A Case Study on Performance Evaluation of Dairy Effluent Treatment Plant and Reuse of Oil -Grease Sludge to Blend in Briquette Manufacturing

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Abstract - The significant ascending growth of dairy industry is majorly contributing to 'White Revolution in India'. According to the National Dairy Development Board (NDDB), the demand for milk is likely to reach 200 million tons by 2022 which was about 150 million tons in 2015-16. Dairy Industry generates about 0.2–10 liters (Avg. 3 liters) of waste water effluent per liter of processed milk which is organic in nature and bio-degradable and hence containing high concentration of BOD and COD. Lean monitoring treatment process generates substandard quality effluent and develops burden on the system for the targeted output. Hence it becomes very much essential to evaluate the performance of ETP and apply the appropriate remedies to overcome the lapses in case of any cause.

The significant characteristics of a dairy effluent contains Temperature, color, pH, BOD, COD, dissolved solids, and suspended solids, chlorides, sulphate, oil and grease. The waste water of dairy contains large quantities of milk constituents as about 2% milk of total quantity of processing milk is added into the drains. It also contains casein, inorganic salts, detergents, caustic soda and sanitizers used for washing & cleaning. Generated dairy wastes are physically white in color and fermentation of milk sugar into lactic acid varies the wide range of pH from 4.0 to 11.0 which is critical to normalize. Also highly variable flow rates gives fluctuations in contamination concentration criticizes the challenges in waste management system.

Keywords — Dairy Industry, Effluent Treatment Plants, Oil and Grease, waste water Characterized Parameters, Performance and Evaluation Studies.

I. INTRODUCTION

'Pune Zillaha Sahakari Dudh Utpadak Sangh Maryadit' is a district level co-operative organization established in 1960, popularly known as 'Katraj Dairy'. Katraj Dairy started with about 0.30 lakh (30,000) litters of milk per day in the first year of operation and by present day it has increased to over 2.5 lakh (0.25 million) litre/day. This industry processes total effluent about 77781700 Litter/year (Katraj Dairy report 2019). This work presents a case study of "Katraj Dairy" with two major aims. First one is to assess the performance of dairy Effluent Treatment Plant (ETP); with the study of performance evaluation of each unit of ETP, and second aim to find the solution for the disposal or reuse of Oil & Grease sludge generated by dairy effluent.

Dairy industry is called as 'Wet Industry' as large amount of water is utilized in processing and generates large volume of waste water effluent (about 1.5 to 3 liters of wastewater per liter of milk processed). Various milk processing operations in a dairy industry to manufacture the products like, cream, cheese, Ice-creams, buttermilk etc. generates waste water which is contaminated with dissolved sugars, proteins and fats which is organic in nature and bio-degradable. This wastewater contains high concentration of organic matter and high BOD-Biochemical Oxygen Demand. Poorly treated wastewater with high level of pollutants creates major environmental problems when it discharged to the surface land or water. To reduce the adverse impact on environment the industrial laws & legislations of pollution control board are made applicable to the industries.

With the view of above mentioned scenario of dairy effluent's environmental impact; a case study of "Katraj

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Dairy", Pune is conducted to evaluate the performance of the effluent treatment plant.

II. AIMS, OBJECTIVES AND LIMITATIONS

A) PERFORMANCE EVALUATION OF ETP

1. Characterization of wastewater in terms of pH, COD, BOD, TSS, TDS, DO, oil and grease, from the selected units of plant.
2. To evaluate the performance of each unit of effluent treatment plant.
3. The check the quality of the reclaimed wastewater to determine its suitability for reuse or dispose.

B) DISPOSAL OR REUSE OF OIL & GREASE SLUDGE

1. To achieve the solution for Safe disposal or reuse of oil and grease waste.
2. To check the manufacturing feasibility of briquettes developed by the fusion of oil & grease with saw dust and its application in the industry as a burning fuel in boilers.

III. METHODOLOGY

3.1 EFFLUENT TREATMENT PLANT - KATRAJ DAIRY

A katraj dairy industry is selected for the study and having treatment capacity of 275 – 325 KLD of waste water. The coordinates for the project site is 24.10°N and 72.25°E. The methodology involved the collection & analysis of samples at the different units of the effluent treatment plant.

3.2 SAMPLING PROCEDURE AND FREQUENCY

In the performance evaluation study of the ETP, it is important to adopt proper sampling procedure. Characterizing the constituents /parameters of the wastewater with respect to the desired aims and objectives of the study is the prime step in the sampling part. Several factors were considered in sampling program.

