EVALUATION OF DIGESTION PARAMETERS IN AN INTEGRATE ANAEROBIC BAFFLED REACTORFOR TREATING INSTITUTIONAL WASTEWATER

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Abstract

The present study was to investigate a laboratory scale integrated anaerobic baffled reactor (IABR) using institutional wastewater with eight hydraulic retention time (HRT) of 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 5.0 and 6.0 days for the degradation of organic pollutants. Six sets of an average influent Chemical Oxidation Demand (COD) of 888, 768 and 656, 1064, 1168 and 1304 mg/l were carried out for the experimental investigation. The maximum COD removal efficiency obtained was 94.37% with an OLR of 0.540 kg COD/m^3.dat a HRT of 3.0 days with the addition of co substrate.

keywords: Chemical Oxidation Demand, Hydraulic Retention Time, Integrate Anaerobic Baffled Reactor, Organic Loading Rate, Volatile Fatty Acid.

1. INTRODUCTION

Water pollution becomes one of the chief concerns of civilized society; the more a society moves towards advancement the more it prone to pollution of water. Domestic, institutional and industrial discharge of water, without proper treatment into the environment causes water pollution. The most recent phenomenon of water pollution is littering on the water bodies. Due to industrial, domestic and agricultural growth, we accumulate large quantity of waste materials which include plastic in all forms, metal wastes, fibre waste, chemical wastes. These waste dumped in a place for a long time or thrown in to the environment, often into the water-bodies, polluted the water affecting the natural living atmosphere and health of the people who depend only on these water resources.

Due to the growth rate of Institutions coupled with the limited water resources, wastewater from instructions necessitates the implementation of advanced effluent treatment systems. The major challenges of current trend for discharging of institutional wastewater are to find an effective solution for effluent treatment which meets all the requirement of environmental protection. To reduce the environmental impact, the Integrated Anaerobic Baffled Reactor (IABR) was chosen for the treatment of Institutional wastewater due to its many advantages citied in the literatures.As compared to the other high rate anaerobic reactors, ABR (Anaerobic Baffled Reactor) was a successful application of anaerobic technology to the treatment of industrial wastewater and was broadly used in treating wastewater (Bachmann et al., 1982; Bachmann et al., 1985; Barber and Stuckey 1999). The ABR was to begin at Stanford University and it can be expressed as a sequence of up-flow anaerobic sludge blanket reactors. As the name recommended that it consists of a sequence of vertical baffles to allow the wastewater to flow below and above them as it passes from the inlet to the outlet. Then the wastewater can approach into close contact with a hugesum of energetic biomass, while the effluent remains relatively free of biological solids (Wang et al., 2004; Krishna et al., 2007; Shivayogimath et al., 1999; Kumar et al., 2007).The ABR's most important benefit is its ability to isolate acidogenesis and methanogenesis down the process longitudinally (Grobicki et al., 1991; Grobicki et al., 1991; Nachaiyasit et al., 1997; Barber et al., 1999; Jianlong Wang et al., 2004).In our, previously recent work, the function of AMBR has been considered about the achieve on bifurcation of Acidogenic and Methanogenic Microorganism in a Compartmentalized Anaerobic Migrating Blanket Reactor (Aruna.C and Asha.B 2019).The benefit of ABR is its capability to divideacidogenesis and methanogenesis longitudinally downwards the reactor (Nachaiyasit et al., 1997; Barber and Stuckey, 1999; Plumb et al., 2001; Uyanik et al., 2002a). This can allowdiverse bacterial inhabitants to lead each partition, acidification predominating in the first compartment section and methanogenesisleading in the

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succeeding compartment (Uyanik et al., 2002b). The present research work is to investigate the reduction rate of Chemical Oxidation demand in an Integrated Anaerobic Baffled Reactor utilized by an Institutional wastewater.

