

Dairy Waste Water Treatment by Using Root Zone Technology System as Tertiary Treatment

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ABSTRACT: India tops in production of milk and involved in processing and manufacturing of various types of milk products. Typical by-products obtained include buttermilk, whey, and their derivatives. Dairy industries have shown tremendous growth in size and number in most countries of the world. Dairy industries discharge wastewater which is characterized by high COD, BOD, TDS, TS, and organic wastes. Such wastewaters become dangerous when released into water bodies. The dairy industry wastewaters are primarily generated from the cleaning and washing operations in the milk processing plants. 2 % of the total milk processed is wasted into drainage systems while washing. The study undertaken involved the characterization of wastewater and the dairy waste is selected for this purpose. By which the pH, suspended solids, TDS, and the significant reduction in the parameters were observed and hence found more useful. In the study we found that initially the waste water sample was alkaline but after the treatment the pH was observed near the Neutral also the TSS and TDS removal efficiency of 81% and 42% respectively was observed.

KEYWORDS: Root Zone; COD; BOD; colocasia esculanta; Dairy effluent.

I. INTRODUCTION

The dairy industry is one of the most important food industries among all the major source of waste water. The amount of Fresh water will depend on the process technology of milk processing. India has the largest livestock population in the world. The dairy industry is a well establish industry and India is known for “Operation flood” also referred as “White Revolution”. It generates between 3.739 and 11.217 million m³ of waste per year (i.e. 1 to 3 times the volume of milk processed)[3]. Treatment and disposal of dairy waste can cost thousands of rupees annually. It is becoming a major problem of disposal of dairy effluents with respect to the environmental aspects and society. Almost all the dairy factories are facing the problem of water treatment, disposal and utilization of the waste water [5]. It is also reported that higher concentration of dairy wastes are toxic to certain varieties of fish and algae. The dairy waste gets converted into highly concentrated organic compounds and toxic compounds which harm aquatic life. Dairy effluent contains soluble organics, suspended, solids, trace organics. They decrease DO, promote release of gases, cause taste and odor, impart color or turbidity, promote eutrophication. Strict rules and regulations are imposed by the government of India in order to protect the environment from toxic waste water by setting standard values and norms. Thus, appropriate treatment methods are required so as to meet the effluent discharge standards [7]. In this regard's it is very necessary to treat the dairy waste water to protect the environment and ecology. But due high cost of chemical and equipment and typical design/arrangement, the industries are not willing/interest to treat the waste water.

II. OBJECTIVE OF THE RESEARCH

- (1) Analyze and characterize the dairy industry waste water before and after the treatment of waste water.
- (2) To check feasibility of using Root Zone Technology System.

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III. EXPERIMENTAL SETUP

A plastic tub of size 450X400X300 is used to prepare model. Different layer of aggregate of size 6-10mm, charcoal of size 4-6, sand of size 2-3mm and black cotton soil is laid in to the plastic tub of thickness 75mm, 55mm, 45mm ,110mm and remaining 15mm is left as a free board to model. Plant use for the model is *colocasias esculanta* are planted in 4 x 3 numbers in to upper layer of soil. Soil of thickness 110mm used too grow plants root to get dense root system into the soil layer. Charcoal layer is to adsorb the pollutants in the waste water. An inlet pipe is fitted at the top of plastic tub and outlet pipe is fitted at the bottom of the plastic tub. The untreated dairy wastewater was applied on to Root zone system in a controlled manner with a flow rate of 20Lit/day. The root zone treatment installations are constructed according to the desired level of purification, the concentration of pollutants and hydraulic and organic loadings. The plants can be set-up as secondary or tertiary treatment for domestic and industrial wastewater treatment systems. This model was installed directly after secondary treatment of Katraj dairy, in Pune. Model was left for 7 days for sterilization by daily giving 20lit/Day dairy waste water. Samples were collected after 7 days of installation. The treated wastewater from the outlet were collected and analyzed in laboratory for following parameters like pH, Total suspended solids (TSS), Total Dissolved solids (TDS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand(COD) and were tested in Kulkarni Laboratories, Dhayri, Pune.

