

Experimental Setup for Treatment of Dairy Wastewater through Artificially Constructed Wetland

Rohan S. Gurav¹, Kiran K. Manthale^{1,2}, Nataraja M.³

Assistant Professor, Dept. of Water & Land Management, VTU, Belagavi, India¹

Dept. of Water & Land Management, VTU, Belagavi, India^{1,2,3}

ABSTRACT: The dairy industry is one of the most polluting food processing industry among all greater volume of wastewater, but also in terms of its characteristics as well. The wastewater generated by the industry is treated by the chemical process to reduce the physical and chemical parameters of wastewater which is more expensive in cost. In this study, artificial constructed wetland is used to treat dairy wastewater to reduce the physio-chemical characteristics and volume of wastewater generated. The 7 parameters are color, odour, pH, BOD, Alkalinity, Total solids, Total dissolved solids were selected for observation. It is found that the performance is observed by before and after treatment of dairy wastewater by the artificially constructed wetland. The experimental work carried out for 7 parameters which give a satisfactory result, hence this conventional treatment method can be used for the treatment of a large volume of dairy wastewater with the natural process and nominal cost. In this study is to treat wastewater generated from the dairy industry by artificially constructed wetland Physiochemical and organic parameters of wastewater samples of dairy were observed to determine the quality and extent of contamination. By which the pH, BOD, Alkalinity, TS, TDS and the significant reduction in the parameters were observed and hence found more useful. In the study, we found that initially, the waste water sample was too alkaline but after the treatment, the pH was observed near the Neutral also the BOD and Alkalinity removal about 79.5mg/L% and 190mg/L respectively observed.

KEYWORDS: Dairy wastewater treatment, Physical and Chemical parameter, Artificial Constructed (Fabricated) Wetland.

I. INTRODUCTION

A Wetlands is area saturated or inundated by water either permanent or seasonally, which produces anaerobic process, which in turn forces the biota, particularly rooted plants. Wetlands are considered as biological diverse of all ecosystems provides home to wide range of plants and animal life. In more recent organic and human generation, wetlands have been valuable as sources, increases ground water recharge, treatment of wastewater effluents, irrigation, industrial water supply, fishing etc.

1.1 Constructed wetland: Constructed wetland name itself indicates the artificial construction of wetlands are engineered systems, are man-made to utilize the natural functions of wetland vegetation, muds and their microbial inhabitants to treat contaminants in surface water, groundwater or waste streams. The feasibility of constructed wetland varies with waste characteristics and climate while the cost of wetland construction is low. [Julie K: Agriculture, Ecosystem and Environment 58(1996) 97-114]. There are some alternative economical methods are used to treatment of dairy wastewater as follows, flotation method, gravity separation method, anaerobic method and aerobic method of trickling filter and activated sludge methods. The constructed wetland treatment is the method by which the waste water is fed to the plant along its root zone there by it degrades the wastes along its intake and then the water percolates through the soil layer towards the outlet by collecting the water. [ISSN VOLUME 2 ISSUE6, 2014] The arrangements are simple. The medicinal plants such as Ajwain, Aloe Vera, Amruthaballi (Guduchi), and others forms of herbs and

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Vol. 6, Issue 8, August 2017

shrub can be used since they take water in large quantity than other family plants for this study. For experiment we have selected a plant from apiaceae family called as Trachyspermum. The experiments are carried out to reuse of water after experiment. The treatment of wastewater through filter bed and plant root absorption for photosynthesis process, physio-chemical parameters were evaluated before and after the study. So the aim of this study is to treat or degrade the dairy wastewater by natural process without chemical usage and to make the water for reuse.

Types of constructed wetlands

- 1) Surface flow constructed wetlands (Free water surface)
- 2) Subsurface flow constructed wetlands
 - A) Vertical flow SSFCW.
 - B) Horizontal flow SSFCW.

