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CHARACTERIZATION OF DAIRY EFFLUENT

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ABSTRACT

Physico-chemical parameters of both untreated and industry treated dairy effluent was carried out. The results revealed that BOD, COD, TDS, TSS etc. of dairy effluent were found to be high even after treatment exceeding the CPCB limits.

INTRODUCTION

Industrialisation is an important tool for the development of any Nation. Consequently the industrial activity has expanded so much all over the world today, that it has become a matter of major concern of the deteriorating environment (Tiwari, 1994). With the rapid growth of industries in the country, pollution of natural water by industrial waste has increased tremendously (Muthusamy and Jayabalan, 2001). Water pollution is the most serious problem faced by Man today. Dairy industry is one of the important industry causing water pollution. In India, dairy industry generates about 6-10 litres of waste water per litre of milk processed depending upon the process employed and product manufactured (Tiwana, 1985).

Generally dairy wastes contain large quantities of milk constituents such as casein, lactose, fat, inorganic salts besides detergents and sanitizers which contribute largely towards high BOD and COD (Marwaha *et.al*., 2001). The high values of suspended solids and dissolved solids shows its high pollution potential. Discharge of such wastes into inland surface water will lead to depletion of oxygen in the water bodies, affecting aquatic life and creating unaesthetic anaerobic conditions.

Several investigations and their reports are available about other industrial effluents, but work on dairy effluent is meagre. Hence the present investigation is aimed to analyze the physico-chemical characteristics of the both untreated and industry treated dairy effluent.

MATERIALS AND METHODS

For the present study, dairy effluent (Both untreated- site A and industry treated- site B) were collected from a dairy, situated in Chennai.

Effluent was collected in 2 1/2 litres capacity polythene containers for a period of 18 months from January 2001 to June 2002 and were brought to the laboratory with due care and were stored at 20^0C for further analysis. The physico-chemical parameters such as pH, EC, TDS, TSS, BOD, COD, alkalinity, total hardness, oil and grease, sodium, potassium, calcium, nitrate , sulphate, a phosphate and chloride of dairy effluent were analyzed following Standard procedure of APHA (1989).

RESULTS AND DISCUSSION

Analysis of physico-chemical characteristics of the dairy effluent collected from site A and B for a period of 18 months are shown in Table 1 and 2. The present investigation revealed that the dairy effluent was milky and greyish black in colour with disagreeable odour which may be due to decomposition of organic matter or presence of various aromatic and volatile organic compounds (Singh *et.al*., 1998) and it may also be due to microbial activity (Nagarajan and Shasikumar, 2002). A large number of pollutants can impart colour, taste and odour to the receiving water there by making them unaesthetic and unfit for domestic consumption. The pH of untreated dairy effluent was between 4.5 to 9 and while in industry treated efflunet it ranged from 7.0 to 8.5. Though the pH is alkaline in fresh conditions, the waste becomes acidic due to decomposition of lactose into lactic acid under anaerobic conditions and may cause corrosion of sewers (Joseph, 1995).

The electrical conductivity (EC) of untreated dairy effluent ranged between 1075-2886 µhos/cm whereas in industry treated effluent it was between 885 to 1950 µhos/cm and they were found to be within the permissible limits (3000 µhos/cm) issued by irrigation guidelines (Hamoda and Al- Awadi, 1996). Such low EC could be attributed to the presence of organic compounds in the effluent (Marwaha *et.al*., 1998).

TSS levels in both untreated (20-700 mg/L) and industry treated (19-650 mg/L) were found to be beyond the permissible limit (100 mg/L) of ISI (1979) for effluent discharge which could be due to various environmental factors, reducing the diversity of aquatic life and resulting in oxygen depletion.

With regard to TDS, both untreated and industry treated effluent were found to have high levels of TDS compared to permissible limits of CPCB (1995) and this high level of TDS may be due to salt content present in the

TABLE -1
Physico- chemical parameters of dairy effluent collected from site A during the period of Jan. 01 to Jun. 02

