INFLUENCE OF pH CONDITION ON THE PERFORMANCE OF FIXED FILM FIXED BED REACTOR IN DAIRY WASTEWATER

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ABSTRACT

Dairy plant wastewater are generally high strength waste containing soluble colloidal and suspended solids with high concentration of organics and therefore requires proper treatment prior to discharge. The objective of this study is to identify the condition of pH in the dairy wastewater. pH is an important parameter which, influenced the performance of the reactor. An experimental model was designed and conducted to study with respect to the interpretation of data. The reactor was allowed to operate at an OLR of 0.073 kg COD/m3.d with a HRT of 5.34 days attained COD removal was 83.75%.

INTRODUCTION

Dairy is one of the industries producing wastewater rich in organic matter and thus leading to creation of odorous and high COD containing wastewater. Waste management in dairy industry is well documented but suitable disposal of effluents in wastewater remains a challenging issue for dairy industry. Anaerobic treatment of organic fractions of agro-industrial wastewater is an attractive process in sustainable approach in large quantities of milk and constituents such as casein, lactose, fat, Inorganic salt, besides detergents and sanitizer used for washing (Kolhe *et al.*, 2009).

Thorat and Wagh (1999) observed the pH of the sludge sample was 8.4. Rao *et al.*, (1993) observed the pH of textile industry effluent varied from 11.0 to 8.0. Kolhe *et al.*, (2008) recorded the pH of sugar industry untreated effluent in the month of November was 6.5 and that of treated is 7.5. Dairy industry needs large volumes of water for various purposes and discharged from a dairy is also equally large in volume with highly variable pollution characteristics. The present study was undertaken to explore the influence of pH conditions on the performance of the digester.

MATERIALS AND METHODS

In the present study an experimental model of fixed film fixed bed reactor was constructed to conduct an experiment for simulated, real waste streams of dairy to evaluate the treatment efficiency under varying experimental conditions. The laboratory model consists of anaerobic fixed film fixed bed reactor having a working volume of 13.0 liters .The reactor was made up clear acrylic plexiglas were sealed to

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avoid any air entrapment and filled with the solid support media, consisting of PVC rings namely Fugino spirals. It was 19 mm out diameter, 1mm thickness and 15 mm height prepared PVC are randomly packed .And it is light , durable and easy to install, inexpensive and high porosity to present clogging by the increased biomass. The material was packed in the reactor to avoid flow tortousity and other physical factor at a height of 50 cm .The reactor was continuously fed with diluted real time dairy wastewater at an influent flow rate of (0.43, 0.86, 1.20, 1.72, 2.16 L/day) by means of peristaltic pump with respect to the Hydraulic Retention Time(HRT). various form (1.87, 2.08, 2.88, 3.74 and 5.34 days). The physical feature and process parameters are presented in Table 1. The schematic of the experimental set up is shown in Figure 1.

Table 1. physical feature and process parameters of experimental model

Reactor volume (liters)	13
Reactor height (cm)	125
Reactor diameter(cm)	12
Height of 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)	
S1	20
S2	45
Influent average COD,(mg/L)	096,2568,2824
Hydraulic Retention Time (days)	1.87,2.08,2.88, 3.74,5.34
Peristaltic pump (Miclin's make)	PP 10 model

The model was designed to have a fixed film fixed bed reactor with a working volume of 13litres. The influent feed was envisaged through a Peristaltic pump which can pump at 0 to 500 CFCC/hour.

The treatment process acclimation was achieved by operating the plant with screened sewage drawn from the treatment facilities of Annamalai University. Seeded properly with an active anaerobic sludge from the treatment facility of "Hatsun Agro Industries Salem". The physical characteristics of the parameter were analysed by Using procedure from standard methods APHA(1992) and tabulated in Table 2.

RESULTS AND DISCUSSION

After achieving the stabilization of biochemical fermentation process, the dairy wastewater was introduced into the reactor to evaluate the performance of the reactor. The dairy wastewater was introduced with a flow rate of 0.43 L/day to the reactor by the gradual addition of domestic sewage such as 20%, 40%, 60%, 80% and 100%. After allowing the dairy wastewater at 100% concentrations, the COD removal was monitored.

The characteristics curves were drawn for the influence of pH with respect to Hydraulic Retention Time (HRT) as shown in Figure 2 . The HRT was gradually increased between 1.87 to 5.34 days with an average COD of 2096 to 2824 mg/L , which is shown in the Figure 2 and the maximum COD removal was achieved at 83.75% at a HRT of 5.34 days.

