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PHYSICO-CHEMICAL ANALYSIS OF EFFLUENTS FROM DAIRY INDUSTRY

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Abstract

The treated and untreated effluents samples from dairy industry were collected and brought in to laboratory for studying physicochemical parameters like pH, temp, color, DO, BOD, COD, TDS, TSS, TS, Chloride Sulphate, Oil & grease were analyzed.

Keywords: Diary Industry, Physico-chemical parameter, Effluents

Introduction

Dairy technology has been defined as that branch of diary science which deals with processing of milk and the manufacture of milk products on an Industrial scale. During the past few years, many agrobased industries have came up in India. The milk processing industry is one such industry during the last two decades due to enormous increase in the milk production. The number of the diary plants of medium and large size has increased. For the efficient handling and processing of milk. Consequent to the increased milk production and processing waste water generation, has also increased. The dairy industry in India on an average has been reported to generate 6-10 litres of waste water per litre of the milk processed. Depending upon the process employed, product manufactured and house keeping exercised. The waste water of diary contain large quantities of milk constituents such as casein, lactose, fal, inorganic salt, besides detergents & sanitizers used for washing (Kolhe et al., 2009)

Materials and Methods

For the present study the effluent samples were collected from dairy industry at the sources and were analyse the parameter in the laboratory. Colour of the effluents was noted by visual observation. Temperature is measured at the site of collection by using thermometer. pH is recorded in immediately at the site of effluent collection with the help of pH by Hanna instruments physico-chemical parameters were analyzed. According to APHA (1995) and Trivedi and Goel(1984).

Table 1.Physico-Chemical Parameters of Diary effluents.

Sr. No.	Particulars	Untreated Effluents	Treated Effluent	I.S.I. Value (mg/lit)
1	Colour	Whitish	Colourless	--
2	Temperature	28^{0}C	25^{0}C	--
3	pH	8.8	7.4	6.5-8.0
4	Dissolved Oxygen	Nil	3.5 mg/lit.	4-6
5	Biochemical Oxygen Demand (BODS)	760 mg/lit.	28.55 mg/lit.	50
6	Chemical Oxygen demands (COD)	1230 mg/lit.	94 mg/lit.	250
7	Total Dissolved Solids	1000 mg/lit.	480 mg/lit.	1500
8	Total Solids	1310 mg/lit.	560 mg/lit.	1100
9	Total suspended Solids	310 mg/lit.	80 mg/lit.	Not above upto 450
10	Chlorides	630 mg/lit.	90 mg/lit.	600
11	Sulphate	395 mg/lit.	75 mg/lit.	Not above 1000
12	Oil and grease	80 mg/lit.	2.5 mg/lit.	10

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Results and Discussion

Colour

It the present investigation the colour of untreated effluents was whitish and treated effluent appears as colorless. Colour is very important factor of the aquatic life for making food from sunlight. Thus, photosynthetic activity reduced due to dark coloration and aquatic ecosystem is totally changed. Colour also affects the other parameters like temperature, DO, BOD etc.

Temperature

Temperature is important for its effects on certain chemical and biological reactions taking place in water and in organisms inhabiting aquatic media and will depend upon seasons and time of sampling. No specific limit for temperature is prescribed by WHO or ISI for the water quality use for the domestic purpose. In the present investigation value of temperature of untreated effluents was 28^0C and treated effluents was 25^0C.

Measurement of temperature is an important parameter required to get an idea of self purification capacity of river, reservoir and control of treatment plant. Water temperature is also important parameter for aquatic life. It is an important factor for calculating solubility of oxygen and carbon dioxide, bicarbonates and carbonates. Temperature of drinking water has an influence on its taste. During the summer, water temperature is higher because of decrease in water table, clear atmosphere and great solar radiation. While in rainy and winter season can be explained on the basis of cloudy atmosphere, high percentage of humidity and high water levels.

pH

pH is defined as the negative log of hydrogen ion concentration. It indicated the acidity and alkalinity of water samples. The hydrogen ion concentration is influenced by biological activities. Besides in addition of chemical substance, presence of organic matter in large quantity may lower the pH we value due to release of CO_2 and SO_2.

The pollution load in most of the chemical industries are in large quantity in the form of acid and alkali in manufacturing unit. The wide variation in the pH value of effluent can affect the rate of biological reaction and survival of various microorganisms.

The presence or absence of various ionic species can have the direct relation with pH of the effluent. Subsequently, such effluent can influence the quality of soil. The reaction between effluent flowing from open drainage system and the soil has direct relevance to the pH of the effluent. It is therefore necessary to evaluate with respect to the pH value.

In the present investigation the pH value of untreated effluent was 8.8 and treated effluent was 7.4.

