

Performance and Evaluation Studies on Dairy Effluent Treatment Plant, DAMUL, KMF, Dharwad, Karnataka

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Abstract - Under the list of most polluting food industries there stands "Dairy industry" also, which generates large volume of effluent with various characteristics because of consumption of large quantity of water and organic nature of milk, ultimately causing environmental threat affecting atmospheric air, water and land. The effluent contains dissolved sugars, proteins whey, caseins, lactose and fats which are organic in nature and bio-degradable. Hence the dairy effluent is considered as containing high concentration of organic matter and high BOD. It is estimated that dairy industries generate nearly 1.50 to 2 liters of effluent per liter of milk processed.

The present study constitutes a project at milk dairy DAMUL, KMF, Dharwad, Karnataka. Under first stage of which the quantification of generation of effluent from various units of production was made as the administration is planning for increase in the production nearly by double the present production. Consequently after increase in production capacity there will be subsequent increase in generation of waste water due to equivalent increase in usage of water. Thus the study helped to ascertain for required equivalent capacity of ETP after increasing production capacity, secondarily the study of performance evaluation of existing ETP, tertiary the evaluation of effluent characteristics before treatment, during course of treatment and after treatment from certain components is carried out. Further suggestions were made for the up-gradation of ETP due to planning of "mere up-gradation in production" by the administration.

Key Words: Quantification, grab sampling, performance and evaluation studies, up-gradation of ETP.

1. Introduction

The milk having different properties viz; a rich nutrient, being converted in to delicious by products has a long history. Nearly 70% of Indian farmers depend on agriculture which constitutes a backbone. In 1965 NDDB was founded.

by Dr.Vergese Kurien. The KMF was established in the year 1974 in Karnataka. On the other hand Dharwad Co-operative Milk Producers Union Ltd. (DAMUL) has been registered under Karnataka Co-operative Act in March-1986. Many delicious and cost effective products are manufactured at DAMUL based on the demand. The processing of milk and milk products involves series of operations which release sufficient quantity of effluent containing organic constituents such as proteins, lactose, and fats including high biological oxygen demand BOD and COD as well as contain soluble organics, total solids and certain trace organics.

Substandard effluent generated due to the substandard design, construction and operation /maintenance in the treatment system of Effluent Treatment Plant (ETP) as well as excess generation (may be at present or in case of proposal put forth) may create major environmental threats. Hence it becomes very much essential for the evaluation of performance of the ETP in a frequent manner as well as to take appropriate remedies to overcome the lapses in case of any cause, in order to maintain the applicable standards as prescribed by the CPCB. The main objective of this project work is to study the "Performance and Evaluation Studies of Dairy Effluent Treatment Plant, DAMUL, KMF, Dharwad, Karnataka". The flow diagram of effluent treatment plant of DAMUL is reflected in fig. 2.1. Accordingly a project has been carried out with the following objects.

- Quantification of effluent from various production units of DAMUL.
- To study effluent treatment units of effluent treatment plant (ETP).
- Characterization and Evaluation studies of Effluent of effluent treatment plant (ETP).
- Technical suggestions for Up-gradation of existing effluent treatment plant (ETP).

2. Materials and Methodology.

2.1 Methodology.

The study was carried at KMF, DAMUL, situated in the well developed industrial area in Lakkamahalli, Dharwad, Karnataka with 19°3'39"N longitudes 73°6'57"E latitudes. As such below methodology has been followed.

- The quantification of effluents was carried with help of electromagnetic flow meters.
- The study of existing working condition of ETP was studied following appropriate Engineering practices under Operation and Maintenance, in coordination with ETP staff and Environment Engineer of KMF, DAMUL.
- Sampling and analysis of effluent was carried out as per standards set out under APHA prior and after treatment. Analysis for effluent characteristics viz; pH, solids, BOD₃, COD, chlorides, sulphate, sodium carbonate as well as oil & grease was carried out in accordance with standard procedures.
- Further duly considering the “mere up-gradation in production planning” by the administration, the technologies which provide best results and economical aspects are suggested.