MATERIALS AND METHODS

Reactor Configuration

A laboratory scale Integrated Anaerobic Baffled Reactor (IABR) was fabricated by white Plexiglass sheets with a total volume of 78.75l and was installed in the Advanced Environmental Laboratory, Department of Civil Engineering, Annamalai University, and Tamil Nadu. The total length of the IABR was 70.00cm; width 25.00 cm and depth 45.00cm having a working volume of 68.25l. The baffles in the reactor was constructed properly to flow from bottom to top, so that it will permit wastewater to run through the sludge bed from base up. The experimental reactor has five compartments and the space of the superiorborder of baffles among the rising and sliding compartments from the water level was about 3cm. Primarilythree compartments are consummated with suspended growth process and rest of the other two are with attached growth process. The Bio carriers were packedarbitrarily in the fourth and fifth compartments. The peak of the reactor was enclosed and a control device was fitted to escape biogas. The biogas was estimated through a biogas flow meter and storedin a bio gas collection bag. The reactor was furnished with single inlet and five out lets vents. Peristaltic pump PP 30 EX was handled to push the influent wastewater in to the reactor. The diagrammaticrepresentation of Integrated Anaerobic Baffled Reactor is exhibit in Figure.1.

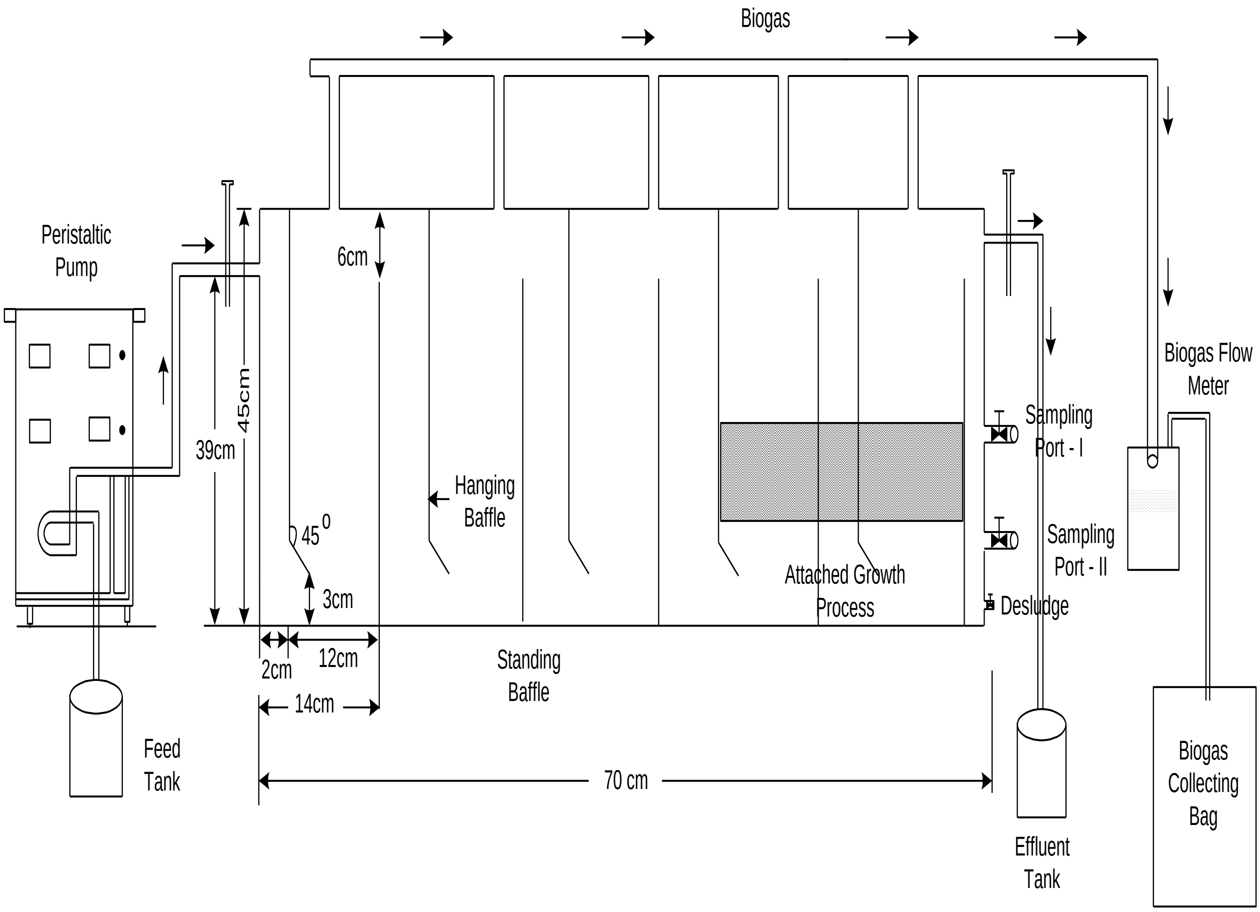

Figure 1 Schematic representation of the Experimental model

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Acclimatization of the reactor

Before start-up of the IABR, the biomass was acclimatized with the slurry from the wastewater treatment unit at Annamalai University and Municipal sewage plant located at Chidambaram Municipality. The collected samples were analysed as per the procedure given in **APHA 2017**.

Results and discussion

After acclimatized, municipal sewage was drawn from the Chidambaram Municipality was utilized in the reactor during start-up period with an influent COD of 780mg/l at an OLR of 0.123kg COD/m^3.d. The reactor attained a steady state from 18 to 21st day onwards, which may be due to the implementation of attached and suspended growth process in only one isolated system.

