant growth & root structure. The results reveal that the treatment or removal efficiency of all parameters are increased while increasing HRT. After 4 to 5 week 24hr & 48hr HRT shows maximum removal efficiency so 24hr is taken as optimum. All the parameters show maximum removal efficiency in third chamber. At the final week of sampling the removal efficiency of BOD in different chambers with 24hr HRT will be 68%, 70%, & 71% which

reaches to 80%, 82%, & 84% with 48hr HRT. COD value of fifth week sampling will be 680 mg/l. This will be reached to each chamber 280 mg/l, 270 mg/l, 260 mg/l respectively with 24hr HRT and it again reduced to 230 mg/l, 210 mg/l, 204 mg/l respectively in 48hr HRT. Phytorid treatment shows excellent removal of turbidity (up to 98%), TSS (up to 80-88%) and also TDS, chloride, iron contents are reduced. Chloride and iron are taken by plant for their cell growth.

Figure 7: Grey water before and after treatment

5.2 Results of Dairy Wastewater Treatment

Dairy wastewater collected from Kozhikode dairy at Peringolam under Kunnamangalam near 15 km from Calicut respectively. The effect of phytoremediation method was determined for reduction of various parameters over each day in a week. Alternate two week samples are taken for analysis. 5 litre sample is kept for blank to analyze characteristic change. Check the reduction of contaminants in different phytoremediation chamber. Variations are compared with the blank. The second week sample is stronger than first so the test results of each days in second week are concluded in tabular columns.

Table 3: Variation of dairy wastewater blank

Parameter	Unit	Day 1	Day2	Day 3	Day4	Day5
pH		6.95	6.8	6.985	7.35	7.58
Turbidity	NTU	330	302	210	143	69
DO	mg/l	3.1	2.8	2	1.6	0.9
TDS	ms/ppt	880	898	868	846	828
TSS	mg/l	798	790	782	743	700
Chloride	mg/l	158	169	169.8	135	130
BOD	mg/l	1150	1280	1200	1050	990
COD	mg/l	784	758	725.3	600	540
Iron	mg/l	3.2	3.12	2.98	2.56	1.850

Table 4: Variation of dairy wastewater in different chamber

	Parameter	pH	TDS	TSS	Turbidity	chloride	BOD	COD	Iron	DO
Day 1	Chamber 1	6.98	835	56	5	116.8	970	620	0.584	2.2
	Chamber 2	6.95	846	62	9	118.9	990	658	0.57	2.3
	Chamber 3	6.86	828.8	54	7	116	980	617	0.563	2.1
Day 2	Chamber 1	6.986	823	53	5	110.3	857	550	0.56	2
	Chamber 2	6.975	835	61	8	114.5	950	596	0.57	2.1
	Chamber 3	6.9	822.5	52	5	111	843	523	0.55	2
Day 3	Chamber 1	7.01	813.8	50	4	104	628	378	0.478	1
	Chamber 2	6.99	828.7	57	5	111.9	760	395	0.492	1.9
	Chamber 3	6.95	812	48	4	107	603	366	0.49	1.8
Day 4	Chamber 1	7.1	813	47	4	102.8	388	315	0.429	2.9
	Chamber 2	7.05	820	54	4	108.9	368	297	0.45	2.5
	Chamber 3	6.985	812	43	3	101	320	272	0.427	2.6
Day 5	Chamber 1	7.23	806	36	3	102	105	228	0.345	4.9
	Chamber 2	7.06	812	45	4	105.4	102	200	0.315	5
	Chamber 3	7.01	804.8	32	3	102	98	186	0.31	5

