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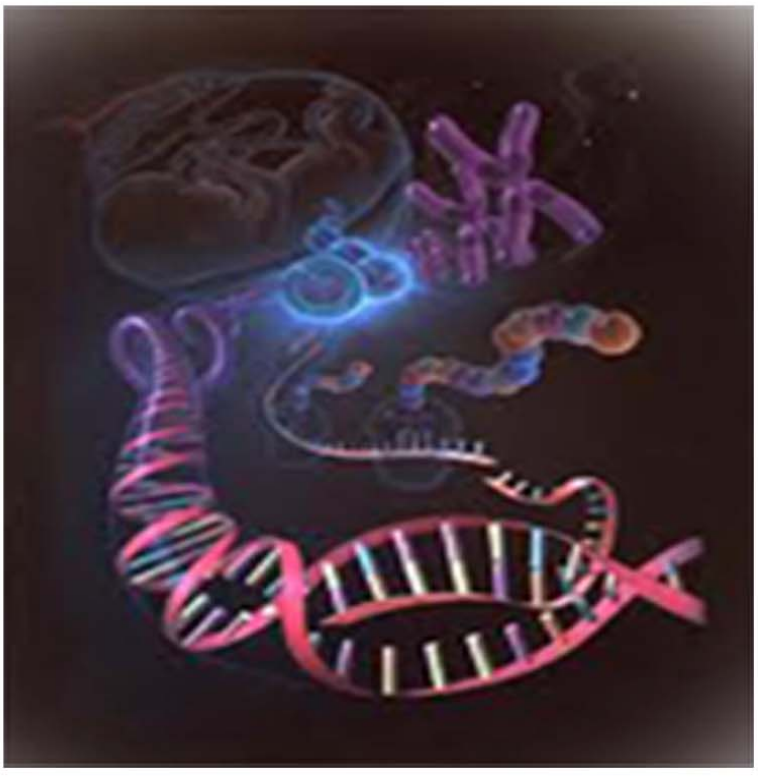

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Research Paper

PHYSICOCHEMICAL CHARACTERIZATION OF DAIRY EFFLUENTS

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Global environmental pollution is one of the major issues, griping earth day by day. The dairy industry effluent was the second most important single source of pollution in streams. Dairy is one of the major agriculture industries and dairy wastewater problem is larger in developing countries because all milk is processed industrially. The effluent discharged by raw milk quality control laboratories are more complex than the ones commonly generated by diaries factories because of the presence of the certain chemicals sodium azide or chloramphenicol which are used for preserving milk before analysis. The environmental impact of these factories can be very high, especially due to the discharge of very large wastewater with high content of organic matter and nutrients (nitrogen and phosphate). Dairy is having particular characteristics of effluents and hence has the different effluent related problems. These problems can be revealed only after the factual study of various physico-chemical characteris. In the present study physico-chemical parameters like color, temperature, pH, DO, TDS, SS, TS, BOD, COD, chloride, Sulphate, oil and Grease taken into account. Total 24 samples of dairy effluents were collected and subjected for analysis for consequent five months from January to May. The study revealed that the dairy effluent is slightly alkaline in nature. The high BOD and COD values obtained by the analysis of dairy effluents indicate the presence of heavy load of organic substances. It is very important that proper waste water treatment systems should be installed.

Keywords: Dairy wastewater, Effluents characterization, Parameters analysis, BOD, COD

INTRODUCTION

The US EPA (Environmental protection agency) has found that dairy wastewater problem caused by poor sewage management pose a substantial health and environmental challenge as the sewage into streams, before it can reach a treatment facility. In the dairy industry various operations like pasteurization, bottling, preparation of butter, cheese, milk powder, etc. Wastewater from dairy industry consists primarily of dilution of milk and its products which impart a very high BOD, sometimes up to 1000 mg/L. The waste water may also contain detergents, germicides, and other chemicals. Characteristics of industrial wastewater vary greatly from industry to industry and within industries also there are variations in

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the quality depending upon the processes, for example quality of wastewater coming out from a cooling tower will be quite different then the wastewater coming out from any chemical process on the other hand there are limited variations in the quality of sewage depending upon season, sewerage system, lifestyle of people, etc. Quality of sewage also plays an important role in design and construction of various treatment units. So need of treat the effluent before flow in the environment. For it first collection of effluent from the dairy, perform physico-chemical analysis to reveal problem of safe disposal (Gross, 2004; EPA, 1999). Color, temperature, pH, DO (dissolved Oxygen), TDS (Total dissolved Solids), TS (Total Solids), TSS (Total Suspended Solids), BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand), chloride, Sulphate, oil and Grease these physicochemical characters are performed.