Performance of IABR with respect to HRT

The experimental study was carried out with two operational stages such as without addition of co substrates (Three sets) and with the addition of co substrates (Three sets). First three stages the raw institutional wastewater with an average influent COD of 888, 768, and 656mg/l was utilized in the reactor by without addition of any substrates.In the first stage the minimum COD removal efficiency was achieved 10.00% at a HRT of 1.0days in the first compartment and maximum COD removal efficiency was obtained 60.17% at a HRT of 3.5days in the fifth compartments for an average influent COD of 888mg/l. In the case of 768mg/l of an average influent COD, the organic pollutant the maximum removal efficiency was achieved 71.71% at a HRT of 6.0days.The performance of COD removal efficiency in the third stage was from 51.31 to 68.75%, 40.79 to 55.42%, 55.29 to 71.26%, 56.47 to 75.86% and 62.35 to 77.01% in the compartments from first to fifth for an average influent COD of 656mg/l.

The removal efficiency was not satisfied with the results obtained so that it was decided to improve the substrate level in the institutional wastewater by adding Glucose as a co substrate for attaining more efficiency. After addition of 1g/l of Glucose in the Institutional wastewater as a co substrate, the average influent COD was increased to 1064mg/l in the stage four. The COD removal efficiency was found to be increased from 62.85 to 75.00%, 40.00 to 60.15%, 66.67 to 70.31%, 68.21 to 82.03% and 69.28 to 84.13% in the first, second third, fourth and fifth compartments as compared to earlier stages after the addition of co-substrates 1g/l of Glucose.

In the fifth stage the concentration of glucose act as an external carbon source was increased to 2 g/l. The maximum 69.93% at a HRT of 3.0days, 60.23% at a HRT of 6.0days, 78.43% at a HRT of 3.0days, 84.96% at a HRT of 3.0days and 90.19% at a HRT of 3.0days for an average influent COD of 1168mg/l. This showed that increasing the glucose concentration from 1 to 2g/l resulted in significantly better performance of the IABR in terms of organic removal.

