Nature Environment and Pollution Technology
An International Quarterly Scientific Journal

ISSN: 0972-6268	Vol. 11	No. 2	pp. 325-328	2012

Original Research Paper

Biokinetic Effect of Hydraulic Retention Time on Dairy Wastewater Using Anaerobic Biofilm Reactor

M. S. Sivakumar and B. Asha
Department of Civil Engineering, Annamalai University, Annamalai Nagar-608 002, T. N., India

Nat. Env. & Poll. Tech.
Website: www.neptjournal.com
Received: 12/12/2011
Accepted: 16/1/2012

Key Words:
Anaerobic biofilm reactor
Dairy wastewater
Biokinetic effect

ABSTRACT

Application of biofilm reactor containing mixed population of bacteria helps in bacterial immobilization as biofilm on a support medium in the reactor overcoming the problem of biomass washout. The characteristic of hydrodynamics behaviour is to help in better understanding and evaluating the performance of the reactor. After the start-up period, the experiment was conducted at five different hydraulic retention times (HRT) of (3.00, 1.50, 1.00, 0.75, 0.60) days. The COD reduction efficiency was observed from 66% to 84%. The average quantity of biogas generation (0.0238, 0.028, 0.0326, 0.0372) m^3/kg COD was also observed.

INTRODUCTION

In biological wastewater treatment, the experiment performance was influenced by the hydrodynamic behaviour since it has contact between the substrate and the microorganisms and controls the mass transfer. The dairy industry requires large quantity of water for the purpose of washing cans, machinery and floor, therefore, producing the liquid waste from process, utilities and service sections (CPCB 1997). The water management in the dairy industry is well documented (Berg VanDen & Kennedy 1983) but effluent production and disposal remain a problematic issue for the industry. The completely mixed thermophilic digesters were proposed in Oregon to treat dairy manure (Tillamook 1999). The study presents utilization of dairy effluents through anaerobic technique and biogas from dairy effluent.

For water conservation in dairy industry, an efficient and cost effective treatment technology has to be developed. The anaerobic biofilm reactor offers a unique treatment option to dairy industry. The advantage of energy recovery in the form of methane and up to 95% of the organic matter in a waste streams can be converted in to biogas (Michal et al. 1995). This design was successfully used to treat landfill leachate and baker's yeast factory effluent. Landfill leachate and yeast effluent both have high COD concentration and both are difficult to degrade biologically. On the other hand, dairy effluents are fairly easily biodegradable, since they consist mainly of diluted dairy products. Thus, the aim of this study was to evaluate the use of anaerobic digester (fixed film fixed bed) in the treatment of a dairy effluent and to study the kinetics of the parameters (Hamzawi et al. 1998). The biofilm microbial support system in the reactor with attached growth performed well with much more process stability.

MATERIALS AND METHODS

The experimental set up consists of anaerobic biofilm reactor having an effective volume of 13.0 litres. The reactor was made up of acrylic Plexiglas randomly packed with the solid support media consisting of PVC rings namely *Fugino spirals* of 19 mm diameter, 1mm thickness and 15mm height prepared from PVC pipe. The packing media has several advantages as it is light, durable, easy to install, inexpensive and has high porosity to prevent clogging by the increased biomass. The *Fugino spiral* was packed in the reactor at a height of 50cm . The spirals are randomly packed in the reactor to avoid flow tortuosity and other physical factors. The reactor was continuously fed with diluted dairy wastewater from the influent tank by means of a peristaltic pump. The % COD reduction and biogas generation were continuously measured by water displacement method in the reactor. The physical features and process parameters are presented in Table 1. The schematic of the experimental set up is shown in Fig. 1.

The real time effluent was collected from M/s Aavin Chilling Plant Ltd., Villupuram. The experiment was operated for five different influent COD levels (3620, 4060, 4300, 4570, 5200 mg/L) of dairy wastewater, treated with five different hydraulic retention times (HRT) (3.0, 1.50, 1.00, 0.75, 0.60) days.