In this study of dairy wastewater is suitable for treating with the emerging green technology called phytoremediation. Phytorid treatment is suitable for treat the industrial effluent such as dairy effluent. The test result reveals the reduction in BOD, COD, TSS & Turbidity etc. Dairy effluent is strong with high BOD and COD. These parameters are considerably reduced by phytoremediation at the weekend. COD removal is 65% &70% in 1st chamber in week 1 and week 2 respectively. This increased gradually in second and third chamber. In second chamber it increases to 65% and74% in week 1, week 2 respectively. Also 67% & 76% COD is removed in 3rd chamber with alternate weeks. BOD removal efficiency in 1st, 2nd & 3rd chamber after 5th day of both week are 84%, 90%, 90% in first sampling and also 90%, 91% & 91%.Naturally available wetland plants such as water hyacinth and fern type plants shows promising result to treat the industrial effluent because it increases the dissolved oxygen content in treated water and treatment efficiency is gradually increases after 3rd day of treatment. Cannas plant shows valuable contaminant reductions with enhancing the aesthetic beauty. Third chamber shows better removal efficiency when compared with others due to the effect of plant growth and plant growth promoting rhizobium fixation by pea plant. The remarkable reduction in BOD, COD, chloride, TSS & turbidity are represented by the help of line graph and also the dissolved oxygen (DO) variation and pH variation in each day in a week will be analyzed and its variations are plotted against the blank.

Figure 8 shows the BOD variation of dairy blank and treated water from different chambers of each day in a week

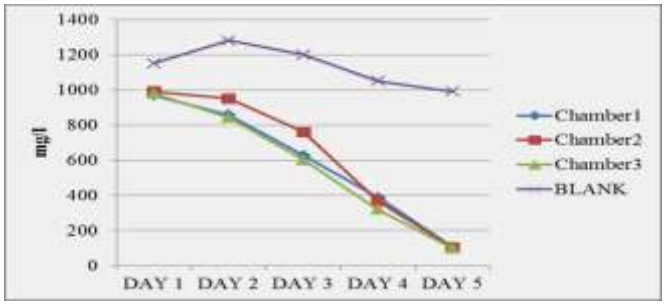

Figure 8: BOD variations in dairy wastewater treatment

Dairy wastewater is very strong and biodegradable in nature. The dairy wastewater has high BOD in initial days. The blank shows a small increase in second day and then slowly reducing the BOD loading to the system by self-purification by diffusing the oxygen present in the environment which results the reduction of BOD of the blank. In the case of different phytorid chambers the BOD gradually reduces and reaches up to below 100 mg/l at the end of 5th day. So the BOD range is within CPCB standard.

This graphs represents the COD variation of dairy waste water.

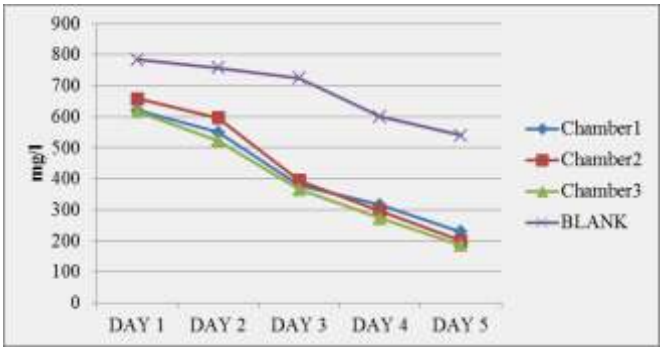

Figure 9: COD variations in dairy wastewater treatment

The COD value gradually reducing over each days of a week. Initial dairy wastewater has a COD value of 784 mg/l. After the 5th day it will reaches below 250 mg/l. The values of COD are 228mg/l in 1st chamber, 200 mg/l in 2nd chamber & 186 mg/l for 3rd chamber. After the 5th day the COD value of blank will be 540mg/l. Removal efficiency of COD is ranges to 70-76%. Maximum removal efficiency is obtained in third chamber.

Figure 10 represents the variation of DO in dairy blank and various chambers are shown below.

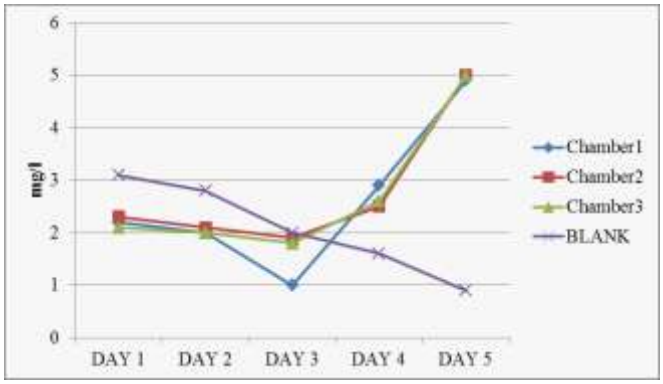

Figure 10: DO variations in dairy wastewater treatment

The presence of DO has determined in each days of a week. The initial DO present in sample is 3.1 mg/l. In the blank the DO value consistently decreasing and reached to 0.9 mg/l at the end of 5th day. The DO value of each chamber will decrease in initial days of treatment after 3rd day DO value will be increasing. DO value reaches up to 5 mg/l. Increased DO improves the treatment quality