IV. RESULTS AND DISSCUSSION

EFFECT ON PH :

The pH of the wastewater is depicted in figure 4.1. The raw dairy wastewater pH values fluctuated with pH values that ranged from 7.4 to 7.7. Variations of treated water pH values for the wetland effluent were maximum of 7.7 and minimum of 7.4.

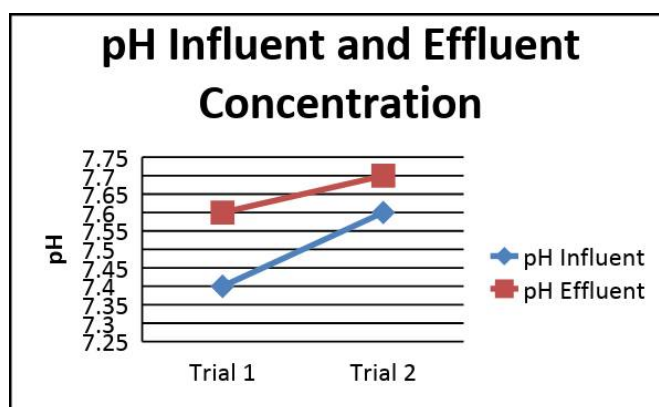


Figure 4.1 Representing pH influent and effluent concentration

BIOCHEMICAL OXYGEN DEMAND (BOD):

Measured concentrations of BOD₅ for the study period are presented in Figure 4.2. The average inlet BOD₅ was 177.5 mg/l. In the first trial, the BOD₅ reduction was from 185 mg/l to 35mg/l which is 82% whereas this result increased remarkably to a level of 92% as shown in figure 4.3.

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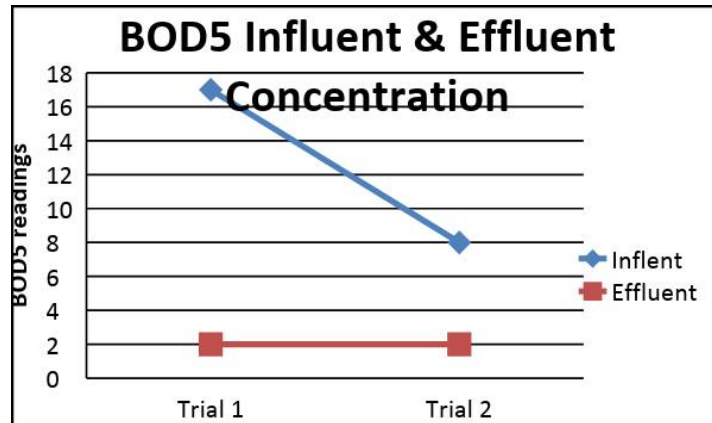


Figure 4.2 Representing BOD5 Influent and Effluent Concentration.

EFFICIENCY OF BOD REMOVAL:

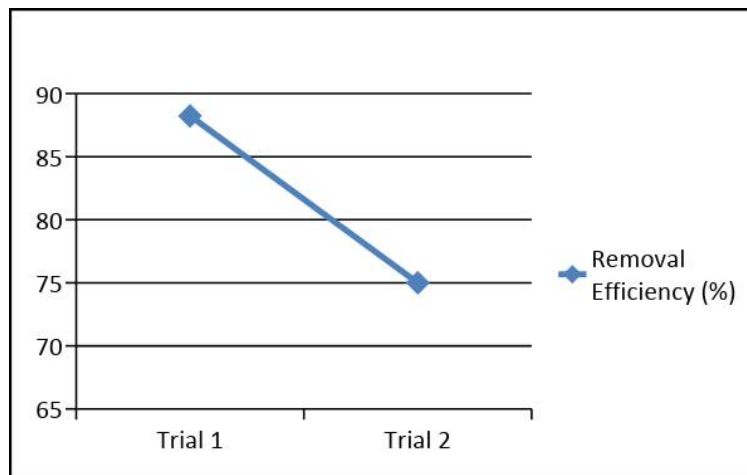


Figure 4.3 Representing BOD5 Removal Efficiency

CHEMICAL OXYGEN DEMAND (COD):