Thorat & Wagh (1999) observed the pH of the sludge sample was 8.4. Rao et al. (1993) observed the pH of the textile industry effluent varied from 11.0 to 8.0. Kolhe et al. (2008) recorded the pH of Sugar industry untreated effluent in November 6.5 and that of treated is 7.5 in November.

Dissolved oxygen (DO)

Dissolved oxygen is one of the important parameter in water quality assessment. Its presence is essential to maintain a variety of forms of biological life in water and the effects of the water discharged in water body are largely determined by oxygen balance of the system. Non-polluted surface water remains normally saturated with the dissolved oxygen. Oxygen can be rapidly removed from the water by discharge of oxygen demanding waste.

Inorganic reducing agents such as hydrogen sulphide ammonia, nitrites and ferrous ions and certain available oxidisable substances also tend to decrease oxygen in water. The solubility of atomospheric oxygen in fresh water ranges from 14.0 mg/L at 0^0C to about 7.0 mg/L at 35^0C under at 1 atm. pressure.

The importance of DO in aquatic ecosystem in brining out various biological changes and its effect of metabolic activities of organisms has been discussed by many ecologists. The winter can be attributed to the higher solubility of oxygen at low temperature. Unllike the lake system river water quality can not be characterized by concentration of nutrients dissolved oxygen.

Most of the fishes require at least 5 mg/l dissolved oxygen for at least 16 hours/day and near less than 3 mg/l for 8 hour is natural water. Containing 8 to 10 mg/l.

In the present investigation dissolved oxygen of untreated effluent was totally Nil. Due to Oil and grease in effluent form milk which inhibits or prevents the entrance at atmospheric oxygen into effluent and the amount of dissolve oxygen present in treated effluent was 3..5 mg/l. Avsan & Rao (2001) observed the DO of sugar mill is ranging between 0-2.0. He observed that it DO is law then it cause anoxic conditions. This causes respiratory distress of fish & fish show erratic movements.

Biochemical oxygen demand (BOD)

Biochemical oxygen demand (BOD) is defined as amont of xygen required by microorganisms. While stabilizing biological decomposable organic matter in a waste under aerobic conditions. Since the test is mainly a bioassay procedure, involving measurement of oxygen consumed by bacteria. While stabilizing organic matter under the aerobic conditions, it is necessary to provide standard conditions of nutrient, supply, pH. Absence of microbial because of the low solubility of oxygen in water strong wastes are always diluted to ensure that the demand does not increase in

available oxygen. Low value of BOD is comparatively in winter months may be due to lesser quantity of total solids, suspended solids in water as well as to the quantitative number of microbial population. (Avasan & Rao, 2001).

In the present study the BOD of untreated effluent was 760 mg/l and that of treated effluent was 28.55 mg/l. Waste water of dairy industry contain large quantities of milk constituents such as casein, lactose, Fat, inorganic salts. Besides detergents and sanitizers used for washing. All these components contribute largely towards their high biochemical oxygen demand.

Trivedi et al. (1986) observed the effluents of textile industry. From the different unit BOD value of mixed effluent ranged between 320 mg/l to 720 mg/l and final effluent 80 mg/l to 640 mg/l.

Chemical oxygen demand (COD)

The chemical oxygen demand test (COD) determines, the oxygen required for chemical oxidation of organic matter with the help of strong chemical oxidant. The COD is a test which is used to measure pollution of domestic and industrial waste. The waste is measure in terms of equality of oxygen required for oxidation of organic matter to produce CO_2 and water. It is a fact that all organic compounds with a few exceptions can be oxidizing agents under the acidic condition. COD test is useful in pinpointing toxic condition and presence of biological resistant substances.

Importance of organic matter in the ecology of bloom. Firming cynobacteria has also reported by many workers.

In the present study the value of COD of untreated effluent was 1230 mg/l and that of treated effluent was 94 mg/l.

Trivedi *et al.* (1986) observed COD value of textile industry ranges from 300 ppm to 2400 ppm.

Total dissolved solids (TDS)

The maximum concentration of total dissolved solids in summer, which increased in rainy seasons. While the minimum value was found in winter probably because of stagnation. In summer most vegetation is decaying, so rise in the amount of dissolved solids was neutral as the products of decaying matter which were settled in the water.

The total solid concentration in waste effluent represents the colloidal form and dissolved species. The probable reason for the fluctuation of value of total solid and subsequent the value of dissolved solids due to content collision of these colloidal particles.

The rate of collision of aggregated process is also influenced by PH of these effluents.

In the rainy season less concentration of total dissolved solids are obtained, due to the concentration of the dissolved solids are obtained due to the dilution of waste effluents with rain water.

Hosetti et al. (1994) reported that total dissolved solids in range 488 ppm in the waste water from Jayanthi Nalla.