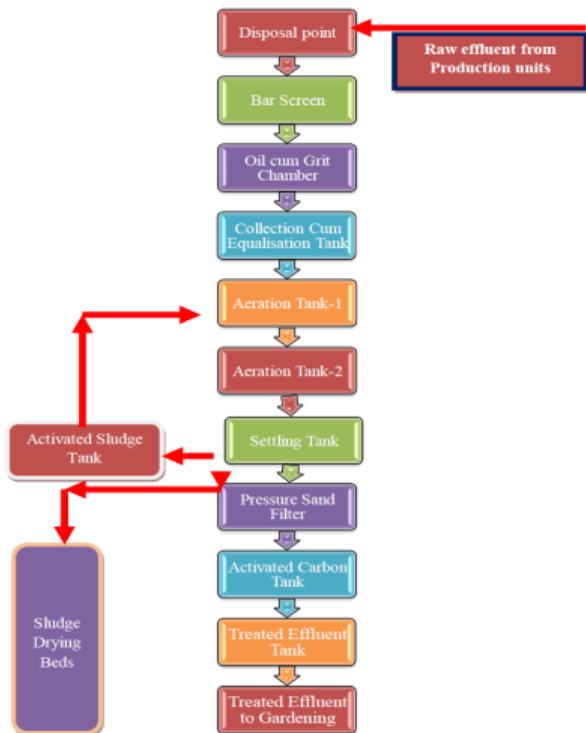


Fig. 2.1 Flow diagram of Effluent Treatment Plant at DAMUL- Dharwad.

2.2 Quantification of effluent from various production units.

A large quantity of waste water is generated due to different operations viz: collection, spillage (leaks, over flow, freezing-on, boiling over and careless handling) of milk during

conveying to different processing units and use of cans & floor washings, use of detergents etc. It is learnt that, the generation of waste water at the time of design of existing ETP was 2.50 lakhs /day. Accordingly the design capacity of ETP is 4.50 lakhs lits/day. The quantity of generation of waste water was quantified with the help of electromagnetic flow meters provided at the outlet of certain particular production units and the quantity of effluent generated is mentioned in following table 2.1.

Table 2.1 Quantification of waste water generation.

Sl. No.	Production Unit	Generation of Effluent (liters/day)
1	Milk receiving Section	90180
2	Milk separation section	118520
3	Pedha, curd, lassi, butter milk, ghee, paneer, Khova and milk powder section	145375
4	Packing section	37175
5	Boiler section	33250
6	Condenser section	22500
7	Can washing section	43500
TOTAL		495000

2.3 Study of existing effluent treatment process at ETP.

In January 1985 the existing ETP was designed, constructed and commissioned on the basis of extended aeration process with design capacity 500 m³/day. The quantity of untreated and treated discharge of effluent is 2.75 MLD i.e., 55% of the total water used. A map of existing effluent treatment plant is shown in the fig. 2.2.

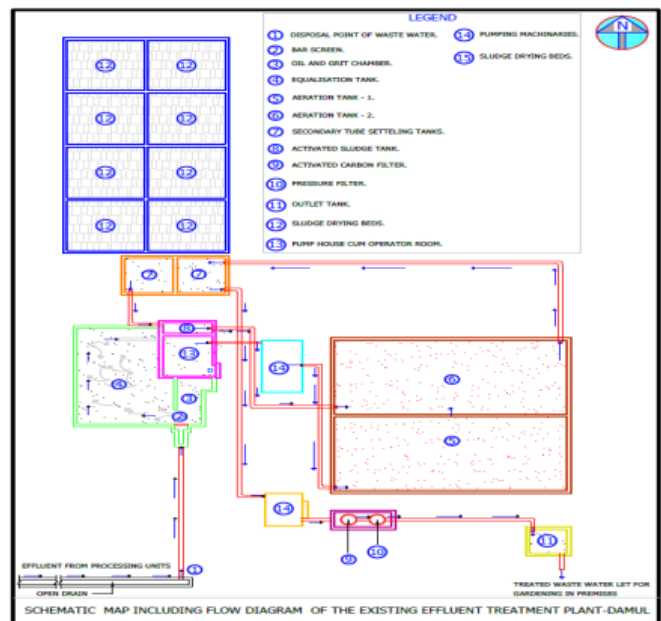


Fig. 2.2 Schematic map including flow diagram of existing ETP- DAMUL, Dharwad.

