Impact of Aerobic Treatment with presence of PVC Media in treating of Dairy Waste Water


Abstract

In any dairy plant, the quantity and characteristics of effluent is depending upon the extent of production activities, pasteurization to several milk products. In the advent of modernization, pollution problems have also emerged in various forms. Effluent treatment involving biodegradable organic wastes can be treated biologically in most cases. Activated sludge process is used in the studies. A bench scale modified sequential batch reactor is established (MSBR) consist of an inlet which is directed to a feed pump having capacity of 2L per hour. The aerobic environment in the reactor is achieved by diffused or mechanical aeration. The efficiency in removal of COD, BOD, and other parameters are checked for 24, 48 and 72 hours respectively. The ammonia removal efficiency of MSBR is 75%. The BOD removal efficiency of MSBR in presence of PVC media is 69%, COD removal efficiency is 68%. Thus the work implies that the application of PVC ring media in the treatment of dairy waste increases the treating efficiency of MSBR

Keywords: Dairy Waste, MSBR, COD, BOD, PVC ring media.

Introduction

Dairy is one of the industries producing wastewater rich in organic matter and thus leading to creation of odorous and high COD containing water. Dairy industry produces huge volumes of wastes, both solids and liquids. This waste poses escalating disposal and pollution problems and represents a loss of valuable biomass and nutrients. However, despite their pollution and hazard aspects, in many cases, dairy processing wastes have a good potential of converting into useful products of higher value as by-product, or even as raw-material for other industries. Dairy plants are considered as ‘wet industry’ because they consume large volumes of water, which is used for very diverse purposes. As a result, dairy plants discharge large volumes of wastewater. The discharge of the polluted water is the most significant contributor to the pollution of environment from the dairy industry in terms of both quality and quantity; contamination by the solid waste and waste gases are less serious. The dairy-industry wastewater is primarily generated from the cleaning and washing operations in milk processing plants. It is estimated that about 2% of the total milk processed is wasted into drains. Dairy wastewater differs widely both in quantity and quality depending on a given dairy-factory production characteristics. Many products in dairy factories are manufactured separately, thus pollutant contents in the dairy wastewater at a given time changes together with the application of another technological cycle of the processing line.

The dairy industry is one of the most polluting industries, not only in terms of the volume of effluent generated, but also in terms of its characteristics as well. It generates about 0.2–10 l of effluent per liter of processed milk. Biological treatment processes offer a cost-effective method to remove organic compounds and nitrogen from the wastewater. Treatment designs are continually evolving to provide greater treatment efficiency, at a lower cost. Biological wastewater treatment is the primary method of preparing food-processing wastewater flows for return to the environment. Increasing industry wastewater loads on existing plants and more stringent government discharge
requirements have put considerable pressure on the food-processing industry to refine and understand better the design and management of biological wastewater treatment processes. MSBRs can be operated in such a way to manipulate both the organism distribution established in the reactor and the physiological state of the organisms developed since they subject organisms to variable concentrations of waste components and dissolved oxygen. SBR operation can be adjusted to accomplish nitrogen removal. The concentrate is an organic biological treatment used to aid the natural biodegradation of carbonaceous matter that would otherwise attempt to decompose through oxidation using the available oxygen in the wastewater. Once the oxygen in the wastewater is consumed (measured as Biochemical or Chemical Oxygen Demand) it renders the wastewater “septic” or anaerobic leading to odor generation and corrosion. Heavy organic materials will also form blockages through fat and grease deposition within conveyance wastewater networks. The concentrate has been extensively trialed and anecdotally proven (unscientifically) in sewage networks and Waste Water Treatment Plants. Although originally tested on sewerage networks, smaller scale systems, and WWTPs, serving as odor and corrosion control as well as reducing grease and bio-slime accumulation, it was proposed that synergies could exist between other industries with similar effluent contaminant issues. Normally, in almost all the dairy industries water has been a key processing medium used for different processes like cleaning, sanitization, heating, cooling, floor washing, which directly implies that the requirement of water is huge, hence giving rise to large amount of waste waters produced which is estimated to be 2% of the total milk production which is wasted into drains. Also, dairy effluents contain dissolved sugars and proteins, fats, and possibly residues of additives. The key parameters are biochemical oxygen demand (BOD), with an average ranging from 0.8 to 2.5 kilograms per metric ton (kg/t) of milk in the untreated effluent; chemical oxygen demand (COD), which is normally about 1.5 times the BOD level; total suspended solids, at 100–1,000 milligrams per liter (mg/l); total dissolved solids: phosphorus (10–100 mg/l), and nitrogen (about 6% of the BOD level). Cream, butter, cheese, and whey production are major sources of BOD in wastewater. The waste load equivalents of specific milk constituents are: 1 kg of milk fat = 3 kg COD; 1 kg of lactose = 1.13 kg COD; and 1 kg protein = 1.36 kg COD. The wastewater may contain pathogens from contaminated materials or production processes. A dairy often generates odors and, in some cases, dust, which need to be controlled. Most of the solid wastes can be processed into other products and byproducts.

Industrial waste may originate from washing milk-carrying and -storing containers, bottles and glasses, sterilizing depositories, delivery station floors and other installations present, such as, pumps, boilers, etc. Waste in pasteurization and sterilization units is mainly composed of machine coolants. Lactic acid bacteria are a group of related bacteria that produce lactic acid as a result of carbohydrate fermentation. These microbes are broadly used by us in the production of fermented food products, such as yogurt (Streptococcus spp. and Lactobacillus spp.), cheeses (Lactococcus spp.), sauerkraut (Leuconostoc spp.) and sausage. These organisms are heterotrophic and usually have complex nutritional necessities because they lack many biosynthetic capabilities. Biological treatment processes offer a cost-effective method to remove organic compounds and nitrogen from the wastewater. Treatment designs are continually evolving to provide greater treatment efficiency, at a lower cost. Biological wastewater treatment is the primary method of preparing food-processing wastewater flows for return to the environment. Increasing industry wastewater loads on existing plants and more stringent government discharge requirements have put considerable pressure on the food-processing industry to refine and understand better the design and management of biological wastewater treatment processes. The aim of the research presented in this work was to evaluate the performance of a laboratory-scale reactor to treat dairy wastewater and to determine the treatment efficiency of MSBR using PVC media, the research was done under aerobic conditions.