1.2 Subsurface flow of constructed wetlands

The wetland is filled with gravel/crushed rocks whose level is 5 cm to 10 cm above water level so that there is no exposure of wastewater to the surface. SSFCW need to be waterproofed, either through compacted clay, reinforced concrete or geomembranes of polyethylenetype. **SSFCW take 80% +/- less space than a SFCW** because of a longer hydraulic retention time as well as a more intense biological and treatment activity. There are two principal types of designs within SSFCW: Vertical Flow and Horizontal Flow SSFCWs. In this study horizontal flow is considered to carry the experiment.

Advantages of Constructed Wetland

1. Wetland are less expansive to construct and processing than mechanical systems.
2. Wetlands have less maintenance, only the maintenance required in monitoring of water level and cleaning of filter media every few years to remove solids and restore adsorption capacity.
3. In wetlands there is no bio-solids or sludge deposited, which further need to disposal.
4. Wetlands can also provide flora and fauna and be more aesthetically agreeable than other water treatment process.

II. MATERIALS AND METHODOLOGY

2.1 Effluent: The artificial fabricated wetland, experimental setup were installed according to the desired level of purification. The medicinal plants can be setup as primary or secondary treatment in dairy industry. The wastewater is collected after bar screening from Belagavi District Co-operative Milk Producers Societies Union Ltd. Belagavi, Karnataka, India. Latitude: 15.8496953, Longitude: 74.4976741.

2.2 Materials used for setup of pilot scale:Gravel of size 20mm, Sand, Red soil, Ajwain plant, Hard Glass of thickness 8mm, Inlet and outlet Valves, PVC pipe, plastic storage tank of 30Lit capacity.

2.3 Experimental Setup: The untreated dairy wastewater was supplied to fabricated wetland in a controlled routine with a flow rate of 1Lit/min. The dairy waste water was treated by fabricated wetland system. The details of artificial fabricated wetland are shown below: The fabricated wetland setup is 0.762M × 0.609M × 0.457M depth. All the side of fabricated wetland is made up of hard glass of thickness 8mm. the bottom layer is 15.2cm (6 inch) of gravel size 20mm. the middle layer is 5.08cm (2inch) of sand and the top layer is 15.2cm (6 inch) of red soil. The outlet pipe is one inch from the wetland depth of 18 inch. The applied flow pattern to the artificial fabricated wetland was surface flow type. Plant of Ajwain were planted on the top layer of fabricated wetland. Treated wastewater from the outlet were collected and analyzed in the laboratory for the following parameters pH, BOD_{3@20}, Alkalinity, Total solids, Total dissolved solids. All the test were carried out as per the standard methods. The artificial fabricated wetland was under observation for effluent collection from 15th April 2017 to 30th May. All experimental test were conducted in Environmental Laboratory.

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Vol. 6, Issue 8, August 2017

III.RESULT AND DISCUSSION

3.1 pH results

A hydrogen ion concentration in the wastewater is shown in graph. During the study pH values were measured throughout the study period. The pH values fluctuated with a range 7.2 to a high of 7.8.

Table 3.1:pH values

Hours	6h	12h	18h	24h	48h
Initial pH values	14.5	13.8	12.2	10.5	11
Outlet pH values	7.8	7.5	7.2	7.2	7.3

