EFFECTIVENESS OF SUGAR EFFLUENT ON FIXEDFILM REACTOR WITH EFFECT OF VOLATALFATTY ACID

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ABSTRACT

Technological solutions allowing the increase of the technological efficiency of anaerobic methods of wastewater treatment are still under investigation. The weaknesses of these solutions can be limited by the use of active fillings. As the capability of retaining microorganisms will act as biofilm factor influencing the performance of this reactor. The aim of the present study was to determine the impact of fixed film reactor active filling on the effectiveness of anaerobic treatment of sugar-industry effluent, the production efficiency and the qualitative composition of the biogas produced. The effluent was analyzed with varying Organic Loading Rate (OLR) The OLR increased from 0.031kgCOD/m^3/day to 0.288kg COD/m^3/day. With an average value of Volatile Fatty Acid (VFA) of The Volatile Fatty Acid was at the maximum of 54mg/l to 24mg/l was calculated by distillation method with five sets off COD concentrations. The maximum COD removal efficiency of 86% along with production of 0.048m^3/kgCOD of biogas at 3 days Hydraulic Retention Time (HRT) was observed.

Keywords: Volatile Fatty Acid, COD, Fixed film Reactor, Organic Loading Rate, Sugar mill effluent.

INTRODUCTION

Industrialization can be considered a desirable option owing to its contribution to the national economic growth. However, it exerts considerable pressure upon the natural resources, along with an increased demand for energy. In addition, the waste generated by the industries is a major environmental concern and the disposal of effluents without appropriate treatment could have long term adverse effects, especially upon the local vegetation and aquatic life. Thus, it is imperative for highly polluting industries to adopt a suitable waste treatment process for the clean disposal of high-strength wastewater. Anaerobic digestion is one such technology, which is gaining wider acceptance in the present scenario over aerobic treatment. This is due to benefits such as lower energy requirements, high degree of waste stabilization, high organic loading rates, lower production of excess sludge, easier preservation of well adapted sludge which can be kept unfed for a period of more than a year without any deterioration, and the production of biogas which can be further used for meeting part of the energy demand.

There are about 393 large and medium scale sugar mills in India with a production figure of about 20×10^6 ton of plantation white sugar in the 1995–1996 season. Of these units, about 26% are yet to attain satisfactory performance level with regard to installation and operation of effluent treatment plants (CPCB, 1997a). The sugar manufacturing process broadly involves the following steps: (a) extraction of sugarcane juice, (b) clarification of the juice by the addition of lime and sulphur dioxide to heated juice at 70 °C, (c) concentration of the clear juice after clarification to 60% solids, (d) syrup sulphitation and crystallization, and (e) centrifugation, drying and bagging the sugar crystals. The manufacturing process primarily produces bagasse and press mud as waste. The former is normally used as fuel in boilers while the latter is employed either for soil enrichment or for biomethanation. In addition, the process generates wastewater, with the typical characteristics.

Sugar-industry effluent is characterized by a high load of suspended solids and nutrients and by a high COD (Chemical Oxygen Demand) mainly due to the presences of carbohydrates [1–3]. Discharge of such effluent into the environment has a negative impact on aquatic ecosystems [4]. As of recent years, fermentation reactors have been the preferred method for treating sugar-industry effluent, encompassing technologies such as anaerobic fixed bed (UAFB) [5], upflow anaerobic sludge blanket (UASB) [6], anaerobic downflow stationary fixed film (DSFF) [7], aerated fixed film (AFF) [8] and anaerobic batch reactors [9]. Advantages of fermentation reactors include low operating costs [10,11], small size of the bioreactors not requiring large investment plots [12], low excess sludge, which can usually be used as a nitrogen- and phosphorus-rich fertilizer [13,14] provided high soil enzymes activity and greater stability in crop production [15], their capacity to treat highly-polluted wastewater and operating at high organic load rates (OLRs) [16]. Anaerobic bioreactors are hermetically closed, limiting the spread of odors and aerosols [17–19]. CH4-rich biogas is an important product of anaerobic biodegradation of organic compounds [20]

MATERIALS AND METHOD

The reactor was fabricated and packed with polyvinyl chloride pipe pieces and it was air tight sealed to maintain anaerobic conditions. The ambient room temperature during the study period was between 29 and 33 °C. Start-up period required by the reactor was 3 weeks. The Laboratory model was made up of clear acrylic Plexiglas having a working volume of **13.0** liters, The packing material used in a packed-bed reactor should be light weight to reduce construction cost and should be able to retain as much biomass as possible. In addition, some researchers suggested that other properties of packing medium might affect the performance of anaerobic reactors. These properties include adsorbing capability (Khan et al., 1981), proton exchange ability (Sanchez and Roque-Malherbe, 1987) and surface characteristics relative to the hydrodynamics of the reactor (Verrier et al., 1987). The reactor was continuously fed with real time Sugar wastewater at an influent flow rate of 0.18, 0.36, 0.54, 0.72; 0.90 l/day by means of Peristaltic Pump with varied Hydraulic Retention Time (HRT).

