"Use Of Phytoremediation for Treatment of Dairy Industry Waste Water for Analysis of COD and BOD"

Er. Nilesh B. Deshmukh, Dr. M. V. Jadhav, Er. Vikas R. Rahane

***Abstract*— Dairy industries have shown tremendous growth in size and number in most countries of the world. These industries discharge wastewater which is characterized by high chemical oxygen demand, biological oxygen demand, nutrients, and organic and inorganic contents. Such wastewaters, if discharged without proper treatment, severely pollute receiving water bodies. In this article stress is given on the lowest cost of the best possible treatment.**

The consumption of large volumes of water and the generation of organic compounds as liquid effluents are major environmental problems in milk processing industry. The volume of freshwater required by this industry can be significantly reduced by recovering the intrinsic water present in dairy industry. This amount of freshwater will depend on the process technology. In recent years, the environmental effects of industrial activities have increased considerably, and current perspectives indicate that the trend for this problem is to be worsening. In this regard study is to treat the waste water generated from the dairy industry by constructed wetland Physico-chemical and organic parameters of water samples of the dairy were examined to determine the quality and extent of pollution. By which the pH, BOD, COD 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 COD removal efficiency 85% and 75% of and respectively was observed.

***Index Terms*— Chemical oxygen demand, water hyacinth, Biological oxygen demand, dairy industry.**

I. INTRODUCTION

The use of water hyacinth as the functional unit in wastewater treatment systems has been increasingly demonstrated and treatment regimens developed as a result of successful pilot projects.

It has a huge potential for removal of the vast range of pollutants from wastewater and has the ability to grow in severe polluted waters. It is also used to improve the quality of water by reducing the levels of organic, inorganic nutrients and heavy metals .Presence of its fibrous root system and broad leaves help them to absorb higher concentrations of heavy metals. It readily reduces the level of heavy metals in acid mine drainage water and silver from industrial wastewater in short time. Water hyacinth can be used like food for people or fodder because its leaves are rich in proteins and vitamin A. But it is not recommended to consume if used for removal of heavy metals and toxic substances as it can cause problems when enter in food chain.

It has the great reproduction potential as it grows double in 5 to 15 days. Only ten plants in just eight months can produce population of 655,330 individuals. It commonly forms dense, interlocking mats due to its rapid reproductive rate and complex root structure. It reproduces both sexually and asexually.

II. SOURCES OF WASTE

The liquid waste from a large dairy originate from the following sections of plants- receiving station, bottling plant, cheese plant, butter plant , casein plant, condensed milk plant, dried milk plant, and ice cream plant. Waste also comes from water softening plant and from bottle and can washing plants. At the receiving station the milk is received from the farms and after inspection the same is emptied into large containers for transport to bottling or other processing's. The empty cans are rinsed, washed sterilized and are returned to the farmers. At the bottling point, the raw milk delivered by the receiving station is stored. The processing includes cooling, clarification, filtration, pasteurization and bottling. In the above two sections, the liquid wastes originate out of rinse and washings of bottles, cans and equipment's, and thus contain milk drippings and chemicals used for cleaning containers and equipment's. The skimmed milk may now be sent for bottling for human consumptions, or for further processing in the dairy for other products like non-fat milk powders. Milk powders are produced by evaporation followed by drying by either roller process or spray process. The dry milk plant wastes consist chiefly of wash waters used to clean containers and equipment's. The soured or spoiled milk and sometimes the skimmed milks are processed to produce caseins used for preparation of some plastics; the process involves the coagulation and precipitation of the caseins by the addition of some minerals acids. The waste from the section includes whey, washings and the chemicals used for precipitation. Very large dairies also produce condensed milk and ice creams. In addition to the wastes from all the above milk processing's units, some amount uncontaminated cooling water comes as wastes these are very often recalculated. The dairy wastes are very often discharge intermittently the nature and composition of waste also depends on the types of products produced and the size of the plants.

Manuscript received February 24, 2015.

Er. Nilesh B. Deshmukh, Department of Civil, PG Student, SRES College Of Engineering, Kopargaon, 423601, India.

Dr. M. V. Jadhav, Department of Civil, Professor, SRES College Of Engineering, Kopargaon, 423601, India.

