International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 02 | Feb 2019 www.irjet.net p-ISSN: 2395-0072

TREATMENT OF SUGAR INDUSTRY WASTEWATER BY ANAEROBIC BAFFLE WALL REACTOR

Rohit I Gaddikerimath[1], Rachana M Madiwalar[2], Saba Mohammad Ayub[3], Soumya S Shingennavar[4], Rahul R Bannur[5]

[1,2,3,4]B.E Student, Dept. of Civil Engineering, S.G.Balekundri Institute of Technology , Belagavi-590010 (Karnataka).
[5]Assistant Professor, Dept. of Civil Engineering, S.G.Balekundri Institute of Technology, Belagavi-590010 (Karnataka).

Abstract - *Water plays an important role in the world economy. It is an excellent solvent for a wide variety of chemical substances thus it is widely used in industrial processes. Also an important resource involved in the creation and the development of healthy life. Since water is such a vital resource for survival, it is our responsibility to manage this resource. The results present in this study are from a laboratory-scale Baffle wall reactor treating sugar industry wastewater at different HRTs. The experiments were performed at hydraulic retention times of 3, 6, 12, 24, 36, 48, 60, 72, 84 and 96hrs based on empty reactor volume of 28 liters and the performance of the reactor was evaluated based on the removal of COD, BOD, TS, TDS, TSS and pH. The initial values of COD and BOD were, 2500mg/L and 1900mg/L respectively and pH value changes from 7.23 to 7.20 with 43% of treatment. This study intends to provide an overall vision of the multi-media filter technology an alternative method for treating wastewater with the help of baffle wall reactor.*

Key Words: *BOD (Bio chemical oxygen demand), COD (Chemical oxygen demand), HRT (hydraulic retention time).*

1. INTRODUCTION

India was the first to begin with the production of sugar following the process of pressing sugarcane to extract juice and boil it to get crystals. Sugar production was estimated to be around 26 million tons. In India there are about 380 sugar factories, of which 105 are in Uttar Pradesh. Also it is the world's second biggest sugar producer. Indian sugar mills generate 0.16-0.76$m^3$of wastewater for every tonnes of cane crushed by them. Like other industries, pollution load from sugar industries can also be reduced by conventional methods. These wastes 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. It is necessary to provide adequate treatment to reduce their pollution potential. It is interesting to note that India ranks 6th in per capita consumption with Brazil being the highest per capita consumer of sugar at 57.6Kg per capita all around the world. About 60% of the crop in India is grown in sub tropical region, while 40% of the crop is grown in tropical region. (Tamil Nadu, Karnataka, Maharashtra, and Madhya Pradesh).Maharashtra and Uttar Pradesh together produce about 60% of the sugarcane grown in India with both states producing almost equal amount. India's consumption of sugar is expected to increase from 18.3Kg per capita to a level of 23/24kg per capita by 2010 and total demand to be of the order of 24.3 million tones. To achieve this level of production, sugarcane needs to be cultivated on an area of about 5.5 million hectares with an average yield of 65 tons per hectares but the increase in area of cultivation may not be possible due to other competing crops.

2. BIOLOGICAL TREATMENT

Biological treatment method is one of the best methods to treat any wastewater like industrial, municipal or agricultural sectors. This treatment is a vital and basic piece of any wastewater treatment plant that treats wastewater from either region or industry having dissolvable natural pollutions or a blend of the two sorts of wastewater sources. Biological wastewater treatment is a process that seems simple on the surface since it uses natural processes to help with the decomposition of organic substances.[3]

3. BAFFLE WALL REACTOR

Baffle wall reactor is a combination of two types of reactor. Waste water treatment by the baffle wall reactor system has become wide-spread as it provides advantage of both the suspended and attached growth phase at the same time. It may be used to treat some rate-limiting subtracts, priority pollutants, volatile organic compounds etc. as well as nitrification.

