TREATMENT OF SUGAR MANUFACTURING INDUSTRY WASTEWATER BY UPFLOW ANAEROBIC FIXED BED REACTOR AT PRECISE TEMPERATURE

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ABSTRACT

Sugar manufacturing effluent was treated in an anaerobic fixed bed reactor seeded with nongranular anaerobically digested sewage sludge. The ambient room temperature during the study period was between 28-37 ºC. Successful reactor starts with granulation was achieved within 90 days of operation. The reactor was started with an OLR of 0.031kgCOD/m^3/day and was loaded up to the minimum COD 2240 mg/l. The maximum % COD removal efficiency of 86% for the sugar wastewater at 3.0 days Hydraulic Retention Time with an influent COD concentration of 3960 mg/l was obtained. The VFA concentration gradually decreased from 54mg/l at 3.00 days HRT and at 24mg/l at 0.6 days HRT. The VFA concentration was decreased drastically with increase the HRT. The VSS ranges from 98mg/l to 165mg/l at 0.6day to 3.0days Hydraulic Retention Time. Under steady state conditions the biomass concentration was progressively increased from 98mg/l to 165mg/l to increases the HRT.

Keywords: Volatile Fatty Acid, Fixed film Reactor, Hydraulic Retention Time, Sugar mill effluent.

INTRODUCTION

Rapid urbanization and industrialization in the developing countries like India pose severe problems in collection, treatment and disposal of effluents. This situation leads to serious public health problems. Unmanaged organic waste fractions from industries, municipalities and agricultural sector decompose in the environment resulting in large scale contamination of land, water and air. These wastes not only represent a threat to the environmental quality but also possess a potential energy value which is not fully utilized despite the fact that they are cheap and abundant on most parts of the world. In order to protect the water resources from onslaught of these wastes, it is necessary to provide adequate treatment to reduce their pollution potential. For biodegradable impurities, the natural choice is biological treatment, which could either be aerobic or anaerobic. Anaerobic treatment converts the wastewater organic pollutants into small amount of sludge

and large amount of biogas as source of energy (Ayati, and Ganjidoust, 2006) ; whereas aerobic treatment needs external input of energy for aeration. The upflow anaerobic sludge blanket (UASB) reactor is by far the most widely used high-rate anaerobic treatment system for variety of wastewater (van Haandel and Lettinga,1994). The most characteristic device of UASB reactor is the three-phase separator or settler. The industry is involved in sugarcane processing action to produce raw sugar from more than 70% of the sugarcane produced in the worldwide (Poddar PK, Sahu. O 2017). In addition to sugar, the industry produces byproducts such as bagasse (residue from sugarcane crushing), press mud (dirt mud residue from juice clarification), molasses (final residue from sugar crystallization) and wastewater (Nandy T, Shastry S 2002). Furthermore, production of bioethanol as an industrial product is also widespread among sugar industries annexed to ethanol distilleries. Ethanol has existed since the beginning of recorded history. The ancient Egyptians and Chinese produced ethanol by naturally fermenting vegetative materials and discovered the art of distillation. Fermentation is the oldest known biotechnology and complex biological process used for the production of ethanol in the distillery. Recently, bioplastic production has emerged as one of the primary interests in the sugar processing industry in which the sugar is converted into lactic acid and polymerizes into biopolymer (Sriroth K etal2016). Principally, the biological treatment method is effective for highly polluted agro-industrial wastewaters from the sugar industries and ethanol distilleries (Pant D, Adholeya A2017). The fixed-film digester is reactor filled with an inert medium or packing that provides a very large surface area for microbial growth through which the influent passes (Singh SP, Prerna2009). These anaerobic microorganisms attach themselves to supporting materials and can create a thin layer of anaerobic bacteria called biofilm which gives the digester its name, fixed film. Anaerobic filter is a fixed-film biological wastewater treatment process where the fixed matrix (support medium) provides an attachment surface that supports the anaerobic microorganisms in the form of a biofilm. Compared to many other high-rate reactors, the fixed-film reactor, which includes anaerobic filter, offers the advantages of simplicity of construction, elimination of mechanical repair, better stability even at higher loading rates and capability to withstand toxic shock loads (Mohana S etal,2009). Another advantage of this reactor is its quick recovery after the starvation process. The anaerobic filter is the first reactor that eliminated the need of recycles and solids separation with the advantages of resistance to shock loads and inhibitions (Hassan S et al 2013).

