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Effluent Treatment Plant of Dairy Wastewater – A Performance Evaluation

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Abstract - ***Dairy industry is most polluting food industry in terms of large amount of water use and considering huge amount of water is used during production of milk and milk products. The wastewater contains dissolved sugars, proteins and fast which is organic in nature and bio-degradable. So that dairy wastewater is considered as high concentration of organic matter and high BOD. It is estimated that dairy industries generate 2.5 to 3 liters of wastewater per liter of milk processed. Such untreated wastewater pollutes land and river system so that proper treatment of dairy wastewater is necessary before disposal in environment. Poorly treated wastewater with high degree of pollutants resulted from poor design, operation and treatment system creates major environmental problems in present situation technologies are trickling filter, anaerobic sludge blanket reactor, wastewater stabilization pond, aerated lagoons but such conventional treatment have problem of high maintenance cost,. Labor cost and also disposal problem of sludge generated form the treatment plant. Considering above stated implications an attempt to make in present research paper to evaluate one of ETP for dairy wastewater. Samples collected from inlet chamber, aeration tank, equalization tank, clarifier outlet. Performance analyzed for evaluation of performance of effluent treatment plant P^H, COD, oil and grease, MLSS, MLVSS and SVI. The aim of present research work was to determine behaviors of various parameters of dairy wastewater. The performance of effluent treatment plant was also evaluated and the quality of the reclaimed wastewater was compared with Maharashtra pollution control board (MPCB) standards to determine its suitability for reuse.***

Key Words: *Dairy Industry, Effluent, Treatment Plants, Environmental Problems*

1. INTRODUCTION

Dairy industry contains high amount of organic constituents. So that it is need to provide required treatment before discharge into the environment. The treatment mostly classified as aerobic and anaerobic treatment. Due to rapid industrial growth world's economy improve with rapid growth but also that make impact in terms of pollution on environment. Large concentration of pollutants in terms of quantity and quality of liquid, solid and gaseous pollutant shows harmful effects on flora and fauna as well as on many areas on environment. Effluent treatment plant in industry installed for meet regulating norms governs by pollution control board. Every industry have a wastewater treatment plant which helps to lower down pollution level of wastewater going to be discharge in to the environment from industrial premises. According to the pollution board norms industry need to be follow land and stream wastewater discharge norms. For effective treatment, industry should study characterization of wastewater, treatability aspects and planning of proper units. In the present study an effort has been made to evaluate one of ETP provided for treatment of wastewater generated by dairy industry. The study was limited to performance evaluation of ETP plant of dairy industry.

1.1 Brief information about Gokul Industry

Gokul milk was established in November 1985 with finance from NDDB. Kolhapur Zilla Shakari Dudh Utpadak Sangh Ltd is parent organization of Gokul. Present setup of Gokul states that its current milk collection is 7, 00,000 liters per Day from 5 chilling sections with daily water requirement of 1.6 Liters per liter of milk processing. Generation of daily wastewater is 14000m3 per day. Gokul carried out work with Process section, collection, processing of milk and other products like Ghee, Butter, Shrikhand Table butter and milk powder.. Gokul has Boiler section with softener provision. All safety measures were providing in Gokul Premises. Regular CIP (cleaning inside procedure section) is carried out for maintain healthy and clean environment. Gokul is famous Milk and Milk product brand in Maharashtra.

1.2 Wastewater Treatment Facility

Quantity of effluent generated from the milk processing is of 1400 m3 per day with peak flow of 150 m3 per hour.

Table -1: Treated Effluent Characteristics

Sr No.	Parameters	Concentration
1	PH	6.5 to 7.5
2	TDS	‹100 mg/L
3	Temperature	‹40^{0}C
4	COD	‹250 mg/L
5	Oil and Grease	‹10 mg/L
6	SVI	‹100 mg/L

The main objective of performance evaluation is to check effluent generated from Dairy industry is proper treated or not treated. The study included characterization of wastewater to ETP. The dairy industry involve the processing of raw milk into various products like milk and milk powder, ghee, cheese, butter by using processes pasteurization ,packaging filing in cans. Dairy handling milk classified as receiving station, processing station, condensing and other product making. General operations in dairy industry are 1) Receiving 2) Pasteurization 3) Packaging 4) Butter Making

1.3 Wastewater and its sources

Wastewater generated from dairy industry contain organic solid due to its dilute and concentrated discharge nature. The following ways from which wastewater is generated.