The results showed that COD was effectively removed at pH of 7.70 to 6.70 with higher concentration COD of 3200 mg/L, the results also indicated that the removal efficiency of COD was raised from 61.22% to 83.75% which influences the pH condition of the reactor. The influent pH was from 7.6 to 8.76, which was in alkaline condition and it was strongly influenced the biodegradation of the reactor (Fig. 2). Initially at HRT of 1.87 days and OLR of 0.054 kg COD/m^3 d, the COD removal was 62.70% finally at

Table 2. Characteristics of Dairy Waste Stream

S. No.	Parameters	Sample -1	Sample - II	Average
1.	pH	6.62	6.75	6.68
2.	Total Suspended Solids, mg/L	560	590	575
3.	Total Dissolved Solids, mg/L	2380	2560	2470
4.	Total Volatile Solids, mg/L	2310	2160	2235
5.	Total Fixed Solids, mg/L	850	910	880
6.	Total Solids, mg/L	2940	3150	3045
7.	BOD_5 @ 20°C, mg/L	2180	1950	2065
8.	COD, mg/L	3160	3360	3260
9.	Nitrogen, (as N) mg/L	17	17.60	17.30
10.	Phosphorus, (as P) mg/L	15	14.30	14.65

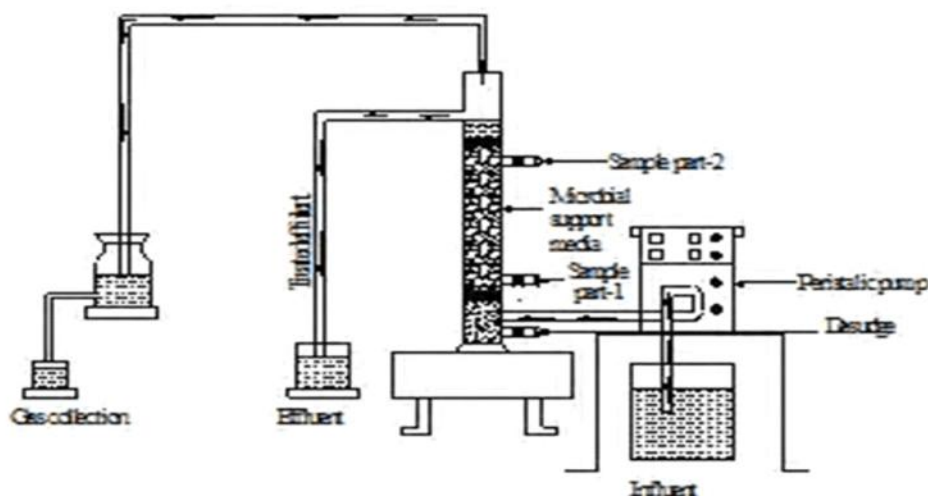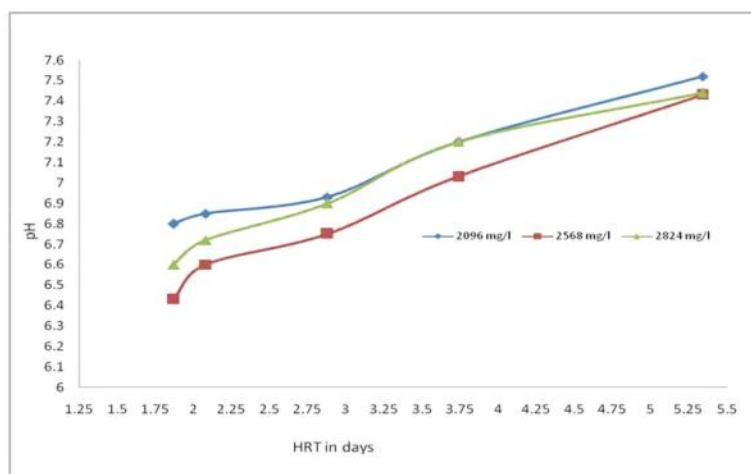**Fig. 1** Experimental set up for anaerobic fixed film fixed bed reactor

Fig. 2 HRT in days Vs pH

5.34 days and OLR of 0.073 kg COD/m³ d, the COD removal efficiency was achieved at 83.75%.

CONCLUSION

The results obtained was shown that the pH influent influences the performances of the biodegradation process and the efficiency was higher for the operation with dairy wastewater as an influent .The reactor was allowed to operate at an Organic Loading Rate of 0.073 kg COD/m3/day with an Hydraulic Retention Time of 5.34 days with a maximum COD removal of 83.75%. The rate of collision of aggregated process is also influenced by pH in the dairy effluent. The COD

removal efficiency was highly influenced by the pH conditions of the wastewater .The greatest efficiency of substrate removal of 83.75% with an alkaline influent pH of 8.30 to 7.52. Therefore, the operation with an alkaline influent implicates maximum levels of purifying efficiency for highest organic content such as dairy wastewater.

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