Treatment Of Dairy Waste

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Abstract: **The dairy industry involves processing raw milk into products including milk, butter, cheese, yogurt, using processes such as chilling, pasteurization, and homogenization. This paper consequently focuses on how the various constituents of waste water vary with aeration. Diffused fine bubble aeration was done in a circular tank at various flow rates (1.5 l/min., 3 l/min., 4 l/min.) at a detention period of 24hrs.3 l/min. was found to be optimum rate of flow at an optimum time period of 72hrs with a reduction of 88% ,90.37% and 70% in COD, BOD and Turbidity respectively. Treatment using natural coagulant *Moringa oleifera* (MO) was also carried out at optimum air rate and optimum time period. Optimum reduction in turbidity was obtained as 76.67%. 6gm/l MO was found to be optimum dosage.**

***Keywords*: Dairy waste water, Aeration, *Moringa oleifera*, Optimum dosage.**

I. INTRODUCTION

The dairy industry involves processing raw milk into products including milk, butter, cheese, yogurt, using processes such as chilling, pasteurization, and homogenization. Typical by-products include buttermilk, whey, and their derivatives. Huge amounts of water are used during the process producing effluents containing dissolved sugars and proteins, fats, and possibly residues of additives. The characteristics of raw effluent having pH, Biochemical oxygen demand (BOD) Chemical oxygen demand (COD), Oil and grease, Total suspended solids (TSS), Total dissolved solids (TDS), phosphorus and nitrogen (about 6% of the BOD level) at a range of value which is harmful to human and environment too.

From International Journal of Environmental Sciences and Research, Treatment of dairy wastewater using aerobic biodegradation and coagulation by Harush D. P, Hampannavar U. S, Mallikarjunaswami M.E, revealed that dairy waste treatment can be done by using coagulation method and aeration method.

According to ‘Treatment of dairy waste water using aerobic biodegradation and coagulation’ 87.43 per cent reduction of COD at 640ml/min was close to 87.05 per cent removal of COD at rate 320ml/min of aeration which were obtained at the end of 72 hours, so optimum dosage was taken as 320ml/min as rate of aeration. Odour removal was around 70 to 80 per cent.

According to International Journal of Engineering Research and Applications, ‘Effect of aeration on seafood processing waste water’ amount of BOD, COD, NH3-N and TKN reduced by 91.20%, 82.79%, 57.76% and 90.61% respectively at a flow rate of 6.4l/min.

The objectives of this study are to find optimum rate of flow required to get optimum reduction in COD, BOD, Turbidity and odour nuisance, aeration is done at optimum rate of flow to get optimum detention period and optimum dosage of MO for optimum reduction of turbidity at optimum rate of flow and at optimum detention period.

II. AERATION

Fine bubble diffused aeration was done in a circular tank using air stones as diffusers. Aeration was done for varying time period at varying air flow rates as 1.5l/min, 3l/min, 4l/min to get optimum flow rate and time period.

Aeration is the intimate exposure of water and air. It is a way of thoroughly mixing the air and water so that various reactions can occur between the components of the air and the components of the water.

Aeration removes or modifies the constituents of water using two methods - scrubbing action and oxidation. **Scrubbing action** is caused by turbulence which results when the water and air mix together. The scrubbing action physically removes gases from solution in the water, allowing them to escape into the surrounding air. Scrubbing action will remove tastes and odours from water if the problem is caused by relatively volatile gases and organic compounds. Oxidation is the other process through which aeration purifies water. **Oxidation** is the addition of oxygen, the removal of hydrogen, or the removal of electrons from an element or compound. When air is mixed with water, some impurities in the water, such as iron and manganese, become oxidized. Once oxidized, these chemicals fall out of solution and become suspended in the water. The suspended material can then be removed later in the treatment process through filtration.

III. METHODS AND MATERIALS

3.1. Fine bubble diffusion:

Although coarse bubble aeration appears to be effective, this is only visual. It is estimated that the aeration efficiency of fine bubbles is 6.6 times greater than that of coarse bubble aeration. Therefore, fine bubble aeration creates an efficient vertical circulation. This continual upward motion of the fine bubbles de-stratifies the water body. Fine bubble diffused aeration, therefore, effectively mixes water and reduces potential anaerobic sediment. This ultimately greatly improves water quality. Air stones were used as diffusers. They were preferred because,

- Dust and dirt particles up to 30micron can pass through it
- No air filters are needed.
- Produce uniform fine bubble.