These factors included;

1) Selection of sampling locations,
2) Type of samples (grab or composite samples),
3) Sample sizes,
4) Time intervals between samples and
5) Total number of samples needed to achieve output values from the analyses.

Each sample in this study is implemented as a grab sample. For each collection point the sample will be collected a minimum of 1 liter for the chemical/physical analyses and 0.25 liters sample will be collected for the microbial analyses. For the microbial analyses, sterile plastic bottles will be used, while for physical / chemical analyses cleaned water bottles will be used. After collection, the samples were immediately transferred to the laboratory for analysis.

The control points, which served as locations for the samples, are as follows:

Point 1: Skimming Tank **Point 2**: Equalization Tank **Point 3:** Aeration Tank-1& Aeration Tank-2 **Point 4:** Secondary Clarifier Tank **Point 5:** Filter Tank. - a) Pressure Sand Filter Tank b) Activated Carbon Filter Tank **Point 6:** Treated Water Tank.

The samples are collected from inlet and outlet of the unit of the ETP. And the characterized parameters are selected as per the function of the ETP unit.

The methods used for the testing of samples - APHA 1996(American Public Health Association).

3.3 CHARACTERIZED PARAMETERS

The objective of this work is the evaluation of performance of ETP and check whether the treatment units of ETP are working with designed efficiency or not. Evaluation process is carried out with the analysis of characterized parameters of the effluent. Within this view, the experimental work has been designed and is presented here with:

The samples were characterized for the significant parameters are as follows and the ETP unit wise parameters are selected as per the function of the respective unit:-

- pH
- BOD (Biochemical Oxygen Demand)
- COD (Chemical Oxygen Demand)
- TSS (Total Suspended Solids)
- DO (Dissolved Oxygen)
- Oil & Grease

3.4 UNIT WISE PERFORMANCE EVALUATION CRITERIA AND RESPECTIVE CHARACTERIZED PARAMETERS

Table 1: Performance Evaluation Criteria and Characterized Parameters

Sr. No	ETP Unit	Function	Performance Criteria	Characterized Parameters
1	Screening Chamber	To remove large floating matters.	-	i)pH, ii)BOD ,iii)COD,iv)TSS, v)TDS, vii)DO vi)Oil & Grease
2	Skimming Tan	To remove floating Oil & Grease	i)oil & Grease removal	i)Oil & Grease
3	Equalizatio nTank	To mixing of the effluent equally.	i) BODii)PH iii)Equalized BOD Mass loading	i)pH, ii)BOD
4	Aeration Tank	To remove the organicmatter (BOD COD)	i)BOD loading Rateii)DO iii)MLSS iv)RAS v)SVI vi)F/M ratio vii)SRT viii) rate of aeration ix)Temp	i)BOD, ii)COD, iii) DO, iv)TSS, v)SVI, vi)MLSS, vii)F/M ratio,viii)pH, ix) Temp

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5	Secondary Clarifier Tank	To separate solid &Liquid	i)SVI ii)SDI iii)Detention time iv) flow rate	i)SVI, ii)SDI, iii)BOD, iv)CODy)TSS
6	Filter Feed Tank	To store the treated water for further treatment	-	-
7	Pressure Sand Filter	To Remove the Suspended Solids	i)Turbidity ii)TSS iii) Particle size removal	i)Turbidity ii)TSS iii)Particle size removal
8	Activated carbon filter	To remove the trace organic matter, chlorine,taste & odor.	i)organic matter ii)Residual Disinfectants Removal iii)Taste & odor	i)organic matter ii)chlorine iii)taste iv)odorv)DO
9	Treated water tank	To store the treated waterfor further application	-	i)pH, ii)BOD, iii)COD,iv)TSS, v)TDS, vi)Oil & Grease vii)DO

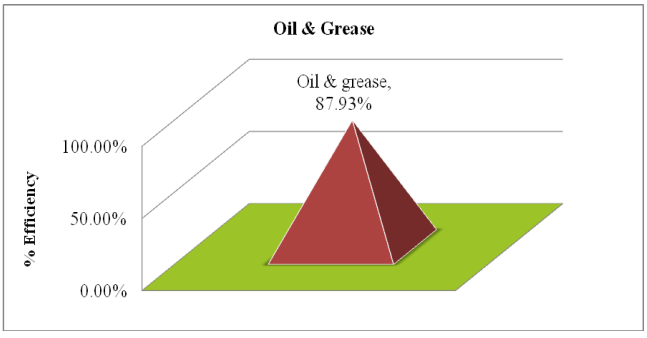
IV. EXPERIMENTAL ANALYSIS

In this study of performance analysis of ETP, the waste water samples were collected from the inlet and outlets of respective units of the ETP system. The Parameters for the performance of units are considered to analyze on the basis of the function of the respective units. The experimental Analysis of collected samples gives the performance evaluation of each unit of ETP.