Er. Vikas R. Rahane, epartment of Civil, Lecturer, Amrutvahini Engineering college, Sangamner, 422605, India

III. NEED TO TREAT THE WASTEWATER

Wastewater from dairies and cheese industries contain mainly organic and biodegradable materials that can disrupt aquatic and terrestrial ecosystems. Due to the high pollution load of dairy wastewater, the milk-processing industries discharging untreated/partially treated wastewater cause serious environmental problems. Hence the importance of carrying out a whey treatment as a starting point in order to optimize a simple and economic method to treat the whole dairy effluent. Moreover, the Indian government has imposed very strict rules and regulations for the effluent discharge to protect the environment.

IV. TREATMENT OF THE DAIRY WASTES

Dairy waste water have low COD and BOD ratio and it can be treated efficiently by biological processes. These wastes contain sufficient nutrients for bacterial growth and this can be prevented by:

(i) The prevention of spills, leakages and dropping of milks from cans.

(ii) The requirement of water can be minimized during washes.

(iii) By segregating the uncontaminated cooling water and recycling the same.

(iv) Utilization of butter milk and whey for the production of dairy by products.

Both high rates tricking filters and activated sludge plants can be operated very effectively for complete treatment of dairy waste. But these conventional methods involve much skilled persons and special type of equipment's. On the other hand the low cost treatment method like oxidation ditches is also used commonly. Use of dairy waste for irrigation after primary treatment in an aeration lagoon may also be good answer for disposal of dairy waste.

V. MATERIALS AND METHODS

This chapter presents the Methodology adopted to achieve the objectives of the proposed study. The manufacturing process of milk along with the sources of waste water generation, characteristic of waste water generated was studied.

The untreated composite wastewater samples were collected from the outlet of equalization tank of M/s PRABHAT DAIRY Ltd. Located at Nagar- Dhandarphal Tal-Sangamner State-Maharashtra at a distance of 10km from the Sangamner The dairy wastewater was treated by using Ptytoremediation system.

The details of ponds are shown below:

The pond area is 24CM X 24CM X 35CM depth .All the side of ponds was covered by steel. The bottom layer is 5 cm of gravel size 5-6 cm. The outlet pipe is 15cm from the bottom at depth of 35 cm. The applied flow pattern to the pond was Surface flow type. Plants of water hyacinth were planted. The treated wastewater from the outlet were collected and analyzed in laboratory for following parameters like pH, COD, BOD_5 For fifteen days. The entire test was performed as per the Standard Methods. The ponds were under observation for effluent collection from 13th November 2014 to 27th November 2014. All analytical tests were conducted in Environmental Engineering Laboratory of Amrutvahini Polytechnic sangamner. Dist Ahmednagar

Table 1 Testing Frequency.

Sr. No	Water Tests	Testing frequency
1	BOD	per days
2	COD	Per day
3	pH	Per day

VI. PONDS SIZING DETERMINATION

The initial step in the project development was determining the quantity of wastewater discharged and the level of BOD, in the wastewater. This was accomplished using limited initial sampling consisting of flow based composite samples and manual tip-bucket collection. In this procedure 10 liter buckets were used to collect the effluent from the dairy discharge pipe. From each full bucket a 500 ml sample was taken and the bucket was emptied and used for additional sampling. All 500 ml samples were composited in one bucket for each day. From this composite sample representative sub-samples were collected for laboratory analysis. Samples were taken during milking sessions on first four dates i.e. from 10th November 2014 to 13th November 2014 and consisted of two morning sessions and two afternoon sessions. The resulting wastewater discharge was determined to have a flow of 100 liters per day and a BOD, concentration of 1226 mg/L. by using various references size requirements were determined.

Fig. 1 Setup of treatment of dairy waste water using water hyacinth

Element	Unit	Value
Pond Size (top)	cm	24x24
Pond Size (bottom)	cm	24x24
Pond Depth	cm	35
Pond Area(top)	Sq.cm.	576
Pond Volume	cm^3	0.0201

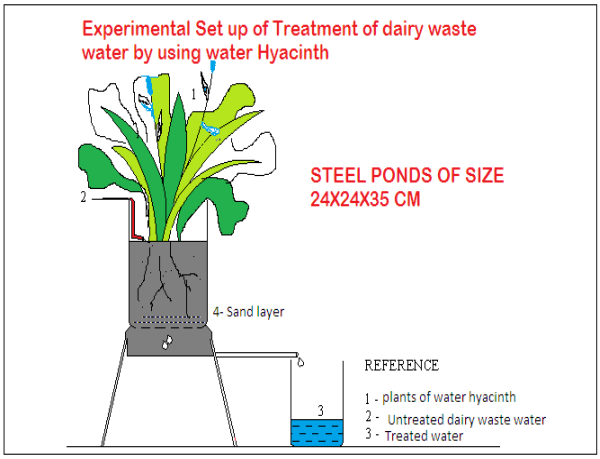


Table 2 Pond Geometrical Details.