MATERIALS AND METHODS

Effluent samples were collected from Akluj "Shivamrut Dudh Utpadak Sahkari Sangh Maryadit, Vijaynager (Vizori)". In each month one sample selected form every week for analysis. Total 24 effluent samples are collected and Collection of effluent as per Jacksch and piper method. Analysis perform by using physico-chemical parameters (by APHA, 1998; Trivedy and Goel, 1984) the Physical parameter- Temperature, pH, TS, TDS and SS and Chemical parameter- Chloride, Dissolved Oxygen (DO), Chemical oxygen Demand (COD), Biological Oxygen Demand (BOD), Sulphate, Chloride, Oil and Grease. The pH of samples was determined at the site itself by using portable hand held pH meter and temperature in Degree Celsius on scientific thermometer. TS, TDS and SS estimated by gravimetric method. Chloride tested as 50 mL of effluent sample was mixed with 2 mL of $K_2Cr_2O_4$ solution in an Erlenmeyer flask. Titrated the contents against 0.02 N $AgNO_3$ until persistent red tinge appears.The silver nitrate reacts with chloride and gives precipitate of AgCl and this silver ion react with chromate to gives radish brown color as end point.

BOD analyzed as dilution of effluent sample was done with aerated water. Two sets were prepared one set for blank and another for sample. The final set for both blank samples was kept for incubation at 20 ^oC for 5 days. In both blank and sample initial 2 mL $MnSO_4$ and 2 mL Alkali Azide Iodide solution was added and mixed properly. Precipitate was allowed to dissolve adding 2 mL Conc. H_2SO_4. Then 50 mL above sample was taken in flask and titrated with 0.0125 N Thiosulphate solution using starch as indicator and BOD was calculated. COD calculated as 20 mL 1 : 1000 diluted effluent sample was taken in COD flask and 10 mL 0.25 N potassium dichromate was added. A pinch of $AgSO_4$ added 30ml of sulphuric acid was added and refluxed for at least 2 h on hot plate.After heating flask contents was cooled and 80 mL cold distilled, water added to make the final volume 140 mL. 2-3 drops of ferroin indicator was added and titrated it with 0.1 N Ferrous Ammonium Sulphate (FAS) solutions. COD can be calculated with formula. Blank was run by taking 20 mL distilled water and using same chemicals. DO determined by titration method as 10 mL of copper sulphate euphonic acid solution taken in conical flask. Then effluent was added allowed to stand for 10-15 min for flocculation, lower layer was taken in narrow mouth flat stoppard reagent bottle of approximately 300 mL

capacity. 2 mL of 4% maganous sulphate ($MnSO_4.2H_2O$) was added by pipette dipping the below the surface, some amount of water was overflow form the bottle. 2 mL alkaline potassium iodide was added in the same manner. The stopper was inserted and mixed until precipitated settle down. 2 mL of concentrated sulphuric acid was added, the precipitate was dissolved by vigorous shaking. 200 mL solution was titrated with Na_2SO_4 solution using 1 mL starch as an indicator. Oil and Grease calculated as 50 mL of effluent was taken in fat extraction flask. Add 50 mL petroleum ether (40-60 ^{0}C). Mixed and allowed to stand for 10 min. Decanted off the ethereal layer in clean dry previously weighed aluminium fat dish. 5 mL of ethanol was added to the flask. Mixed and allowed to stand for 5 min. Decanted off the top layer into the dish, extract was dried on hot plat, cooled in a desi-ccater and weight was taken.

RESULTS AND DISCUSSION

Effluent samples were collected from Akluj "Shivamrut Dudh Utpadak Sahkari Sangh Maryadit, Vijaynager (Vizori)". This study was undertaken to detection of the important pollution parameters in dairy industry wastewater. Total 24 sample of whey collected and subjected for analysis. From 24 samples; 5 in January, 4 samples in February, 5 samples each in March, April and May given Tables 1, 2, 3, 4 and 5.