In the present study the total dissolved solid of untreated effluent was 1000mg/l and that of treated effluent was 480 mg/l. Rao, et al., (1993) studied textile industrial effluent and recorded total dissolved solid value. Which ranges from 8500 mg/lit to 10,000 mg/lit.

Total solids (T.S)

The term solid refers to the matter either filterable or infilterable that remains as residue upon evaporation and subsequent drying at a defined temperatures employed for drying and ignition. Different forms of solids are defined on the basis of method applied for their determination.

The total solids are sum of the values of the total dissolved solids and that suspended solids. The solid varies in proportions to temperature and rerely varied inversely to the water level. High concentration of total solids during summer was probably due to low level of water. The direct relationship between rainfall and total solids was attributed to an increased load of soluble salts from the catchments areas as a result of surface run off.

In effluent, total solids, total dissolved solids, total supended solids are compolsed mainly of carbonates, bicarbonates, chlorides, sulphate, phosphate, nitrate, Ca, Mg, Na, K, Mn and organic matter. Stills and other particles, polluting water increase the concentration of total solids.

In the present study the value of total solid present in untreated effluent was 1310mg/l and treated effluent was 560 mg/l.

Total suspended solids (T.S.S.)

Suspended solid do not mean that they are floating matters and remain on top of water layer. They are under suspension and remain in water sample. BIS has not set any limit of total suspended solid for drinking water. Total suspended solids play an important role in water and waster water treatment. Their presence in water sample cause depletion of oxygen level.

Devi (1980) reported total plankton, which showed a sterkling parallelism with suspended solids. Effluent from the different industries may have the different amount of solid particulate matter. When the effluent flows through the open drainage system particulate matter is expected to show greater degree of variance. If the effluent is highly acidic then the solid may dissolved in it, therefore it is necessary to evaluate effluent for the particulate matter.

In the present study suspended solids content of untreated effluent was 310 mg/l. and that of treated effluent was 80 mg/l.

Avsan & Rao (2001) observed the T.S.S. & sugar mill effluents is 220 to 790 mg/lit.

Chloride

Chloroides are generally present in natural water. The presence of chloride in the natural water can be attributed to dissolution of salts deposits discharged of effluent from chemical industries, oil wll operations sewage discharge of effluent from chemical industreis, oil well operaitons sewage discharge, irrigation drainage sea water intrusion in coastal areas.

The chloride content in the river water has been investigaged by Hancock (1973) working on Vionis river pointed the significance of chlorides and stated that for this principle source is animal matter, sewage and drainage from refuse and animal matter.

In the present study chloride of untreated effluent was 630 mg/l and treated effluent was 90 mg/l. Kolhe et al. (2008) observed that the effluent from sugar mill is having 205 mg/lit untreated effluent chloride and the treated effluent was 170-180 mg/lit.

Sulphate

Sulphate in one of the major cataion occurring in natural water. Sulphate being a stable, highly oxidized, soluble form of sulphur and which is generally present in natural surface and ground waters. Sulphate it self has never been a limiting factor in aquatic systems. The normal levels of sulphate are move than adequate to meet plants need. When water is over loaded with organic waste to point that oxygen is removed then sulphate as an electron acceptor is often used for break down of organic matter to produce H2S and produce rotton egg smell (Welch, 1980).

In the present study the values of sulphate for untreated effluent was 395 mg/l and that of treated effluent was 75 mg/l. Kolhe et al. (2008) observed the sugar mill effluent was having sulphate of untreated effluent is 660 mg/l and treated effluent showed 220 mg/l.

Oil and grease

The oil and grease content of domestic and certain industrial waste waster and of sludge's is an important in handling and treatment of these material for ultimate disposal. Oil and grease may influence waste-water system. If present in excessive amount. They may interfere with an aerobic and anaerobic biological process and lead t decreased waste water treatment efficiency. A knowledge of quantity of oil and grease present in effluent is helpful in proper design and operation of waste water. Industrial waste contain high quantity of oil and grease which may cause a serous problem if discharged into water body without treatment. In the present study oil and grease of untreated effluent was 80mg/l and treated effluent was 2.0 mg/l. Trivedi et al., (1986) reported oil and grease in textile industry effluent varies from 230 to 1897 mg/l.

Conclusion

Waste water quality can be maintained within safe limits better handling of plant. For treatment plant all the necessary units are there. The treat water is used for gardening purpose.After analysis made by MPCB, of effluent sample, they suggested some repairy and maintenance work of treatment plant, unit which is necessary.As far as the treatment plant is concerned, it is also efficient for handling any kind of variations in water. Lastly it is concluded that the treatment plant is working with satisfactory efficiency.

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