4. STATEMENT OF PROBLEMS

The sugar industry effluent contains high chemical oxygen demand (COD). The initial COD of 2500mg/Lt, initial BOD of 1900mg/Lt and pH of 7.23. Considering all the problems above a low cost efficient treatment is essential for sugar industry.

5. OBJECTIVES OF THE STUDY

The study has been done on Treatment of Sugar industry wastewater by Baffle wall Reactor. The specific objectives are as follows

- To study the variation of COD content with respect to different HRTs.
- To study the variation of BOD content with respect to different HRTs.

- To study the variation of TS content with respect to different HRTs.
- To study the variation of pH during the treatment period with respect to different HRTs.
- To get the Optimum Hydraulic Retention Time of the reactor.

6. METHODOLOGY AND MATERIALS

Baffle wall reactor consists of compartments which are baffled to force the incoming wastewater up through a series of sludge blankets, thereby minimizing the loss of biomass. In this reactor two baffle walls have been provided inside the reactor to make three separate chambers. Baffle wall has been provided for stabilizing an anaerobic reactor during the start-up period and to eliminate the shock loading regimes would lead to harsh conditions in the compartments of the reactor and to provide sufficient substrate for the anaerobic bacteria in the final compartment of the reactor.

Table 6.1: Design details of Baffle wall Reactor

PARAMETERS	DETAILS
Total Height of Reactor	60cm
Width of the reactor	30cm
Volume of the reactor	48.69liters
Spacing between baffle walls	9.33cm
Height of feeding tank from the reactor	75cm
Diameter of inlet	2.5cm
Thickness of acrylic sheet	0.5cm

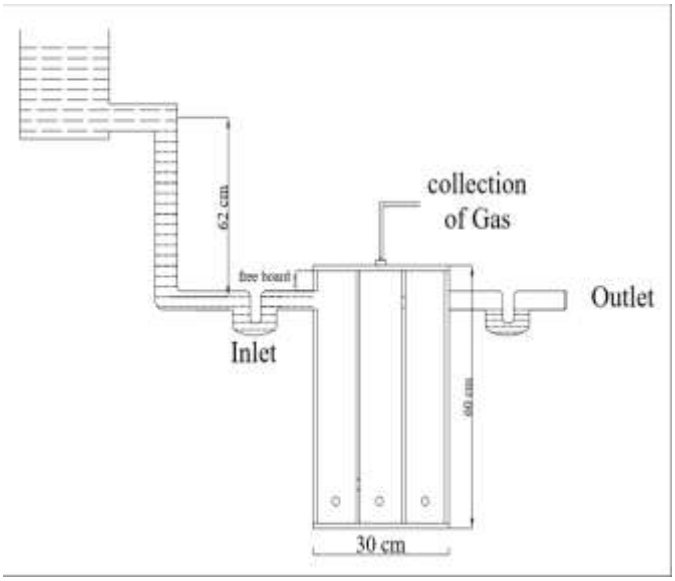

Fig 6.2: Schematic Diagram of Baffle wall Reactor

6.3 MATERIALS USED

- Acrylic sheets
- Silicon gel
- M-seal and gum tapes
- chloroform
- PVC pipes

A laboratory scale baffle wall reactor was fabricated. The overall height of the reactor is 60cm and the volume of the reactor is 49litters. It is made of Acrylic sheets of 0.5cm thick and PVC pipes of 1/2" diameter.

7. WORKING PROCEDURE OF BAFFLE WALL REACTOR

The feeding tank is filled with wastewater and is connected to baffle wall reactor. Height of the feeding tank is kept 62 cm with constant maintain and feeding. Both the inlet and outlet of the reactor are made U shaped so that to maintain the anaerobic condition inside the reactor. The wastewater feed to reactor by the feeding tank. Two baffle walls are provided by making 3 chambers inside the reactor. These 3 chambers will have outlets to collect the sludge provided during the process, and alternative holes are made to both the baffle walls. At the top a free board of 5cm is given for the gas collection. When the water enters in the 1st chamber from the inlet of baffle wall reactor velocity of water gets reduced. The vertical movement of water occurs and enters in the next chambers. Thus the treated water is collected from the outlet.

