Jr. of Industrial Pollution Control 23 (2)(2007) pp 223-22

EVALUATION STUDIES ON AERATION METHODS FOR TREATING SUGAR EFFLUENT IN ATTACHED – GROWTH AEROBIC REACTOR

C. JODHI* AND V. NEHRU KUMAR

Department of Civil Engineering, Annamalai University,
Annamalainagar 608 002, India

Key words : Attached- growth, Aerobic reactor, Sugar effluent, Diffused aeration.

ABSTRACT

In any attached-growth biological treatment systems, active aeration is very important to harness the inherent advantages like higher growth rate of microorganisms, $è_c$, less sludge and higher rate of substrate conversion into stable compounds. The present study envisaged an experimental model of attached - growth aerobic reactor having nine liters of effective volume with diffused aeration system and alternatively surface aeration facility also. The experiment was run alternatively for both the methods of aeration under varying influent rates (0.19, 0.38, 0.50, 0.75 & 1.50 lit/hr) and varying COD (1015.16, 1531.85, 2031.64, 2522.16 and 2996.72mg/L). It is found that the model performed COD removal from 68.87% to 88.66% for the applied organic loading rates of 0.0047 to 0.1244 Kg COD/m^2.day for surface aeration and 69.88% to 93.57% for diffused aeration in similar, identical experimental conditions.

INTRODUCTION

Sugar mill effluent is highly biodegradable, and largely treated in Biological treatment plants. The existing treatment facilities in sugar industries, invariably, require revamping in terms of its process and engineered systems. The biological treatment methods, where bacteria and other microorganisms are used to remove contaminants by assimilating them-has long been a mainstay of wastewater treatment in the sugar mills.

The aeration systems are the utmost important while treating high COD, biodegradable waste streams. The aerobic methods viz; surface and diffused, do have their own exclusive advantages. The present experimental model was envisaged to test both the methods of aeration over the experiment, for treating sugar mill effluent.

EXPERIMENTAL SETUP

The nuclei of the experimental setup is an attached - growth aerobic reactor having nine liters of effective volume. The physical and process parameters of the experimental model are listed in Table.1. The schematic of the experimental setup is presented in Fig.1 and 2.

Table 1

Physical and process parameters of experimental model

Effective volume of the reactor, liters	: 9
Effective size of the reactor, m	: 0.30x0.30x0.10
Fill media, %	: 30
Surface area of microbial support media, sq.m	: 0.945
Influent flow rate, lit/hr	: 0.19,0.38,0.50,0.75 & 1.50
Hydraulic retention time, hrs	: 06,12,18,24,48
Influent average COD, mg/L	: 1015.16,1531.85, 2031.64, 2522.16 and 2996.72
Organic loading rate, Kg COD/m^2.day	: 0.0173,0.0258,0.0346,0.0429 and 0.0522

The surface aeration is incorporated in the model using a turbine blade (9 cm dia) that get energized by 85 watts motor. The impeller speed was controlled for the rotational speed of 100 to 150 rpm. The diffused aeration is incorporated by diffusing air through a porous (pore dia 0.003 m; 54 numbers) stainless steel pipe (0.019 m dia) and air was supplied at 15 litres/minute from an aqua blower. The clarifier system is having a surface area of 0.09 sq.m. A peristaltic pump is used to regulate the influent flow rate of effluent.

EXPERIMENTAL METHODOLOGY

The sugar effluent samples were obtained from M/s. MRK Co-operative Sugar Mill, Sethiyathope and analyzed for critical parameters. The synthetic preparation is simulated on the basis of analyzed parameter values of the samples. Synthetic effluent streams are used for the experimental works.

The model was initiated with domestic wastewater and sugar effluent was fed in parts and process acclimatization was achieved for synthetic sugar effluent stream over a period. The experiment was conducted for different operating conditions, viz; varying flow rate, and varying influent COD.

The operating conditions are interpreted for the model – specific hydraulic retention times (HRT, hrs) and organic loading rates (OLR, Kg COD/m^2.day)

RESULTS AND DISCUSSION

The COD removal efficiency under varying organic loading rates (0.0047 to

Fig. 1 Experimental model of attached growth aerobic reactor (Diffused aeration)

Fig. 2 Experimental model of attached growth aerobic reactor (Surface aeration)

0.1244 Kg COD / m^2.day) for different influent COD (1015.16, 1531.85, 2031.64, 2522.16 and 2996.72 mg / L) are presented in figures 2.1, 2.2, 2.3, 2.4 and 2.5 for treating sugar mill effluent using surface aeration.

The COD removal efficiency under varying organic loading rates (0.0047 to 0.1244 Kg COD / m^2.day) for different influent COD (1015.16, 1531.85, 2031.64,

Fig. 3.1, 3.2, 3.3, 3.4 and 3.5 HRT vs COD Removal (varying influent COD) DA – Diffused Aeration, SA - Surface Aeration.

2522.16 and 2996.72 mg/L) are presented in figures 2.1, 2.2, 2.3, 2.4 and 2.5 for treating sugar mill effluent using diffused aeration.

The COD removal efficiency under varying hydraulic retention time (48, 24,18,12 & 06 hrs) for different influent COD (1015.16, 1531.85, 2031.64, 2522.16 and 2996.72 mg/L) are presented in Figs. 3.1, 3.2, 3.3, 3.4 and 3.5 for treating sugar mill effluent using diffused aeration and surface aeration.

CONCLUSION

The maximum COD removal efficiency of 93.57% was observed, while the model was run using diffused aeration. This is higher than 88.66% of COD removal efficiency, which was observed in similar conditions of experiment for surface aeration. Hence, it can be concluded that diffused aeration is preferable in place of surface aeration

REFERENCES

Connie, D., Demoyer, Erica, L. Schierhotz, John Gulliver, S. 2003. Impact of bubble and free surface oxygen transfer on diffused aeration systems. *Water Research.* 37 (8) : 1890-1904.

Lee, M., Kang, J., Lee, C.H., Haam, S., Park, H.H., Kim, W.S. 2001. Oxygen transfer characteristics in a pilot scale surface aeration vessel wiyh simcar aerator. *Environ tecnol.* 22 (1) : 57-68.

Metcalf and eddy, INC. 2003. *Wastewater Engineering Treatment and Reuse.* Tata McGraw-hill Pub. Co. Ltd, New Delhi fourth edition.

Monteith, H,D., Bell, J.P., Parker, W.J., Meicer, H. Harvey, R.T. Effect of bubble-induced surface turbulence on Gas – Liquid mass transfer in diffused aeration systems. *Water Environment Research.* 77 (2) : 128-137.

Rieger, L., Abex, J., Guger, W. and Siegrist 2006. Modelling of aeration systems at wastewater treatment plants. *Water Science & Technology.* 53 (4-5) : 439- 447, IWA Publishing .

Udaya Simha, L.2001. Effect of tank shape on surface aeration. *International Conference on Civil Engineerimg, IISC, Bangalore,* Interline Publishing. 759-763.