4.1 Skimming Tank

Table-2: Performance Evaluation of Skimming Tank

Sr. No	Parameter	Inlet – Skimming Tank	Outlet – Skimming Tank	% Efficiency	Avg. Efficiency
1	Oil & Grease	348	42	87.93 %	87.93 %



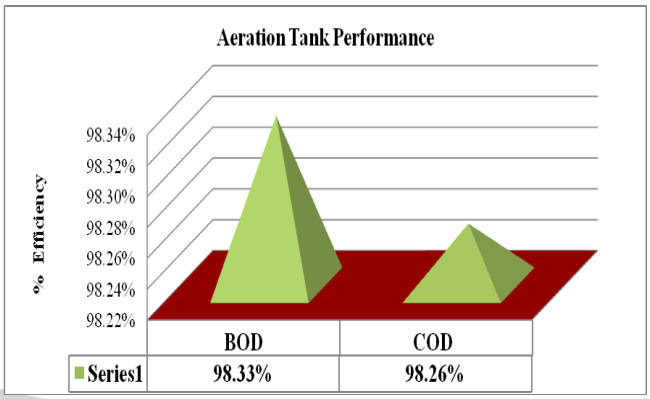
GRAPH 1: PERFORMANCE EFFICIENCY OF SKIMMING TANK

According to the reading of Table -2 & Graph -1, the oil &Grease removal efficiency of skimming tank is 87.93 %.

4.2 Aeration Tank

Table-3: Performance Evaluation of Aeration Tank

Sr. No	Parameter	Inlet – Aeration Tank	Outlet – Aeration Tank	% Efficiency	Avg. Efficiency
1.	pH	10.08	8.12	-	98.29 %
2.	TSS	86	14262	-	
3.	COD	1603	27.78	98.26 %	
4.	BOD	600	10	98.33 %	



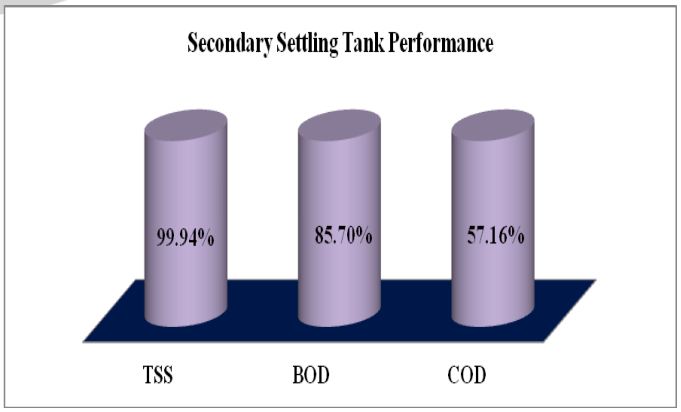
Graph 2: Performance Efficiency of Aeration Tank

The significant parameters considered to Aeration Tank are COD & BOD. The graphical representation shows the removal efficiency of aeration tank is 98.26 % and 98.33 % respectively. Table -3 shows the Average efficiency of the aeration tank for the COD & BOD parameters is 98.29 %.

4.3 Secondary Clarifier Tank

Table - 4: Performance Evaluation of Secondary Clarifier Tank

Sr. No	Parameter	Inlet – Secondary Clarifier Tank	Outlet - Secondary Clarifier Tar	% Efficiency	Avg. Efficiency
1	pH	8.12	8.37	-	80.93 %
2	TSS	14262	8.0	99.94 %	
3	COD	27.78	11.9	57.16 %	
4	BOD	10	1.43	85.7%	



Graph 3: Performance Efficiency of Secondary Clarifier Tank

The main function of Secondary Clarifier Tank is to settling of suspended solids, which is known as removal efficiency of TSS. Secondary Clarifier Tank gives the removal efficiency of TSS as 99.94 %. Along with that the BOD & COD removal is 85.70 % and 57.16 % respectively.