Chemical oxygen demand concentrations measured during the study period for the wetland effluent are plotted in figure 4.4 along with the influent COD concentration. Average influent COD is 1375 mg/l. A plotting of the removal efficiencies for the system is shown in figure 4.5 and displays a reduction for the system ranging from 76% to 85%.

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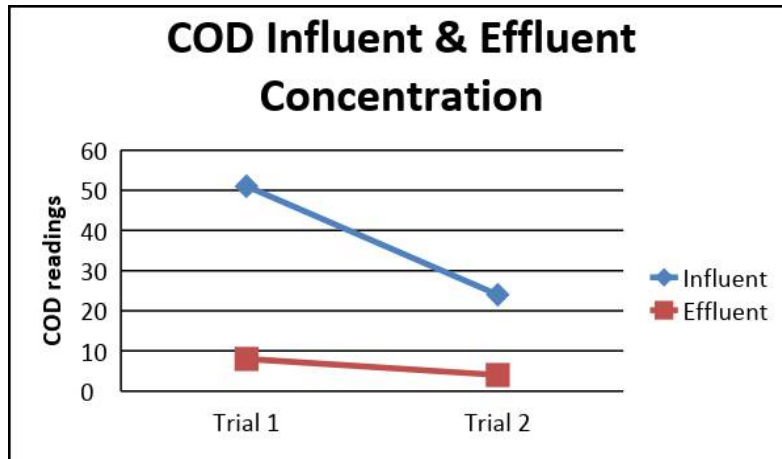


Figure 4.4 Representing COD Influent and Effluent Concentration.

EFFICIENCY OF COD REMOVAL:

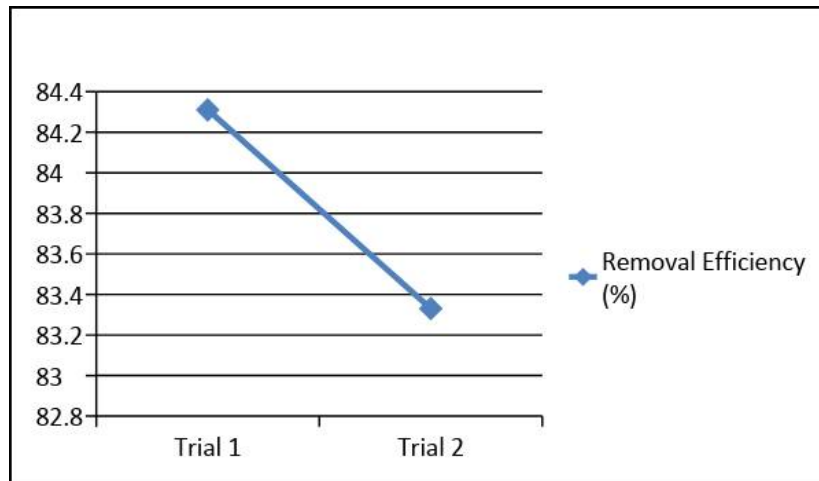


Figure 4.5 Representing COD Removal Efficiency

TOTAL SOLIDS (TS):

The raw wastewater was estimated to have an average TS concentration of 957.5 mg/l. TS concentrations measured during the study period for the wetland effluent are plotted in figure 4.6 along with the influent TS concentration and plotting of the removal efficiencies for the system is shown in figure 4.7 and displays a reduction for the system as a ranging from 76% to 80%.

