Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.2911

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (6):** 622-627 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Studies on Effluent Treatment Plant for Dairy Industry and their Effects

Brijesh Goel[1], Vishal Kumar[2*], Mukesh Ruhela[1], Digvijay Singh Teotia[1], Sweta Singh[2], Vijay Kumar Bhatnagar[1] and Upendra Singh[3]

[1]Department of Environmental Engineering, Subahrti Institute of Technology & Engineering

[2]Department of Food Technology, Subahrti Institute of Technology & Engineering

Swami Vivekanand Subharti University Meerut - 250005 (U.P.)

[3]Agril. Engg. Deptt., SKNCOA, Sri Karan Narendra Agriculture University, Jobner Rajasthan

*Corresponding Author E-mail: vishalkumarsingh129@gmail.com

Received: 26.04.2017 | Revised: 5.06.2017 | Accepted: 8.06.2017

ABSTRACT

In order to understand the above stated implication. An attempt has been made in evaluation of complete effluent treatment plant of dairy industries. Pollution load parameters analyzed for evaluation of performance of ETP are COD, BOD_5 at 20 degree centigrade, TSS, Oil and grease. Mass balance of COD, TSS and Nitrogen are performed to find the fate of pollutants in ETP. Parameter tested was meant for the testing of water for the suitability of secondary effluent for reuse in irrigation. The COD, BOD ^0C and TSS removal efficiency of ETP are from 97%, 95% and 94% respectively. Water used in domestic and industrial applications can become polluted to varying degrees. Water is also used as a transport medium to carry away waste products. As awareness of the importance of improved standards of water treatment grows, process requirements become increasingly exacting. The food industry contributes significantly to pollution, particularly as the pollutants are of organic origin. Organic pollutants normally consist of 1/3 dissolved, 1/3 colloidal and 1/3 suspended substances, while inorganic materials are usually present mainly in solution. Dairy industry is one of the largest water consumers, where water reuse and recycling is a critical challenge. Every production unit requires such a water treatment plant that may tackle unbalanced level of BOD, COD, (total suspended solids) TSS and total dissolved solids (TDS).Our treatment systems provide unique and innovative solution to filtration and screening problems in the dairy processing units.

Key words: *Dairy Plant, Wastes, Pollution, COD, BOD and TSS.*

INTRODUCTION

Rapid growth of industries has not only enhanced the productivity but also resulted in the production and release substances into the environment creating health hazards and effected normal operations, flora and fauna. There wastes are potential pollutants when they produce harmful effects on the environment and generally released in the form of solids, liquid effluent and slurries containing a spectrum of organic chemicals.

Cite this article: Goel, B., Kumar, V., Ruhela, M., Teotia, D.S., Singh, S., Bhatnagar, V.K. and Singh, U., Studies on Effluent Treatment Plant for Dairy Industry and their Effects, *Int. J. Pure App. Biosci.* **5(6):** 622-627 (2017). doi: http://dx.doi.org/10.18782/2320-7051.2911

Thu pollution is a necessary evil of all development. To combat the plethora of environmental evils of present day society, efficient and environmentally safe organic waste treatment technologies are needed,

Beside like other industries that have serious waste disposal problem the dairy industry is faced with the prospect of having to erect a large number of relatively small treatment plant. Liquid effluent from dairy industry poses environmental problems like water and soil pollution. Oil grease in Effuent generated from Dairy industry poses a major threat to the environment besides lactose another pollutant component considering the project demand by 2020 A.D. 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 effluent with high levels of pollutants caused by poor design, operation or treatment systems creates major environmental problems when discharge to surface water or land. 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. . This organic load is basically constituted of milk (raw material and dairy products), reflecting an effluent with high levels of chemical oxygen demand (COD), biochemical oxygen demand (BOD), oils and grease, nitrogen and phosphorus. The automatic cleaning system – CIP (cleaning in place) – discard rinse waters with pH varying between 1.0 and 13.0, further complicating the question of treatment. BOD is directly related to milk wastes (90% to 94% of the effluent BOD), and in some cases losses can reach 2% of the volume processed by the industry[1].