In the final stage the Glucose concentration was increased to 3 g/l and attained the most effective removal efficiency of 94.37% at a HRT of 3.0days in the fifth compartment with an average influent COD of 1304mg/l with the addition of 3g/l of Glucose as a co substrate. Also tried for further increase of co substrates but not found an efficient removal of COD concentration. In anaerobic systems, for example, HRT affects the degradation of volatile solids into a water vapour product (Gerardi et al., 2003).

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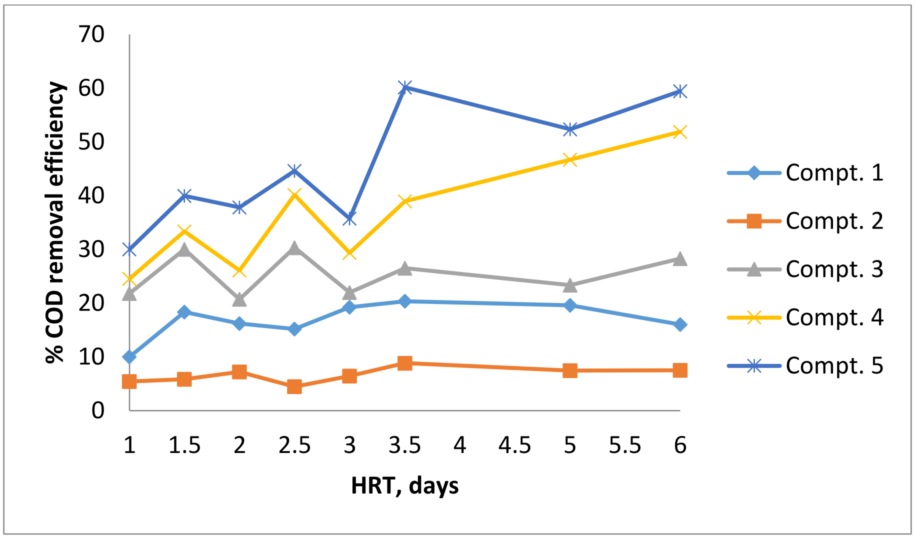

Figure 2. Profile of % COD removal efficiency with an average influent COD of 888mg/l

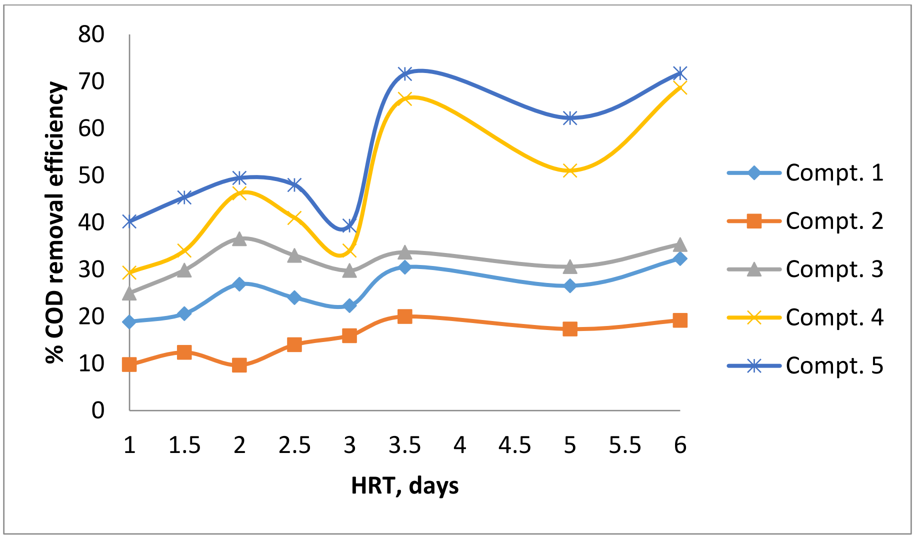

Figure 3. Profile of % COD removal efficiency with an average influent COD of 768 mg/l

