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Evaluation of Anaerobic Fluidized Bed Reactor for treating Sugar mill effluent - a Case Study

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ABSTRACT
Anaerobic treatment processes are credible options for providing sustainable treatment to biodegradable waste streams. The Anaerobic Fluidized Bed Reactor (AFBR) is an evolving process that requires waste specific design methodologies based on kinetics of the specific process. The research was precisely an experimental study on AFBR having23.56 litres of effective volume to evaluate its treatment performance and gas recovery in terms of Chemical Oxygen Demand (COD), Hydraulic Retention Time(HRT)and Organic Loading Rate (OLR). The synthetic sugar influent COD was variedfrom 1500 to 4000 mg/lit. The OLR for the operating flow rates were ranged from 1.36 to 28.8 Kg COD/m^3.day for HRT varied from 3.2 to 24 hrs. The maximum COD removal efficiency is 90.06 at an operating OLR of 3.42 Kg COD/m^3.day. The maximum biogas yield was observed at 0.28 m^3/kg COD removed.
Keywords – AFBR, COD, HRT, OLR, INFLUENT

I. INTRODUCTION

Biodegradable industrial Waste streams are gaining importance as alternate and non-conventional energy sources. Anaerobic digestion of dissolved organics into biogas is one of the best options in waste to energy strategies. The use of biogas back in the source industry will make it further attractive and more purposeful to justify the capital investment for establishing waste treatment facilities.

Among the prominent industrial waste streams which are biodegradable and with more of dissolved organics, agro based industries like sugar are more significant in India. The waste streams from these industries are high COD and biodegradable in nature with requisite nutrients for anaerobic biodegradation. Perhaps, the seasonal nature of these industrial operations made the anaerobic degradation as less popular in all these years. However, recent methods with more engineered systems, it has now gaining importance that we use these streams as sources for energy.

Anaerobic Fluidized bed reactor (AFBR) is rated more effective by virtue of its complementing components of both suspended and attached growth microbial systems. The present study was envisaged as an experimental work to evaluate the performance of AFBR for treatment and as well to recover energy from sugar waste streams.

II. EXPERIMENTAL SET UP

The experimental set up on AFBR for an effective volume 23.56 lit with functional components like peristaltic pump (1 to 15 lit/hr), wastewater tank, treated effluent collection tank, water displacement assembly for gas measurement and effluent sampling ports in the reactor.

The schematic of the experimental set up is presented in **Fig 1.1.**

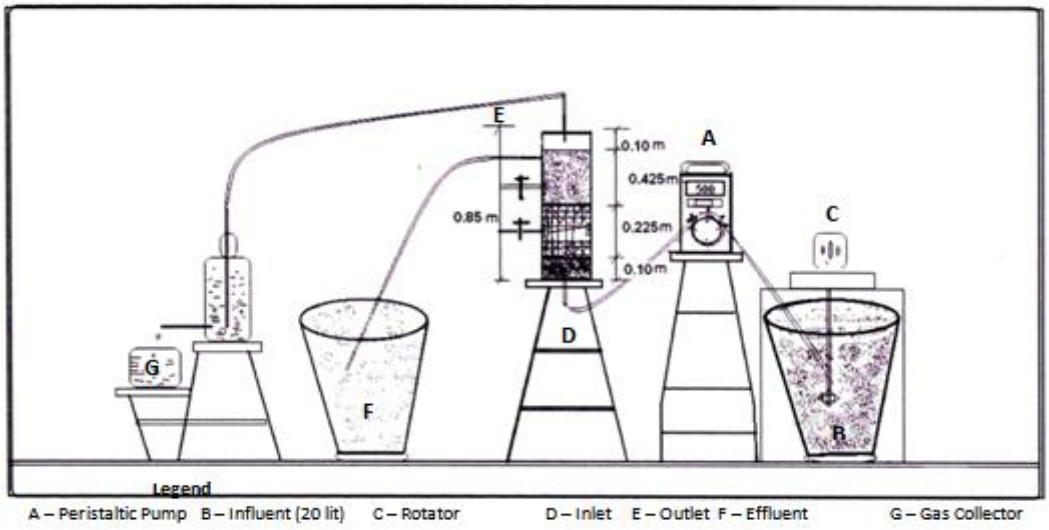

Fig 1.1schematic of the experimental set up

The Model was designed empirically to test run a specified flow range of influent (1 to 7.5 lit/hr) which will have HRT of 3.2 to 24 hrs.