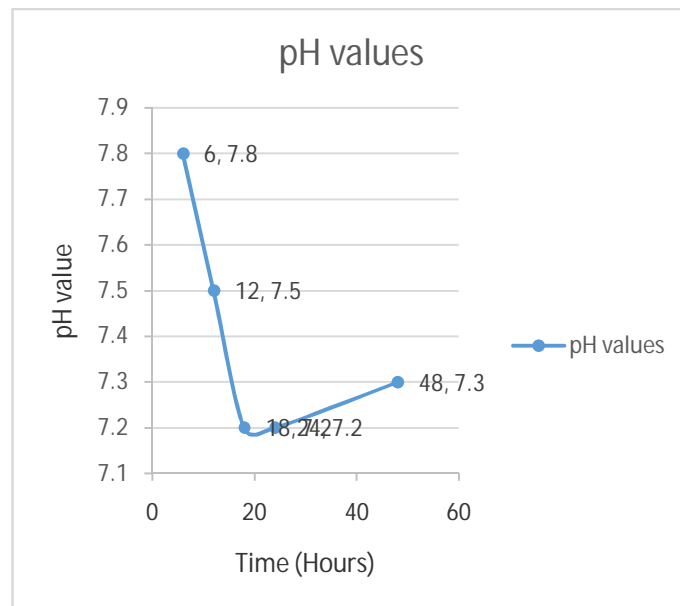


Fig 3.1: Shows the Variation in pH Values with respect to time

3.2 Alkalinity

Alkalinity in dairy wastewater resulted both P- alkalinity as well as M-alkalinity. The experimental study carried out P-alkalinity [Phenolphthalein] is absent after the treatment and M-alkalinity [Methyl orange] were evaluated as 190mg/L to 274mg/L.

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Vol. 6, Issue 8, August 2017

Table 3.2: Alkalinity Values

Alkalinity mg/L(Before treatment)	P- Alkalinity 190mg/L		M-Alkalinity 310mg/L		
	6h	12h	18h	24h	48h
Hours	6h	12h	18h	24h	48h
Alkalinity mg/L (After treatment)	274	230	190	200	208

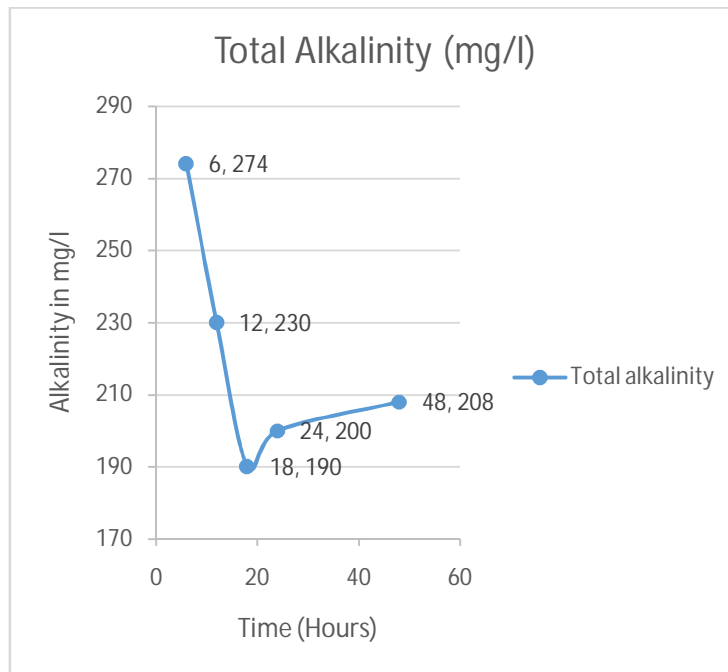


Fig 3.2: Shows the Variation of Alkalinity with respect to time.

3.3 Total Solids

Total solids were tested using boiling of wastewater in porcelain evaporating dish taking of 50ml, it is found that total solids is of 2000mg/L before treatment. After treatment with respect to time total solids reduces to 1250mg/L at 18 hours.

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Vol. 6, Issue 8, August 2017

Table 3.3: Total Solids Values

Total solids mg/L(Before treatment)	2000mg/L				
	6h	12h	18h	24h	48h
Total solids mg/L (After treatment)	1720	1700	1250	1400	1480

