# Characterization of Dairy Effluents by Physicochemical Parameters

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*Authors' contributions*

*This work was carried out in collaboration between all authors. Author VSS designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author MW managed the analyses of the study and author MBK managed the literature searches. All authors read and approved the final manuscript.*

**Research Article**

## ABSTRACT

**Aims:** The dairy industry faces growing scrutiny of its environmental stewardship.  The potential impact of an individual operation on the environment varies with animal concentration, weather, terrain, soils, and numerous other conditions. It is hoped that management practices found on dairy industry will benefit by the management practices. So properly applied the Management Practices, the factual study of dairy effluent by various physico-chemical characters concern for environmental health and safety.
**Study Design:** Effluent samples were collected from dairy industries. The samples were characterized by physical parameters like pH, temperature, TS, etc. and chemical parameters BOD, COD, DO etc.
**Place and Duration of Study:** Effluent samples were collected from dairy industry of district Kolhapur Maharashtra (India).Physico-chemical characteristics of the effluent during the months between March to August 2011.
**Methodology:** Total 4 samples of dairy effluents were collected by composite sampling at the time 9, 12, 3, 6 o'clock per day and stored at $4^{o}$c for further analysis. Then on the next day in quintet it was subjected to analyze the physicochemical parameters like Temperature, pH, DO, TDS, TSS, TS, BOD, COD, chloride, Sulphate, oil and Grease.
**Results:** The study revealed that the dairy effluent is slightly alkaline in nature, and high temperature, BOD & COD values obtained by the analysis of dairy effluents indicate the

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presence of heavy load of organic substances. Also a higher temperature and oils and Greases which lower the dissolved oxygen activities can cause serious problems in disposal of waste water. Above the standard value suspended and dissolved organic solids are responsible for creating nuisance.

**Conclusion:** Dairy industry tested in this study was found high levels of pH, BOD, COD, TSS It is very important that proper waste water treatment systems should be installed for the protection of the environmental health and for the ecological balance.

*Keywords: Dairy wastewater; effluents characterization; parameters analysis; BOD; COD.*

## 1. INTRODUCTION

Water pollution is the introduction into fresh or ocean water of chemical, physical, biological materials which degrades the quality of the water and affects the organism living in it. A 2007 study reports that the discharge of untreated sewage is single most important cause for pollution of surface and ground water in India. Dairy is one of the major agriculture industries and dairy wastewater problem is larger in developing countries because all milk is processed industrially. Among the major industries in India, dairy is one of the industries producing wastewater rich in organic matter and thus leading to creation of odorous and high COD containing water [1]. Dairy industry produce wash water, a high strength waste, as a byproduct of cleaning the milking facility after each milking event to maintain sanitary operations. Wash water composition includes high concentrations of cleaning products, fresh water, milk waste and animal waste [2]. The dairy waste is basically organic and slightly alkaline in nature, when discharged in to streams without treatment, result in rapid depletion of dissolved oxygen(DO) and encourage the growth of algae i.e. eutrophication. Due to the overuse of surfactants in dairy, the waste can become unamenable to the biological treatment. Characteristics of industrial wastewater varies from industry to industry and within industries also there are variations in 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. The dairy industry on an average has been reported to generate 6-10 liters of waste water per liter of the milk processed [3]. Quality of sewage also plays an important role in design and construction of various treatment units. So there is a need of treatment to the effluents before discharge in to the environment. For that purpose effluent collected to perform physicochemical analysis to reveal problem of safe disposal [4]. 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 .

## 2. MATERIAL AND METHOD

The effluent samples were collected from dairy of Kolhapur at $74^0$ East and $19^0$ North of Maharashtra (India). Total milk collection is about 41,851,986 lit/year and 28,48,624 lit/year milk sold by the Dairy. They also produces other milk products by processing the milk. The sample was collected in duplicate by composite sampling at the time 9, 12, 3, 6 o'clock in a clean sterile plastic container and stored at 4ºC until the analysis was carried out according to the methods of APHA [4]. The flow rate of effluent average daily is 14 MGD. The samples were analyzed physically for parameters such as 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 [4,5]. The pH of samples was determined by pH meter and temperature in Degree Celsius on scientific thermometer. TS, TDS and TSS estimated by gravimetric method. Chloride, DO determined by titration method. Chemical oxygen Demand (COD) analyzed and Biological Oxygen Demand (BOD) analyses form incubation at 20ºC for 5 days.