VII. INITIALCHARACTERISTICS OF RAW WASTEWATER

The initial characteristic of the wastewater shows that BOD is very high and the waste is highly biodegradable. The nitrogen content is good enough for biological treatment.

Table 3 Initial characteristics of raw wastewater

SN	Parameter	Unit	Value
1	pH	-	7.6-7.8
2	BOD_5@ 20 ˚C	mg/L	1226-1425
3	COD	mg/L	1860-1915

(Source: Prabhat dairy Sangamner)

VIII. ACTUAL EXPERIMENTAL SET UP

Approximately 50 liters of raw effluent from dairy was brought to the laboratory in plastic containers and the experiments were set up in steel boxes. The plants used for the study was an emergent wetland plant water hyacinth. The experimental plants were initially subject to stabilization in tanks containing well water for one month for acclimatization. The base of the tank was filled with gravel and wetland soil up to 5cm in height. Ten liters of the respective dilutions of the effluent were prepared and then transferred to steel boxes of size 24x24x35cm. For each experimental set, two controls were maintained with ten liters of water and ten liters of raw effluent. For treatments, the plants which maintained in the stock tanks were collected, cleaned and introduced in the experimental tanks. Approximately 1kg of water hyacinth is placed in each experimental tank used for the study, each occupying half of tanks. Five no's of each experimental setup was maintained. 500ml each of water and effluent from the respective treatment sets were collected periodically for analyzing the changes in its physico-chemical characteristics subsequently with an interval of 1 day up to 15 days. After 15 days we have done the result analysis.

Fig. 2 Laboratory Setup of treatment of dairy waste water.

IX. RESULTS OF ANALYSIS

The water samples were collected for testing from 13th November 2014 to 27th November 2014.The waste water testing of each pond was performed each day and various parameters such as P^H, BOD, and COD etc. were calculated. The summarized results are tabulated below

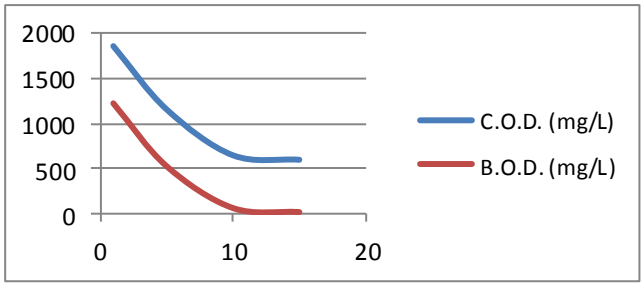
A] Performance appraisal water hyacinth ponds

The BOD and COD removal performance of all the five ponds is monitored regularly and is presented in table.

Table 4 Performance of POND – I (Liquid Depth 10 cm)

Day	pH	C.O.D. (mg/L)	B.O.D. (mg/L)
1	7.6	1860	1226
5	7.4	1160	530
10	6.9	650	65
15	6.9	600	20

Fig 3 Graph of Days v/s BOD and COD Fig 4 Graph of Days v/s P^H



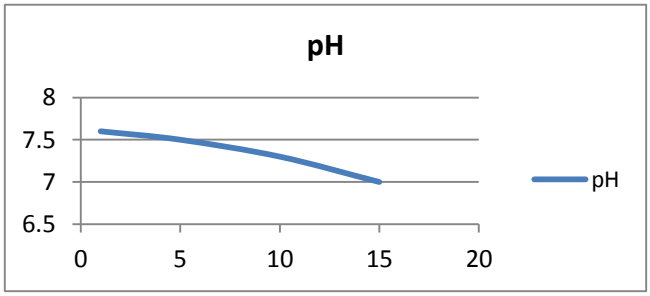
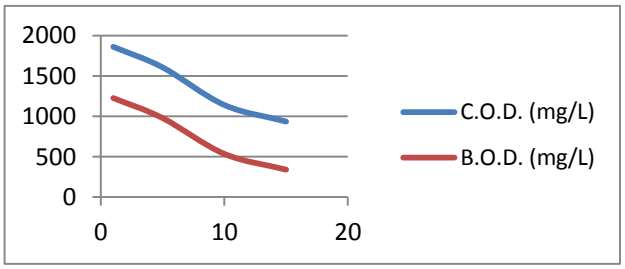


