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# A STUDY ON EFFECT OF VOLATAILE FATTY ACID ON ANAEROBIC BIO FILM REACTOR USING DAIRY WASTEWATER

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## ABSTRACT

**In recent decades the use of anaerobic biofilm reactor has been established for the treatment of different effluents. As the capability of retaining microorganisms was act as biofilm factor influencing the performance of this reactor. The present study aims to evaluating the effectiveness of treating a dairy effluent with high pollution potential. The effluent was analyzed with varying Organic Loading Rate (OLR) 0.1502, to 0.266 kg COD/ $m^3$/day, with an average value of Volatile Fatty Acid (VFA) of 172.8, 132.0, 193.0, 203.0and 172mg/L. The maximum COD removal efficiency of 84% along with production of 0.048$m^3$/kgCOD of biogas at 3 days Hydraulic Retention Time (HRT) was observed.**

## INTRODUCTION

The anaerobic digestion is a complex process in which organic matter is converted into a mixture of methane, and carbon dioxide. The overall conversion is carried out by a mixture of microorganisms through several biochemical reactions in and parallel (Henze and Harremoess, 1983). It is generally proved that, in case of non particulate substrate or non-excessively complex organic matter, the limiting setup is the conversion of Volatile Fatty Acid (VFA) into methane (Batstone *et al*., 2001). It is known that in the case of the anaerobic degradation of dairy wastewater (DWW) the limiting step is the hydrolysis of particulate sub-strates (Pavlostatis and Giraldo-Gomez, 1991) or the degrada-tion of the long-chain fatty acids, LCFA, to volatile fatty acids, (Hanaki *et al*., 1981). It is natural that flocculent sludge being predominantly acidogenic (Lettinga, 1996) will result in a better degradation of complex substrates, compared to granular sludge which is mainly methanogenic (Lettinga, 1996). Hwu (1997) verified that in expanded granular sludge bed (EGSB) reactors the bacteria that degrade LCFA to VFA were found in the fine biomass particles and not in granular aggregates. An alternative possibility would be the production of biogas in a second step of the anaerobic digestion. (Danesh and Oleskiewicz 1996) observed

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that activated sludge systems used for biological nutrient removal improve when fed with wastewater rich in volatile fatty acids (VFA). The reactor performance is usually evaluated in terms of process efficiency and stability through estimation of organic matter removal, VFA levels, quantity and composition of biogas produced, etc. However, little effort has been made to assess reactor biomass in terms of relative population levels of methanogenic species under varied operational environmental conditions.

## MATERIALS AND METHODS

The laboratory model consists of anaerobic biofilm reactor having a working volume of 13.0 liters. The reactor was made up of clear acrylic Plexiglas were sealed to avoid any air entrapment and filled with the solid support media, consisting of PVC rings namely *Fugino spirals*. It has 19mm out diameter, 1mm thickness and 15mm height prepared PVC pipe are randomly packed. And it is light, durable and easy to install, inexpensive and high porosity to present clogging by the increased bio mass. The material was packed in the reactor to avoid flow tortousity and other physical factor at a height of 50cm. The reactor was continuously fed with diluted real time dairy wastewater at the influent flow rate of (0.18, 0.36, 0.54, 0.72, 0.90L/day) by means of peristaltic pump with varies Hydraulic Retention Time (HRT ). The % reduction of Volatile Fatty Acid (VFA) was calculated and bio gas generation are 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 the Figure 1.

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

| | | |
|---|---|---|
| Reactor volume, liters | : | 13 |
| Reactor height, cm | : | 125 |
| Reactor diameter, cm | : | 12 |
| Height of the bio mass 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

The real time effluent was collected from M/S Aavin chilling plant Ltd., Villupuram, T.N India. The biofilm reactor was operated at five different average influent COD (3620, 4060, 4300, 4570, 5200 mg/L) of dairy wastewater, varying with five different Organic Loading Rate (OLR) 0.1502, 0.1706, 0.1798, 0.1912 and 0.266 kg COD/$m^3$/days.

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## RESULT AND DISCUSSIONS

The production and conversion of VFA with respect to OLR are presented in Figure (2). The levels of VFA concentration are recorded under different Hydraulic Retention Time (HRT) are presented in Figure (3). The biofilm reactor was operated for a maximum OLR of 0.3655 kg COD/$m^3$/day with a VFA of 125mg/L .The VFA concentration was increased with increase the Hydraulic Retention Time (HRT). The maximum COD removal efficiency attained at 84% for three days Hydraulic Retention Time. The biogas production was increased as a result of an increase in the concentration of VFA, the maximum biogas yield from the reactor was found 0.048of $m^3$/kgCOD removed. In this study the microbial growth, which simulate the production and conversion of VFA.