From collected samples mean values are taken out, theses are in Table 6. The study revealed at the dairy effluent is slightly alkaline in nature. The high BOD and COD values obtained by the analysis of dairy effluent indicates the presence of heavy load of organic metal. The discharge of wastewater to the environment without any treatment plays significant risk for public health and environmental pollution. The industrial wastes leads contamination of the water, soil and air when

Table 1: Physico-Chemical Characteristics of WHEY Samples (January)

Parameters	Samples (January)					Mean
	1	2	3	4	5	
Temperature (^{o}C)	36	36	34	32	34	34.4
P^H	10	9.5	9.8	10	11	10.06
DO (mg/L)	1.2	1.05	1.2	1.4	1.2	1.21
BOD (mg/L)	600	600	650	790	608	649.6
COD (mg/L)	1500	1600	1400	1495	1500	1499
TDS (mg/L)	1600	1560	890	1500	1660	1442
SS (mg/L)	200	240	290	290	240	252
TS (mg/L)	1800	1800	1180	1790	1900	1694
Sulphate (mg/L)	200	205	223	223	300	230.2
Chloride (mg/L)	162	166	146	142	142	151.6
Oil and Grease (mg/L)	2	3	3	2	3	2.6

Table 2: Physico-Chemical Characteristics of Whey Samples (February)

Parameters	Samples (February)				Mean
	6	7	8	9	
Temperature (°C)	32	34	32	34	33
pH	9.3	9.7	10	9.9	9.73
DO (mg/L)	1.2	1.05	1.2	1.4	1.21
BOD (mg/L)	600	550	600	540	572.5
COD (mg/L)	1495	1650	1600	1650	1598.75
TDS (mg/L)	1500	1690	1690	1500	1595
SS (mg/L)	200	290	240	240	242.5
TS (mg/L)	1700	1980	1930	1740	1837.5
Sulphate (mg/L)	223	205	200	223	212.75
Chloride (mg/L)	147	156	152	156	152.75
Oil and Grease (mg/L)	2	3	4	2	2.75

Table 3: Physico-Chemical Characteristics of Whey Samples (March)

Parameters	Samples (March)					Mean
	10	11	12	13	14	
Temperature (°C)	32	34	34	32	32	32.8
PH	10	9.12	10	9.7	10	9.76
DO (mg/L)	1.25	1.2	1.4	1.2	1.4	1.29
BOD (mg/L)	730	520	600	500	500	570
COD (mg/L)	1489	1495	1400	1650	1400	1486.8
TDS (mg/L)	1460	1600	1490	1200	860	1322
S.S.(mg/L)	200	250	250	285	200	237
TS (mg/L)	1660	1850	1740	1485	1060	1559
Sulphate (mg/L)	223	205	200	223	205	211.2
Chloride (mg/L)	156	163	142	148	148	151.4
Oil and Grease (mg/L)	3	3	3	4	3	3.2

they are discharged without being subject to treatment or when they are treatment using inappropriate methods.

Table 1 reveals the physico-chemical characteristics of five whey samples collected during January 2007. Mean values of physical

Table 4: Physico-Chemical Characteristics of Whey Samples (April)

Parameters	Samples (April)					Mean
	15	16	17	18	19	
Temperature (°C)	34	32	34	32	30	32.4
pH	10	09	9.35	10	9.25	9.52
DO (mg/L)	1.1	1.12	1.4	1.2	1.2	1.2
BOD (mg/L)	520	530	590	500	600	548
COD (mg/L)	1500	1400	1500	1400	1495	1459
TDS (mg/L)	1790	1600	1460	550	600	1200
SS (mg/L)	285	200	285	253	290	262.6
TS (mg/L)	2075	1800	1745	803	890	1462.6
Sulphate (mg/L)	300	205	223	200	300	245.6
Chloride (mg/L	152	152	147	148	177	155.2
Oil and Grease (mg/L)	2	2	3	4	3	2.8

Table 5: Physico-Chemical Characteristics of Whey Samples (May)

Parameters	Samples (April)					Mean
	20	21	22	23	24	
Temperature (°C)	33	34	31	32	30	32
PH	10	9.85	10	10	10	9.97
DO (mg/L)	1.25	1.20	1.4	1.12	1.40	1.27
BOD (mg/L)	500	550	590	500	520	552
COD (mg/L)	1400	1495	1400	1500	1489	1456.8
TDS (mg/L)	1500	1650	790	860	800	1120
SS (mg/L)	290	285	253	240	200	253.6
TS (mg/L)	1790	1935	1043	1100	1000	1373.6
Sulphate (mg/L)	200	300	205	200	300	241
Chloride (mg/L)	152	142	152	138	142	145.2
Oil and Grease (mg/L)	4	4	3	3	2	3.2

characteristics such as PH, TDS and SS are 10.06, 1442 mg/L, 252 mg/L, respectively, and mean values of chemical characteristics such as DO, BOD, COD, Chloride, Oil and Grease are 1.21, 649.6, 1499, 151.6 and 2.6 mg/l, respectively. Results obtained by Shivamrut laboratory are also in the same range for the whey samples collected in January.