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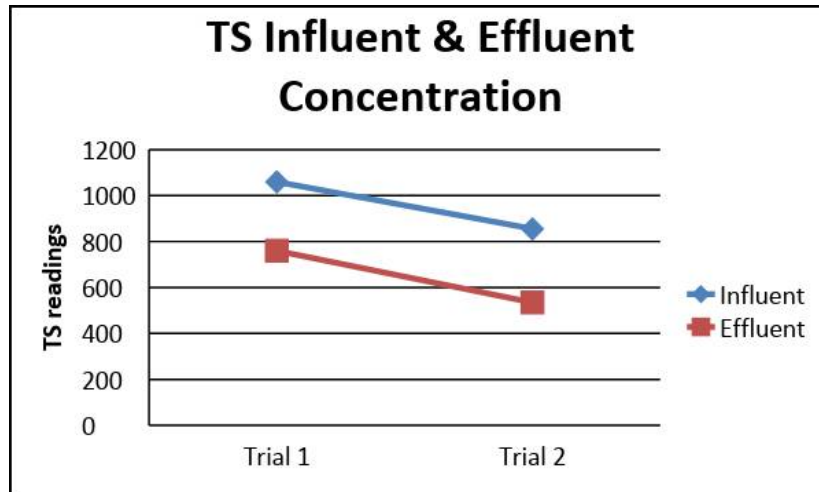


Figure 4.6 Representing TS Influent and Effluent Concentration.

EFFICIENCY OF TS REMOVAL:

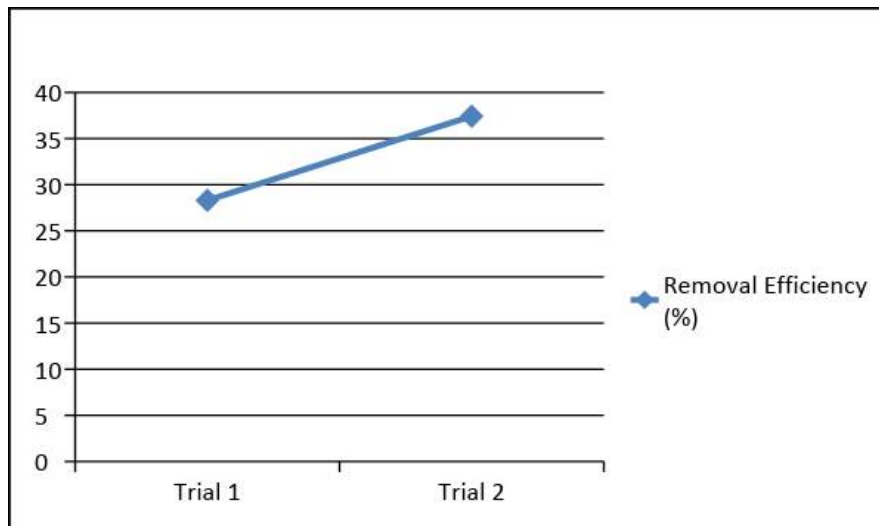


Figure 4.7 Representing TS Removal Efficiency

TOTAL DISSOLVED SOLIDS:

The raw wastewater was estimated to have an average TDS concentration of 935 mg/l. TDS concentrations measured during the study period for the wetland effluent are plotted in figure 4.8 along with the influent TDS concentration and a plotting of the removal efficiencies for the system is shown in figure 4.9 and displays a reduction for the system as ranging from 77% to 81 %.