Milk is received at the plant or receiving in standard 80-lb cans. It is dumped to a weigh vat and the cans are washed in a can washer and returned to the producer. From the weigh vat milk is pumped to a storage tank or, if the is a receiving station, the milk is cooled and pumped to a tank truck for hauling to a bottling or processing plant. About 50% of the milk produced in this country is used as whole milk. A small amount of this is bottled as raw milk, but the major portion is pasteurized prior to further handling.

Biogas, a mixture consisting primarily of methane and carbon dioxide, is produced from dairy through anaerobic digestion, a natural process that breaks down organic material in an oxygen free environment and it is well documented process for treating organic waste[2,3,4].

Effluent from dairy industry and their treatment

Wastes from dairy industries contain milk solids in a more or less dilute condition, but in varying concentration. These solids enter the waste from almost all of the operations. Effluent generate by dairy industries. Dairy effluent contains soluble organics, suspended solids, trace organics. All these components contribute largely towards their high biological oxygen demand (BODS) and chemical oxygen demand (COD). Dairy wastes are white in colour and usually slightly alkaline in nature and become acidic quite rapidly due to the fermentation of milk sugar to lactic acid. The suspended matter content of milk waste is considerable mainly due to fine curd found in cheese waste[5]

MATERIEL AND METHODS

The objective of this work is to evaluation of pollution parameters of effluent from dairy industries and check whether the treatment unit are working with designed efficiency or not. Within this view, the experimental work has been designed.

Monitoring of ETP and its performance evaluation

Samples were collected from ETP at different sampling points of ETP and characteristics for parameters BOD, COD, Nitrogen, Phosphorus, nitrogen, oil and gases, pH, acidity, alkalinity etc. mass balance of VSS, COD, nutrition {nitrogen} in Anaerobic- aerobic process. Design calculation of treatment units.

The ETP of samprash foods Pvt Ltd, Aligarh, U.P. having capacity to treat 500 m^3/day of wastewater was selected for the study. The

system was designed to handle to treat wastewater having high organic content and suspended solids. The heart of the systems is anaerobic and aerobic biological reactor. The system was designed to handle BOD_5 at 20 ^{0}C of 800 mg/L and suspended solid (SS) 250 mg/L. The various point sources of wastewater is collected in a combined underground sewer and conveyed to the main collection cum equalization tank, wherein the effluent are homogenized and in controlled condition are pumped to anaerobic digester for the biomethanation of the effluent. All three stage of anaerobic reaction namely hydrolysis, Aceto-genesis, methanogenesis are takes place inside the anaerobic digester, which result into reduction of COD, COD and other organic impurities. The gases generated in the system are methane and flared off from the anaerobic digester itself due to small in quantity. The overflow from the system is taken to further aerobic biological degradation in the aerobic tank. The treated effluents are let into secondary clarifier for the separation of solid and liquid. The treated effluent are let into secondary clarifier for the further tertiary treatment through dual media filter and activated carbon filter and sludge settled in the bottom are taken to sludge holding tank for the mechanical drying and disposal through mechanical filter press. The final treated water is suitable for reuse in irrigation[7]. In streams it is consumed at very rapid rate causing depletion of oxygen and in some cases exhaustion resulting in serious pollution. Hence the rapid growth in the size of dairy operations has resulted in new laws and regulations governing the handling and disposal of manure. Completely mixed the rmophilic digesters were proposed in Oregon to treat dairy manure[6].

RESULT AND DISCUSSION

Characterization of effluent from equalization tank of dairy industries

Suspended solid in wastewater from ETP was found to be 720 mg/L. Pollution prevention or source generation reduction refers to any processor technology that seeks the reduction or elimination of the volume, concentration or toxicity of generating source residues[2]. The use of acid, alkali, cleansers and sanitizers in the milk based food industries typically result in highly variable effluent pH values. Literature data indicated that pH value ranged between 4.7 – 12, with an average of 7.2. in the present case value of effluent from equalization tank is 6.7. The present pH is quite favorable for the process. The phosphorus in wastewater from milk based food industries originates from cleansing compounds and from milk or product spillages during processing. Total phosphorus concentration in the present study was 3.6 mg/L.