8. RESULTS

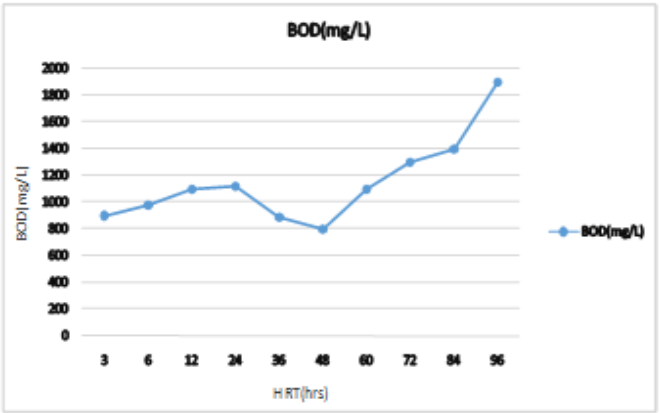

Chart-8.1: Variation of BOD with different HRT

Initially the wastewater of BOD concentration 1900mg/liters was feed into the baffle wall reactor. The reactor was tested for different HRT's staring at 96hrs. Then HRT was reduced to 84hrs, 72hrs, 60hrs, 48hrs, 36hrs, 24hrs, 12hrs, 6hrs, and 3hrs, respected BOD values are 1400mg/liters, 1300mg/liters, 1100mg/liters, 800mg/liters, 890mg/liters, 1120mg/liters, 1100mg/liters, 980mg/liters, and 900mg/liters.

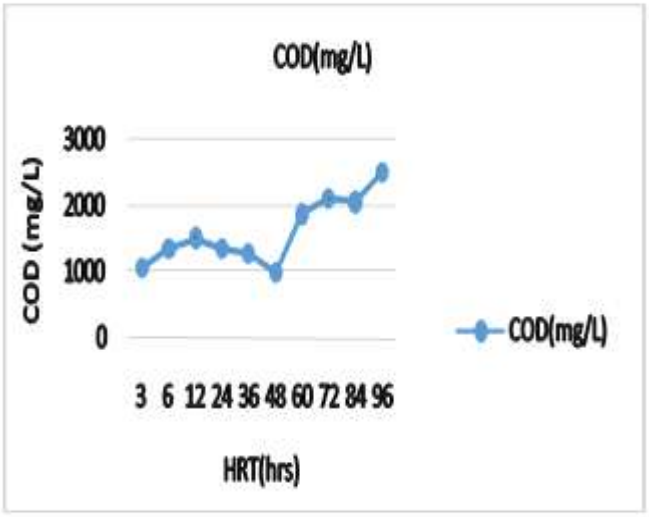

Chart-8.2: Variation of COD with different HRT

For COD concentration first wastewater was feed into reactor with initial COD of 2500mg/liters. The reactor was tested for different HRT's staring at 96hrs. Then HRT was reduced to 84hrs, 72hrs, 60hrs, 48hrs, 36hrs, 24hrs, 12hrs, 6hrs, and 3hrs, respected COD values are 2060mg/liters, 2120mg/liters, 1880mg/liters, 1040mg/liters, 1280mg/liters, 1360mg/liters, 1520mg/liters, 1360mg/liters, and 1080mg/liters