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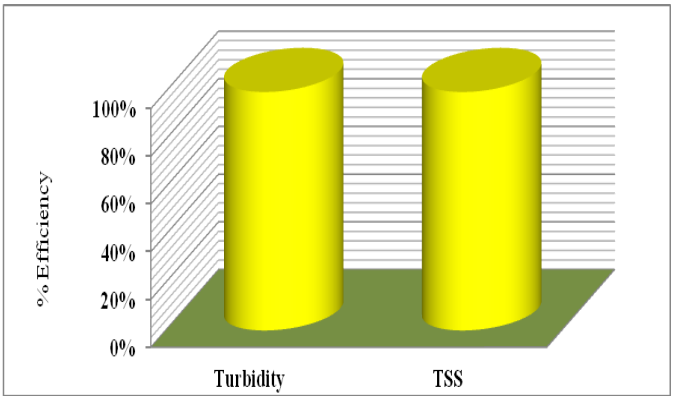
4.3 PRESSURE SAND FILTER

Table-5: Performance Evaluation of Pressure Sand Filter

Sr. No	Parameter	Inlet – Pressure Sand Filter	Outlet - Pressure Sand Filter	% Efficiency	Avg. %Efficienc
1.	Turbidity	1.2	< 1	25 %	29.17 %
2.	TSS	18	12	33.34 %	



Graph 4: Performance Efficiency of Pressure Sand Filter

Pressure Sand Filter is responsible for particle removal by filtration process. The Pressure Sand Filter gives the turbidity and TSS removal efficiency as 25 % and 33.34 % respectively which is below satisfactory and need to be improved.

4.5 Activated Carbon Filter

Table-6: Performance Evaluation of Activated Carbon Filter

Sr. No.	Parameter	Inlet - Activated Carbon Filter	Outlet - Activated Carbon Filter	% Efficiency	Avg. Efficiency
1.	Chlorine	< 0.1	< 0.1	0 %	166.67 %
2.	DO	2.4	6.4	166.67 %	
3.	Odor	Agreeable	Agreeable	-	

4.6 Calculation of Estimated Final Effluent BOD Concentration through Activated Sludge process:

- Formula for Estimated BOD

$$\text{BOD eff.} = (\text{Soluble BOD}) + \frac{\text{BOD}}{\text{VSS}} \times \frac{\text{VSS}}{\text{TSS}} \times \text{TSS}$$

$$\text{BOD eff.} = 1.17 + \frac{1.43}{158} \times \frac{158}{8} \times 8$$

(Soluble BOD = 1.17mg/l, VSS = 158 mg/l & TSS = 8mg/l - According to Lab Report)

∴ BOD (eff) = 2.6 mg /lit

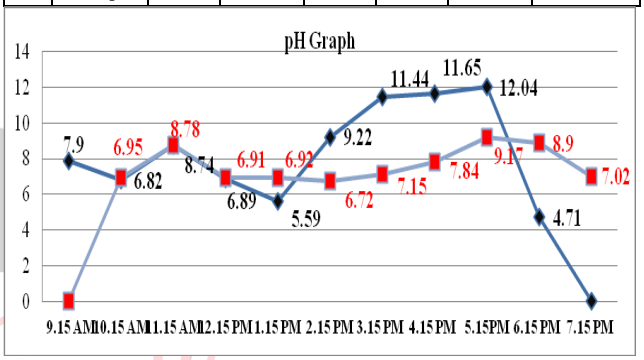
(Final effluent BOD concentration by laboratory analysis is 3.2 mg /lit.)

∴ The efficiency of Activated Sludge Process for BOD to be improved by 23.07 %.

4.7 Equalization Tank

Table-7: Equalization Tank - Sample Collection Data

Sr. No.	Time	Inlet pH	Outlet pH	Inlet BOD	Outlet BOD	Flow Rate m³ hr	Flow Rate m³/ sec
1	9.15 am	7.90	-	580		14.4	0.0040
2	10.15 am	6.82	6.95	720	660	14.6	0.00405
3	11.15 am	8.74	8.78	560	600	14.8	0.00411
4	12.15 pm	6.89	6.91	520	620	14.6	0.00405
5	1.15 pm	5.59	6.92	540	520	14.4	0.0040
6	2.15 pm	9.22	6.72	620	740	17.6	0.00488
7	3.15 pm	11.44	7.15	460	480	19.5	0.00541
8	4.15 pm	11.65	7.84	580	480	22.1	0.00613
9	5.15pm	12.04	9.17	360	440	20.4	0.00566
10	6.15 pm	4.71	8.90	580	500	20.6	0.00572
11	7.15 pm	-	7.02	-	640	-	-



Graph 5: Equalization Tank - Inlet and Outlet pH Values

Graph 6 showing the equalization of pH in Equalization tank. The graph of inlet values of pH and outlet pH has been drawn. The pH at outlet shows more equalized line which shows the satisfactory working of pH equalization of Equalization tank.