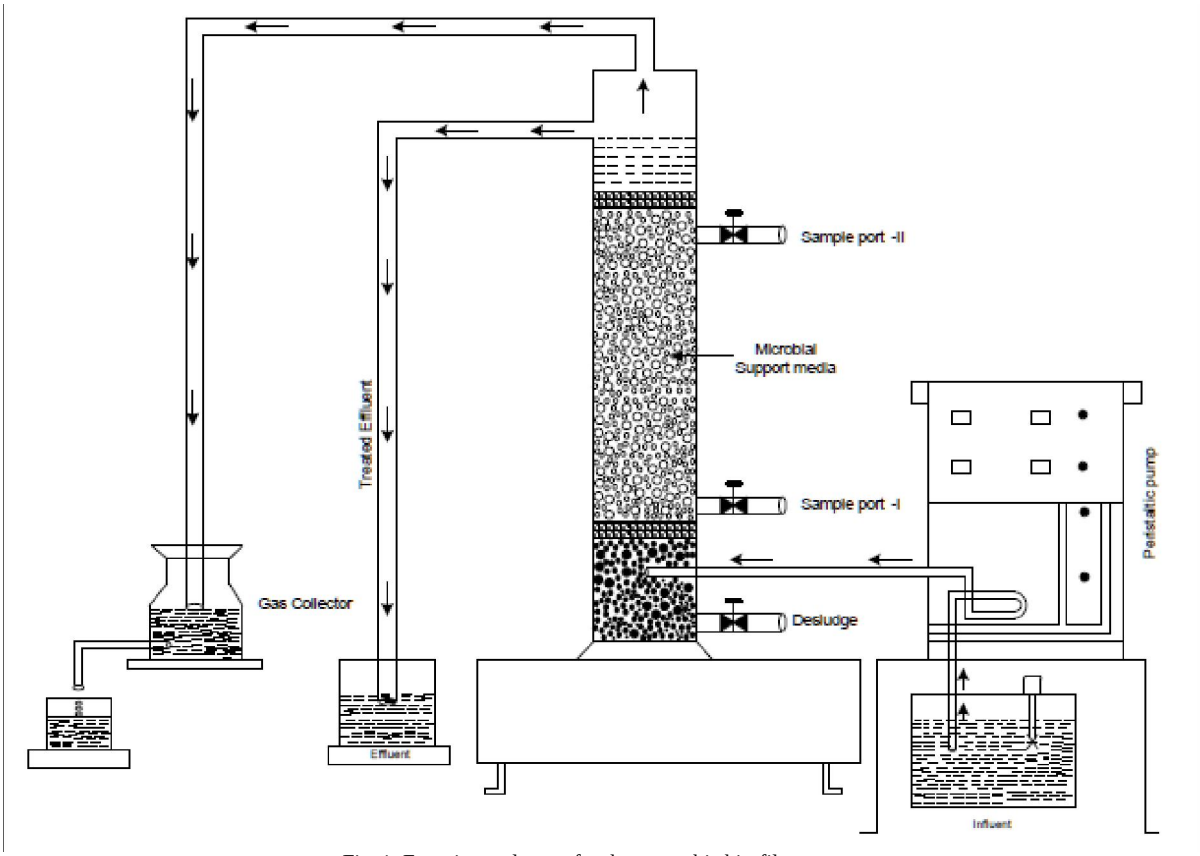

Fig. 1: Experimental setup for the anaerobic bio-film reactor.

Table 1: Physical features and process parameters of experimental the model.

Reactor volume, L	:	13
Reactor height, cm	:	125
Reactor diameter, cm	:	12
Height of the biomass support media fill, cm	:	50
Diameter of the influent and effluent pipes, cm	:	0.6
Sample ports from the bottom of the reactor, cm S1S2	:	2045
Influent average COD, mg/L	:	3620, 4060, 4300, 4570, 5200
Hydraulic Retention Time, days	:	3.00, 1.50, 1.00, 0.75, 0.60
Peristaltic Pump (Miclin's make)	:	PP 10 model

RESULTS AND DISCUSSION

The attached growth microbial reactor was continuously fed with diluted real time dairy wastewater with an influent flow rate of 0.18, 0.36, 0.54, 0.72, 0.90 L/daywith varying HRTs. To increase the flow rate from 0.18 L/day to 0.90 L/day at an average value of COD concentration of 3620, 4060, 4300, 4570, 5200 mg/L and to retain the % COD removal efficiency of 66% to 84%. The maximum % COD removal efficiency of 84% was attained at an influent COD of 4500 mg/L with the corresponding flow rate of 0.18L/day at 3.0 days HRT. The maximum biogas of 0.048m^3/kg COD concentration was achieved at an influent flow rate of 0.18 L/day at 3.0 days HRT with an influent COD concentration of 5250 mg/L. The % COD removal efficiency for the dairy wastewater under varying HRTs is shown in Fig. 2. The biogas removal efficiency for treating dairy waste under varying HRTs is presented in Fig. 3.

CONCLUSION

The present study reveals that the biogas production and the % COD removal efficiency of dairy waste using an anaerobic biofilm reactor can be successfully achieved. The reactor was

