Dairy Industry Wastewater Treatment using Sequential Batch Reactor

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Abstract— Dairy industries have shown tremendous growth in size and number. These industries facing the problem of wastewater treatment and its disposal. Huge amount of Fresh water is used mainly for cleaning equipment and work area also during processing of milk and milk products. This wastewater contains high concentration of organic matter, high BOD, COD, suspended solids, nitrogen, etc. Such wastewaters, if discharged without proper treatment, severely pollute receiving water bodies. Thus proper treatment of dairy wastewater is necessary before disposal. There are so many treatment plants working on different conventional treatment techniques like ASP, trickling filter, waste stabilization pond, etc. But conventional treatment has limitations space, economy, and maintenance problem and technically skilled labours are required. In this study, the various recent advancements in the treatment of dairy wastewater using sequential batch reactor is discussed. The Sequential Batch Reactor (SBR) is one of the probable options for treatment of industrial wastewater. It works on natural settlement and aeration process in single tank of SBR. SBR is a fill-and draw system for aerobic wastewater treatment. The results totally depend on the experimental work by giving specific time period. Main aim is removal of pH, BOD, COD and TSS compared with standard effluent values and maintenance cost with as effective treatment as possible.

Key words: BOD, COD, Cost Effective, Dairy Wastewater, SBR Tank, Space

I. INTRODUCTION

The dairy industry is one of the most polluting of industries, not only in terms of the volume of effluent generated, but also in terms of characteristics as well. In the dairy industry, some amount of wastewater gets produced during starting, equilibrating, stopping and rising of the processing units. However, a majority of wastewater gets produced during cleaning operations, especially between products changes when different types of product are produced in a specific production unit and clean-up operations. The quality and quantity of the product content in the dairy wastewater at a given time changes with the application of another technological cycle in the processing line. Nearly 2% of the milk handled in a dairy goes out as waste water & the volume of waste water generated is 2- 10 time the milk processed. The major pollutants in wastewater discharges from milk based food industry are organic matter, suspended solids, pH, nitrogen, phosphorus, and fats. The strength of the waste varies very widely depending upon the products. Since, dairy waste water contain high concentrations of organic matter. These effluents may cause serious problems, in terms of organic load on the local municipal sewage treatment systems. The treatment techniques may include physical, chemical and biological treatment method. Thus Effluent with such characteristics cannot be used for land for agriculture purpose and cannot be discharged into public sewer or surface water.

The organic substances in dairy wastewaters come from primarily, the milk and milk products wastes. The current techniques are time consuming and uneconomical. This study focused on to give primary treatment to dairy waste water and to check the efficiency of SBR for treatment of dairy wastewater in a specially designed SBR tank which will help reduce the further treatment used. Thus by using the SBR tank, we can treat the waste water by natural process of settlement. The general working of the SBR is in five steps, fill, react, settle, decant, and idle.

Selection of the sampling in dairy industry is very important since it gives an idea of the source and types of pollutants present in the waste-water. For this study in dairy industry in Pune region is selected. In current scenario it has its own treatment plant,

SCREENING→GRIT CHAMBER→AERATION→HOLDING TANK→SECONDARY CLARIFIER→TREATED WATER.

But it is not giving standard result due to high cost of electricity, operation and maintenance. The aim of the study is to reduce the organic matters, odour and save the cost of treatment process by suggesting SBR to their process. SBR tank technique gives the positive results with economy.

II. PROCEDURE & MATERIALS

The complete project work depends on the selected cycle time as:

A. Fill Phase

During the fill phase, the basin receives influent wastewater. The influent brings food to the microbes in the activated sludge, creating an environment for biochemical reactions to take place.

B. React Phase

During this phase, no wastewater enters the basin and the mechanical mixing and aeration units are on. This phase allows for further reduction of wastewater parameters.

C. Settle Phase

During this phase, activated sludge is allowed to settle under quiescent condition. The activated sludge tends to settle as a flocculent mass.

D. Decant Phase

Clarified treated effluent (supernatant) is removed from the tank. No surface foam or scum is decanted.

E. Idle Phase

This step occurs between decant and the fill phases. The idle period is used when the system is waiting for enough effluent to process.

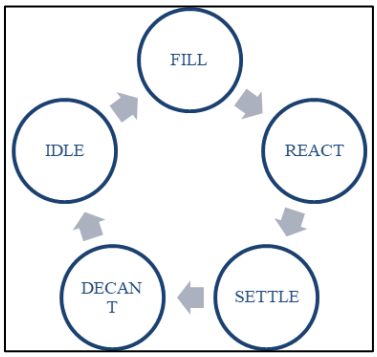

Fig. 1: SBR Operation for One Cycle

Then analysis of Inlet and Outlet effluent with proper intervals of cycles. The feed stock for the Stabilization Tank was collected from dairy industry and were analysed immediately after collection. (within@1hr.) The performance parameters such as pH, TSS, COD and BOD were analysed as per procedure detailed in Standard Methods.