Table-8: Inlet BOD Mass Loading Calculations

Sr. No.	Time	Avg. Flow rate m³/sec	Avg. Flow Rate lit/ hr	Avg. BOD Concentration mg/ lit	BOD Kg/ lit	BOD Mass Loading Kg/ hr.(Inlet)
1	9.15 am	0.0040	14285.71	580	580 x 10⁻⁶	8.28
2	10.15a m	0.00405	14464.28	720	720 x 10⁻⁶	10.41
3	11.15 am	0.00411	14678.57	560	560 x10⁻⁶	8.21
4	12.15 pm	0.00405	14464.28	520	520 x 10⁻⁶	7.52
5	1.15 pm	0.0040	14285.71	540	540 x 10⁻⁶	7.71
6	2.15 pm	0.00488	17428.57	620	620 x 10⁻⁶	10.80
7	3.15 pm	0.00541	19321.42	460	460 x 10⁻⁶	8.88
8	4.15 pm	0.00613	21892.85	580	580 x 10⁻⁶	12.69 Peak
9	5.15pm	0.00566	20214.28	360	360 x 10⁻⁶	7.27 Min
10	6.15 pm	0.00572	20428.57	580	580 x 10⁻	11.84

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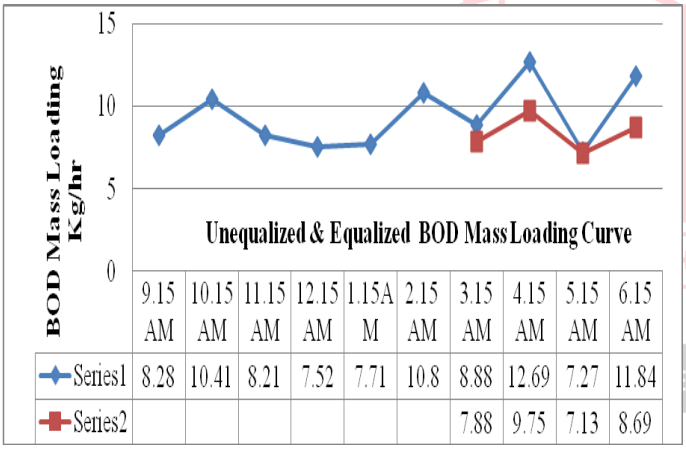
					^{6}	
Average		0.00480	17142.85		Avg.	9.36

Table-9: Out Let BOD Mass Loading Calculations (To be required)

Sr. No.	Time	Vol ^{m}of flow during time period (m^3)(Vic)	Vol ^{m}of storage at the end of time period (m^3) Vsc & Vsp)	Avg. BOD concentration during time period (inflow)mg/ l (Xic & Xsp)	Equalized BOD concentration during time period mg/ (Xoc)	Equalized BOD concentration during time period kg/l	Equalized BOD mass Loading Rate during time period Kg/ hr.
1	9.15 am	14.4	-	-	-		-
2	10.15 am	14.6	-	-	-		-
3	11.15 am	14.8	-	-	-		-
4	12.15 pm	14.6	-	-	-		-
5	1.15 pm	14.4	-	-	-		-
6	2.15 pm	17.6	-	-	-		-
7	3.15 pm	19.5	2.22	460	460	460 x 10^{-6}	7.88
8	4.15 pm	22.1	7.04	580	569.04	569.04 x 10^{-6}	**9.75 Peak**
9	5.15 pm	20.4	10.16	360	416.44	416.44 x 10^{-6}	**7.13 Min**
10	6.15 pm	20.6	13.48	580	507.33	507.33 x 10^{-6}	8.69
							Avg. = 8.36



Series 1: Un-equalized BOD Mass Loading kg/hr. **Series 2**: Equalized BOD Mass Loading kg/hr.

Graph 6: Un-equalized & Equalized BOD Mass Loading Curve

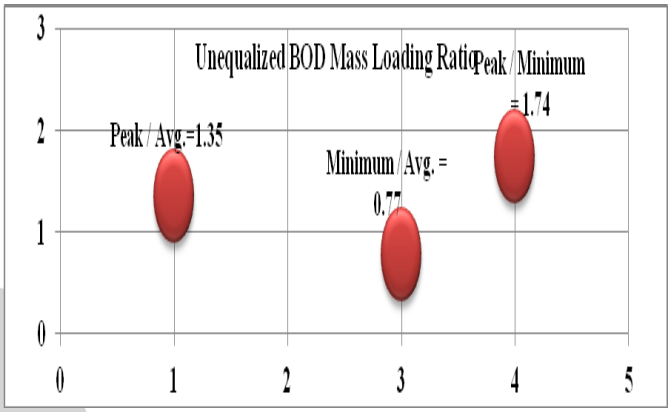
Table-10: Comparison of Required BOD Mass Loading and Actual BOD Mass Loading Achieved