3.2. Aeration tank:

Circular tank was used for aeration. It was found that the circular tanks are the most energy efficient. As per A chanta Ramakrishna Rao et al circular tanks produce maximum energy efficiency for a given input energy, followed by square tanks, rectangular tanks of L/W equal to 1.5 and rectangular tank of L/W equal to 2. This suggests that the circular tanks perform the better as far as power requirements are concerned and hence provide better economy. Although the square tanks were the best for quick aeration, they consumed more energy than the circular tanks.

3.3. Preparation of *Moringa oleifera* seeds powder*:* The M.O. dry pods were obtained from a field. High quality pods, those which were new and not infected with disease, were selected. Seeds were opened and from pods and then dried sunlight 48 hr. Hulls and wings from the kernels were removed manually. The kernels were crushed and ground to a medium fine powder in grinder. The powder was sieved using 0.45mm mesh and the powder was stored in a container in refrigerator to avoid loss of its activity. The fine powder was used as coagulant for analysis.

IV. RESULTS AND DISCUSSION

From the initial analysis of sample it was found that BOD, COD, Turbidity, oil and grease were exceeding their permissible limits.

TABLE 1: DETERMINATION OF OPTIMUM FLOW RATE

EFFLUENTS	1.5 l/min	3 l/min	4 l/min
Reduction in BOD (%)	48.52	67.93	61.48
Reduction in COD (%)	43	66	60.01
pH	Nil	Nil	Nil
Oil and grease	Nil	Nil	Nil
Reduction in Turbidity (%)	20.42	33.57	37.72

On aerating the dairy waste at an airflow rate of 1.5 l/min and for detention period of 24hrs, the COD value which was initially 2970mg/l was reduced to 1693mg/l that is, 43% of reduction was occurred. The BOD was reduced to 761.85mg/l from its initial value of 1480mg/l that is 48.52% was reduced. Turbidity is reduced to 230NTU from 298NTU. pH value was observed as same as that of untreated sample.

At an air flow of rate 3 l/min at 24hrs, the COD was reduced to 1009.8mg/l, BOD to 474.6mg/l and turbidity to 192NTU. There was 66% reduction in COD 67.93% reduction in BOD and 33.57% reduction in turbidity. pH value increased to 8 due to the removal of CO_2.

Rate of flow is increased to 4 l/min. COD, BOD and turbidity were reduced to 1187.45mg/l, 569.98mg/l and 180NTU respectively. The percentage in reduction was found to be 60.01% in COD, 61.48% in BOD and 37.72% in turbidity. pH value was increased to 8 due to the removal of CO_2.There was no change in oil and grease due to aeration. From these observations, the optimum rate of flow would be 3l/min.(fig.1)

