"LOW-COST ECO-FRIENDLY TREATMENT FOR DAIRY WASTEWATER"

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Abstract: The dairy industry is generally considered to be largest source of food processing. These industrial wastewater is characterized by high COD, TDS, turbidity and nitrates. This wastewater is treated in two stages, coagulation and vermin biofiltration. Coagulation was used as a primary treatment in which jackfruit seed powder is used as a coagulant in removing turbidity. Vermi biofiltration was used as secondary treatment of dairy wastewater in removing COD and nitrates using the Eisenia fetida earthworm species and wetland plant Cyprus rotundus. The earthworms' gut acted as a bioreactor and they reduced the dairy wastewater solid and liquid organic wastes through ingestion and expelling these as vermicompost. 500 gm earthworms were used in the vermifilter. The treated water pH increased from being acidic to neutral. In dairy wastewater, chemical oxygen demand (COD), total dissolved solids (TDS) , turbidity and nitrates decreased by 85.3%, 99.8%, 99.5% and 93.6% respectively through vermifiltration. Vermifiltration significantly decreased the dairy water physicochemical parameters compared to an ordinary bio-filter without earthworms.

1. INTRODUCTION

The dairy industry consumes considerable amount of water for its production processes, generating large volumes of effluents with high load pollution, which if not properly disposed or treated, can cause serious problems of environmental contamination. The wastewater treatment means the removal of the contaminants from any form of wastewater, includes physical, chemical and biological processes so that water can be reused. Typical process wastewater generated in dairy industry has BOD about 345 mg/L, COD - 1280 mg/L, TDS - 1500 mg/L, TS - 1963 mg/L and oil and grease concentration of 20 mg/L. All these components contribute largely towards their high biological oxygen demand (BOD) and chemical oxygen demand (COD). Dairy wastes are white in colour and usually slightly alkaline in nature and become acidic quite rapidly due to the fermentation of milk sugar to lactic acid.

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 its characteristics as well. It generates about 0.2–10 litres of effluent per litre of processed milk with an average generation of about 2.5 litres of wastewater per litre of the milk processed. Dairy processing effluents are generated in an intermittent way and the flow rates of these effluents change significantly. The volume, concentration, and composition of the effluents arising in dairy industry are dependent on the type of product being processed, the production program, operating methods, design of the processing plant, the degree of water management being applied, and subsequently the amount of water being conserved. These dairy industries generate different types of waste including: wastewater from the production line (cleaning of equipment and pipes) cooling water, domestic wastewater, the acid whey and sweet. Due to this 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.

All these components contribute largely towards their high biological oxygen demand (BOD) and chemical oxygen demand (COD) which is much higher than the specified limits of Indian standard institute (ISI), now Bureau of Indian standard (BIS), for the discharge of industrial effluents. As these wastes are generally released to the nearby stream or land without any prior treatment are reported to cause serious pollution problems. Dairy effluents decompose rapidly and deplete the dissolved oxygen level of the receiving streams immediately resulting in anaerobic conditions and release of strong foul odours due to nuisance conditions. The main environmental problems related to milk production affect the pollution of water, air and biodiversity. They often cause a growth of algae and bacteria that consume oxygen in the water and eventually suffocate the rivers leading to the gradual disappearance of fish. Hence the need to treat dairy effluents by various processes

2. MATERIALS AND METHODOLOGY

The dairy wastewater sample was collected from a Hassan Dairy Industry, Karnataka. In this study, jackfruit seed, earthworms and wetland plants are used. *Eisiena Fetida* commonly known as Tiger worm earthworms species are used and was collected from Krushi Vignana Kendra, Hassan. Wetland plant Cyprus rotundus was collected from the farm nearby Hassan.

2.1 Natural Coagulation Treatment

Jackfruit seeds (Artocarpus Heterophyllus) were collected from households and was boiled and sundried for 48 hours. Then the seeds were grained to fine powder in grinding mills. The powder was sieved using 0.45 mm mesh and was stored in an airtight container to prevent the entry of moisture into it and to avoid loss of its activity. The fine powder was used as coagulant in solution form for analysis.

Fig 1: Preparation of coagulant

Coagulation and flocculation are the most common method used for the removal of turbidity, colour, suspended matters, microorganisms and other odour producing substances. It involves the addition of coagulants that brings together the small destabilised particles to form large flocs so that they settle under the force of gravity and can be easily separated from the water. Jar test apparatus was selected for coagulation – sedimentation. Jackfruit seed coagulant was fed to the respective samples in varying dosages. Initially rapid mixing was carried out for 2 minutes at 100 rpm followed by slow mixing for 25 minutes at 20 rpm. The sample after coagulation was allowed to settle for 30 minutes. The supernatant obtained was filtered and its characteristics (turbidity) were determined.