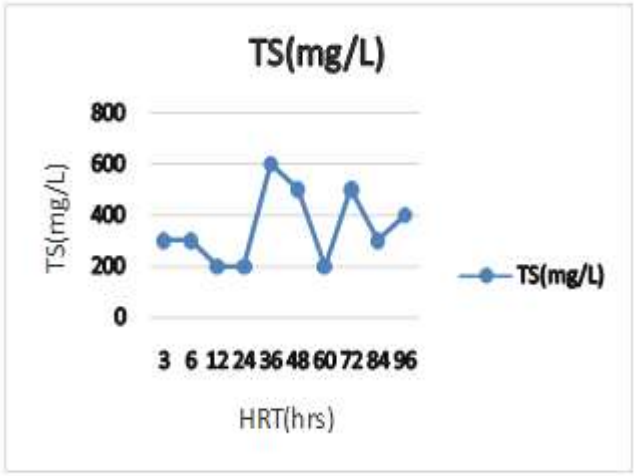

Chart-8.3: Variation of TS with different HRT

Initially the TS concentration 400mg/liters was feed into the baffle wall reactor. The reactor was tested for different HRT's staring at 96hrs. Then HRT was reduced to 84hrs, 72hrs, 60hrs, 48hrs, 36hrs, 24hrs, 12hrs, 6hrs, and 3hrs, respected TS values are 300mg/liters, 500mg/liters, 200mg/liters, 500mg/liters, 600mg/liters, 200mg/liters, 200mg/liters, 300mg/liters, and 300mg/liters.

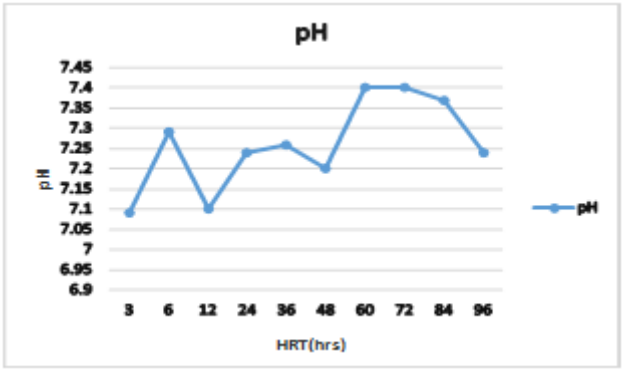

Chart-8.4: Variation of pH with different HRT

Initial value of pH 7.23 wastewater was feed into Baffle wall reactor. The reactor was tested for different HRT's staring at 96hrs. Then HRT was reduced to 84hrs, 72hrs, 60hrs, 48hrs, 36hrs, 24hrs, 12hrs, 6hrs, and 3hrs, respected pH values are 7.37, 7.40, 7.40, 7.20, 7.26, 7.24, 7.10, 7.29, 7.09. Hence Optimum HRT was obtained at 48hrs.

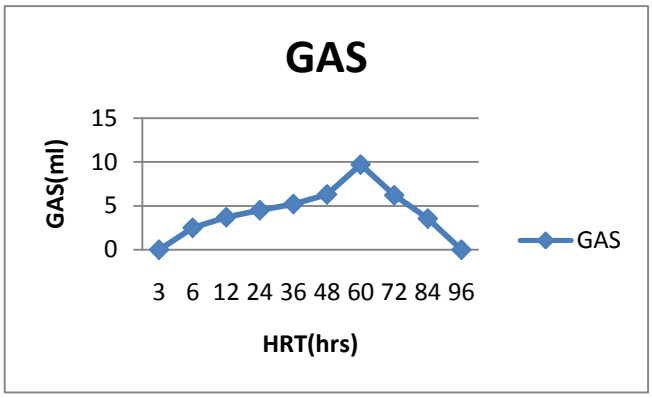

Chart-8.5: Gas collection with different HRT

Initial value of Gas collected was zero when the wastewater was feed into Baffle wall reactor. The reactor was tested for different HRT's staring at 96hrs. Then HRT was reduced to 84hrs, 72hrs, 60hrs, 48hrs, 36hrs, 24hrs, 12hrs, 6hrs, and 3hrs, respected gas collected values are 3.55ml, 6.2ml, 9.7ml, 6.3ml, 5.21ml, 4.5ml, 3.7ml, 2.5ml, and zero.

10. CONCLUSIONS

The proposed biological anaerobic treatment process appears to be promising wastewater treatment method for industrial wastewater with respect to the reduction in BOD COD, pH and increase in the TS.

- At 48 hrs COD, BOD, pH are reduced and TS was increased hence the optimum HRT of the Baffle wall Reactor was found at 48 hrs.
- The efficiency of the Baffle wall Reactor is about 43%.
- Hence the sugar industry wastewater can be effectively treated by Baffle wall Reactor.