## CONCLUSION

The present study has been performed that the Volatile Fatty Acid and the % COD removal efficiency of dairy wastewater using an anaerobic bio film reactor was successfully achieved. The reactor was run by the diluted high strength real time dairy wastewater at a maximum COD removal efficiency of 84% with Hydraulic Retention Time of three days. The maximum Volatile Fatty Acid (VFA) 240/mg/L, and the maximum influent COD 5250mg/L with Hydraulic Retention Time of three days.

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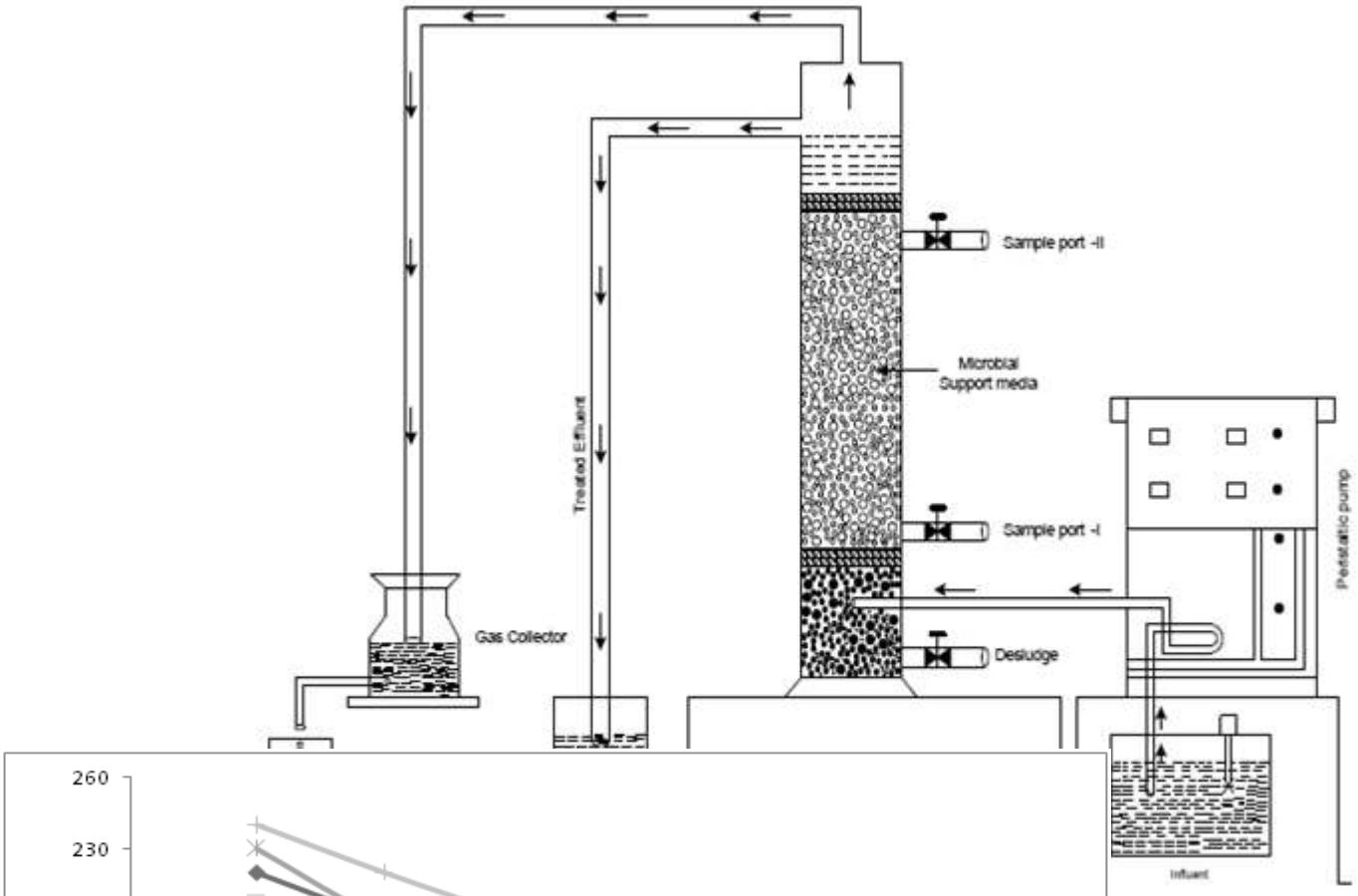