Fig 2: Jar test

2.2 Vermi Biofiltration Treatment

This secondary treatment was carried out using vermin bio filtration unit having dimensions of 45cm X 30cm X 35cm . The vermi biofiltration unit was filled with a layer of gravel, sand and a layer of loamy soil. Provision has been made to collect the filtered water at the bottom of the filtration unit. The bottom most layer is made up of gravel aggregates of size 10-15mm dia upto 50mm high above which a layer of gravel of size 5-7 mm dia upto 50mm high above which a layer of coconut coir upto 50mm high above which is a layer of sand upto 50 mm and top layer consists of loamy soil along with earthworms, wetland plants and small quantity of partially decomposed cow dung.

The dairy wastewater is sprinkled through the pipe network for 3 hours with the help of the pump to attain uniform distribution of wastewater on vermifiltration bed and allowed to retain for 9 hours. Wastewater percolated down through different layers of bed and the final effluent was collected from the bottom of the filtration unit after 24 hours. The vermin biofiltration unit was allowed for drying for 24 hours and then the 2nd cycle was carried out.

Fig 3: Experimental set for vermi biofiltration treatment

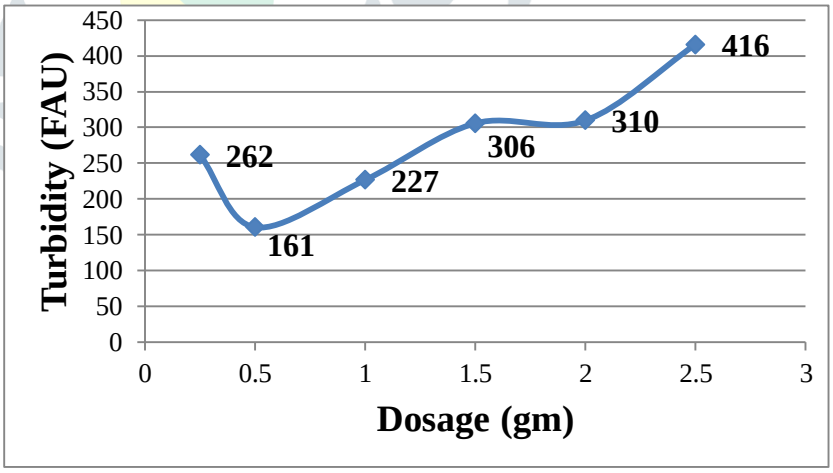
3. RESULTS AND DISCUSSION

3.1 Raw Wastewater Characteristics

Sl no.	Parameter	Result
1	pH	6.82
2	TDS	1488 gm/l
3	Turbidity	3795 FAU
4	Nitrate	84 mg/l
5	Alkalinity	688 mg/l
6	Acidity	622 mg/l
7	COD	1672 mg/l

3.2 Natural Coagulation Treatment

Beaker	Dosage (ml)	Turbidity (FAU)
1	0.25	262
2	0.5	161
3	1	227
4	1.5	306
5	2	310
6	2.5	416



3.3 Vermi Biofiltration Treatement

3.3.1 First cycle of vermi bio filtration

Sl no.	Parameter	Result
1	TDS	3.13 gm/l
2	Turbidity	22 FAU
3	Nitrate	8.6 mg/l
4	COD	311 mg/l

3.3.2 Second cycle of vermi bio filtration

Sl no.	Parameter	Result
1	TDS	2.94 gm/l
2	Turbidity	18 FAU
3	Nitrate	5.3 mg/l
4	COD	245 mg/l

4. CONCLUSION

In this study we mainly analysed the turbidity removal efficiency of jackfruit seed powder in the first stage of treatment. Turbidity reduction of 95% at an optimal dosage of 5 ml/l was achieved. In the secondary treatment Results showed that vermifilter achieves good performance; the results were better than conventional wastewater treatment. The vermifilter treatment was cost effective, 60 to 70% of cost reduction is possible, odor free with the good efficiency of removal of parameter COD, TDS and nitrate were reduced by 85.4%, 99.8%, and 93.6% respectively. There is no sludge formation in this process instead of that vermi compost was formed which can be used as fertilizer. The vermifiltered water is most suitable for irrigation purpose but would require further treatment for other uses.

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