Table 6: Mean Values of Physico-chemical Characteristics of Whey Samples

Test Sample Parameters	January	February	March	April	May
Temperature (°C)	34.4	33	32.8	32.4	32
pH	10.06	9.73	9.76	9.52	9.97
DO (mg/L)	1.21	1.21	1.29	1.2	1.27
BOD (mg/L)	649.6	572.5	570	548	552
COD (mg/L)	1499	1598.75	1486.8	1459	1456.8
TDS (mg/L)	1442	1595	1322	1200	1120
SS (mg/L)	252	242.5	237	262.6	253.6
TS (mg/L)	1694	1837.5	1559	1462.6	1373.6
Sulphate (mg/L)	230.2	212.75	211.2	245.6	241
Chloride (mg/L)	151.6	152.75	151.4	155.2	145.2
Oil and Grease (mg/L)	2.6	2.75	3.2	2.8	3.2

Table 2 shows the physico chemical characteristics of four whey samples collected during February 2007. Mean values of chemical characteristics such as DO, BOD, COD, Chloride, Oil and Grease are 1.21, 575.5, 1595,152.75, 2.75 mg/l respectively, and mean values of physical characteristics such as pH, TDS and SS are 9.73, 1595 mg/lit, 242.5 g/L respectively. Monory *et al.* (2006) gives short term solution for Dairy waste from Mexico and he observed same results that we had also observed in physico chemical characteristics of whey samples. Effect of pH and Temperature on Dairy Wastewater Characterized by Tandon (2012) University of Maryland then he observed that properties of wastewater studies and laboratory analysis gives the right the result as we observed here. We compare the results to check the results are different or not but we seen that these are senior of that work, so the work up to that equals the characteristics.

Physico chemical characteristics of five whey samples collected during March 2007 are given in Table 3 Mean values of physical characteristics such as pH, TDS and SS are 9.76, 1322 mg/L, 237 g/L, respectively, and mean values of chemical characteristics such as DO, BOD, COD, Chloride, Oil and Grease are 1.29, 570, 1486.8, 151.4, 3.2 mg/L, respectively.The typical wastewater from a milk processing butter and milk powder was treated in a modified activated sludge system in order to establish process characteristics and investigate operational problems during the philosophical studies from Massey university by Anne Leonard in 1996, resulted need to study of observation, characterization and laboratory Analysis to perform researchcal studies and developing solutions for the research problem. By the this study we also record the related result exact the same records.

Physico chemical characteristics of five whey samples collected during April 2007 are presented in Table 4. Mean values of physical characteristics such as pH, TDS and SS are 9.52, 1200 mg/L, 262.6 mg/L, respectively, and mean values

of chemical characteristics such as DO, BOD, COD, Chloride, Oil and Grease are 1.2, 548, 1459, 155.2 and 2.8 mg/L, respectively. The operation and performance of anaerobic digesters treating thermomechanical pulping wastewater was investigated. Changes in the nature of the suspended solids passing through the reactor are such that subsequent suspended solids removal will be more efficient and have a lower loading rate than for the untreated wastewater. By Hearn, Christopher Rae partial fulfilment of the requirements for the degree of Doctor of Philosophy in Process and Environmental Technology at Massey University.

Physico chemical characteristics of five whey samples collected during April 2007 are presented in Table 5. Mean values of physical characteristics such as P^H, TDS and SS are 9.52, 1200 mg/L, 262.6 mg/L, respectively, and mean values of chemical characteristics such as DO, BOD, COD, Chloride, Oil and Grease are 1.2, 548, 1459, 155.2 and 2.8 mg/L, respectively. The average, minimum and maximum values obtained from the analyses of the wastewater samples prior to treatment.Table 6 shows physico chemical characteristics of five whey samples collected during May 2007. Mean values of physical characteristics such as pH, TDS and SS are 9.97, 1120 mg/L and 253.6 mg/Lrespectively. The results indicated that pollution parameter levels of wastewater samples of dairy industry tested in this study was found high.the same results obtained by F. seda bilir ormanci Ankara University, School of Veterinary Medicine, Department of Food Hygiene and Technology 06110, Diskapi-Ankara (2009).