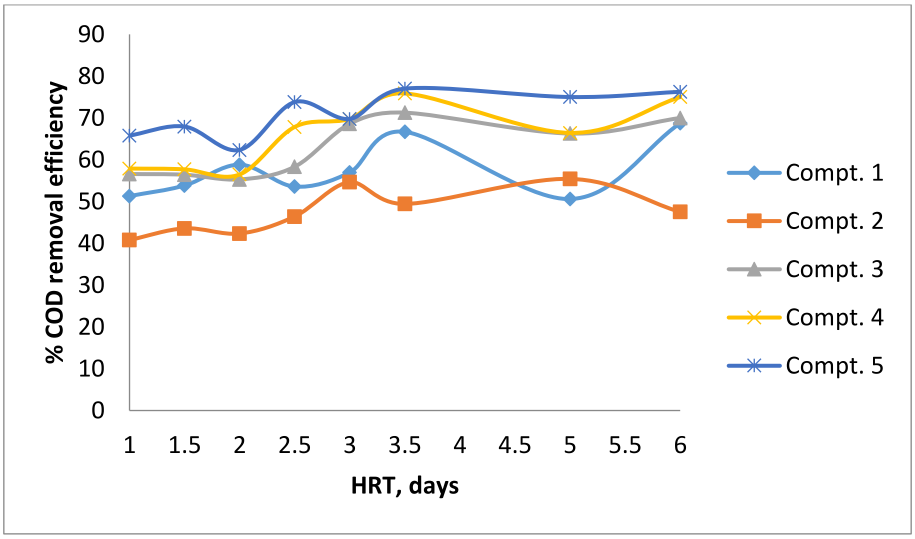

Figure 4. Profile of % COD removal efficiency with an average influent COD of 656 mg/l

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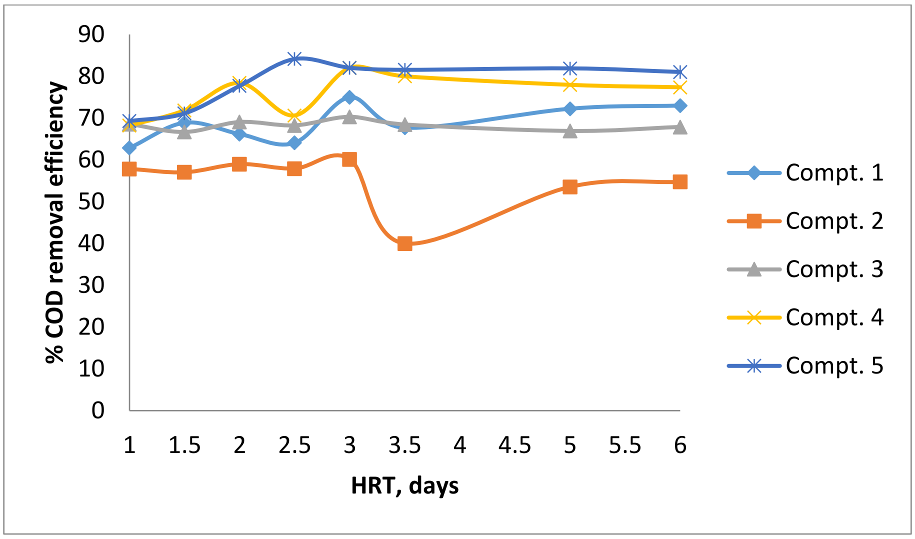

Figure 5. Profile of % COD removal efficiency with an average influent COD of 1064 mg/l