- The treatment system has been designed to meet the standards of CPCB and being discharged in industrial premises for gardening purpose.
- The effluent being organic in nature generated from different processing units shall convey through open drains to ETP for the purpose of treatment.
- The effluent is collected in the collection cum

equalization tank through the bar screen, grit chamber and grease chamber by gravity to trap wastes such as floating materials, oily matters and grease respectively. The waste materials thus trapped are being taken off manually in a frequent manner.

- From collection tank the waste water is pumped to aeration tank (activated sludge process) as shown in the fig. 2.3 and secondary aeration tank by means of centrifugal pumps where necessary root blower shall supply air by diffused aeration for mixing of waste water to enhance the activated sludge process in order to maintain adequate bio mass and to control BOD, COD and other pollutants etc.
- Mean while the overflow from aeration tank is collected in the secondary tube settling tank for solid liquid (bio-mass) separation.
- The over flow from secondary tube settling tank is allowed to collect in the treated effluent collection tank.
- The sludge thus collected is either sent to sludge drying beds or subjected to activated sludge process by means of recycling to the primary aeration tank in order to boost the biomass.
- The liquid effluent from settling tank is pumped to PSF and ACF for removal of suspended solids, turbidity and color from effluent, there by finally the treated effluent is collected in the treated effluent collection tank as shown in fig. 2.4 from where the same is sent to garden in the industrial premises.



Fig. 2.3 Effluent under treatment, (Aeration tank).



Fig. 2.4 Effluent after treatment, (Treated effluent collection tank).

3 Results and Discussions.

Under characterization and evaluation studies of effluent treatment plant (ETP), the grab samples of effluent under treatment were collected from four points viz: raw effluent just at the entrance of bar screen, out lets of aeration tank and sedimentation tank as well as from final treated effluent collection tank (treated hold up tank). The analysis of quality of effluent was made by means of laboratory testing related to physical, chemical and biological characteristics of effluent twice in a week for a period of 12 weeks. The analysis was carried out in the laboratory of Angadi Institute of Technology and Management, Belagavi (AITM) duly following the standard methods as recommended by APHA

3.1 Evaluation of the characteristics of effluent before and after the treatment.

The samples collected were analyzed for p^H @ 25 degree Celsius, total suspended solids (TSS), total dissolved solids (TDS), chloride content, oil /grease, bio-chemical oxygen demand (BOD) and chemical oxygen demand (COD) values. Consequently the results were compared with allowable effluent standards prescribed by the CPCB as mentioned in the table 3.1. The average values are represented in table 3.2, further the graphical representation of the average values of the effluent are represented in fig. 3.1.

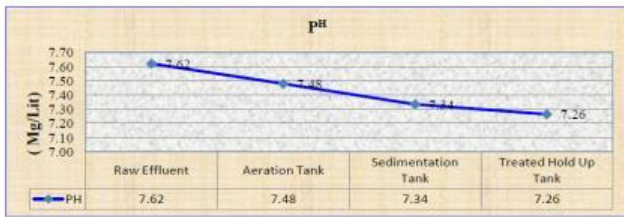
Table no. 3.1 Dairy Effluent Characteristics as per CPCB

Sl No.	Dairy effluent characteristics	Effluent Standard as per CPCB
1	p^H value, at 25°C	6.5 to 8.50
2	Total suspended solids (TSS)	Not to exceed, 150 mg/liter
3	Biological Oxygen Demand (BOD ₅)	Not to exceed, 100 mg/liter
4	Chemical Oxygen Demand (COD)	Not to exceed, 250 mg/liter
5	Oil and Grease	Not to exceed, 10 mg/liter

Table no. 3.2 Average values (Sixteen Analysis) of the effluent characteristics of different units (components) of ETP.