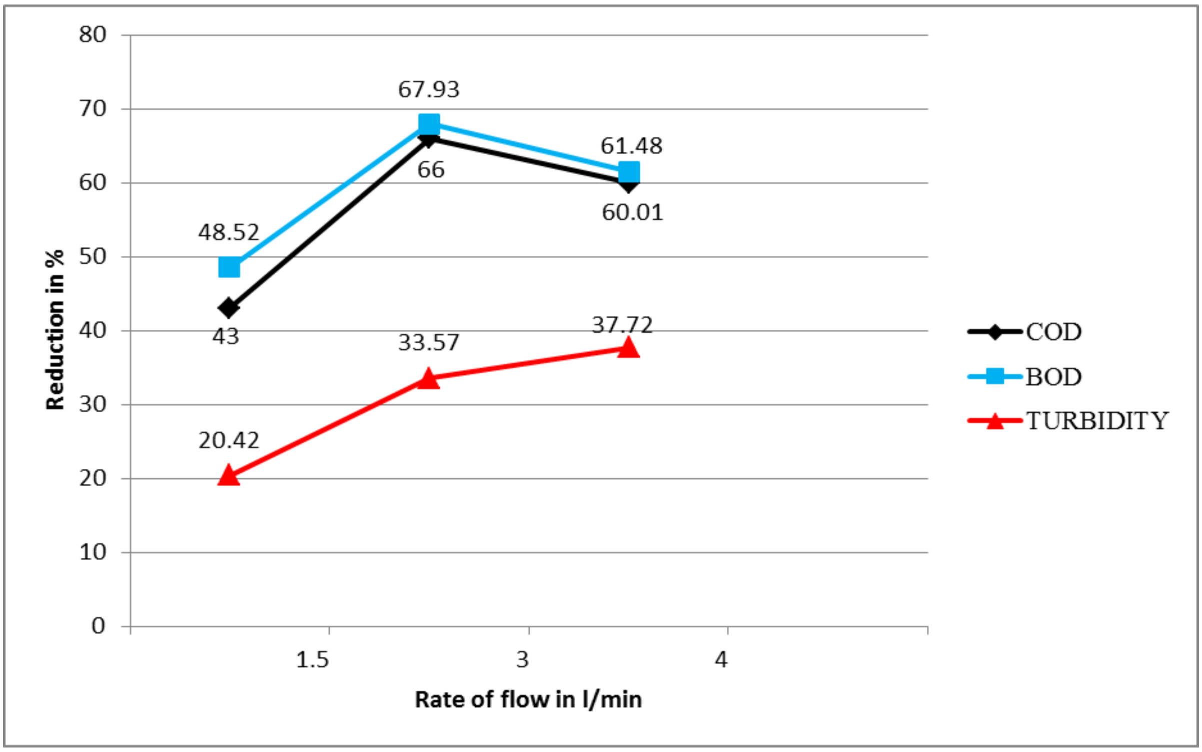

Fig. 1

TABLE 2: DETERMINATION OF OPTIMUM DETENTION PERIOD AT OPTIMUM FLOW RATE

EFFLUENTS	AFTER 1 DAY	AFTER 2 DAY	AFTER 3 DAY	AFTER 4 DAY
Reduction in BOD (%)	67.93	82.85	90.37	90.52
Reduction in COD (%)	66	78.6	88	89.01
Reduction in Turbidity (%)	33.57	40.96	70	70
pH	Nil	Nil	Nil	Nil
OIL & GREASE	Nil	Nil	Nil	Nil

From this analysis reduction of COD, BOD and Turbidity were found to be optimum after three days of treatment at 3l/min. There was 88%, 90.37% and 70% reduction in COD, BOD and Turbidity which was near to that of four days treatment. So optimum time period was found to be 72hrs (3 days). (fig. 2)