Turbidity reduction in each chambers and variation in blank are shown in figure 11

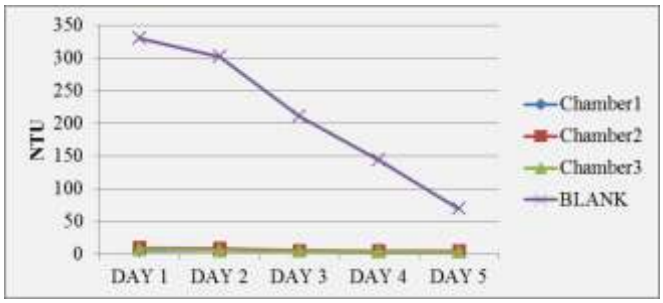

Figure 11: Turbidity variations in dairy wastewater treatment

The dairy wastewater is containing high amount of fats and oil. Initially the dairy waste water is highly turbid and shows a milky appearance. Initial value of turbidity is noted as 330 NTU after the 1st day treatment it tremendously reaches to below 10 in all chambers & at the end of 5th day turbidity in 1st, 2nd, and 3rd chambers are 3 NTU, 4 NTU, and 3 NTU. Cannas and umbrella palm (1stchamber) and combination of cannas, natural fern type, water hyacinth and marigold, pea plant, hibiscus (3rd chamber) shows maximum turbidity reduction.

pH variation of dairy wastewater analyzed each day in a week by pH meter. Similiarly pH of treated water from different chambers are noted. Variation of pH are plotted below.

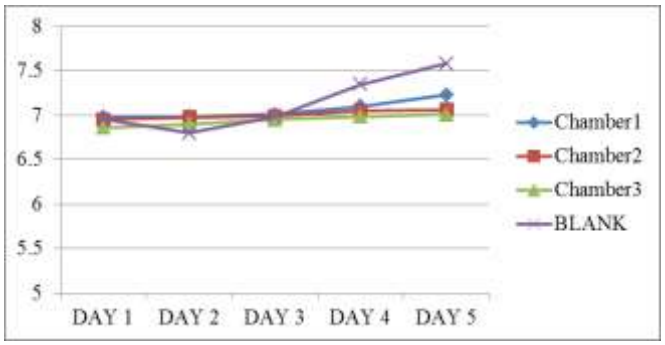

Figure 12: pH variations in dairy wastewater treatment

Initial pH of dairy wastewater is 6.95. In the blank this will be changes to 7.58 after the end of 5th day. All the chambers show pH in neutral range after 5th day of treatment.

Figure 13 represents the chloride reduction of dairy wastewater by phytoremediation.

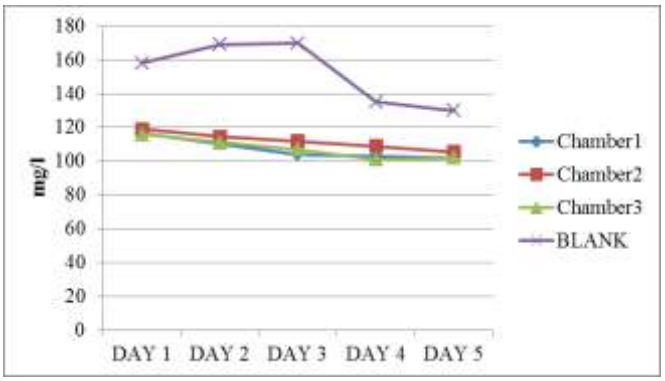

Figure 13: Chloride variations in dairy wastewater treatment

Chloride content of dairy wastewater is due to milk processed; product of manufacturing and also cleaning of equipment's & can. Initial chloride content of sample is 158 mg/l. This will gradually increase and then decreased. At the end of 5th day chloride contents of each chambers are 102 mg/l, 105.4 mg/l, and 102 mg/l respectively.