1) Washing and cleaning out product remaining in tanks, tankers, cans, piping systems and other equipment's which are used for processing.
2) Spillage from leakages, overflow of cans and careless handling by workers.
3) Container leakages.
4) Wastewater generation from processing unit cleaning activities.
5) Spilled products ,by- products like whey

2. EFFLUENT TREATMENT PLANT

Effluent treatment plant system was designed to handle and treat wastewater having high organic content and suspended solids.

Table -2: Treatment Units in ETP

Sr. No	Units Name	Capacity
1	Raw Effluent Tank	100m^3
2	Fat Removal Unit	80m^3*2
3	Equalization Tank	300m^3*2
4	UASB	500m^3
5	Aeration Tank	615m^3
6	Clarifier	300m^3
7	Effluent Tank	400m^3
8	Sludge Drying Bed	200m^3

2.1 Material and Method

The source for the collection of wastewater sample throughout the present study was Gokul Dairy, Kolhapur. The duration for this research work was two months. The methodology involved in collection of samples at different units. The process in treatment of dairy industrial effluent consists of one and more process such as equalization, Neutralization, Physical and Biological Treatment. The wastewater samples were collected using one liter plastic bottles from collection tank, aeration tank, clarifier and UASB. All samples were transported in lab.

Fig -1: Wastewater sample analysis

Fig -2: Wastewater sample collection from clarifier

Major pollutants in wastewater discharges from Dairy Industry are organic matter, suspended solids, and fats. This Plant is designed to reduce COD less than 250 mg/L Raw effluent tank pump wastewater to fat removal tank then with help of gravity wastewater comes to Equalization Tank and then to UASB, Aeration Tank and clarifier so on.at last treated wastewater collected in the effluent tank and it conveyed to agricultural area near Gokul for irrigation purposes. Sludge handling is done with help of sludge drying bed and dried sludge is collected and transport to systematic managed disposal site. Effluent treatment plant is in well operating condition by regular operation and maintenance was carried out by workers appointed by Gokul. Plant capacity is sufficient to handle peak flow and change in wastewater constitutes.

3. RESULTS AND DISCUSSIONS

Sr No.	PH		Temperature		TDS		COD		SVI	
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
1	10.32	6.91	28.3	26.5	980	640	1800	210	600	95
2	11.85	7.47	27.8	25.7	1100	710	1650	185	540	80
3	11.78	7.95	29.0	27.3	1368	982	1589	205	510	54
4	12.36	7.23	27.1	26.8	1827	1281	1958	230	490	80
5	10.62	7.36	26.4	25.2	935	528	1960	239	320	38

Data taken during 2 months (20 June 2015 to 20 August 2015) of this study but for convenience only 5 days data are presented in Table-1.

P^H - P^H of the individual sample was measured immediately after its collection by a P^H meter. The P^H of effluent varies from 10.62 to 12.36 before the treatment, whereas value of outlet P^H varies from 7.23 to 8.67.

Temperature- Temperature of the individual sample was measured immediately after its collection by temperature rod .the temperature of effluent varies from 27.1 to 29.0 before treatment, whereas value of outlet temperature varies from 25.2 to 27.3.

Total Dissolved Solids (TDS): The total solid concentration in waste effluent represents the colloidal form and dissolved species. The probable reason for 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 P^H of these effluents. The TDS content in the effluent varied from 935 to 1827 mg/l before treatment whereas after physical and biological treatment the values obtained were 528 and 1281 mg/l respectively.

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 1589 to 1960 mg/l before treatment whereas after physical and biological treatment the values obtained from 185 to 239 mg/l respectively.

SVI- sludge volume index for determine sludge concentration in wastewater. The amount of solids present in activated sludge has major influence on degree of settling. The SVI content in the effluent varied from 320 to 600 mg/l before treatment whereas after physical and biological treatment the values obtained were from 38 to 95 mg/l.