Parameters	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan-02	Feb	March	April	May	June
Colour								Milky										
Odour								Disagreable										
pH	4.5	6	6.5	8	6.5	6	6.5	7	6.5	6	6	6	5	6.5	6	8	8.5	5.5
EC µhos/cm	1900	1500	1075	2600	2624	2886	2540	2526	2400	2376	2183	1950	1475	1100	2640	2700	2750	2700
TSS mg/L	40	30	20	90	134	300	700	600	560	560	440	250	38	25	24	95	130	310
TDS mg/L	1150	1000	890	1500	1720	1890	1900	2426	2320	1652	1610	1536	1250	1010	895	1495	1725	1900
BOD mg/L	390	300	260	400	420	440	455	490	330	310	295	260	380	310	270	410	430	450
COD mg/L	680	610	460	795	952	1500	1590	1590	1630	910	320	300	685	615	470	790	955	1510
Oil & Grease mg/L	0.025	0.030	0.050	0.068	0.070	0.079	0.080	0.082	0.088	0.061	0.059	0.058	0.030	0.015	0.013	0.016	0.025	0.045
Alkalinity mg/L	440	425	400	450	475	590	600	652	660	500	482	464	450	442	440	456	470	500
Total Hardness mg/L	420	430	435	448	455	450	490	530	460	445	420	410	400	390	380	382	395	430
Calcium ppm	98	95	90	96	100	107	120	151	101	97	95	90	87	85	80	89	97	105
Potassium ppm	17	20	25	27	28	30	35	40	50	22	20	15	12	11	9	17	22	28
Sodium mg/L	215	225	230	365	372	278	385	387	351	350	274	229	225	221	219	295	300	310
Sulphate mg/L	10	15	20	90	100	103	104	114	58	15	7	7.5	7	7	6	7.5	10	15
Nitrate mg/L	26	15	45	48	50	54	50	39	35	30	25	20	18	17	16	26	30	40
Phosphate mg/L	10	14	14	15	18	20	21	23	9	8	7	6	5	4	4	7	12	18
Chloride mg/L	215	198	170	370	415	417	420	446	430	426	358	299	175	200	210	375	410	415

TABLE -2

Physico-chemical parameters of dairy effluent collected from site B during the period of Jan 01 to June 02

Parameters	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan-02	Feb	March	April	May	June
Colour						Greyish Black												
Odour						Disagreeable												
pH	7	7.5	7.5	8	8.5	8	7.5	8.5	8.5	8.5	7.5	8	7	8	7.5	8.5	8	8.5
EC µhos/cm	946	900	890	1060	1471	1800	1932	1950	1858	1810	1800	1750	940	890	885	1070	1480	1810
TSS mg/L	380	29	19	80	125	225	356	650	580	540	429	236	35	24	21	90	127	300
TDS mg/L	980	960	720	890	1150	1250	2318	2200	1698	1200	1125	895	950	710	690	880	1145	1255
BOD mg/L	200	195	170	173	180	210	250	200	160	146	135	100	210	200	175	180	185	200
COD mg/L	350	300	295	325	340	410	440	446	390	350	336	310	345	315	305	320	345	400
Oil and Grease mg/L	0.015	0.020	0.025	0.060	0061	0.063	0.063	0.063	0.068	0.055	0.052	0.049	0.022	0.010	0.009	0.010	0.015	0.020
Alkalinity mg/L	425	420	395	425	450	545	580	624	392	465	450	452	442	425	420	430	460	475
Total Hardness mg/L	400	405	400	425	430	405	468	418	310	430	403	390	385	376	360	358	387	396
Calcium ppm	95	90	85	90	97	100	110	104	78	95	90	80	81	70	65	75	90	95
Potassium ppm	15	17	22	25	26	28	33	37	45	20	18	12	10	9	6	15	16	24
Sodium mg/L	200	210	218	340	342	356	365	293	202	320	245	210	208	203	205	255	275	280
Sulphate mg/L	8	12	18	30	55	65	70	85	43	14	7	7	3	3	2	4	4.5	5
Nitrate mg/L	22	34	40	45	49	52	48	33	31	27	23	17	16	12	10	21	23	30
Phosphate mg/L	8	11	10	12	13	14	16	20	4	7	5	4	4	3	3	6	10	14
Chloride mg/L	200	185	160	352	410	412	400	435	420	416	345	290	170	195	200	370	405	400

sample and also renders it unsuitable for irrigation.

The results of present study revealed that BOD levels of both untreated (260-490 mg/L) and industry treated (100-250 mg/L) dairy effluent surpassed the CPCB limit of 30 mg/L for effluent discharge into inland surface waters reflecting high organic load and pollution potential. Moreover the presence of organic matter will promote anaerobic processes leading to the accumulation of toxic compounds in water bodies. This is in accordance with the work of Panneerselvam (1998) and Prabakar (1999).

The present investigation showed high levels of COD in both untreated and industry treated effluent which could render the aquatic body unsuitable for the existence of aquatic organism (Goel, 2000) due to the reduction in the dissolved oxygen content (Panneerselvam, 1998).

Analysis of dairy effluent from both sites showed the presence of oil and grease which was far below the permissible limits of CPCB (1995). Though oil and grease are found in negligible amount, its continuous discharge into an aquatic ecosystem could also destroy the nursery ground of a variety of fishes (Kumaraguru, 1995). Alkalinity was found to be high which is harmful to aquatic organism (Nemerow, 1978).