Table 5 Performance of POND – II (Liquid Depth 15 cm)

Day	pH	C.O.D. (mg/L)	B.O.D. (mg/L)
1	7.6	1860	1226
5	7.5	1605	978
10	7.1	1140	535
15	7.0	935	340

Fig 5 Graph of Days v/s BOD and COD Fig 6 Graph of Days v/s P^H



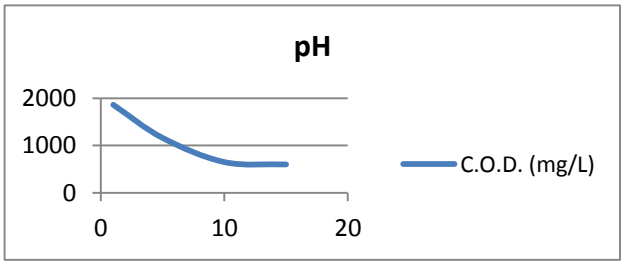
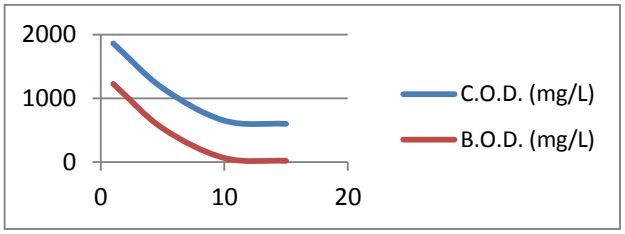


Table 6 Performance of POND – III (Liquid Depth 20 cm)

Day	pH	C.O.D. (mg/L)	B.O.D. (mg/L)
1	7.6	1860	1226
5	7.5	1635	990
10	7.1	1280	656
15	7.0	1155	540

Fig 7 Graph of Days v/s BOD and COD Fig 8 Graph of Days v/s P^H



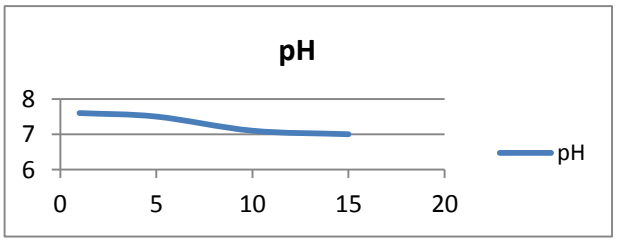
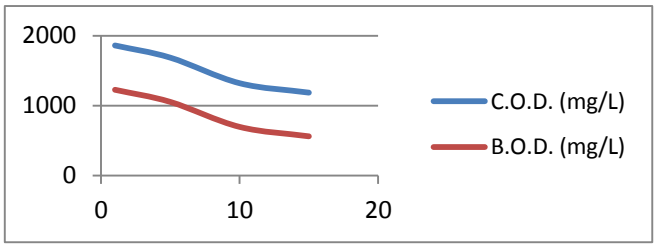


Table 7 Performance of POND – IV (Liquid Depth 25 cm)

Day	pH	C.O.D. (mg/L)	B.O.D. (mg/L)
1	7.6	1860	1226
5	7.5	1685	1052
10	7.3	1320	695
15	7.0	1185	560

Fig 9 Graph of Days v/s BOD and COD Fig 10 Graph of Days v/s P^H



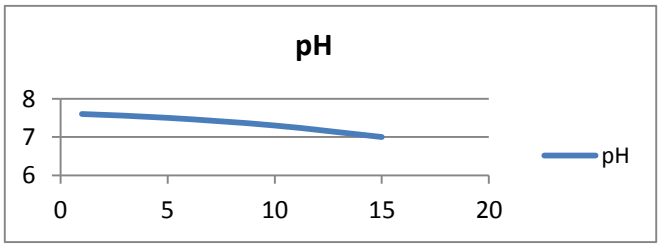
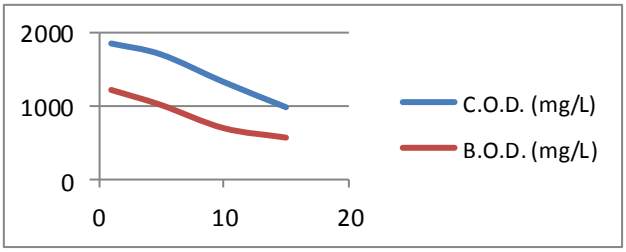
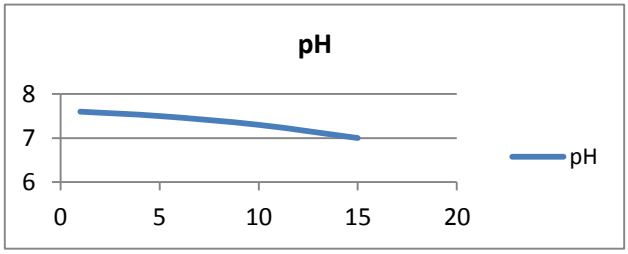


