

Performance evaluation of Effluent Treatment Plant of Dairy Industry

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ABSTRACT

Dairy industry is among the most polluting of the food industries in regard to its large water consumption. Dairy is one of the major industries causing water pollution. Considering the increased milk demand, the dairy industry in India is expected to grow rapidly and have the waste generation and related environmental problems are also assumed increased importance. Poorly treated wastewater with high level of pollutants caused by poor design, operation or treatment systems creates major environmental problems when discharged to the surface land or water. Various operations in a dairy industry may include pasteurization, cream, cheese, milk powder etc. Considering the above stated implications an attempt has been made in the present project to evaluate one of the Effluent Treatment Plant for dairy waste. Samples are collected from three points; Collection tank (CT), primary clarifier (PC) and Secondary clarifier (SC) to evaluate the performance of Effluent Treatment Plant. Parameters analyzed for evaluation of performance of Effluent Treatment Plant are pH, TDS, TSS, COD, and BOD at 20°C The pH, TDS, TSS, COD and BOD removal efficiency of Effluent Treatment Plant were 26.14 %, 33.30 %, 93.85 %, 94.19 % and 98.19 % respectively.

Keywords—Dairy industry, Effluent treatment, Performance evaluation, Removal efficiency, Wastewater characteristics.

I. Introduction

Waste water generated in a dairy contains highly putrescible organic constituents. This necessitates prompt and adequate treatment of the waste water before its disposal to the environment. Almost all the organic constituents of dairy waste are easily biodegradable. Hence the wastewater is amenable to biological treatment-either aerobic or anaerobic¹. Rapid growth of industries has enhanced the productivity but also resulted in the production and release of toxic substances into the environment, creating health hazards and affected the natural ecosystem making it unbalance. These wastes are potential pollutants when they produce harmful effects on the environment and generally released in the form of solids, liquid effluents and slurries containing a spectrum of organic and inorganic chemicals². Effluent treatment in industries to meet the discharge standards mentioned by GPCB has always been a great problem for the industrialists. Every industry effluent treatment plant needs to treat the effluent for this purpose in their own industry via effluent treatment plants. Before discharging the treated effluent on to the land or any surface water body the industries should meet the effluent discharge standard norms³.

In order to have proper processes in the ETP, Characterization of waste water, treatability studies and planning of proper units and processes for effluent treatment is very much necessary.

In the present study an effort has been made to evaluate one of the ETP provided for the treatment of wastewater generated by dairy industry. The study was limited to the performance evaluation of the ETP Plant of dairy industry.

The aim of the present research work was to determine the behavior of various parameters of the dairy industry wastewater. Characterization of wastewater was evaluated in terms of pH, total suspended solids (TSS), total dissolved solids (TDS), Biochemical oxygen demand (BOD) at 20°C and Chemical oxygen demand (COD) for the influent & effluent from the selected plants. The performance of the effluent treatment plant was also evaluated & the quality of the reclaimed wastewater was compared with Gujarat Pollution control Board (GPCB) standards to determine its suitability for reuse.

II. Materials and Method

The source for the collection of wastewater samples throughout the present studies was the Dairy industry. The study was conducted in Banas Dairy, located in Palanpur, Gujarat. The coordinates for the

project site is 24.10°N and 72.25°E. The duration for this research work was Five months. The methodology involved the collection of samples at the different units of the treatment plant having capacity to treat 400m³/day of waste water.

The process in the treatment of industrial effluent may consist of any one or more of the following processes: 1. Equalization 2. Neutralization 3. Physical Treatment 4. Biological Treatment⁴.

The effluent treatment plant consist of Collection tank (CT), Screening chamber, Oil and Grease removal tank, Equalization tank (ET), Neutralization tank (NT), Primary Clarifier (PC), aeration tank (AT) and Secondary clarifier (SC). The systematic flow diagram of ETP is shown in Figure 1.

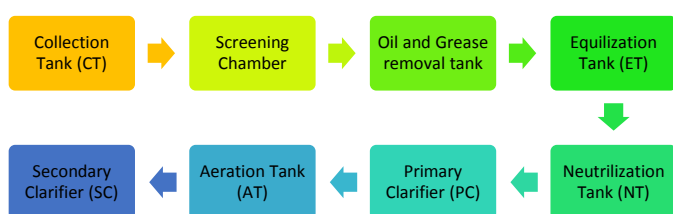


Fig. 1 - flow sheet of ETP of Dairy Industry

The wastewater samples were collected using sterile one liter plastic containers. Samples were collected in pre-sterilized bottles from Collection tank (CT), primary clarifier (PC) and Secondary clarifier (SC) for physicochemical analysis (pH, COD, BOD, TSS and TDS). All samples were transported to the laboratory and analyzed within 30 min. All parameters were analyzed in accordance with standard methods of GPCB.