Sr. No.	BOD Mass Loading at outlet Required as per calculations	BOD Mass Loading Achieved As per outlet BOD lab Analysis	% Efficiency	Avg. % Efficiency
1	7.88	8.22	- 4.31 %	-5.96 %
2	9.75	7.59	22.15%	
3	7.13	8.30	-16.40 %	
4	8.69	10.89	-25.31 %	

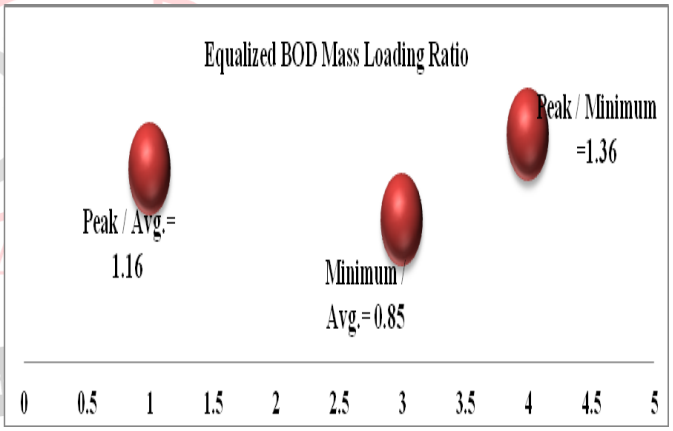
BOD Mass Loading Efficiency of Equalization tank to be improved by 5.96 %

Table-11: BOD Mass Loading Ratios

Sr. No	Ratio	Un-equalized BOD (Inlet)	Equalized BOD (Outlet)
1	Peak / Avg.	12.69 / 9.36 = 1.35	9.75 / 8.36 = 1.16
2	Min / Avg.	7.27 / 9.36 = 0.77	7.13 / 8.3 = 0.85
3	Peak / min	12.69 / 7.27 = 1.74	9.75 / 7.1 = 1.36



Graph 7: Un-Equalized BOD Mass Loading Ratio



Graph 8: Equalized BOD Mass Loading Ratio

Table-12: Calculation of Actual BOD Mass Loading Rate Achieved (According to Outlet BOD Concentration by Lab Analysis)

Sr. No	Time	Vol of flow during time period (m^3)(Vic)	Vol of storage at the end of time period (m^3) Vsc & Vsp)	Avg. BOD concentration during time period (outflow)mg/ l (Xic & Xsp)	Equalized BOD concentration during time period mg/l (Xoc)	Equalized BOD concentration during time period kg/l	Equalized BOD mass Loading Rate during time period Kg/ hr.
1	9.15 am	14.4	-	-	-		-
2	10.15 am	14.6	-	-	-		-
3	11.15	14.8	-	-	-		-

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4	12.15 pm	14.6	-	-	-		-
5	1.15 pm	14.4	-	-	-		-
6	2.15 pm	17.6	-	-	-		-
7	4.15 pm	22.1	2.22	480	480	480 x 10^{-6}	**8.22**
8	5.15 pm	20.4	7.04	440	443.28	443.28 x 10^{-6}	**7.59**
9	6.15 pm	20.6	10.16	500	484.60	484.60 x 10^{-6}	**8.30**
10	7.15 pm	22.8	13.48	640	585.38	585.38 x 10^{-6}	**10.03**

Table-13: Comparison of Calculated Equalized BOD at Outlet with Laboratory Analyzed Equalized BOD at Outlet

Sr. No.	Time	Equalized BOD at outlet (by Calculations) mg/lit	Time	Equalized BOD at outlet (by Laboratory Analysis)mg/lit	% Efficiency difference	Avg. % Efficiency
1.	3.15 pm	460	4.15 pm	480	-4.34 %	
2.	4.15 pm	569.04	5.15 pm	440	22.67 %	93.03 %
3.	5.15 pm	416.44	6.15 pm	500	-20.06 %	
4.	6.15 pm	507.33	7.15 pm	640	-26.15 %	

Efficiency of equalization tank should be improved by 6.97 % to achieve the calculated equalized BOD value at outlet.