III. EXPERIMENTAL METHODOLOGY

The experiment was started with stabilization of digestion process in the reactor using domestic wastewater. The reactor was observed stabilized over 31 days with COD removal varies from 72-75% for the influent average COD of 640 mg/l .

The sugar effluent was sampled from an industry on three different and varied conditions and time. The characteristics were used for formulating the composition of synthetic preparation of sugar waste water. The experiment was run using synthetic stream of sugar wastewater.

The experiment was run for two different operational parameters viz., influent flow rate (1,2,4,5,6 and 7.5 lit/hr) and Influent COD (1500,2000,2500,3500 and 4000 mg/l). Under the actual operating conditions and influent characteristics, the organic loading rate is interpreted and found to vary from 1.36 to 28.8 Kg COD/m3.day.

IV. RESULTS AND DISCUSSION

The comprehensive results of the experiments for its full run have been evaluated in terms of % COD removal and gas generation m^3/Kg COD removed.

The experimental results for influent and effluent COD, % COD removal, OLR versusv_s % COD removal and biogas generation in all operating conditions.

The results are graphically presented. The HRT versus % COD removal were presented in Fig 1.2. The OLR versus % COD removal were presented in **Fig 1.3.**The biogas generation versus Kg COD removed were presented from **Fig 1.4**. The HRT versus Gas conversion is presented in **fig 1.5**