III. Results and Discussions

Data taken during 5 months of this study are presented (TABLE 1) and discussed.

pH: pH of the individual sample was measured immediately after its collection by a pH meter. The pH of the effluent varied from 9.60 to 9.93 before the treatment, whereas the value of pH after physical and biological treatment was found 8.43 and 7.22 respectively. The percentage reduction of 27.25 % was achieved. The finding of the present study are in agreement with GPCB standards (TABLE 2).

Total Suspended Solids (TSS): Suspended solid do not mean that they are floating matters and remain on top of water layer. They are under suspension and remain in water sample. Total suspended solids play an important role in water and waste water treatment. Their presence in water sample cause depletion of oxygen level. The TSS content in the effluent varied from 1732 to 1766 mg/l before treatment whereas after physical and biological treatment the values obtained were 1200 and 98 mg/l respectively. The

percentage reduction of 94.45% was achieved. Similar result were observed by Chaudhari et al (2010)⁵. The TSS value in our study was 98 mg/l which were in accordance with the GPCB standards (TABLE 2). TSS is an important parameter for designing wastewater treatment plant and the length of time for which wastewater should be retained for primary treatment

Total Dissolved Solids (TDS): The total solid concentration in waste effluent represents the colloidal form and dissolved species. The probable reason for the fluctuation of value of total solid and subsequent the value of dissolved solids due to content collision of these colloidal particles. The rate of collision of aggregated process is also influenced by PH of these effluents. The TDS content in the effluent varied from 1837 to 1858 mg/l before treatment whereas after physical and biological treatment the values obtained were 1459 and 1229 mg/l respectively. The percentage reduction of 33% was achieved. Both the value of TDS was within the limit of GPCB standards (TABLE 2).

Chemical Oxygen Demand (COD): : The chemical oxygen demand test (COD) determines, the oxygen required for chemical oxidation of organic matter with the help of strong chemical oxidant. The COD is a test which is used to measure pollution of domestic and industrial waste. The waste is measure in terms of equality of oxygen required for oxidation of organic matter to produce CO₂ and water. It is a fact that all organic compounds with a few exceptions can be oxidizing agents under the acidic condition. COD test is useful in pinpointing toxic condition and presence of biological resistant substances. For COD determination samples were preserved using H₂SO₄ and processed for COD determination after the entire sampling operation was complete. The COD of the effluent varied from 2013 to 2049 mg/l before treatment whereas after physical and biological treatment the values obtained were 1331 and 97 mg/l respectively. The percentage reduction of 95.26 % was achieved. Similar result observed by Chaudhari et al (2010). The value of COD after treatment was under GPCB standards (TABLE 2).

Biological Oxygen Demand (BOD): For BOD₅ samples were immediately processed after Collection for the determination of initial oxygen and incubated at 20 °C for 5 days for the determination of BOD₅. The BOD of the effluent varied from 1362 to 1366 mg/l before treatment whereas after treatment the values obtained was 24 mg/l respectively. The percentage reduction of 94 % was achieved. Similar result observed by Chaudhari et al (2010). The value of BOD after treatment was under GPCB standards (TABLE 2).

Table 1. Physico-chemical Parameter of Waste water

Sr.No.	Parameter	(CT)	(PC)	(SC)
1.	pH	9.93	8.43	7.22
2.	TSS	1766	1200	98
3.	TDS	1858	1459	1229
4.	COD	2049	1331	97
5.	BOD	1366		24

Table 2. Comparison between treated effluent characteristics and GPCB standards.

Sr.No.	Parameter	GPCB standard	Treated effluent
1.	pH	6.5 to 8.5	7.22
2.	TSS	100	98
3.	TDS	2100	1229
4.	COD	100	97
5.	BOD	30	24

Following figures shows the comparison of treated effluent with GPCB standards.