TSS variation of dairy blank and treated water are shown below

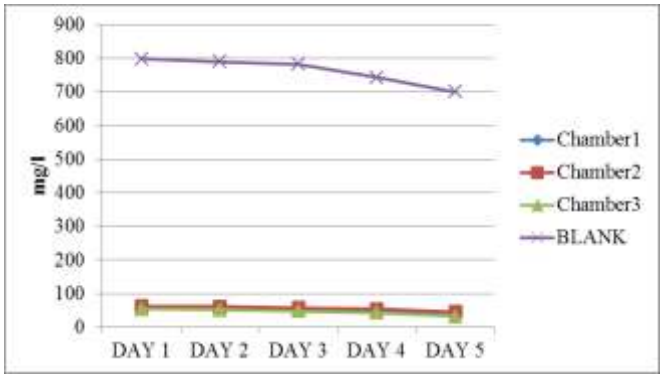

Figure 14: TSS variations in dairy wastewater treatment

Dairy wastewater shows high suspended impurities so initial the TSS concentration of dairy wastewater is 798 mg/l. In the blank this will be reduced to 700 mg/l in the 5th day. All treated water shows TSS concentration below 100 mg/l at its 1st day of treatment. Almost 95 % removal is obtained for TSS.

Figure 15 gives the observational result of phytoremediation in dairy wastewater treatment. Initially the influent shows the milky appearance with oil content after the treatment it will be clear with free from oil and fat.

Figure 15: Dairy Wastewater and treated water

This result shows this dairy effluent is properly treated by phytoremediation. Treated water nearly meets the irrigation standards. Naturally available wetland plants such as water hyacinth and fern type plants shows promising result to treat the industrial effluent because it increases the dissolved oxygen content in treated water and treatment efficiency is gradually increases after 3rd day of treatment. Cannas plant shows valuable contaminant reductions with enhancing the aesthetic beauty. Third chamber shows better removal efficiency when compared with others due to the effect of plant growth and plant growth promoting rhizobium fixation by pea plant. In this chamber shows maximum plant growth in terms of shoots and height of the plants observed under the treatment period. . Phytorid treatment is suitable for treat the industrial effluent such as dairy effluent. The test result reveals the reduction in BOD, COD, TSS & Turbidity etc.

6. Conclusion

According to these results phytoremediation is a promising technology for grey water treatment as well as dairy wastewater treatment. It is suitable for both domestic as well as industrial wastewater treatment. In this treatment will show remarkable reduction in BOD, COD, turbidity, TSS & TDS. The concentration of iron and chloride content are reduced. Commonly available wetland plants such as water hyacinth & fern type plants shows efficiency to treat the wastewater. It provides more DO to the system. Each chambers shows efficiency to purifying the wastewater. Cannas and umbrella palm have sufficient phytoremediation property. It treats wastewater and gives an aesthetic beauty. The third chamber shows better removal efficiency due to no of plants and microbial fixation. The no of plants are more in this chamber so it leads to wider root networks and also the pea plant is a legume plant are planted in the chamber this will naturally fix the growth promoting microorganisms such as rhizobium this leads to increasing growth rate and enhancing the treatment efficiency in stressed conditions. In this study clear that the phytoremediation property will be affected by plant growth and growth promoting microorganism's associated with rhizosphere. Phytoremediation process occurs in three chambers will dependent on HRT. HRT increases treatment efficiency also increases. After a continuous treatment the plant have wider root network then the time required for purification will be reduced. According CPCB Effluent standards 1995 BOD, COD, chlorides, turbidity, TSS & pH requires a minimum quality for effluent. In this study the treated water reaches the required quality for land irrigation. So the treated water by phytorid treatmet unit will be suitable for irrigation and agricultural purposes. The phytoremediation achieved by phytorid treatment by using natural available plants are suitable for reuse and the treatment is efficient for grey water & dairy wastewater treatment. Phytorid treatment or phytoremediation also enhances the beauty of environment and also solves the environmental problems with less cost and space. Treated water is fit for irrigation and suitable for agricultural reuse. Phytorid treatment is also suitable for wastewater treatment from campus, house, airports etc. It is applicable for secondary and tertiary treatment of wastewater. Phytorid treatment or phytoremediation is a green technology for wastewater treatment and contaminated land remediation.

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