MATERIALS AND METHODS

A laboratory scale fixedfilm reactor was fabricated from acrylic pipe of 150 mm internal diameter. The overall height of the reactor was 1500 mm, one inlet at 60 mm from the bottom of the reactor was provided for the influent. The effluent outlet was provided at 60 mm below the top level of the reactor. One opening at the top of the reactor was provided for collection of gas. The three-phase separator was designed to meet these requirements, as per the guidelines given by Lettinga and Hulshoff Pol (1991). The three-phase separator was provided at a distance of 865 mm from the bottom. Baffles are provided to guide gas bubbles into the separator to collect the gas generated and to allow the settling of suspended solids. Five sampling ports are provided at a height of 135 mm from the bottom of the reactor at 170 mm c/c. the effective volume of the reactor was 13.0 liters. The effluent tube was connected to the water seal to avoid the escape of gas through the effluent. The gas out let was connected to a wet gas meter through rubber tubing. Miclins peristaltic pump (Model: PP 20) was used for feeding the reactor. Brass check valve of ¼ inch size was fixed at the bottom of the reactor to facilitate the sludge withdrawal. The lid of the reactor and other fittings were sealed to maintain anaerobic conditions inside the reactor.

RESULT AND DISCUSSIONS

The maximum % COD removal efficiency of 86% for the sugar wastewater at 3.0 days Hydraulic Retention Time with an influent COD concentration of 3960 mg/l was obtained**.** It was concluded that the influence of COD reduction was increase to increases the HRT. The pH variations are observed for the different operating conditions of Hydraulic Retention Time**.** The pH values got decreased while increasing HRT in sugar effluents. The VFA concentration gradually decreased from 54mg/l at 3.00 days HRT and at 24mg/l at 0.6 days HRT as shown in **Figure 1.** The VFA concentration was decreased drastically with increase the HRT. The VSS ranges from 98mg/l to 165mg/l at 0.6day to 3.0days Hydraulic Retention Time as shown in **Figure 2.** Under steady state conditions the biomass concentration was progressively increased from 98mg/l to 165mg/l to increases the HRT.The maximum biogas of 0.048m^3/kg COD removed was attained at 3days HRT at average COD value of 2472mg/l. The biogas conversion was increases to increases the HRT.