Sl No	Waste water Characteristics	Raw Effluent	Aeration Tank	Sedimentation Tank	Treated Hold up Tank	
1	PH	Total of all 16 Weeks	121.94	119.67	117.36	116.23
		Average	7.62	7.48	7.34	7.26
2	Total Suspended Solids	Total of all 16 Weeks	10002.50	8089.85	5318.28	2766.50
		Average	625.16	505.62	332.39	172.91
3	BOD	Total of all 16 Weeks	9165.75	6929.14	4413.19	1713.45
		Average	572.86	433.07	268.73	92.30
4	COD	Total of all 16 Weeks	21094.50	13338.50	8795.10	4959.20
		Average	1318.41	833.66	549.69	249.69
5	Chlorides	Total of all 16 Weeks	2052.10	1540.25	1358.40	1169.51
		Average	128.26	96.27	84.90	73.09
6	Total Dissolved Solids	Total of all 16 Weeks	14270.50	11677.02	9721.40	8405.05
		Average	891.90	729.81	607.59	525.32
7	Sulphate (as SO ₄)	Total of all 16 Weeks	2095.55	1641.84	1317.45	846.54
		Average	130.97	102.62	82.34	52.91
8	Residual Sodium Carbonate	Total of all 16 Weeks	71.37	83.95	102.65	121.60
		Average	4.46	5.25	6.41	7.60
9	Sodium absorption Ratio	Total of all 16 Weeks	191.55	214.50	235.99	268.20
		Average	11.97	13.41	14.75	16.76
10	Oil and Grease	Total of all 16 Weeks	804.00	478.00	301.00	158.50
		Average	50.25	29.88	18.81	9.91

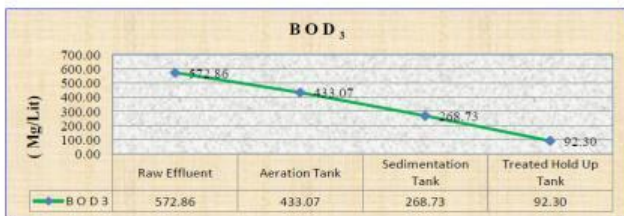
Fig. 3.1 Graphical representation of effluent characteristics (average values obtained from 12 weeks) for which the effluent from different units of ETP was subjected to analysis.



Variation of P^H at different units (components) of ETP.



Variation of Total Suspended Solids at different units (components) of ETP.



Variation of B O D₃ at different units (components) of ETP.



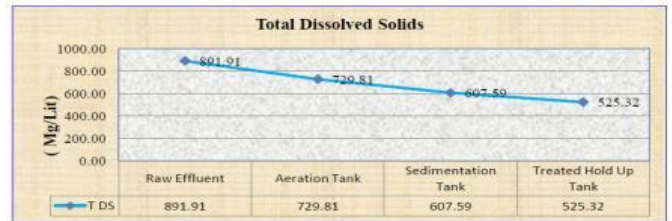
Variation of C O D at different units (components) of ETP.



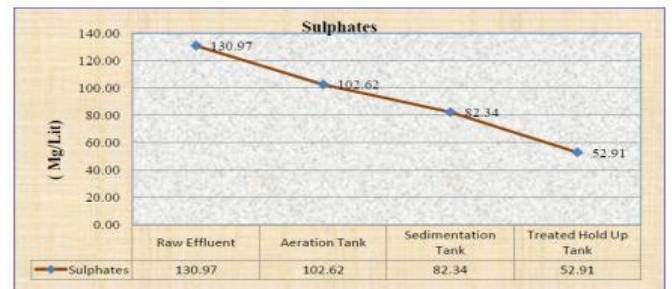
Variation of Chlorides at different units (components) of ETP.



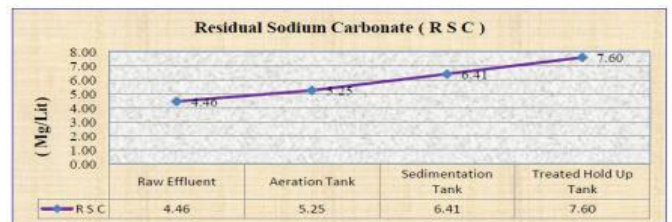
Variation of Total Dissolved Solids at different units (components) of ETP.