ETP & Anaerobic-Aerobic Process Performance

Effluent from dairy industries was treated by Up flow sludge blanket type anaerobic digester. Sequence of operation is explained in the methodology. The performance of ETP is evaluated by parameters COD, BOD, Oil & Grease, pH, TSS etc. the data given in tabular form under conclusion head represent the monthly variations in samples. Data presented in tabular form shows the monthly variation of COD at different sampling points. COD in the raw effluent was found to be 1250 mg/L, which is reduced to 75 mg/L after secondary clarifier. Standard deviation and in the plant waste minimization techniques.

Organic Matters

The removal of dissolved and particulate carbonaceous BOD and stabilization of organic matter found in effluent is accomplished biological using a variety of microorganism in the absence of oxygen in the anaerobic digester and in the presence of oxygen matter. First, a portion of the waste is oxidize to end products to obtain energy for call maintenance and the synthesis of new cell tissues.

Suspended Particles

The concentration of solids at various sampling points. In the present case, no primary treatment is provided, so whatever removal is there i.e. because of secondary

clarifier. A certain rise of concentration of TSS at sampling points P-4 & P-5 was observed which is due to oxidation of substrate and production of biomass.

Oil & Grease

The concentration of oil & grease at different sampling points. If grease is not removed before discharge of treated waste water, it can interfere with the biological life in the surface water and create unsightly films. The concentration of oil & grease in raw effluent was 25 mg/L. as the effluent passes through oil & grease trapping unit the concentration reduced to 14 mg/L. at the end of the treatment unit concentration reduced to 5 mg/L.

Table 1.1 Value of total suspended solids for different months

Total Suspended Solid (mg/L)					
Sampling Point	Dec	January	February	March	April
P_1	750	830	780	830	810
P_2	710	740	680	730	790
P_3	740	680	650	720	740
P_4	1850	1900	2320	2450	2540
P_5	2210	2420	2410	2360	2210
P_6	45	55	60	47	40

Table 1.1.2 ANOVA Analysis Value of total suspended solids

Source	D.F.	S.S	M.S.	F-Cal	Significance	CD	SE (d)	SE (m)	CV
Replications	05	733826.17							
Treatment	04	14782327.8	3695581.97	12.34	0.000032	663.647	315.924	223.392	48.145
Error	20	5988491.33	299424.57						
Total	29	21504645.3							

-----Table 1.2 Value of BOD at 20 ^{0}C temperature

BOD at 20 ^{o}C					
Sampling Point	Dec	January	February	March	April
P_1	680	740	725	630	710
P_2	610	690	620	590	655
P_3	650	595	650	670	625
P_4	175	220	190	202	170
P_5	170	180	150	180	195
P_6	22	34	45	26	29

Table 1.2.1 ANOVA Analysis Value of BOD at 20 ^{0}C temperature

Source	D.F.	S.S	M.S.	F-Cal	Significance	CD	SE (d)	SE (m)	CV
Replications	05	110911.07							
Treatment	04	1809918.87	452479.72	36.95	0.000000	134.212	63.891	45.177	28.068
Error	20	244919.93	12246.00						
Total	29	2165749.87							

Table 1.3 Value of COD

COD					
Sampling Point	Dec	January	February	March	April
P_1	1250	1305	1290	1320	1330
P_2	1240	1235	1250	1220	1260
P_3	1235	1220	1240	1150	1220
P_4	590	540	520	615	480
P_5	485	550	515	510	490
P_6	45	48	49.5	41	43

Table 1.3.1 ANOVA Analysis of COD

Source	D.F.	S.S	M.S.	F-Cal	Significance	CD	SE (d)	SE (m)	CV
Replications	05	236685.78							
Treatment	04	5842467.63	1460616.91	48.99	0.000000	209.411	99.689	70.491	21.329
Error	20	596269.77	29813.49						
Total	29	6675423.18							

Table 1.4 Values of pH level for Different Month

pH					
Sampling Point	Dec	January	February	March	April
P_1	7.4	6.8	6.9	6.3	5.9
P_2	6.4	7.1	6.8	7.3	7.0
P_3	6.7	7.2	6.4	7.1	6.9
P_4	7.9	8.0	8.2	8.5	8.5
P_5	7.4	7.9	8.2	7.7	7.9
P_6	7.5	7.2	8.1	7.3	7.4