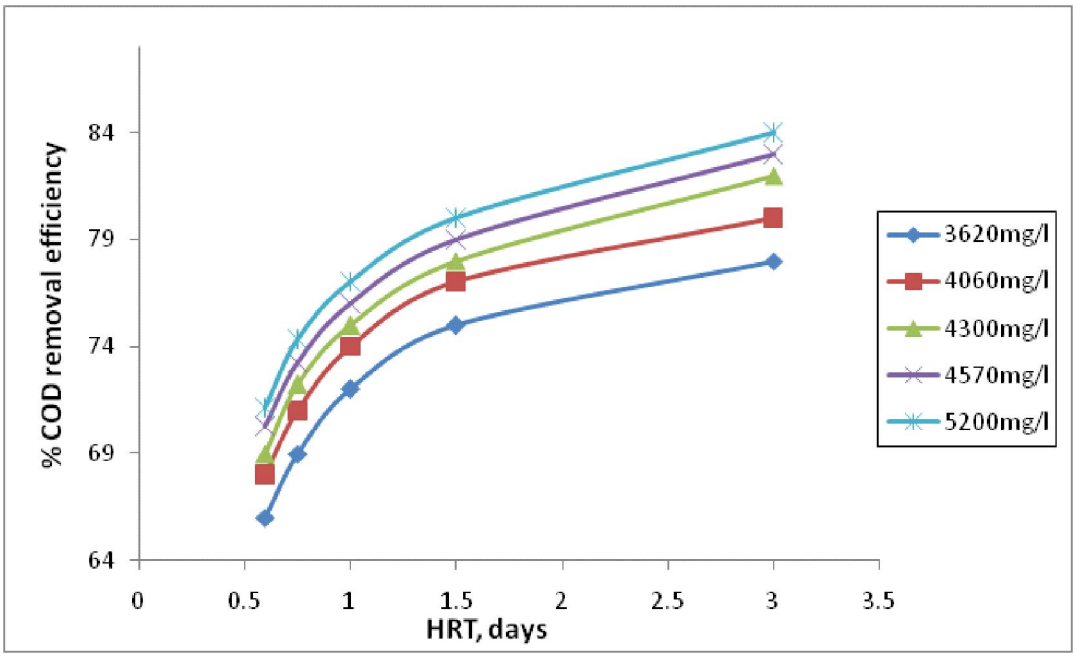

Fig. 2: HRT Vs % COD removal efficiency.

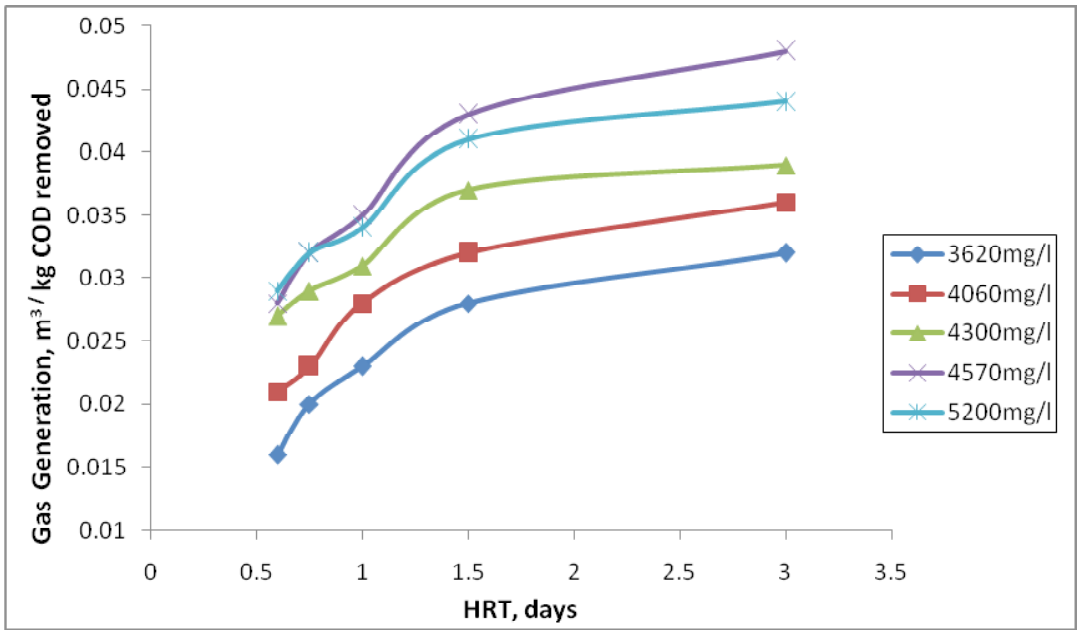

Fig. 3: HRT Vs gas generation.

run by the diluted high strength dairy wastewater at a maximum COD removal efficiency of 84% with HRT of three days. The maximum biogas of 0.048m^3/kg COD production was achieved at influent COD of 5250 mg/L with HRT of three days.

ACKNOWLEDGEMENT

The authors are thankful to the authorities of Annamalai University for having permitted to carry out this research work in the University.

REFERENCES

Berg Van den, L. and Kennedy, K.J. 1983. Dairy waste treatment with anaerobic stationary fixed film reactors. Water Science & Technology, 15(8-9): 359-68.

CPCB 1997. National inventory of large and medium industry and status of effluent treatment and emission control system. Programmed Objective Series PROBES/68/1997-98). Central Pollution Control Board, New Delhi, pp. 411.

Hamzawi, N., Kennedy, K. and Mclean, D. 1998. Anaerobic digestion of co-mingled municipal solid wastes and sewage sludge. Water Science Technology, 38: 127-132.

Michal, P., Shlomo, K. and Gedaliah, S. 1995. Some biochemical aspects of the anaerobic degradation of dairy industries. Water Research, 29: 1549-1554.

Tillamook 1999. Anaerobic digester a success at dairy farm. Bio Cycle, 40 (3): 18.