Nature Environment and Pollution Technology © Technoscience Publications	Vol. 6	No. 3	pp. 481-484	2007

EVALUATION STUDIES ON AERATION METHODS FOR TREATING SUGAR EFFLUENT IN SUSPENDED-GROWTH AEROBIC REACTOR

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ABSTRACT

The sugar mill effluent is characteristically biodegradable with BOD_5 of 1000-2500 mg/L and COD of 2000-4500 mg/L. The biodegradability varies from 0.3-0.5. The present study evaluates the performance of suspended-growth aerobic reactor, operated under different methods of aeration systems, viz., diffused aeration and surface aeration for treating the sugar mill effluent. The model was run under varying operating conditions, viz., influent flow rates (0.19, 0.38, 0.50, 0.75 and 1.50 L/hr) and influent COD (1036.67, 1526.84, 1995.68, 2549.61 and 3016.72 mg/L). The OLR (0.6498, 0.9725, 1.4125, 1.9651 and 2.5084 kg COD/MLSS day) and HRT (48, 24, 18, 12 and 06 hrs) are interpreted for the respective conditions of flow rate and influent COD. The COD removal was observed for a maximum of 86.73% starting from 65.90% for surface aeration and a maximum of 88.76% from 67.50% COD removal for diffused aeration.

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 the processes and engineered systems. The biological treatment methods (Metcalf & Eddy 2003), where bacteria and other microorganisms are used to remove contaminants by assimilating them has long been a main-stay of wastewater treatment in the sugar mills.

The aeration systems are 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 (Rieger et al. 2006, Udaya Simha 2001) 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 a suspended-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 Figs. 1 and 2.

The surface aeration is incorporated in the model using a turbine blade (9 cm dia), which gets 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/min 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.

Table 1: Physical and process parameters of experimental model.

1. Effective volume of the reactor, litres	:	9
2. Effective size of the reactor, m	:	0.30 × 0.30 × 0.10
3. Influent flow rate, L/h	:	0.19, 0.38, 0.50, 0.75 & 1.50
4. Hydraulic retention time (HRT), hrs	:	6, 12, 18, 24, 48
5. Influent average COD, mg/L	:	1036.67, 1526.84, 1995.68, 2549.61 & 3016.72
6. Organic loading rate, kg COD/kg MLSS/day	:	0.6498, 0.9725, 1.4125, 1.9651& 2.5084

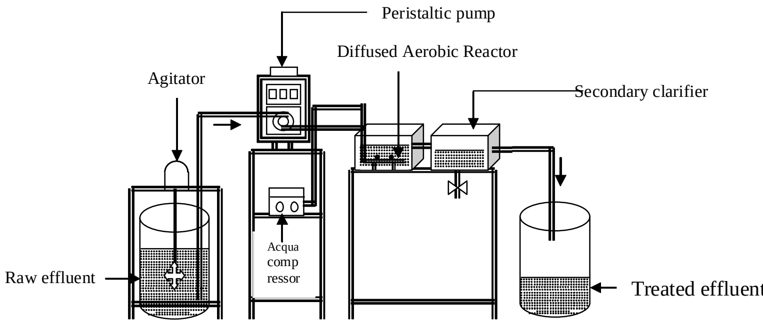

Fig. 1: Experimental model of suspended growth aerobic reactor (diffused aeration).

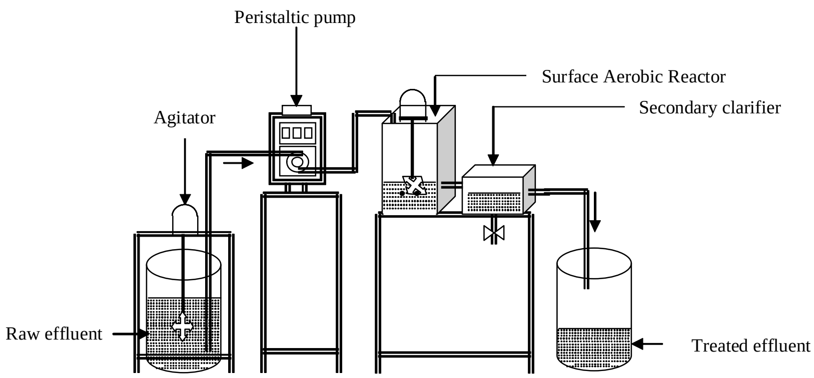

Fig. 2: Experimental model of suspended growth aerobic reactor (surface aeration).

The model was initiated with domestic wastewater, 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 rates and varying influent COD (Connie et al. 2003).