Table 1.4.1 ANOVA Analysis of pH level for Different Month

Source	D.F.	S.S	M.S.	F-Cal	Significance	CD	SE (d)	SE (m)	CV
Replications	05	0.40							
Treatment	04	6.99	1.75	6.39	0.001760	0.634	0.302	0.214	7.136
Error	20	5.47	0.27						
Total	29	12.86							

Table 1.5 Values of Total Solids for Different Month

Total Solids					
Sampling Point	Dec	January	February	March	April
P_1	1850	1780	1790	1820	2050
P_2	1970	1945	1930	2120	1790
P_3	1750	1860	1910	1950	2040
P_4	3850	4135	3680	3940	3880
P_5	3250	3640	3950	3560	3890
P_6	1050	1420	1140	950	1050

Table 1.5.1 ANOVA Analysis of Total Solids for Different Month

Source	D.F.	S.S	M.S.	F-Cal	Significance	CD	SE (d)	SE (m)	CV
Replications	05	1403470.00							
Treatment	04	19011421.6	4752855.42	8.42	0.000375	911.202	433.771	306.722	31.331
Error	20	11289438.3	564471.92						
Total	29	31704330.0							

Table 1.6 Value of Total Dissolved Solids for Different Month

Total Dissolved Solids					
Sampling Point	Dec	January	February	March	April
P_1	921	850	820	710	950
P_2	1050	1161	1171	980	821
P_3	845	940	1242	1143	1111
P_4	971	1020	855	931	880
P_5	965	940	1051	924	1220
P_6	920	981	825	1020	1052

Table 1.6.1 ANOVA Analysis Value of Total Dissolved Solids for Different Month

Source	D.F.	S.S	M.S.	F-Cal	Significance	CD	SE (d)	SE (m)	CV
Replications	05	148175.87							
Treatment	04	100252.33	25063.08	2.14	0.113239	N.S.	62.467	44.171	11.090
Error	20	234130.47	11706.52						
Total	29	482558.67							

Table 1.7 Values of Oil and Grease For Different Month

Oil & Grease					
Sampling Point	Dec	January	February	March	April
P_1	40	38	32	29.5	32.6
P_2	25.5	23.2	18.9	21.2	25.2
P_3	15.5	12.4	9.5	8.2	9.2
P_4	13.2	12.5	11.8	11.4	10.3
P_5	10.1	9.2	8.4	10.4	9.8
P_6	7.4	8.4	8.8	9.6	7.3

Table 1.7.1 ANOVA Analysis of Oil and Grease For Different Month

Source	D.F.	S.S	M.S.	F-Cal	Significance	CD	SE (d)	SE (m)	CV
Replications	05	76.47							
Treatment	0 4	2504.63	626.16	58.35	0.000001	3.973	1.891	1.337	20.077
Error	20	214.63	10.73						
Total	29	2795.72							

REFERENCES

1. Boyd, J. "Unleashing the Clean Water Act, the Promise and Challenge of the TMDL Approach to Water Quality," Resources, Issue 139 (2000).
2. Borzacconi, L., Lopez I. and Vinas M. Application,ofanaerobic digestio n to the treatment of agroindustrial effluents in Latin America, Water Science and Technology, **(32)12:** 105–111 (1995).
3. Lawson, P.S. Municipal solid waste conversion to energy, Biomass and Bioenergy. 2 **(16):** 319–330 (1992).
4. RalphS. and Keith R. Anaerobic,digestion of crops and farm,wastes in the United Kingdom, Agriculture Ecosystem & Environment, **30 (12):** 85–95 (1990).
5. Bharathi, M A. "A Novel Approach for Energy Efficient Data Aggregation using Elephant Behavior as a Swarm Intelligence", International Journal of Lecture Notes on Software Engineering IACSIT Press, ISSN:2301-3559, (2013).
6. Tillamook, Anaerobic digester a success at dairy farm, BioCycle, **40(3):** 18 (1999).
7. Cameron, M., Trenouth C. Resource Management Act - Practice and performance: A case study of farm dairy effluent management. Wellington. Ministry for the environment (1999).