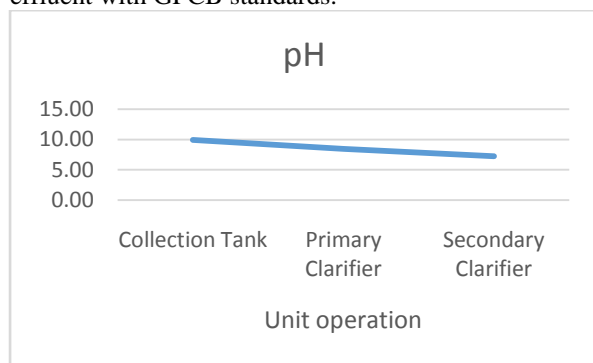


Fig. 2 - pH value of the effluent

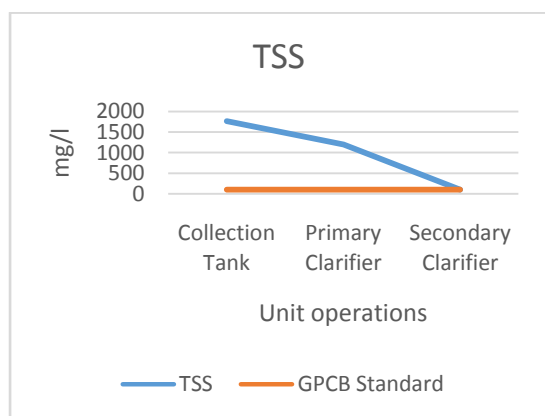


Fig. 3 - TSS value of the effluent with respect to GPCB Standard

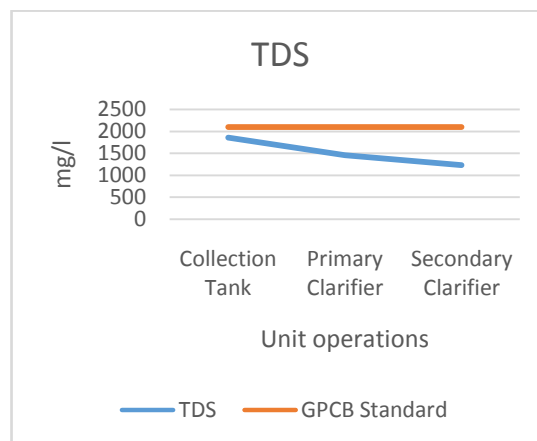


Fig. 4 - TDS Value of effluent with respect to GPCB standard

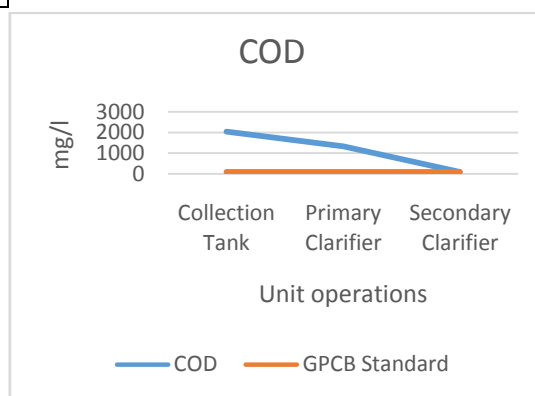


Fig. 5 - COD value of effluent with respect to GPCB standard

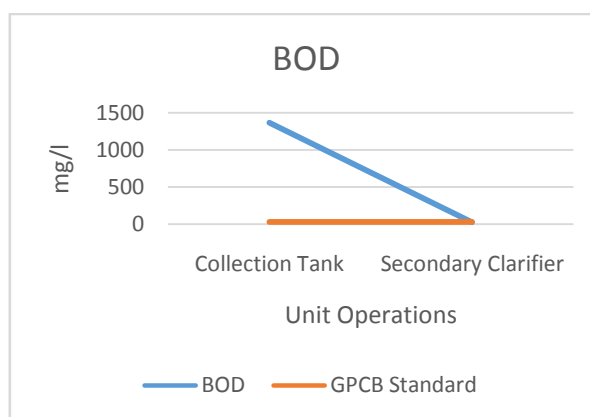


Fig. 6 - BOD value of effluent with respect to GPCB standard

Following table shows the overall efficiency of the effluent treatment plant.

Table 3. Percentage reduction of various parameter

Sr.No.	Parameter	% reduction
1.	pH	27.25
2.	Total Suspended solids	94.45
3.	Total Dissolved Solids	33.86
4.	Chemical Oxygen Demand	95.26
5.	Biological Oxygen Demand	98.18

IV. Conclusion

Present study concerned with the performance evaluation of ETP for dairy industry and as per available 5 month data it can be concluded that, the overall performance of the effluent treatment plant was satisfactory. The individual units are also performing well and their removal efficiencies are satisfactory. The removal efficiency of total suspended solids was 94.45 %, COD removal efficiency was 95.26 % and BOD removal efficiency was 98.18 % this shows the capability of plant to withstand shock load. The treated effluent meet the GPCB standard for discharge in inland surface water hence it can be said that the plant is working efficiently. This treatment plant is high potential for BOD, TSS and COD removal. Thus this treatment Technology can be considered as a potential plant for Dairy wastewater treatment.

V. Acknowledgement

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