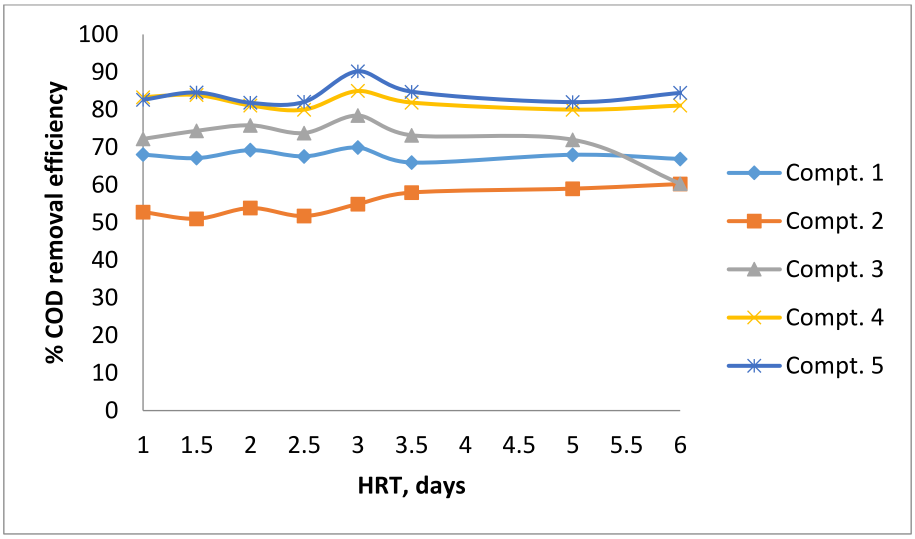

Figure 6. Profile of % COD removal efficiency with an average influent COD of 1168 mg/l

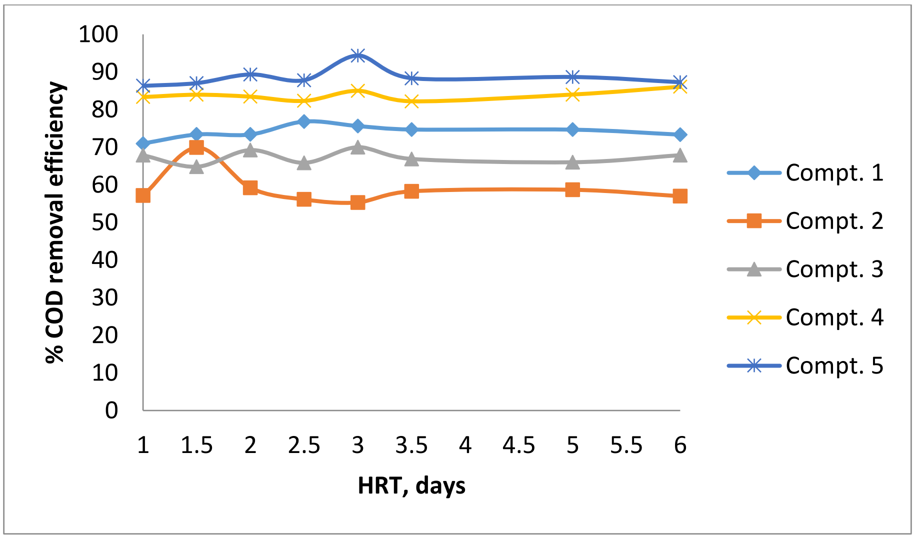

Figure 7. Profile of % COD removal efficiency with an average influent COD of 1304 mg/l

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CONCLUSION

The results arrived from this experimental study wasfound to be feasible process for treating institutional wastewater through Integrated Anaerobic Baffled Reactor. The Integrated Anaerobic Baffled Reactor was able to treat institutional wastewater by removing maximum of 77% of organic substances in terms of COD without utilizing any co-digestion with a HRT of 5 days. After addition of co substrates, the removal efficiency was rapidly increased to 94.37% at an OLR of 3.0days with an influent COD of 1250mg/l. The bio carriers in the fourth and fifth compartments provide an efficient microbial population to adhere and breed. The modifications in the IABR eliminates the disadvantages in terms of shorter span during start-up of the reactor and also achieved a better performance with addition of co-digestion. This promising technology will overcome the possible limitations associated with conventional ABR by addition of co substrate.

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