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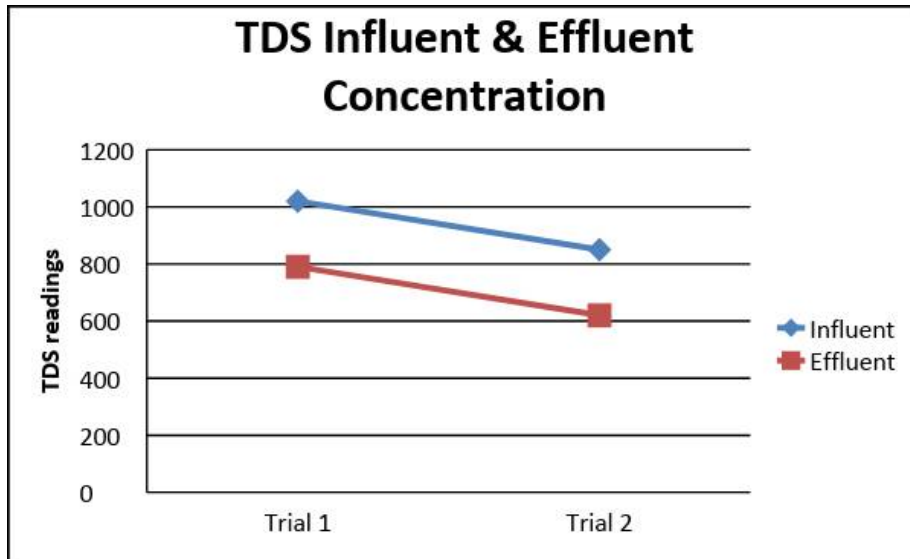


Figure 4.8 Representing TDS Influent and Effluent Concentration.

EFFICIENCY OF TDS REMOVAL:

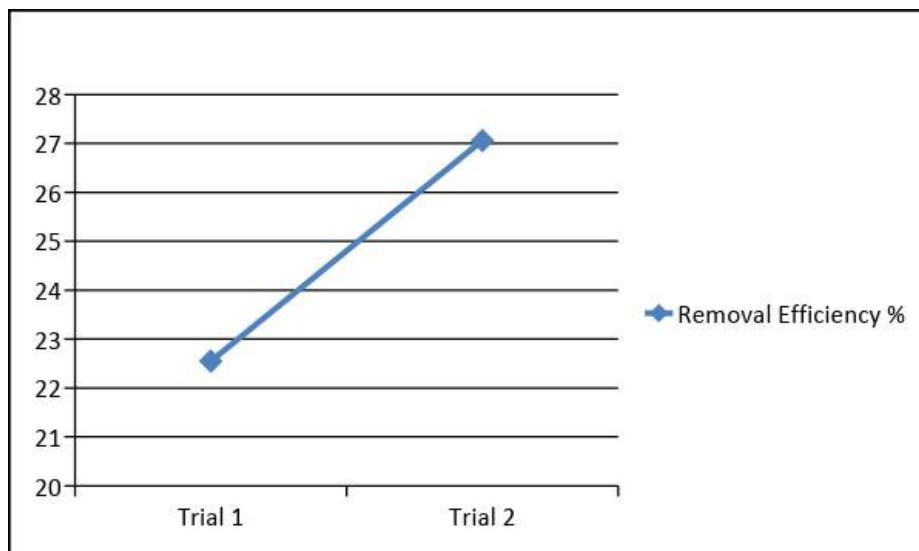


Figure 4.9 Representing TDS Removal Efficiency

TOTAL SUSPENDED SOLIDS:

The raw wastewater was estimated to have an average TSS concentration of 1457.778 mg/l. TSS concentrations measured during the study period for the wetland effluent are plotted in figure 4.10 along with the influent TSS

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concentration and plotting of the removal efficiencies for the system is shown in figure 4.11 and displays a reduction for the system as a ranging from 74% to 78%.