4.8 Calculations in Performance Evaluation of Equalization Tank

4.8.1Calculation of Vol ᵐ of storage at the end of time period (m³) (Vsc & Vsp):

- Formula

Vsc = Vsp + Vic – Voc ---------- (A)

- **Sample Calculation**

1) Consider the time 3.15 PM data to calculate Vsc;
Where
Vsp = 0, Vic = 19.5m³, Voc = 0.00480 x 3600 = 17.28 m³
By putting the values in Eq. (A), we get,
Vsc = 0 + 19.5 – 17.28
∴ Vsc = 2.22 m³

4.8.2 Calculation of Equalized BOD concentration during time period mg/l (Xoc):

- Formula

$$Xoc = \frac{(Vic \cdot xic) + (Vsp \cdot Xsp)}{(Vic + Vsp)} \quad \text{------- (B)}$$

- Sample Calculation:

1) Consider the time 3.15 PM data to calculate Xoc;
Where
Vic = 19.5 m³, Xic = 460 mg/l, Vsp = 0, Xsp = 0
By putting the values in Eq. (B), we get,

$$Xoc = \frac{(19.5 * 46) + (0 * 0)}{(19.5 + 0)}$$

∴ Xoc = 460 mg/l

4.8.3 Calculation of Equalized BOD mass Loading Rate during time period Kg/ hr.

- Formula

Mass Loading Rate = BOD X Avg. Flow rate

- Sample Calculations:

1) Consider the time 3.15 PM data to calculate BOD Mass Loading Rate ;
Mass Loading Rate = 460 x 10^{-6} X 17142.85

∴ MASS LOADING RATE = 7.88 KG/HR

V. RESULT ANALYSIS

For the effluent treatment plant the Result analysis is carried out for two concepts. Firstly with the help of executed study the result analysis is carried out for performance evaluation of each unit of ETP and along with that the efficiency of effluent treatment plant also get executed.

5.1 Result Analysis for Performance Evaluation of Each Unit of ETP:

As per the conducted study of performance evaluation of ETP, the analysis of results has been interpreted for respective units of ETP. The performance efficiency of each unit of ETP is shown in below table. The significant parameters with respect to the function of respective unit are analyzed in performance evaluation study and the calculated efficiency of each unit of ETP has been summarized under result analysis concept.

Table -14: Avg. Performance Efficiency of ETP Units

Sr. No.	ETP Units	Avg. Efficiency
1.	Skimming Tank	87.93 %
2.	Aeration Tank	98.29 %
3.	Secondary Clarifier Tank	80.93 %
4.	Pressure Sand Filter	29.17 %
5.	Activated Carbon Filter	166.67 %

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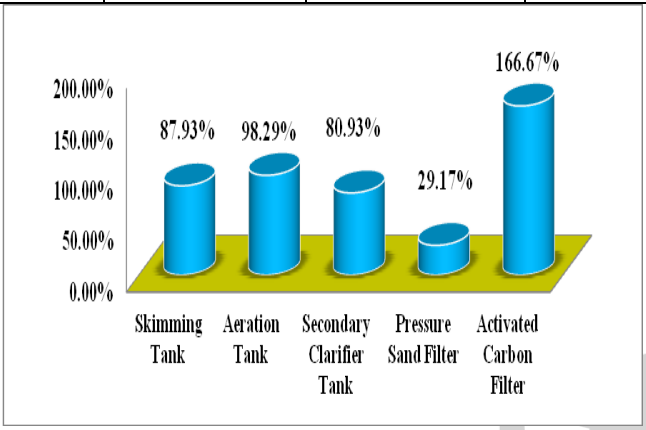
Sr. No.	Parameters	Permissible Limit Value As Per IS - 10500:2012	Final Treated Effluent Values
1	pH	6.5 to 8.5	8.3
2.	TSS	Max 100	< 5
3.	BOD	Max 30	3.2
4.	COD	Max 250	< 20
5.	Oil & Grease	Max 10	4



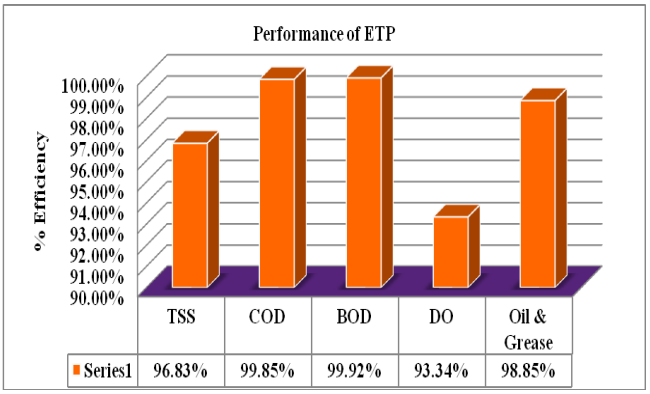
Graph 9: Avg. Performance Efficiency of ETP Units

5.2 Result Analysis for Performance Evaluation of ETP

In performance evaluation of ETP the significant parameters like Ph, TSS, COD, BOD, DO and Oil & Grease are analyzed at inlet of screening chamber and at outlet of final treated effluent. Interpretation of result shows in below table with the graphical representation.