Table 8 Performance of POND – V (Liquid Depth 30 cm)

Day	pH	C.O.D. (mg/L)	B.O.D. (mg/L)
1	7.6	1860	1226
5	7.5	1710	1020
10	7.3	1335	705
15	7.0	990	575

Fig 11 Graph of Days v/s BOD and COD Fig 12 Graph of Days v/s P^H





X. DISCUSSION

With reference to preliminary investigations when treated with Water hyacinth based CWs mentioned above it has been observed that,

- The P^H of dairy effluent was found to decrease .The P^H was within limits for all samples.
- BOD value for all the samples were within the range.
- COD values were within the range.
- Thus both BOD and COD did not show much variation. BOD and COD values decrease from day 1 to day 15.

XI. FUTURE SCOPE

- Different plants can be use for same study.
- Other pollutant such as Phosphates, Nitrates, Nonmetals and metals can also be Remove by this method.
- Phytoremidiation system can use for Domestic Wastewater Treatment.

XII. CONCLUDING REMARKS

The need for improvement and conservation of the environment in India is necessitating the provision of energy and cost effective secondary wastewater treatment facilities for small communities such as schools, hospitals, military camps, colleges, farms, industries, and universities where on-site wastewater disposal technology is predominant.

Phytoremideation system operates using natural processes and usually do not require substantial energy inputs. The biological processes are typically solar-driven as light and carbon sources are used to derive the microbial and plant processes.

The result showed that the average percentage removal of wetland system was pH is near to neutral axis, TDS Removal was 49%, BOD_5 removal was 85%, and COD removal was 75%

In above project total 5 ponds samples were analyzed for various parameters for 15 days .The analysis and the results of the tests conducted for the samples can be concluded with following remarks.

- The analysis results showed that most of the parameters were in acceptable limit.
- However the limitation is that it is a slow process.
- BOD level being low so odor problem is less in nearby area.
- In the present study 1 kg plant mass is used for all ponds. The quantity of plant mass can be varied as a part of future study.
- From the overall analysis it can be seen that the quality of dairy waste water is in control but some results shows negative values it may pollute the nearby area in future. So immediate control measures need to be taken.
- The present study was aimed at evaluating the potential of water hyacinth for BOD, COD, TSS, DS, etc reduction in dairy wastewater.
- From the present study it is clear that utilization of water hyacinth have effectively removed the waste water contaminants of dairy and this is better solution for achieving cleaner production technology.

REFERENCES:

[1] Swati Bhavsar, Vedavati Pujari, Dr. V .V. Diwan Potential of Phytoremediation for dairy Waste Water Treatment. (2011) pp.16-23.
[2] Swati A. Patil, Vaisali V.Ahire, M.H. Hussain Dairy Waste Water –A case Study (2014) pp.30-34.
[3] Shahabaldin Rezania, Mohd Fadhil Md Din, Mohanadoss Ponraj, Fadzlin Md Sairan, Siti Fatimah binti Kamaruddin , Nutrient uptake and wastewater purification with water hyacinth and its effect on plant growth in batch system (2013) pp.81-85.
[4] A. A. Pachpute, S.B.Kankal, Dr.M.V. Jadhav, Use of Artificial Wetlands for treatment of dairy industry waste water for analysis of BOD and COD (2014) pp.38-41.
[5] Ashwini Dubey, Omprakash Sahu, Root Zone Method for Dairy Waste Water (2013) pp.74- 77.
[6] Moushumi Hazra, Kirti Avishek, Gopal Pathak, Developing an artificial wetland system for wastewater treatment –A Design Perspective (2011) pp.8-18.
[7] Piyush Gupta, Surendra Roy, Amit Mahindarkar, Treatment of water using Water Hyacinth Water Lettuce and Vetiver Grass-A Review (2012) pp. 201-210