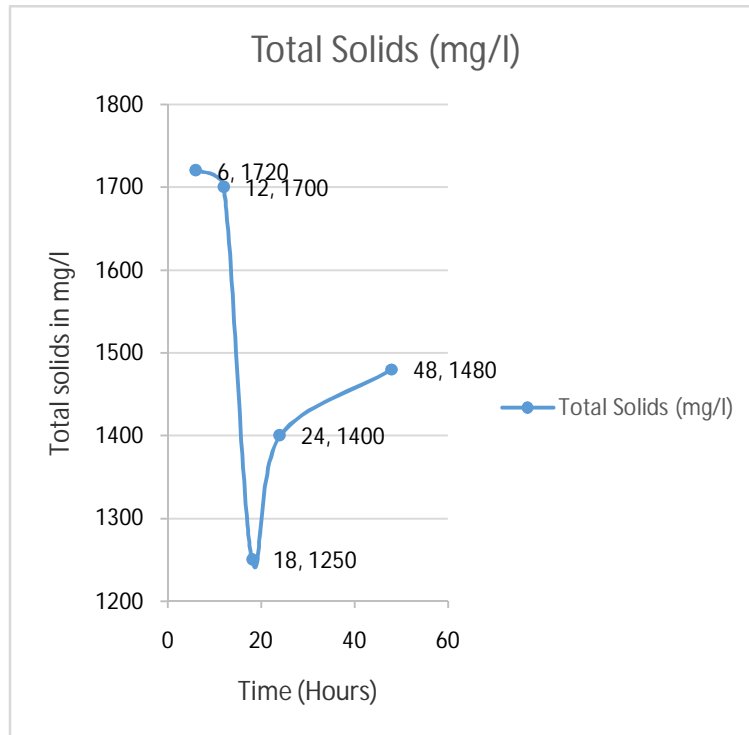


Fig3.3: Shows the Variation of Total Solids with respect to time.

3.4 Total Dissolved Solids

The reduction in dissolved solids was observed during the study. Initially at 712 mg/L before treatment. After treatment through constructed wetland gradually decreased with respect to time.

International Journal of Innovative Research in Science, Engineering and Technology

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Website: www.ijirset.com

Vol. 6, Issue 8, August 2017

Table 3.4: Total Dissolved Solids Values

TDS mg/L (Before treatment)	712 mg/L				
Hours	6h	12h	18h	24h	48h
TDS mg/L (After treatment)	476	410	300	378	392

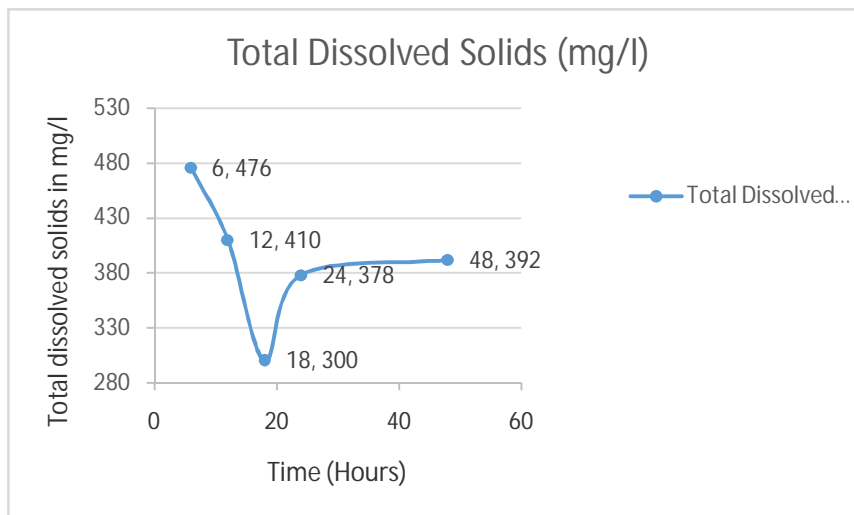


Fig 3.4: Shows the Variation of Total Dissolved Solids with respect to time

3.5 Biological Oxygen Demand (BOD₃)

The biological oxygen demand is tested by volumetric method taking a sample of 200ml BOD bottles, for testing initial DO and one sample bottle is kept in incubi meter for 3days DO to find BOD of the wastewater.