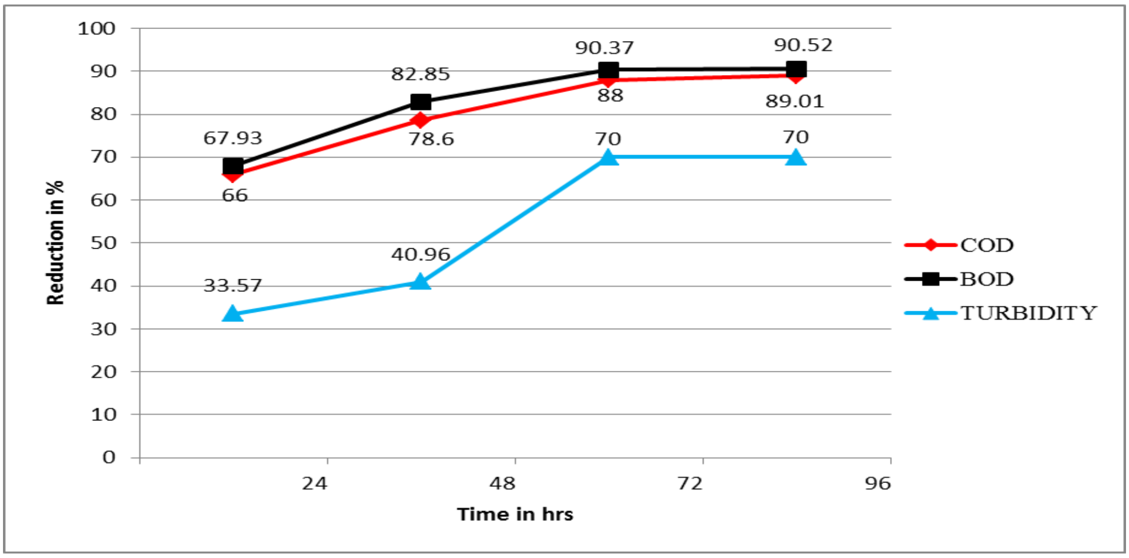

Fig. 2

TABLE 3: DETERMINATION OF OPTIMUM COAGULENT DOSAGE AT OPTIMUM FLOW RATE AND OPTIMUM DETENTION PERIOD

EFFLUENTS	3gm/l	6gm/l	9gm/l
Reduction in COD (%)	89.02	90.1	89.3
Reduction in BOD (%)	90.52	91.6	89.7
Reduction in Turbidity (%)	70	76.67	60

By treating the sample with *Moringa Oliefera* as natural coagulant at optimum rate of flow and at optimum detention period, it was observed that there was no further reduction in COD and BOD.

Initially the sample was treated with 3gm/l of MO. It was found that, turbidity was reduced to 90NTU. That is 70% reduction was obtained after 3 days treatment at 3l/min. Then treated the sample with 6gm/l. The reduction in turbidity was obtained as 76.67%. Again treated the sample with 9gm/l. Only 60% reduction can be obtained. Optimum dosage of MO was obtained as 6gm/l at an air rate of 3l/min after 3days of treatment.

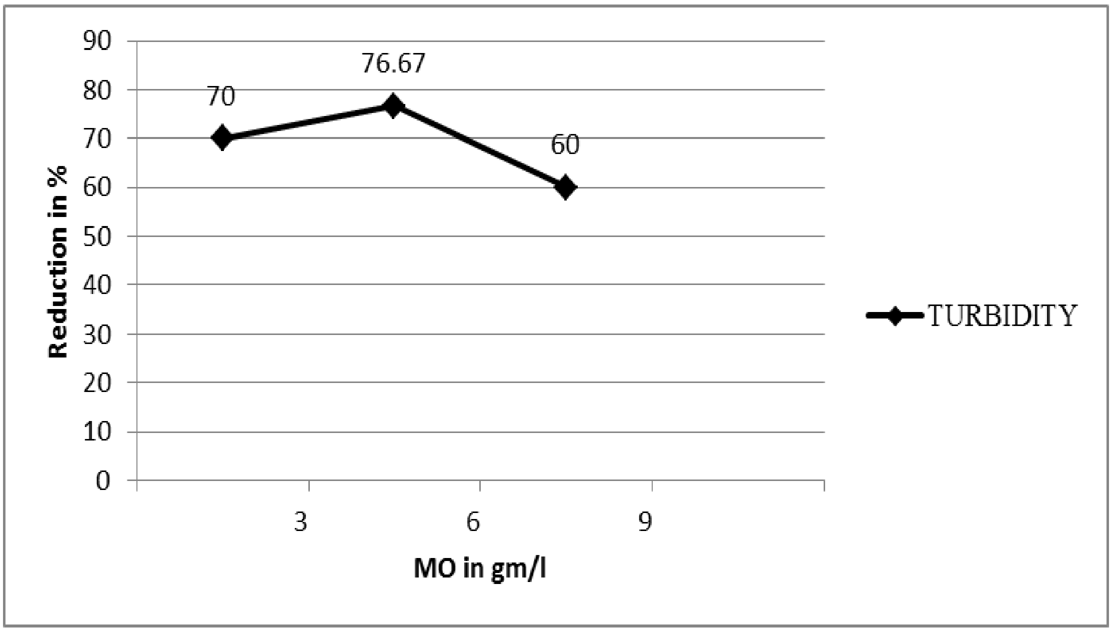

Fig. 3

V. CONCLUSIONS

It was found that optimum rate of flow is 3l/min at optimum time period of 72hrs with a reduction of 88% in COD, 90.37% in BOD and 70% in Turbidity. Optimum amount of MO required is 6 gm/l with 76.67% reduction in Turbidity. No any effect on oil and grease due to aeration. As increasing the rate of aeration pH was increases due to removal of CO_2.

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