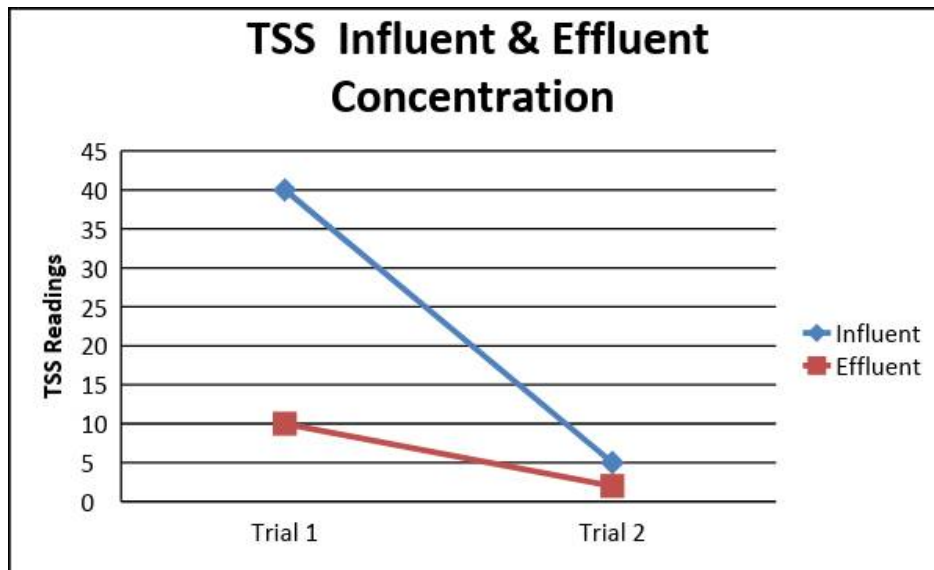


Figure 4.10 Representing TSS Influent and Effluent Concentration

EFFICIENCY OF TSS REMOVAL:

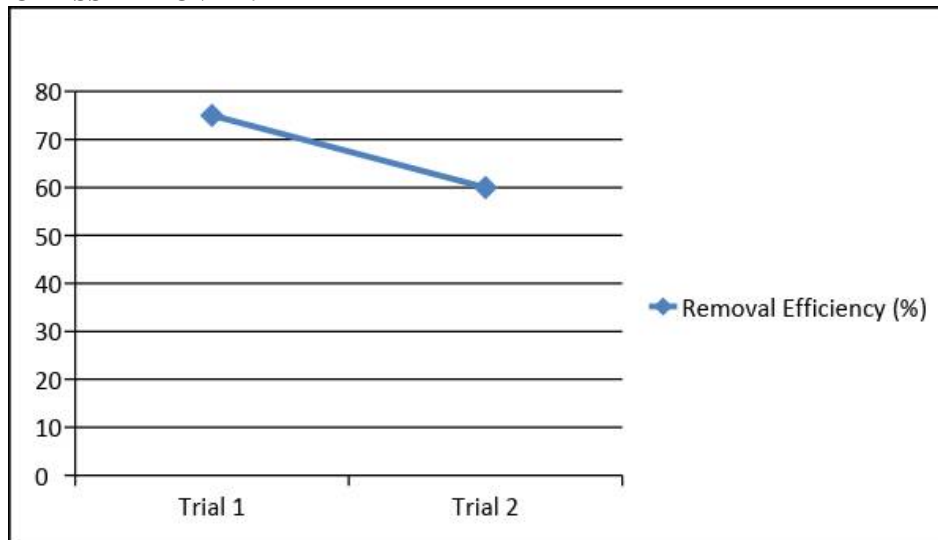


Figure 4.11 Representing TSS Removal Efficiency.

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OVERALL RESULT:

Parameters Tests Carried Out	Percentage Removal	Percentage Removal
pH	-	-
BOD	88.23%	75%
COD	84.31%	83.33%
TS	28.3%	34.72%
TDS	22.55%	27.06%
TSS	75%	60%

V. CONCLUSION

In the Root Zone treatment process of dairy wastes, various quality characteristics were studied and it was found that initially the pH turned out to be more alkaline which ranged from the value of 7.4-7.7. During the set-up procedure of the model the characteristics of the raw waste water which were considered as influent for the model had higher values for BOD, COD, TS, TDS and TSS values. Within a span of a week the values were changed as a result of giving an indication that the model has been properly adjusted to the influents which approached the model. The removal efficiency for the 1st trial had good values as compared to the 2nd trial. Through this observation of Characteristic changes in the treated effluent water it can be stated that there was a considerable growth of the bacterial film on the root zone equipment.

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