The Figure 1 shows the Bar graph of Physico-chemical characteristics of whey samples (January). The graph plotted parameter verses mg/lt, sample 1 shown in color blue, sample 2 by red color, sample 3 by light green color, sample 4 by purple color, sample 5 by sky blue color, samples mean by brown color. The figure indicates that BOD, COD, TDS, TS values are very high. Physico-chemical characteristics of whey samples (February) comparison between samples 6,7,8,9 by line graph presented in Figure 2. It clearly illustrate that the sample 9 shows

Figure 1: Physico-Chemical Characteristics of Whey Samples (January)

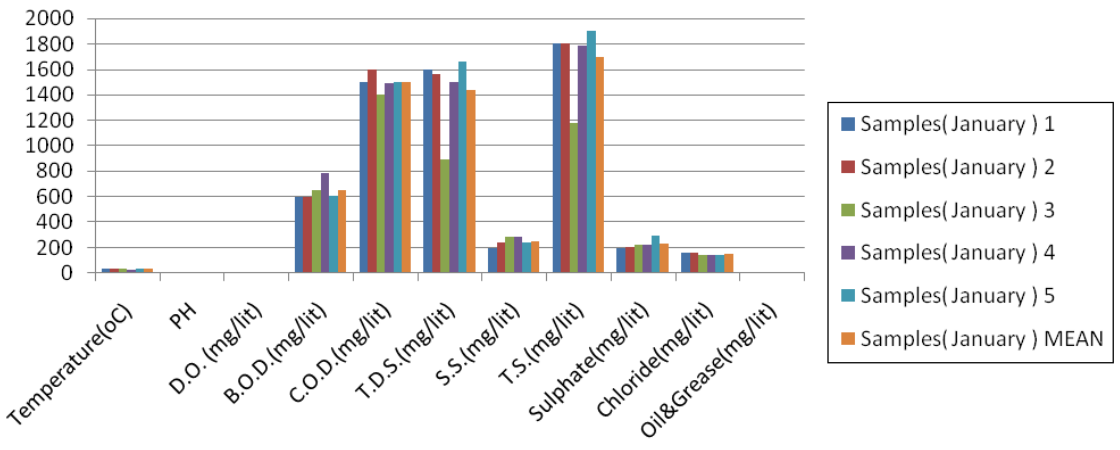


Figure 2: Physico-Chemical Characteristics of Whey Samples (February)

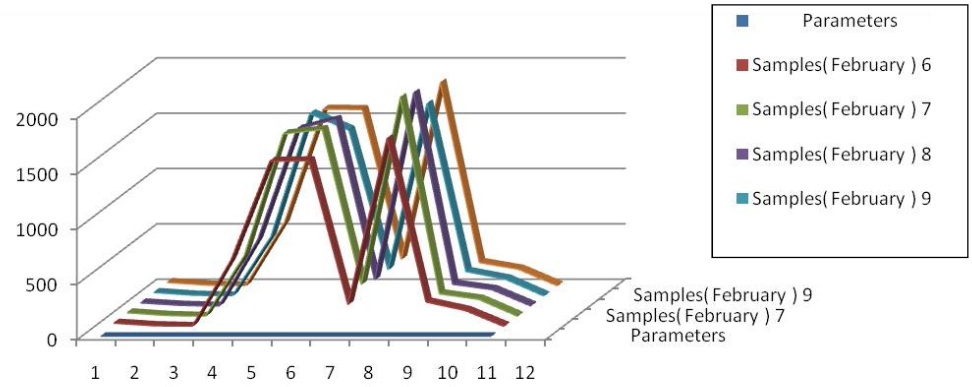


Figure 3: Physico-Chemical Characteristics of Whey Samples (March)