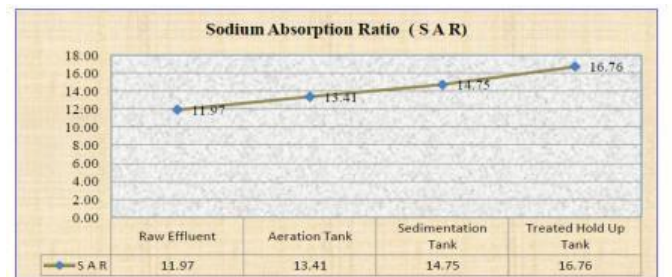
Variation of Total Dissolved Solids at different units (components) of ETP.



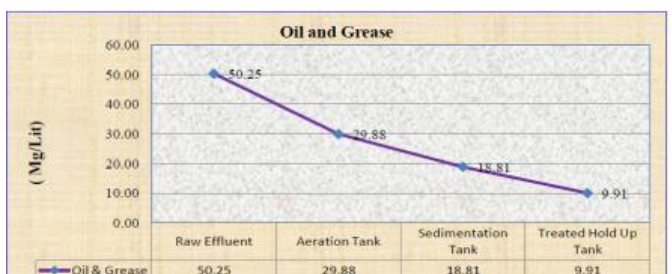
Variation of Sulphates at different units (components) of ETP.



Variation of residual sodium carbonate at different units (components) of ETP.



Variation of ratio in Sodium absorption at different units (components) of ETP

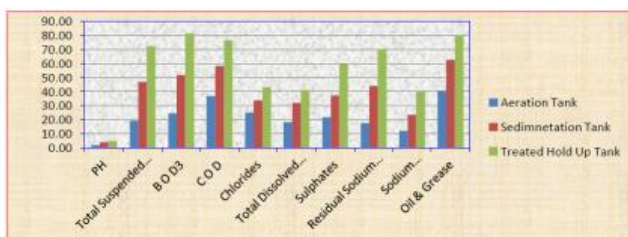


Variation of Oil and Grease at different units (components) of ETP.

On the other hand average percentage removal efficiency of effluent characteristics at different levels are reflected in the table 3.3 & the graphical representation of the same in fig. 3.2.

Table 3.3 Average Percentage Removal Efficiency of Dairy Effluent Characteristics at Different Levels.

Sl No	Parameters	Aeration Tank	Sedimentation Tank	Treated Hold Up Tank
1	pH@ 25°C	1.86 %	3.76 %	4.68 %
2	Total Suspended Solids	19.12 %	46.83 %	72.34 %
3	BOD ₅	24.40 %	51.85 %	81.31 %
4	COD	36.77 %	58.31 %	76.49 %
5	Chlorides	24.94 %	33.80 %	43.01 %
6	Total Dissolved Solids	18.17 %	31.88 %	41.10 %
7	Sulphate (as SO ₄)	21.65 %	37.13 %	59.60 %
8	Residual Sodium Carbonate	17.63 %	43.79 %	70.38 %
9	Sodium absorption	11.98 %	23.20 %	40.02 %
10	Oil and Grease	40.55%	62.56%	80.29%


Fig. 3.2 Average Percentage Removal Efficiency of Dairy Effluent Characteristics at Different Levels.

5. CONCLUSIONS

Present study has been carried out in Angadi Institute of Technology and Management, Belagavi and was concerned with the Performance Evaluation of existing ETP of DAMUL, milk dairy. After evaluation it is opined as below.

- The physical condition of ETP is good enough.
- The performance of the ETP is good but not excellent. Hence it is essential to monitor with prime care in a regular manner.
- The effluent from the dairy after treatment compliances the standards of irrigation for the safe disposal as prescribed by CPCB.
- Duly considering the advance technologies which provide best results and cost effective, it is proposed to provide certain additional components to the existing ETP viz; Proposed Bar Screen (PBS), Proposed Collection Tank (PCT), Proposed Acedogenic Reactor (PADR), Proposed Up Flow Anaerobic Sludge Blanket Reactor (PUASBR), Proposed Aeration Tank (PAT)-1, Proposed Aeration Tank (PAT)-2, Proposed Clarifier, Proposed Membrane Bio Reactor (PMBRT), Proposed Ozone Reactor Tank (PO3RT), Proposed Ozone Treated Tank (PO₃TT).

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