Table 3.5: Biological Oxygen Demand Values

BOD ₃ mg/L (Before treatment)	79.5 mg/L				
Hours	6h	12h	18h	24h	48h
BOD ₃ mg/L (After treatment)	78	63	43.5	60	65.10

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Vol. 6, Issue 8, August 2017

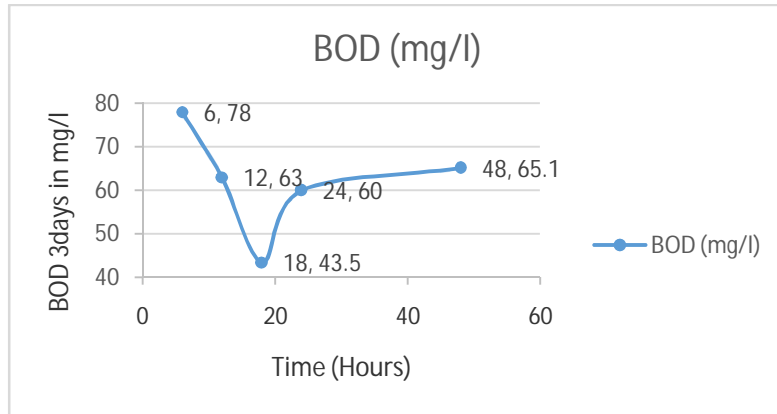


Fig 3.5: Shows the Variation of BOD 3days with respect to time.

IV. CONCLUSION

The following conclusions were drawn from the study carried out on treatment of dairy wastewater using artificial constructed wetland with horizontal flow system. Dairy wastewater is generated from the processes like washing plant, packaging plant, ghee plant and casein plant with chemical used for the cleaning compartments as following characteristics; pH-11-15, Alkalinity-310mg/L, Total dissolved solids- 712mg/L, Total solids- 2000mg/L, Total suspended solids- 1288mg/L, Biological oxygen demand 79.5mg/L. The pilot scale set up of an artificial constructed wetland dimensions are 30inch × 24inch × 18 inches with working volume of 188.307 Liters and the fabrication is carried out with a hard glass of having thickness 8mm with inlet and outlet arrangement. The optimum treatment of dairy wastewater through artificial constructed wetland is attain at 18h. After 18h it reaches to anaerobic condition as it reaches the chemical parameters gradually increases. Artificial constructed wetland is an alternative method to treatment of dairy industry wastewater.

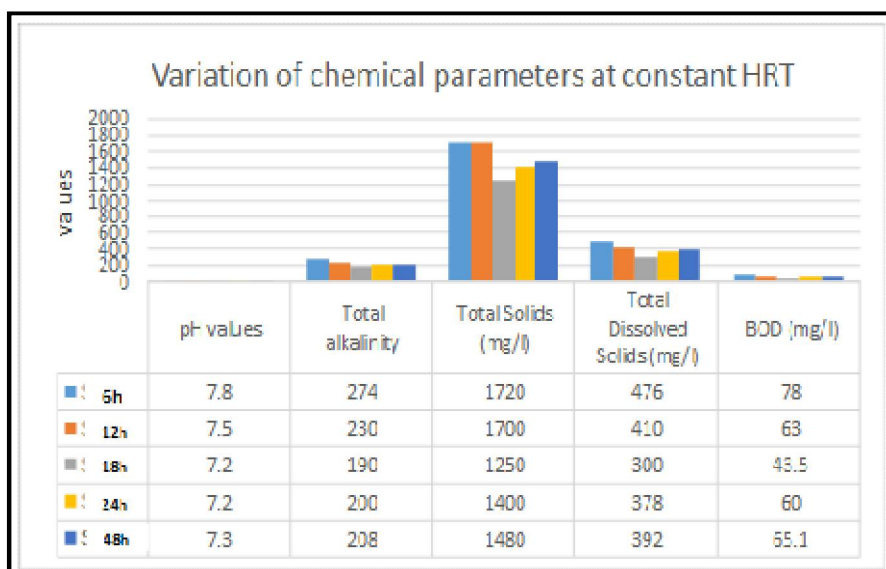


Fig 3.6: Shows the Variation of Chemical Parameters with respect to time.

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Vol. 6, Issue 8, August 2017

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