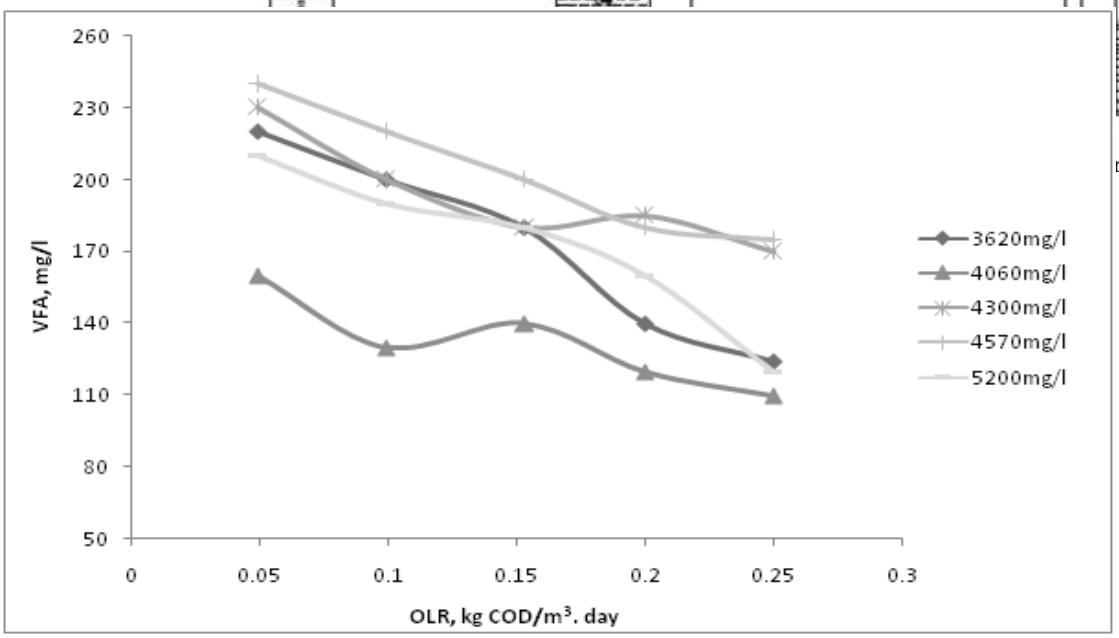


**Fig. 2** OLR, kg COD/$m^3$. days Vs VFA, mg/L

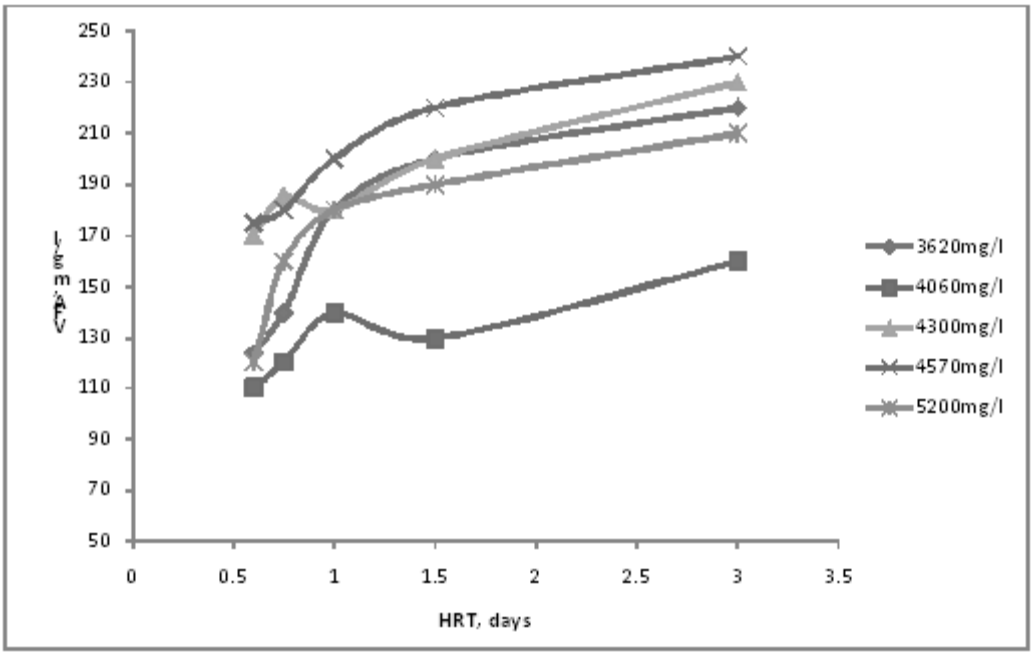


**Fig. 3** HRT, days Vs VFA, mg/L

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