III. EXPERIMENTAL SETUP

The prepared model of stabilization tank works on the basis of principle of gravity where the particles having specific density more than water will settle down. In model reactor, a slope is provided to collect the sludge at the bottom of the tank to get drawn through the outlet. Two number of air diffusers are provided for aeration. Another outlet is provided at the side wall of the tank to collect treated wastewater. The capacity of the tank is 35 litres and cycle time is 5 hours.

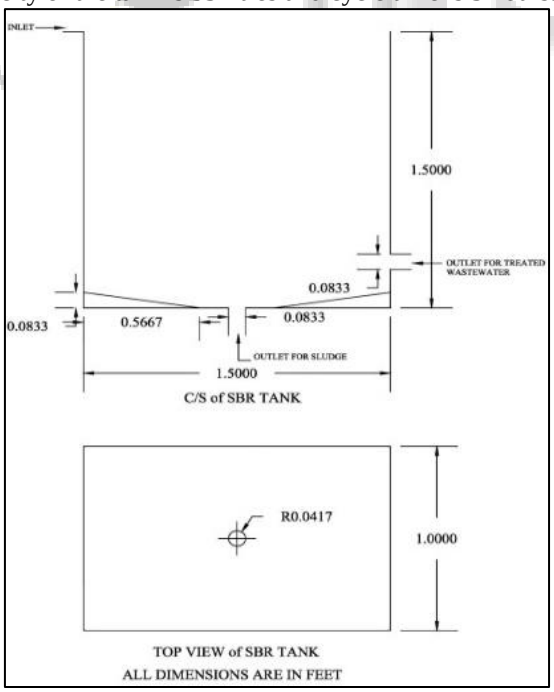

Fig. 2: Dimensions of Tank

The dairy wastewater is fed in the tank and it is hold for 1 hour. Then aeration is started and it continues for 3 hours. After the aeration the wastewater is kept steady for 30-45 minutes to settle down the sludge at the bottom of the tank. After settling time is completed the treated wastewater is collected through the outlet provided at the side wall of the tank and the remaining sludge is removed from the bottom outlet.

The results obtained from this system are highly satisfied while comparing with standard results.

A. Specifications of Tank

The SBR tank is rectangular in shape having following specifications:

- Total dimensions of tank: (1.5ft. X 1.0ft. X 1.5ft.)
- Capacity of tank: 40 litres
- No. of air diffusers: 2

IV. RESULTS & DISCUSSION

Different analysis were done at inlet and outlet to understand the chemical and biological characteristic of dairy wastewater. The different test conducted are mentioned as pH, TSS, TDS, COD, BOD, Chlorides and sulphates.

Sr. No.	Characteristics	Unit	Value
1	pH	-	4.93
2	Total Suspended Solids	Ppm	177.20
3	Chemical Oxygen Demand	Ppm	800.00
4	Biological Oxygen Demand	Ppm	230.00
5	Total Dissolved Solids	Ppm	450.00
6	Chlorides	Ppm	35.45
7	Sulphates	ppm	82.20

Table 1: Characteristics of Wastewater

Sr. No.	Characteristics	Unit	Value
1	pH	-	3.28
2	Total Suspended Solids	Ppm	67.20
3	Chemical Oxygen Demand	Ppm	263.00
4	Biological Oxygen Demand	Ppm	18.33
5	Total Dissolved Solids	Ppm	420.00
6	Chlorides	Ppm	31.90
7	Sulphates	ppm	70.29

Table 2: Characteristics of Treated Wastewater

Sr. No.	Characteristics	Unit	Value
1	pH	-	5.67
2	Total Suspended Solids	Ppm	189.20
3	Chemical Oxygen Demand	Ppm	992.00
4	Biological Oxygen Demand	Ppm	290.00
5	Total Dissolved Solids	Ppm	600.00
6	Chlorides	Ppm	46.08
7	Sulphates	ppm	119.20

Table 3: Characteristics of Wastewater

Sr. No.	Characteristics	Unit	Value
1	pH	-	4.63
2	Total Suspended Solids	Ppm	71.75
3	Chemical Oxygen Demand	Ppm	326.12
4	Biological Oxygen Demand	Ppm	20.45
5	Total Dissolved Solids	Ppm	760.67
6	Chlorides	Ppm	41.46
7	Sulphates	ppm	87.16

Table 4: Characteristics of Treated Wastewater

The pH value of wastewater was high compared to that of treated wastewater. The pH of the treated wastewater reduced naturally. Sometimes it was high due to higher pH of industrial wastewater with respect to production.

Removal of TDS & TSS observed is also very effective. The main reason is the aeration provided was very effective. The values of TDS & TSS gradually reduced.

It was observed that due to aeration and natural settlement, very effective removal of COD & BOD was observed.

Very effective removal of Chlorides & Sulphates was observed.

V. CONCLUSION

In the present study, lab scale model was setup in the laboratory & following investigations were concluded

1) The operating cost of Sequential batch reactor is low as compared to other wastewater treatment technologies.
2) For COD & BOD removal of dairy wastewater, Sequential batch reactors can be effectively used on large scale.
3) For developing countries, where the conventional wastewater treatment plants may fail because of high land cost and maintenance, this treatment is particularly suitable.
4) It may result in significant, economic and environmental benefits, if recycled for aquaculture and agriculture.

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