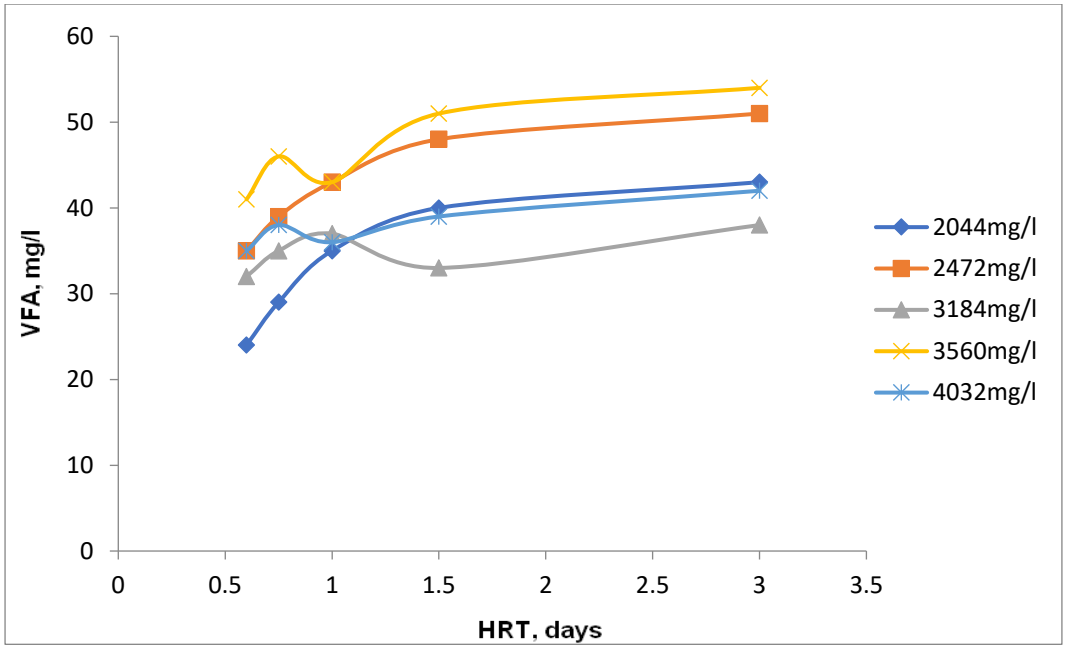

Figure: 1 HRT, days Vs VFA, mg/l for sugar effluent

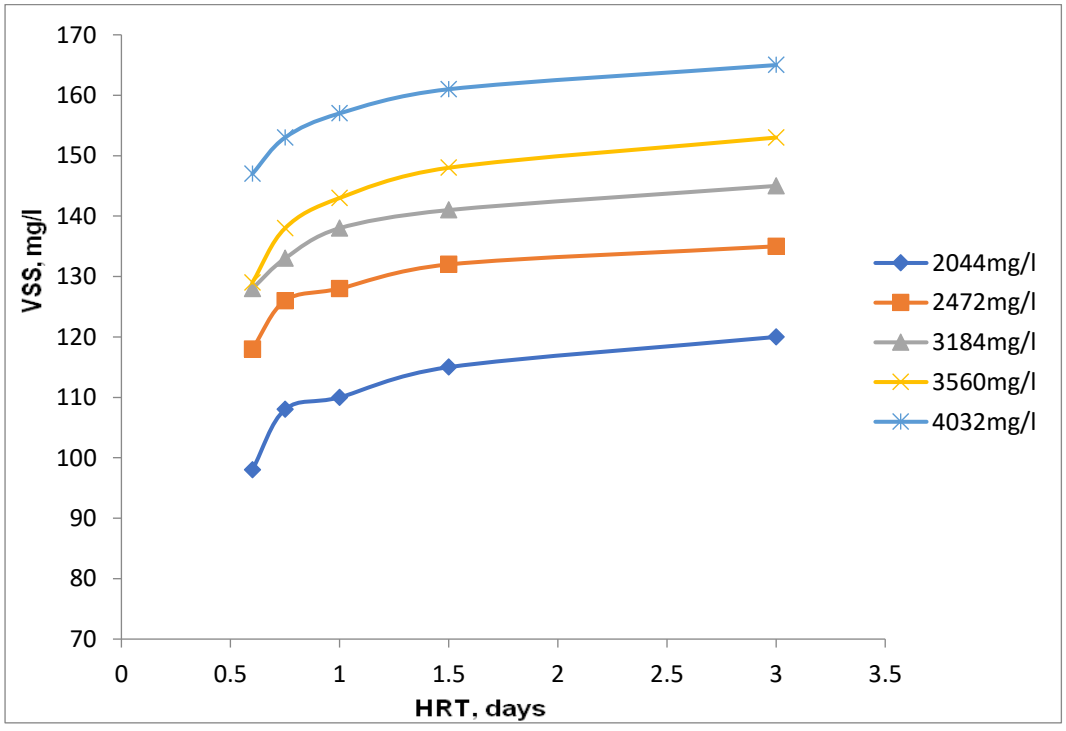

Figure: 2 HRT, days Vs VSS, mg/l for sugar effluent

CONCLUSIONS

Start-up of a fixed bed reactor can be achieved within 90 days with anaerobic nongranular sludge and sugar industry wastewater as substrate. fixed bed reactor strategy is feasible to treat sugar industry wastewater efficiently with a COD removal efficiency of 86% at much lower HRT of 3days. The VFA concentration gradually decreased from 54mg/l at 3.00 days HRT and at 24mg/l at 0.6 days HRT Methane rich biogas can be produced at the rate of $0.04m^3/kg$ anaerobic filter of fixed-film digester group is emerging with better performance than the other high-rate anaerobic reactors.

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