Experimental Program

Materials and Methods

Sample Collection

The waste water has been obtained from ASM dairy, which is located at Kangeyam, Tirupur district in Tamil Nadu. The waste water has high amount of COD, BOD and turbidity with acidic waste water lines. Some of the important waste water characteristics are given in table 1.

Sampling

Sampling of waste water is done at the main collecting tank using grab sampling method, the
sample bottles are of 50 liter capacity which are cleaned three times with tap water then with distilled water and rinsed fully with 6N HNO₃ for removal of every signs of pathogens or odor.

Samples collected are used immediately for the study. Before conducting the study, the initial parameters are noted.

**Related Images**

![Figure 1.Collection site](image1)

![Figure 2.Aeration chambers](image2)

![Figure 3.Feed pump (6L/hour)](image3)

![Figure 4.Sample before and after treatment](image4)

**MSBR Setup**

![Figure 5.Modified Sequential Batch Reactor](image5)
Results and Discussions

Table 1. Dairy waste characteristic

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameters</th>
<th>Initial concentration</th>
<th>24 Hours aeration</th>
<th>48 Hours aeration</th>
<th>72 Hours aeration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>pH</td>
<td>5.6</td>
<td>5.8</td>
<td>6.3</td>
<td>6.7</td>
</tr>
<tr>
<td>2</td>
<td>Conductivity(mS)</td>
<td>6.92</td>
<td>5.60</td>
<td>4.83</td>
<td>3.9</td>
</tr>
<tr>
<td>3</td>
<td>TDS (ppm)</td>
<td>0.46 x 10000</td>
<td>0.62 x 10000</td>
<td>0.7 x 10000</td>
<td>0.82 x 10000</td>
</tr>
<tr>
<td>4</td>
<td>Turbidity( NTU )</td>
<td>190.2</td>
<td>132.6</td>
<td>68.2</td>
<td>42.3</td>
</tr>
<tr>
<td>5</td>
<td>Ammonia (mg/l)</td>
<td>3.2</td>
<td>2.6</td>
<td>1.9</td>
<td>0.8</td>
</tr>
<tr>
<td>6</td>
<td>BOD (mg/l)</td>
<td>520</td>
<td>430</td>
<td>260</td>
<td>160</td>
</tr>
<tr>
<td>7</td>
<td>COD (mg/l)</td>
<td>800</td>
<td>666.3</td>
<td>450</td>
<td>250</td>
</tr>
<tr>
<td>8</td>
<td>TS (mg/l)</td>
<td>4500</td>
<td>900</td>
<td>500</td>
<td>200</td>
</tr>
<tr>
<td>9</td>
<td>TSS (mg/l)</td>
<td>2400</td>
<td>1800</td>
<td>1100</td>
<td>700</td>
</tr>
<tr>
<td>10</td>
<td>Odour</td>
<td>Objectionable</td>
<td>Decreased</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>11</td>
<td>Colour</td>
<td>Greyish white</td>
<td>Greyish white</td>
<td>Partially white</td>
<td>Colour less</td>
</tr>
<tr>
<td>12</td>
<td>Oil and grease (mg/l)</td>
<td>60.3</td>
<td>48</td>
<td>35.4</td>
<td>22.5</td>
</tr>
</tbody>
</table>

Table 1 gives the three day aerobic treatment results, the harmful pollutants present in the dairy waste water is varying during the aeration. The color and odor present in the waste water was completely removed by the three day aeration process. The lab scale MSBR setup proved its efficiency to treat the dairy wastewater in the presence of PVC media. The pH value was bought down to 6.7, other parameters such as BOD, COD, were eventually reduced with 69% and 68% of efficiency, oil and grease was removed up to 62% and ammonia was minimized with 75% of removal efficiency.

Total suspended solids present in the dairy wastewater was reduced from 2400mg/L to 700mg/L with an efficiency range of 70% and the total solids present in the dairy wastewater was reduced from 4500 mg/L to 200mg/L which clearly shows the treatment effect on dairy wastewater. Turbidity varies from 190.2NTU to 42.3NTU, with an efficiency rate of 77%. This results proved that the MSBR setup using PVC media was successful and the treatment was efficient to reduce the parameters present in the dairy waste water.

Conclusions

Treatment of wastewater plays a vital role on human health; furthermore the limitation of water resources and sustainable use of alternative water sources have led to demand for the development. The variations in major parameters due to aerobic treatment in the dairy waste were studied. The aerobic treatment process is more economical than any other conventional treatment methods. The major pollutant parameters present in wastewater were reduced by the aerobic treatment. Formation of sludge is stable and uniform. Low cost resources are involved in this operation. Efficiency in treatment of wastewater was good when compared with any other conventional treatment process adopted for dairy waste treatment. This can be used for pilot scale treatment process and also used for large scale industries with higher efficiency. The COD removal efficiency in MSBR is 68%. BOD removal efficiency is found to be 69%, ammonia is reduced up to 75%. The sludge produced during aerobic treatment can be used as agricultural fertilizers. The other parameters of the wastewater were also reduced eventually which proves that using PVC rings as media is an effective solution for treating diary waste water.

References