## 3. RESULTS AND DISCUSSION

The objective of this study was to investigate the main pollution parameters of wastewater from dairy industry. Total 4 samples of dairy effluents were collected by composite sampling at the time 9, 12, 3, 6 o'clock per day and stored at 4ºC for further analysis. On the site pH and Temperature recorded and on the next day in triplicates it was subjected to analyze the physicochemical parameters like DO, TDS, TSS, TS, BOD, COD, chloride, sulphate, oil & Grease.

Physico chemical characteristics of four effluent samples from Dairy collected during March, April, May and June 2011 are presented in Table 1. Table 1 reveals that mean values of physical characteristics such as Temp., pH, TDS, TSS and TS are 34ºC, 9.8, 1222mg/L, 290 mg/L, 1837mg/L respectively and mean values of chemical characteristics such as D.O. B.O.D., C.O.D., Sulphate, oil & Grease and chloride are 1.2 mg/L, 650 mg/L, 1448 mg/L, 223 mg/L, 2 mg/L and 153 mg/L, respectively. The average, minimum and maximum values obtained from the analyses of the wastewater samples prior to treatment. These values are greater than Standard limits for Agriculture Irrigation given by the Maharashtra pollution control board (India). The standard limit for Agriculture Irrigation are as follows: for pH, B.O.D., C.O.D. ,S.S., Oil & Grease, T.D.S., Sulphate, Chloride are 5.5 – 9,100 mg/L,250 mg/L,200 mg/L,10 mg/L,2100 mg/L,1000 mg/L,600 mg/L respectively.

The Fig. 1 and Fig. 2 display bar graph of physico-chemical characteristics of whey samples (dairy-I). The graph plotted parameter verses mg/lit, this figure easily indicate that BOD, COD, DO, TDS, TS, TDS valves is very high because the bars height is very clearly seen high than temperature, pH, TSS, sulphate, chloride, oil & Grease.

The wastewaters are typically characterized by the following:

1. They are mainly diluted milk or milk products.
2. There are significant quantities of cleaning compounds and sanitizers present.
3. The contaminants are essentially organic with a high organic strength when compared to other waste streams like domestic wastes
4. There are marked variations in hourly, daily and seasonal composition and flow rates which complicate their treatment.
5. They have a high BOD and COD.
6. They have a high sodium content from the use of caustic soda for cleaning.