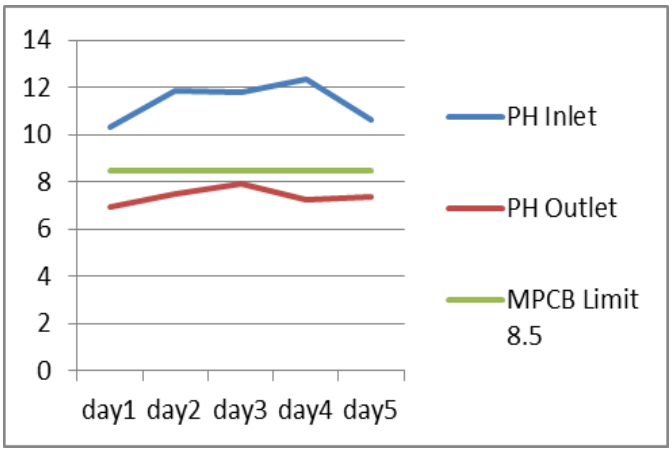

Chart-1: P^H value of effluent with respect to MPCB limit

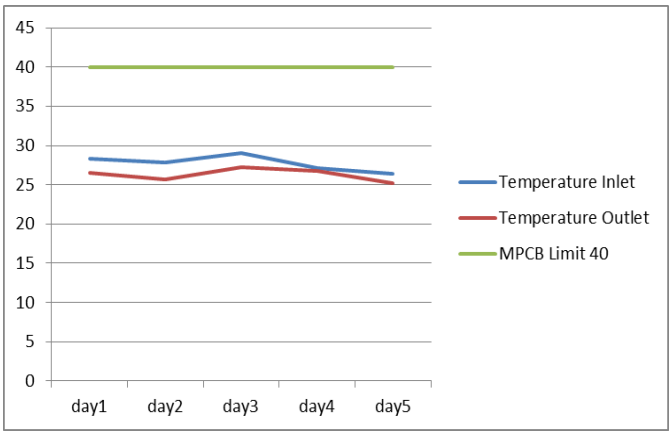

Chart-2: Temperature value of effluent with respect to MPCB limit

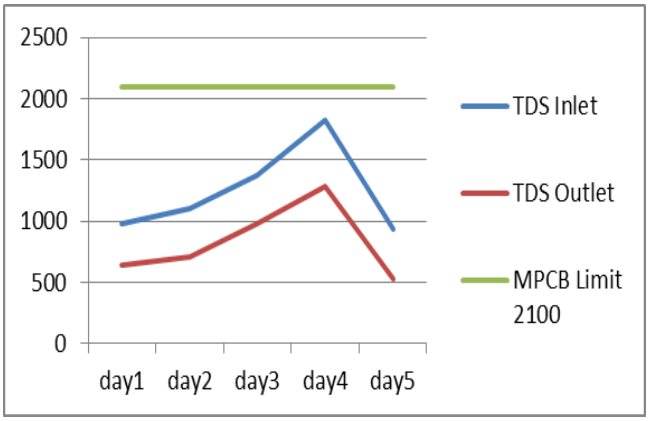

Chart-3: TDS (mg/L) value of effluent with respect to MPCB limit

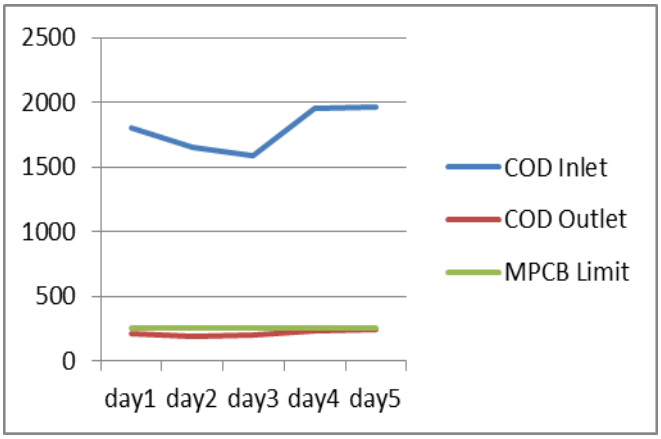

Chart-4: COD (mg/L) value of effluent with respect to MPCB limit

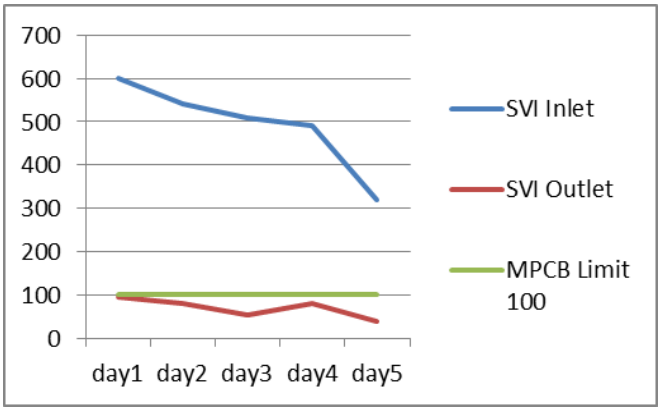

Chart-5: SVI (mg/L) value of effluent with respect to MPCB limit

4. CONCLUSION

Present study concerned with performance evaluation of ETP for dairy industry. 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 treated effluent meets the MPCB 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, reduction for P^H, Temperature, TDS, and COD. Thus this treatment Technology can be considered as a potential plant for Dairy wastewater treatment

5. ACKNOWLEDGEMENT

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