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

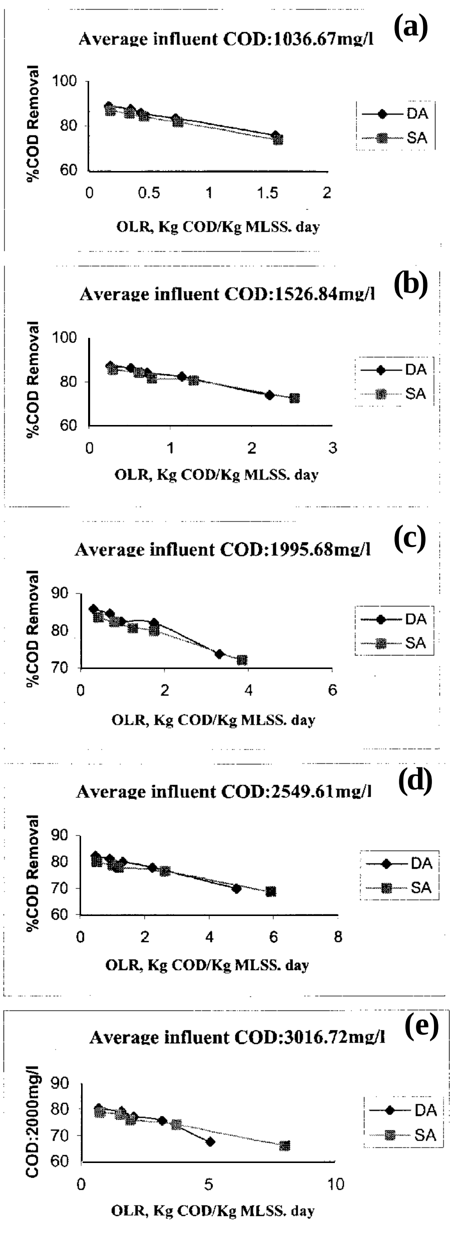

Fig. 3a, b, c, d, e: OLR vs COD removal (varying influent COD)
DA = Diffused aeration
SA = Surface aeration

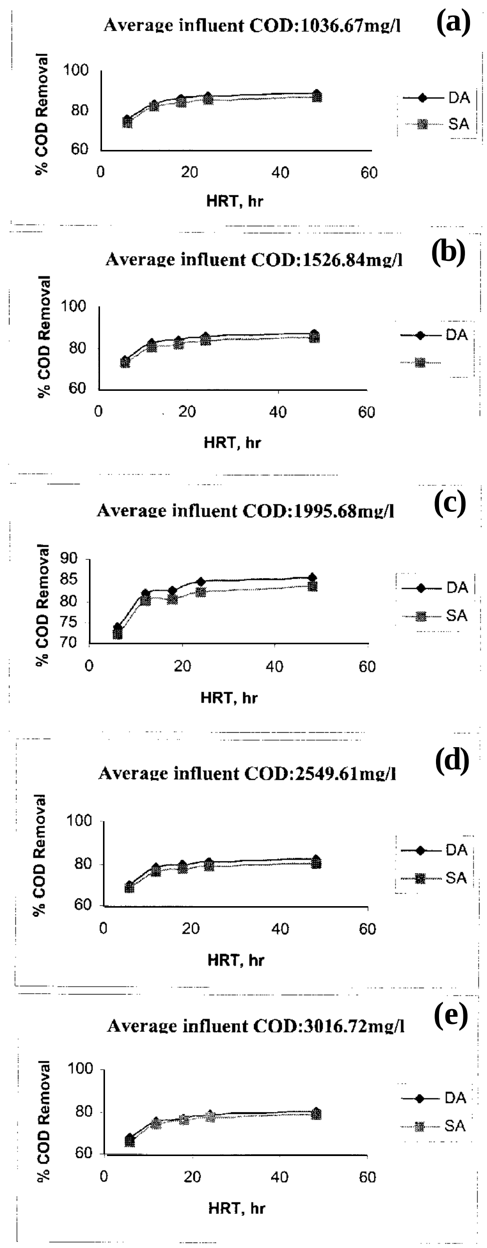

Fig. 4a, b, c, d, e: HRT vs COD removal (varying influent COD)
DA = Diffused aeration
SA = Surface aeration

RESULTS AND DISCUSSION

The COD removal efficiency under varying organic loading rates (0.6633 to 3.1819 kg COD/kg MLSS/day) for different influent COD (1036.67, 1526.84, 1995.68, 2549.61 and 3016.72 mg/L) are presented in Figs. 3 (a, b, c, d, e) for treating sugar mill effluent using surface aeration.

The COD removal efficiency under varying organic loading rates (0.6498 to 2.5084 kg COD/kg MLSS/day) for different influent COD (1036.67, 1526.84, 1995.68, 2549.61 and 3016.72 mg/L) are presented in Figs. 3 (a, b, c, d, e) for treating sugar mill effluent using diffused aeration.

The COD removal efficiency under varying hydraulic retention times (48, 24,18,12 and 06 hrs) for different influent COD values (1036.67, 1526.84, 1995.68, 2549.61 and 3016.72 mg/L) are presented in Figs. 4 (a, b, c, d, e) for treating sugar mill effluent using diffused aeration and surface aeration.

The maximum COD removal efficiency of 88.76% was observed, when the model was run using diffused aeration. This is higher than 86.73% 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.

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