Table- 15: Performance Evaluation of ETP

Sr. No.	Parameter	Inlet-Screening Chamber	Outlet-Final Treated Effluent	% Efficiency	Avg. Efficiency
1.	pH	3.65	8.3	-	97.75%
2.	TSS	158	<5	96.83 %	
3.	COD	13950	<20	99.85%	
4.	BOD	4500	3.2	99.92 %	
5.	DO	3	5.8	93.34%	
6.	Oil & Grease	348	4	98.85 %	



Graph 10: Performance Evaluation of ETP

5.3 Comparison of Final Treated ETP Effluent with Permissible Limits

Table-16: Final Treated Effluent Suitability Check with Permissible Limiting Values

VI. DEVELOPMENT OF BRIQUETTES: EXPERIMENTATION

6.1 Material & Methodology of Briquettes

6.1.1 Raw Material Used

i) Oil & Grease from Dairy: Extracted material from skimming tank of dairy ETP
ii) Saw Dust
iii) Bagass: dry and shredded to the size of 2 mm to 2.5 mm
iv) Chinch-turfal is also used in crushed and grinded form.
v) Municipal Garden solid waste: About 20 to 30 tons of garden waste is collected daily in Pune Municipal area.

6.1.2 Proportion of Raw Materials

Table-17: Proportion of Raw Material for Briquette

Sr. No	Raw Material Used	Proportion
1.	Garden Waste + Bagass	60 %
2.	Saw Dust	20 %
3.	Chinch-Turfal	10 %
4.	Oil & Grease from Dairy Waste	10 %

Figure-1: Developed Briquette Samples

Table-18: Lab Tested Briquette Parameters and Results

Sr. No	Parameter	Unit	Result
1.	Moisture content	%	5.94
2.	Ash Content	%	16.01
3.	Volatile Matter	%	77.19
4.	Fixed Carbon	%	0.85
5.	Gross Calorific Value	Cal / gm	3515

6.2 Result Analysis of Briquette

6.2.1 Permissible Value Analysis of Developed Briquette:

Table -19: Permissible Value Analysis of Developed Briquette

Sr. No	Parameter	Resulting value of developed	Permissible value	Remark

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		Briquette		
1.	Moisture content	5.94%	Min≤12% max≤15%	Satisfied
2.	Ash Content	16.01%	≤10.0%	Not satisfied
3.	Volatile Matter	77.19%	Not specified	-
4.	Fixed Carbon	0.85%	≤10.0%	Satisfied
5.	Gross Calorific Value	3515 Cal/gm	Min ≥14.5 MJ/kg , Max≥14.5 MJ/kg 3345cal /gm)	Satisfied

VII. CONCLUSION

7.1 Performance Evaluation of ETP

- According to the Table -14, Result analysis of Performance evaluation of each unit of ETP, skimming tank, equalization tank, Aeration Tank, Secondary Clarifier Tank , Pressure Sand Filter and Activated Carbon Filter gives the result as 87.93 %, 93.03 %, 98.29 %, 80.93 %, 29.17 % and 166.67 % respectively. With the result is can be concluded that the Katraj Dairy ETP units are working with satisfactory conditions with optimized efficiency. Only the efficiency of the pressure sand filter is needed to be improved.
- Result analysis Table -15 shows the Performance evaluation of ETP as 97.75 % reflects the efficient performance of ETP.
- Final Treated Effluent Disposal Suitability check**:** For the selected prescribed parameters of final treated effluent as pH, TSS, BOD COD and Oil & Grease are checked for its permissible limits as per the IS 10500:2012 standards to dispose off in natural stream as well as to reuse that water. With the interpretation of Table -16 it can be concluded that the final treated effluent of the Katraj dairy ETP is satisfactory, acceptable and safe to environment for reuse or dispose.

7.2 A Solution for Disposal or Reuse of Oil &Grease

- Looking towards the disposal or reuse solution of oil & grease sludge generated in the dairy, the experimentation of development of briquettes is carried out. The analysis of the developed briquettes is carried out. The Comparison of proximate analysis results of the Developed briquette with Permissible Value Analysis for utilization of Briquettes concludes that the briquettes which are developed with Oil & Grease sludge are suitable to be used in the boilers as a burning fuel.

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