RESULT AND DISCUSSIONS

The Volatile Fatty Acid was at the maximum of 54mg/l to 24mg/l was identified by distillation method with five sets off COD concentrations and the OLR impacts were shown in Figure 4. pH of the sugar mill wastewater plays a key role in VFA generation. The ability of methanogenic bacteria to resist higher VFA accumulation is highly dependent on the alkalinity value of the system as well its buffering capacity.

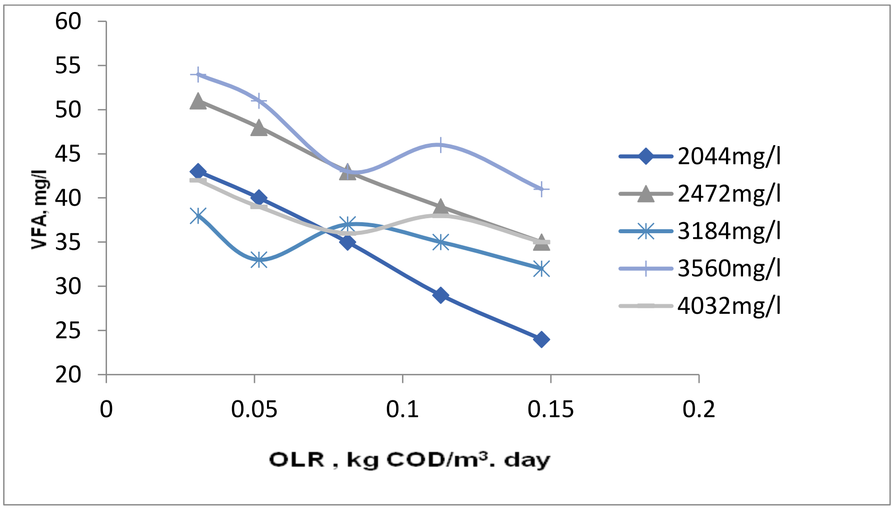

Figure: 4. OLR, kg COD/m^3.day Vs VFA, mg/l

The Volatile Suspended Solids attained the maximum of 165mg/l at OLR of 0.0548kgCOD/m^3/day, and the minimum 98mg/l was obtained at OLR of 0.1469 kg

COD/m^3/day**.** It was observed that the biomass concentration decreases with the increase the OLR of the sugar effluents as shown in Figure 5

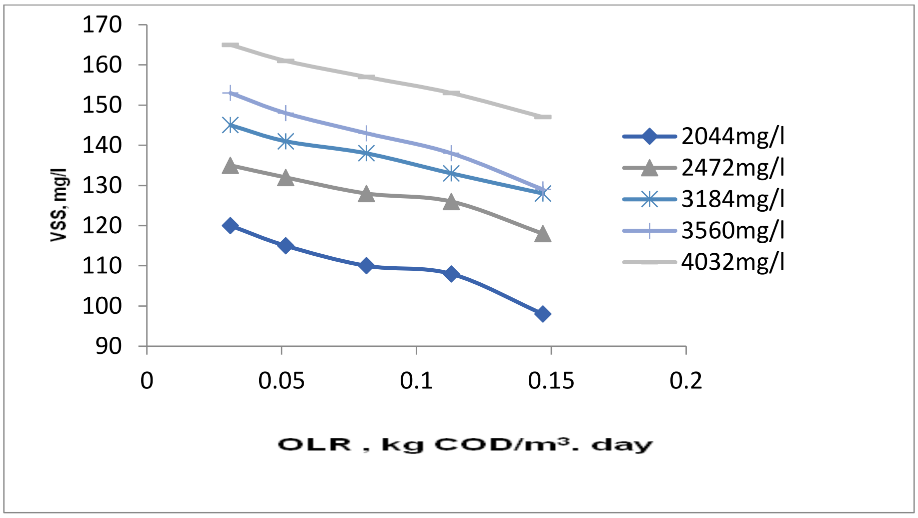

Figure.5 OLR, Kg COD/m^3.day Vs VSS, mg/l

CONCLUSION

The Volatile Fatty Acid levels were gradually decreased with increased level of Organic Loading Rates. The VSS were calculated for varying five sets of average value of Organic Loading Rate and corresponding characteristic curves were plotted. The maximum VSS of 95mg/l was observed at 5250mg/l COD with respective OLR of 0.0726kg COD/m^3/day. After achieving steady state, the fixed film reactor manages to suppress the growth of VFA-utilizing methanogen and increased the VFA output.

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