**Table 1. Physico-chemical character analysis from dairy**

| Sample | Temp. (°C) | pH | DO (mg/L) | BOD (mg/L) | COD (mg/L) | TDS (mg/L) | TSS (mg/L) | TS (mg/L) | Sulphate (mg/L) | Chloride (mg/L) | Oil& Grease (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 30/03/2011 | 36 | 10 | 1.2 | 600 | 1500 | 1600 | 200 | 1800 | 200 | 162 | 2 |
| 23/04/2011 | 34 | 9.8 | 1.2 | 650 | 1400 | 890 | 290 | 1180 | 223 | 146 | 3 |
| 02/05/2011 | 32 | 10 | 1.4 | 790 | 1495 | 1500 | 290 | 1790 | 223 | 142 | 2 |
| 17/06/2011 | 34 | 9.8 | 1.2 | 650 | 1400 | 900 | 290 | 1180 | 223 | 162 | 3 |
| Total | 136 | 39.6 | 5 | 2690 | 5795 | 4890 | 1070 | 5950 | 869 | 612 | 10 |
| Mean | 34 | 9.9 | 1.25 | 672.5 | 1448.75 | 1222.5 | 267.5 | 1487.5 | 217.25 | 153 | 2.5 |
| SD($\sigma$) | 1.63299 | 0.11547 | 0.1 | 81.8026 | 56.3286 | 380.384 | 45 | 355.094 | 11.5 | 10.5198 | 0.57735 |
| SD Error | 0.8165 | 0.05774 | 0.05 | 40.9013 | 28.1643 | 190.192 | 22.5 | 177.547 | 5.75 | 5.25991 | 0.28868 |
| Degrees of Freedom | 3 | 0.05 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
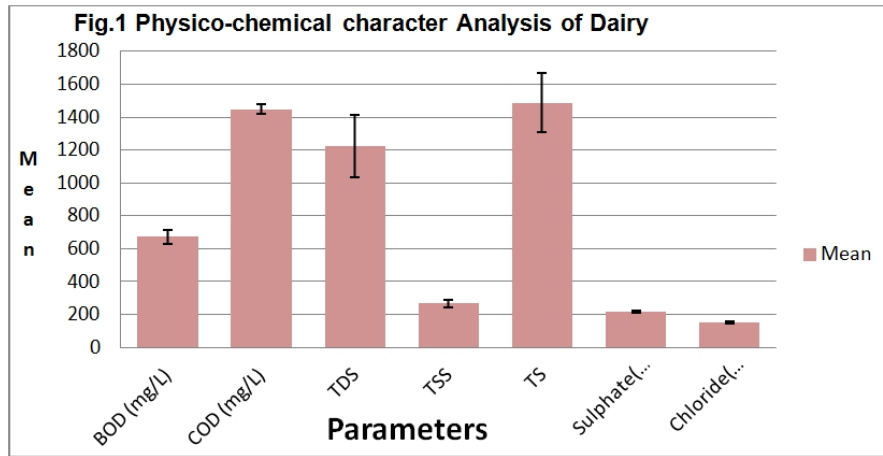
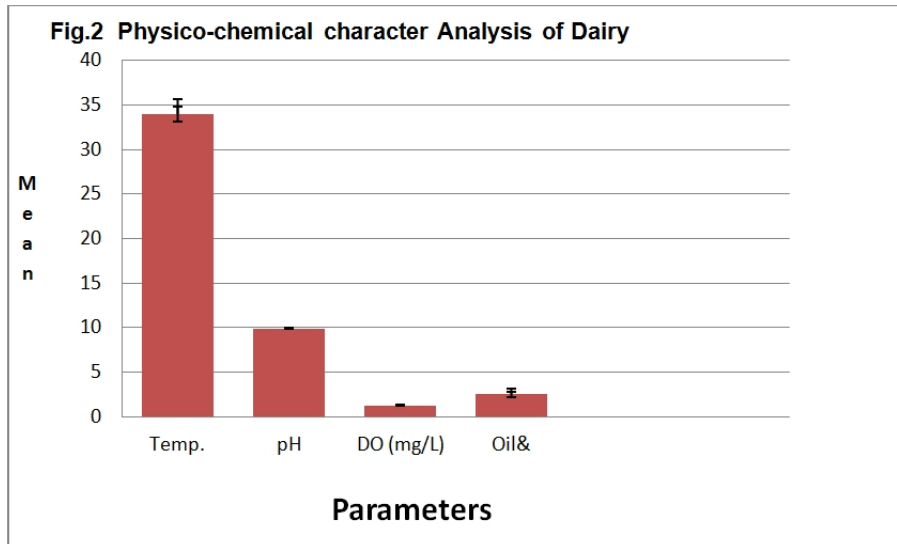**Fig. 1. Physico-chemical character analysis of dairy**



**Fig. 2. Physico-chemical character analysis of dairy**

The study revealed that the dairy effluent is slightly alkaline in nature, and high temperature, BOD & COD values obtained by the analysis of dairy effluents indicate the presence of heavy load of organic substances. Also a higher temperature and oils and greases which lower the dissolved oxygen activities can cause serious problems in disposal of waste water. Above the stander value suspended and dissolved organic solids are responsible for creating nuisance.

## 4. 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 (Total suspended solid),

sulphate and pH values before treatment whereas the samples from the dairies  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

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## COMPETING INTERESTS

Authors have declared that competing interests exist.

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