REFERENCES

1) "Biological baffle wall Reactor" by:Hazen(1990)

2) Waste water treatment by: M.N.Rao and A.K.Datta

3) K.Kaviyarasan , "Application of uasb reactor in industrial wastewater treatment – a review", International Journal of Scientific & Engineering Research, Volume 5, Issue 1,(2014)

4) Herbert H.P Fang and H.K Chui, "Maximum cod loading capacity in uasb reactor at 37^0c";

5) Herbert H. P. Fang; "Uasb treatmentof wastewater with concentrated mixed VFA" (volatile fatty acid)

6) A.S.Tanksali,"Treatment of sugar industry wastewater by upflow anaerobic 9Osludge blanket reactor". BLDEA's V.P.P.G.H College Of Engineering And Technology,Bijapur, Karnataka,India. Corres.author: anutanksali@gmail.com, Tel: 9449532917.

7) Hina Rizvi, Nasir Ahmad, Farhat Abbas,"Uasb reactor treating municipal wastewater". Arabain Journal of Chemistry.(2015)

8) T.T.Tran, A.Nopharatana and P.Chaiprasert,.(2003) "Performance of Anaerobic Hybrid and Mixing Reactors in Treating Domestic Wastewater" Asian J. Energy Environ.

9) ArunMittal,. August – 2011 "Biological Wastewater Treatment" Water Today article.

10) T. Subramani, S. Krishnan, P. K. Kumaresan and P. Selvam,. May-June 2012 "Treatability Studies on Hybrid Up-Flow Anaerobic Sludge Blanket Reactor for Pulp and Paper Mill Wastewater" International Journal of Modern Engineering Research (IJMER).

11) Lettinga G, Vanvelsen AFM, Hobina SM, Zee W, Klapswik A., 1980. "Use of the upflow sludge blanket (USB) reactor concept for biological wastewater treatment". Biotechnol Bioeng .

12) Gupta, S.K., Gupta, S.K., Singh, G., 2007. "Biodegradation of distillery spent wash in anaerobic hybrid reactor". Water Res.

13) K.R.Venkatesh, M.Rajendran & A.Murugappan ,.May 2013 " Start-Up Of An Upflow Anaerobic Sludge Blanket Reactor Treating Low-Strength Wastewater Inoculated With Non-Granular Sludge" International Refereed Journal of Engineering and Science (IRJES).

14) Y. Satyawali, M. Balakrishnan., "Wastewater treatment in molasses-based alcohol distilleries for COD and color removal: A review" TERI University, Darbari Seth Block, India Habitat Centre, Lodhi Road, New Delhi 110 003, India.

15) Deepak Pant and Alok Adholeya, "Biological approaches for treatment of distillery wastewater: A review". Bioresource Technology.

16) Bharati Sunil Shete and N. P. Shinkar, "Fixed film fixed bed reactor – low cost approach" International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD).

17) N.B. Prakash, Vimala Sockan, V. Sitarama Raju, "Anaerobic Digestion of Distillery Spent Wash".

BIOGRAPHIES

Rohit I Gaddikerimath is B.E. Student, Dept. of Civil Engineering in S.G. Balekundri Institute of Technology, Belgavi – 590010, Karnataka India.

Rachana M Madiwalar is B.E. Student, Dept. of Civil Engineering in S.G. Balekundri Institute of Technology, Belgavi – 590010, Karnataka India.

Saba Mohammad Ayub is B.E. Student, Dept. of Civil Engineering in S.G. Balekundri Institute of Technology, Belgavi – 590010, Karnataka India.

Soumya S Shingennavar is B.E. Student, Dept. of Civil Engineering in S.G. Balekundri Institute of Technology, Belgavi – 590010, Karnataka India.

Prof. Rahul R Bannur is working as Assistant Professor, Dept. of Civil Engineering in S.G. Balekundri Institute of Technology, Belgavi – 590010, Karnataka India.