It may be noted that total hardness, calcium, potassium, sodium, nitrate, sulphate and phosphate including chloride were found to be higher in both the untreated and industry treated dairy effluent when compared to the limit prescribed by IKC (1993) and CPCB (1995). The presence of ions impart hardness to water and make it unsuitable for washing, bathing and industrial purposes. The results of the above study is in agreement with the work of Panneerselvam (1998) and Prabakar (1999) in sago and sugar mill effluents. From the results of above study it can be inferred that physico-chemical parameters such as BOD, COD, TDS and TSS were recorded to be higher than the permissible limits of CPCB in both untreated and industry treated dairy effluent. Moreover, the untreated effluent was found to be more toxic compared to industry treated effluent which may be due to the treatment process that perhaps reduced the toxicity of the effluent and this is in accordance with the observations of Thorat and Wagh (2000), Noorjahan *et. al*. (2000) and Nagarajan (2002) and Shasikumar (2002). Though a number of physical and chemical methods are available for the treatment of dairy effluent one such method which gained importance is the biological method using micro organism and it was found to be most promising technique for the dairy waste treatment (Chaubey, 2002) and the micro organisms serves as efficient detoxifiers of pollutants capable of oxidizing the organic and inorganic constituents. Further the biologically treated dairy effluent can be used for agricultural (Geetha and Vembu, 1998) and aquacultural purposes (Nagarajan and Shasikumar, 2002) after suitable dilution.

REFERENCES

APHA, 1989. Standard methods for the examination of water and wastewater, 17th edition.

Chaubey, M. 2002. Treatment of dairy effluent with fixed film bioreactor technology. *Environ. Pollut. Cont. J.* 5(2): 36-38.

CPCB, 1995. Pollution control: acts, rules and modifications issued their under central pollution control board, New Delhi.

Geetha, S. and Vembu, B. 1998. Effect of tannery effluent on the morphological and biochemical features of *Elusine Corocana Gaertn*. *J. Ecotoxicol. Environ. Monit.* 8 (3) : 183 -186.

Goel, P.K. 2000. *Water pollution, causes, effects and control*. New age international (P) Ltd., publishers, New Delhi.

Hamoda, M.F. and Al-Awadi, S.M. 1996. Improvement of effluent quality for reuse in a dairy farm. *Wat. Sci. Tech.* 33 (10-11) : 79-85.

IKC, 1993. Handbook for cattle breeding in (Dutch) 6th (ed.). information centre for live stock breeding *IKC* K. Asijee (red.). ISBN 90-800999-2-9, IKC, Lelystad, the Netherlands.

ISI, 1979. Guide for treatment and disposal of effluent of cane sugar industry. IS: 4903. First Revision, ISI, New Delhi.

Joseph, K. 1995. Pollution control in dairy industry. paper presented at Tamil Nadu veterinary and animal sciences university at veterinary college on 10th Oct. 1995, sponsored by institute of food and dairy technology and Tamil Nadu pollution control board.

Kumaraguru , A.K. 1995. Water pollution and fisheries. *Ecol. Environ. Cons*. 1(1-4) : 143 -150.

Marwaha, S.S., Panesar, P.S. and Singh, B. 1998. Studies on the isolation of efficient yeast strain for the treatment of dairy waste water. *Poll. Res*. 17(1) : 56-57.

Marwaha, S.S., Panesar, P. S., Gulati, V. and Kennedy, J.F. 2001. Development of bench scale technology for the treatment of dairy waste waters by *Candida parapsilosis MTCC* 1965. *Indian J. Microbiol*. 41: 285-287.

Muthusamy, A. and Jayabalan, N. 2001. Effect of factory effluent on physiological and biochemical contents of *Gossypium hirsutum L. J. Enviorn. Biol.* 22(4): 237-242.

Nagarajan, K. and Shashikumar, R. 2002. Effect of sago effluent on selected physiological aspect of the fresh water fish, *Labeo rohita*. *J. Ecotoxicol. Environ. Monit*. 12 (3) : 233-238.

Nemerow, N.L. 1978. Industrial water pollution: origins, characteristics and treatment. Addison- Wesley publishing company inc., Philippines.

Noorjahan, C.M., Dawood Sharief, S., Nausheen Dawood and Ghousia Nisha, A. 2002. Studies on the tannery effluent and its effects on biochemical constituents of an edible crab, *Scylla serrata*. *Indian J. Environ. Toxicol*. 12 (1) : 15-17.

Panneerselvam, A. 1998. Studies on sago industry effluent and its bioremediation using the white-rot fungus, *Phanerochaete chrysosporium* (Burds). Ph.D. Thesis, University of Madras.

Prabakar, K. 1999. Bioremediation of sugar and distillery efflunets. Ph.D. Thesis, University of Madras.

Singh, S.M., Varshneya, I. and Nagarkoti, M. 1998. Assessment of physico-chemical parameters of effluents of three factories of Bareilly district and their possible effects on grazing animals and cereals. *J. Environ. Biol.* 19(3): 271-274.

Thorat, S.R. and Wagh, S.B. 2000. Physico-chemical analysis of tannery waste. *J. Indus. Pollut. Cont.* 16 (1) : 107-109.

Tiwana, N.S. 1985. Nature and magnitude of water pollution in Punjab. Proc. Sem. on status of Environ. Pollut. held at PAU, Ludhiana, India.

Tiwari, P.K. 1994. An agenda for pollution control in dairy industry. *Indian dairyman.* 46 (10) : 617-624.