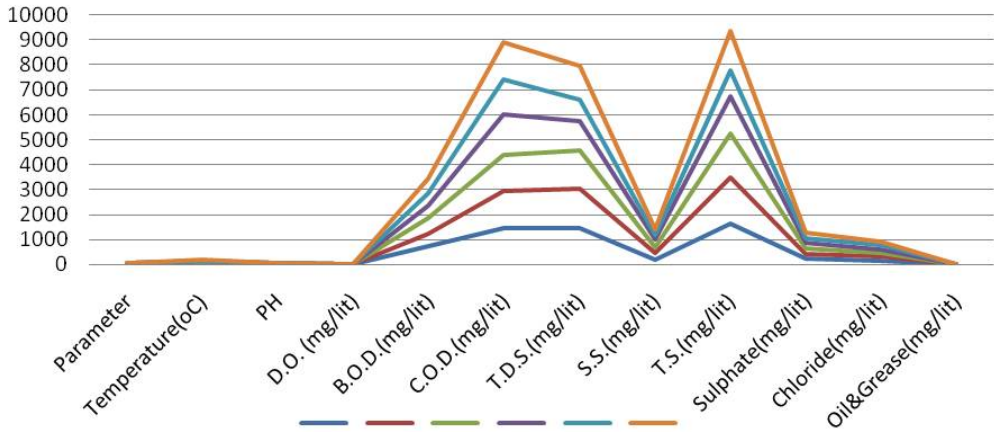
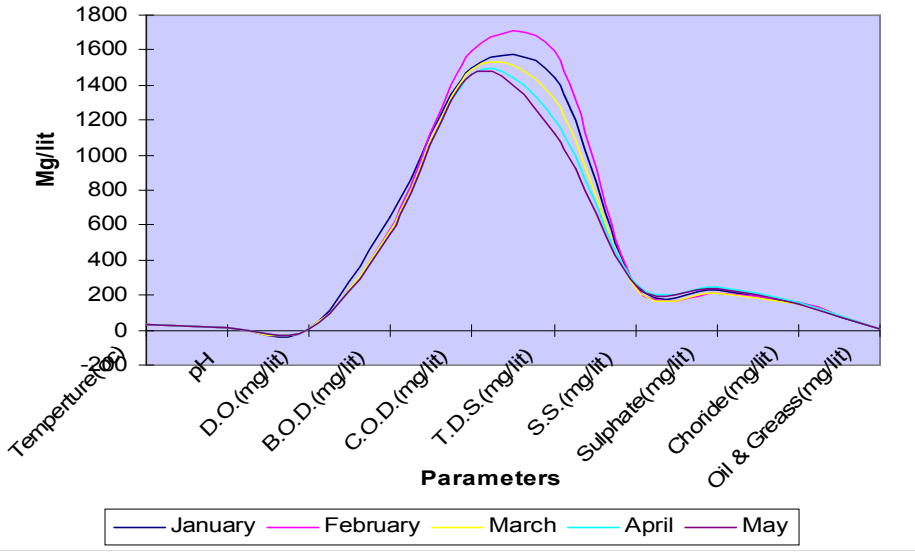


Figure 4: Mean Values of Physico-Chemical Characteristics of Whey Samples (Jan-May)



higher valves than other 6, 7, 8 samples. In the Figure 3 graph for Physico-chemical characteristics of whey samples (March) plotted and it show the high values of COD, BOD, TS. Line graph for Mean values of physico-chemical characteristics of whey samples of month of January by blue line, February by pink line, march by line yellow, April by sky blue, May by violet. February line upper to other lines, it concluded that in month of February the BOD, COD, TDS, SS values are high.

CONCLUSION

The objective of this study was to investigate the main pollution parameters of wastewater in dairy. The wastewater samples were tested for BOD (Biological oxygen demand), COD (Chemical oxygen demand), DO, Chloride, Oil and Grease TSS, Sulphate and pH values before treatment whereas the samples from Shivamrut Dairy tested before treatment. The results indicated that pollution parameter levels wastewater samples of dairy industry tested in this study was found high. To avoid the environmental pollution and to protect public health, wastewater treatment systems are recommended for dairy industry.

It has been determined as the conclusion that the BOD, COD, TSS, oil and grease values in the wastewater of the milk industry prior to treatment are high. It has been observed on the other hand that the values determined in the wastewater samples obtained the treatment have been reduced to comply with the legal limits. Based on these findings, we have come to the conclusion that the treatment of the wastewater of the milk industry is inevitable for the prevention of the increase of the loads, of which the source is the milk industry, for the protection of the environmental health and the preservation of the ecological balance. It has been determined that first the balancing pools, then chemical treatment, subsequently treatment with proper method and conclusively the implementation of the ventilation pools and discharge would be appropriate.

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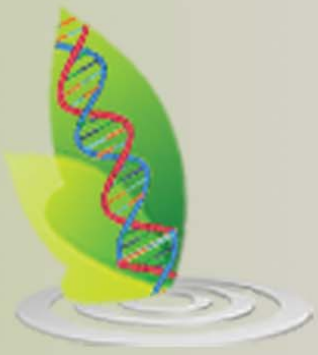

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