

PERFORMANCE EVALUATION OF DIPHASIC FIXED BED FIXED FILM ANAEROBIC REACTOR FOR TREATING DAIRY EFFLUENT

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Key words : Diphasic digester, Microbial support media, COD, VLR.

ABSTRACT

In any dairy plant, the quantity and characteristics of effluent is depending upon the extent of production activities, from chilling to pasteurization and to several milk products. The application of anaerobic digesters in the first phase of treatment, which is followed by high rate aerobic treatment, remains as the most common effluent treatment scheme for dairy plants. The two phased digester plants viz . Acetogenic and Methanogenic digesters with microbial support media is the recent trend for optimized COD removal for 70-75%. The present study evaluated a laboratory model having a Diphasic digester (38 liters of effective volume) for treating dairy effluent. The model was run for different combinations of synthetic influent COD, mg/L (8000, 8996, 9956, 10976 and 11981) and Flow rate, m³/day (0.006, 0.012, 0.024, 0.036 and 0.048) . The maximum % COD removal efficiency was observed at 71.5 % for a VLR of 14.5 Kg COD/m³ day The kinetic parameters are estimated using the experimental data and a linear regression model is proposed to simulate the performance of the of a hybrid, Diphasic digester.

INTRODUCTION

In recent times, the production of processed milk is raised to 200 million tons per annum, in India. . About 0.9 to 3 L of water (per L of milk) is required for washing and cleaning operations. The effluent is generated at the rate of 1 to 3 L per liter of milk processed. The high COD effluent stream requires anaerobic treatment systems.

The Diphasic digester, with modified form of having installed with microbial growth media, is experimented with dairy effluent for system evaluation studies and estimation of kinetic constants.

EXPERIMENTAL SETUP

The experimental setup consist of a Diphasic di-

gester reactor having effective reactor volume of 0.03843 m³ (38.43 L) The physical features and process parameters of the experimental model, are listed in Table 1. The schematic of the experimental set up is shown in Fig. A.

EXPERIMENTAL METHODOLOGY

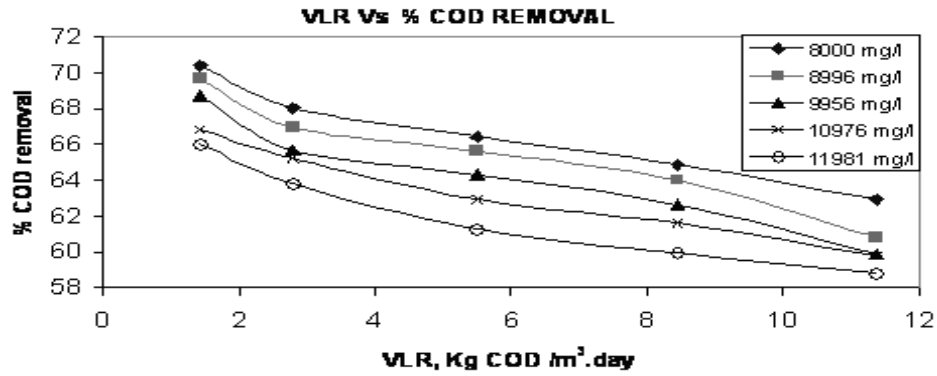
The experiment was initiated using domestic wastewater. The reactor was observed to attain the steady state conditions after 60 days with an average COD removal of 60%. Three random samples were obtained from M/s. Hatsun Agro Industries Private Ltd., Kari Patti, Salem district, Tamilnadu and were analyzed for specific parameters.

The real time wastewater was introduced in reactor with an overall average VLR of 6.50 Kg COD/m³

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Table 1. Physical features and process parameters of experimental model Reactor type: *Diphasic anaerobic digester*

Specifications	Acetogenic Reactor	Methanogenic Reactor
Reactor volume, m ³	0.0113	0.0314
Reactor diameter, m	0.12	0.20
Reactor height, m	1	1
Height of biomass support media fill, m	0.4	0.45
Influent pipe diameter, m	0.006	0.006
Sample ports (from bottom of the reactor)		
S1	0.17	0.12
S2	0.4	0.4
S3	0.65	0.65
Reactor Volume, m ³	0.00452	0.01413
Specific area of the fill, m ² /m ³	500	350



day and in stages, mixed with domestic wastewater, in proportion of 20%, 40%, 60% and 100%. The performance of the reactor was studied and the steady-state conditions were observed to attain with COD reduction for an average value of 65 % after 30 days. The synthetic dairy effluent is prepared using milk powder (Amulya brand) and introduced after the process stabilization. The model reactor was operated under different conditions

I) Volumetric Loading Rates: In A.R. : 4.77 to 55.908 Kg COD/m³.day
 In M.R. : 1.279 to 16.614 Kg COD/m³.day
 Overall : 1.26 to 14.81 Kg COD/m³.day

II) Average influent COD, mg/L : 8000, 8996, 9956, 10976, 11981.

III) Hydraulic Retention Time (HRT), hrs.

Acetogenic reactor : 40.713, 20.356, 10.178, 6.785 and 5.089.
 Methanogenic reactor : 113.09, 56.548, 28.274, 18.849 and 14.137

METHANOGENIC REACTOR ACETOGENIC REACTOR

RESULTS AND DISCUSSIONS

Fig. 1 shows the maximum COD removal as 74.8 % at a HRT of 153 hours for a VLR of 4.937 Kg COD/m³.day
 Fig. 2 shows the maximum COD removal as 71.5 % at a VLR of 1 Kg COD/m³.day
 Fig. 3 shows the maximum yield of bio-gas at 0.325 m³/kg COD removal at 10 Kg COD/m³.day of VLR

CONCLUSION

The Modified Diphasic digester is found to treat dairy waste water for a maximum COD removal of 71.5% and 0.325 m³ of gas production/kg COD removed. Hence Diphasic digester can be used for removing COD up to 75% and the rest can be removed in the down stream aerobic systems, more effectively and economically

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