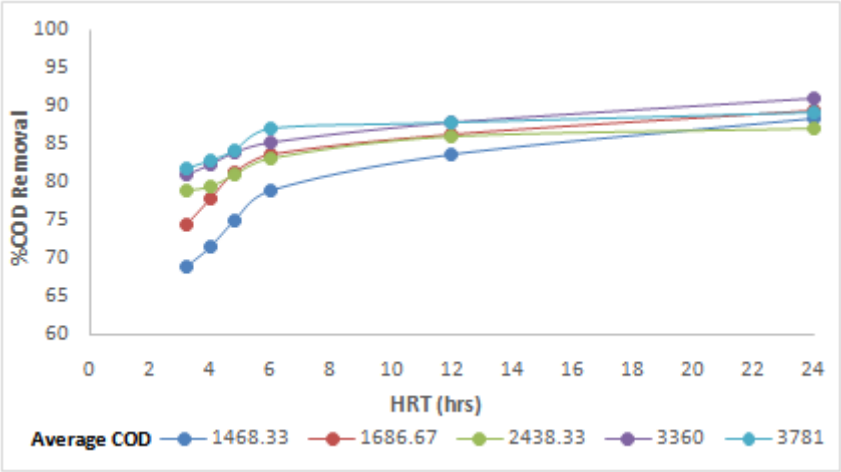

Fig 1.2 HRT Vs % COD removal

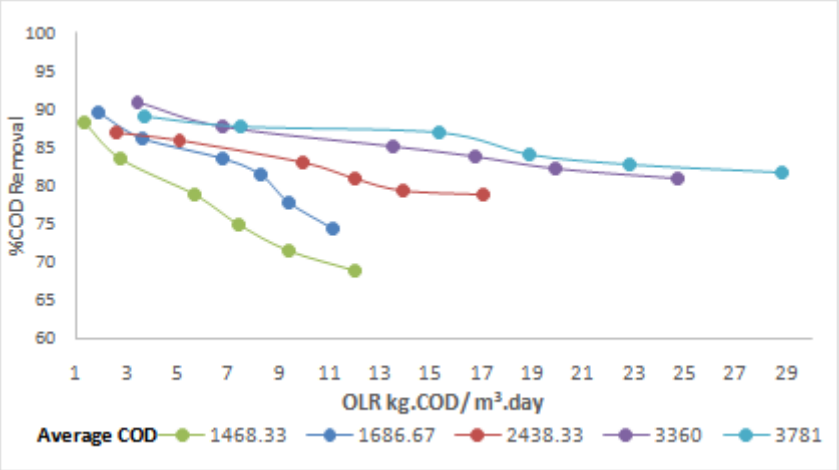

Fig 1.3OLRVs % COD removal

The maximum % COD removal was observed for 28.80 Kg COD/m^3.day and for an HRT of 3.2 hrs. The maximum biogas generation was observed for Kg COD removed at 0.28 m^3 and for an HRT of 24 hrs.

The minimum % COD removal was observed for 1.36 Kg COD/m^3.day and for an HRT of 24 hrs. The minimum biogas generation was observed for Kg COD removed at 0.20 m^3 and for an HRT of 3.2 hrs.

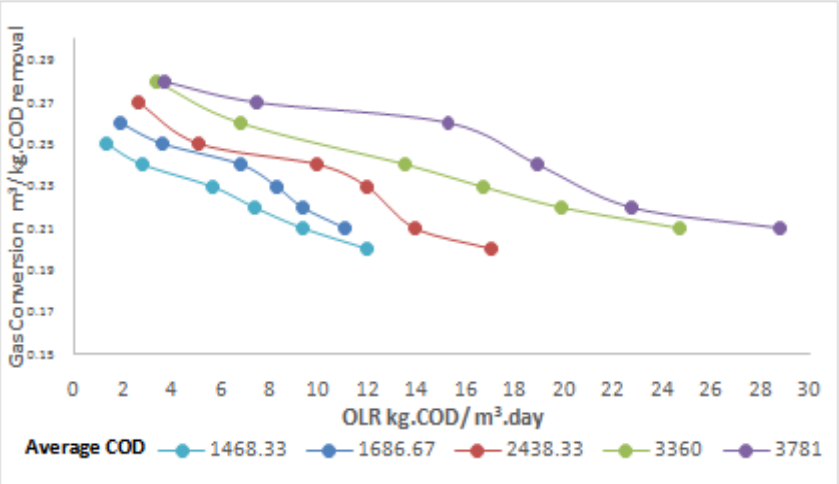

Fig 1.4OLRVs % GasConversion

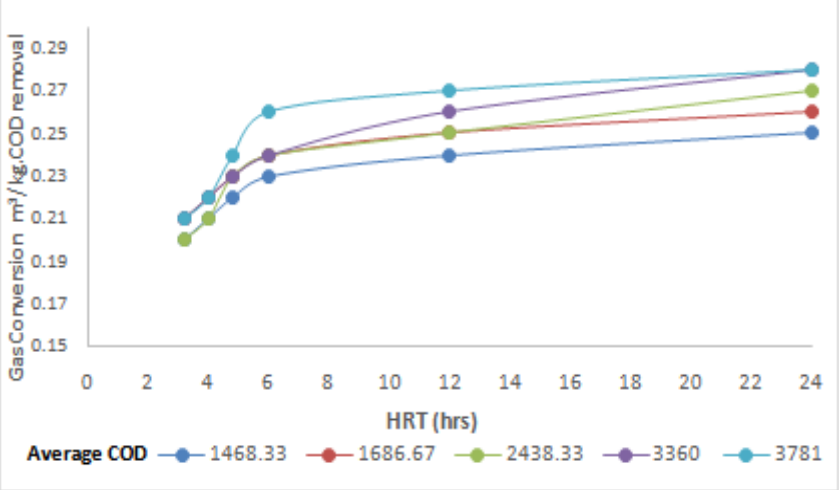

Fig 1.5HRTVs % GasConversion

V. CONCLUSION

The maximum % COD removal of 90.06 % was observed for the applied OLR of 3.42 Kg COD/m^3.day in a HRT of 24 hrs is an encouraging aspect to qualify anaerobic fluidized reactor for the treatment of Sugar industrial effluent.

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