Global Journal of Environmental Research 4 (1): 31-33, 2010
ISSN 1990-925X

Evaluation of Batch Aeration as a Post Treatment for Reducing the Pollution Load of Biomethanated Coffee Processing Waste Water

[1]M. Selvamurugan, [2]P. Doraisamy, [3]M. Maheswari and [4]N.B. Nandakumar

Department of Environmental Sciences,
Tamil Nadu Agricultural University, Coimbatore -641003, Tamil Nadu, India

Abstract: The coffee processing industry is one of the major agro-based industries contributing significantly to the India's national income. Coffee fruits are processed by two methods *viz.,* wet and dry process. In wet processing, coffee fruits generate enormous quantities of high strength wastewater requiring systematic treatment prior to disposal. The present study is attempts to assess the efficiency of batch aeration as post treatment of coffee processing waste water from a UAHR by continuous and intermittent aeration system. Results showed that the maximum BOD, COD and TS removal efficiency of 74.5 %, 68.6 % and 49.3 %, respectively were recorded in biomethanated CPWW aerated continuously. The finding of the study indicated the efficiency of batch aeration in treating wastewater as post treatment of previously treated coffee processing wastewater by the Upflow Anaerobic Hybrid Reactor (UAHR).

Key words: Coffee processing wastewater · Batch aeration · COD · BOD · TS removal

INTRODUCTION

Coffee, which belongs to the genus *Coffea* of rubiaceae family, is one of the most popular beverages consumed throughout the world. Preparation of washed coffee requires pulping and washing equipments and adequate quantity of clean water. The water requirement for production of one tonne of clean coffee is 80,000 litres for Arabica and 93,000 litres for Robusta while using conventional pulper and washer. The resultant wastewater is acidic, containing high amounts of suspended and dissolved organic solids which have the potential to damage the environment [1]. The pollution potential of wastewater and increasing water demand, highlight the need to develop wastewater treatment technology that allows the reduction of pollutants and reuse of effluents. Full scale application of anaerobic treatment of agro-industry effluent has led to quite reasonable organic pollution reductions [2]. Under appropriate operational conditions, anaerobic reactor will remove the organic and suspended solids loads with an efficiency of 70-80 %. However in many cases the produced effluent will require a post treatment step to produce a final effluent quality that is compatible with the standards set by the environmental control authorities [3]. Aeration is a well developed technology which has been used by the industries for years to stabilize waste solids, as well as to control odor. It is the process of bringing about contact between air and water for the purpose of promoting biological degradation. In wastewater treatment processes, aeration introduces air into a liquid, providing an aerobic environment for microbial degradation of organic matter. Secondary treatment in the form of batch aeration process aims at the oxidation and removal of soluble and finely divided suspended materials not removed by the previous treatments. Although application of the aeration process as secondary treatment was proposed, the treated effluent still remained unacceptable in the case of high organic matter containing wastewater; thus, it is necessary to implement a proper post-treatment technology. To ensure that an effluent quality that complies with the Central Pollution Control Board (CPCB) Standards for the effluent discharge, the subject of this work was to assess the efficiency of aeration for post treatment of biomethanated coffee processing wastewater.

Corresponding Author: M. Selvamurugan, Department of Environmental Sciences, Tamil Nadu Agricultural University, Coimbatore -641003, Tamil Nadu, India

MATERIALS AND METHODS

A batch aeration experiment was conducted to assess the reduction in pollution load of coffee processing waste water previously treated by anaerobic high rate reactor. The biomethanated CPWW using UAHR was used as a feed for batch aeration. In this experiment, seven litres of biomethanated coffee processing waste water (CPWW) was taken in plastic buckets of 10 litres capacity and aerated using a mini aerator. The flow rate of mini aerator was calculated as 0.98 litres/min. The biomethanated coffee processing waste water was aerated continuously and intermittently based on the treatment details given below.

Treatments:

T_1 - Biomethanated CPWW without aeration (control);
T_2 - Biomethanated CPWW + continuons aeration (24 hr)
T_3 - Biomethanated CPWW + Intermittent aeration (12 hr interval)
T_4 - Biomethanated CPWW + Intermittent aeration (6 hr interval)
T_5 - Biomethanated CPWW + Intermittent aeration (3 hr interval)

The experiment was conducted for 8 days duration. The MLSS concentration of 1.5-2.0 g L^{-1} was maintained for all the treatments. The samples were drawn at 24 hours interval and analyzed for changes in pH, EC, total solids, biochemical oxygen demand and chemical oxygen demand according to the standard methods of APHA [4].

RESULTS AND DISCUSSION

The biomethanated CPWW using UAHR was treated through batch aeration. The biomethanated CPWW had a pH of 6.30 and EC of 0.50 dSm^{-1}. The BOD, COD and TS of feed were 1120, 2200 and 1420 mg L^{-1}, respectively. During aeration, the pH of the treated effluent increased continuously upto eight days irrespective of the treatments. In general, continuous aeration of biomethanated CPWW performed significantly better compared to intermittent aeration. Continuous aeration (24 hr) of CPWW has the maximum increase in pH to the level of 7.20. It was followed by intermittent aeration of 12 hr and 6 hr intervals, which registered an increase in pH level of 6.80 and 6.76, respectively. Both continuous and intermittent aeration reduced the EC of CPWW. Among the treatments, biomethanated CPWW aerated continuously (24 hr) resulted in maximum decrease in EC level of 0.23 dSm^{-1} followed by intermittent aeration of 12 hr and 6 hr intervals, which recorded a decrease in EC level of 0.28 dSm^{-1} and 0.32 dSm^{-1}, respectively. Changes in BOD_5 of the wastewater during batch aeration are demonstrated in Fig. 1. The BOD_5 of the biomethanated CPWW recorded a gradual decline during the experimental period. The maximum BOD reduction was recorded in biomethanated CPWW and aerated continuously when compared to intermittent aeration. Maximum reduction in BOD was recorded on eighth day in biomethanated CPWW aerated continuously for 24 hr (74.5 %) followed by biomethanated CPWW aerated intermittently at 12 hr intervals, 6 hr intervals and 3 hr intervals (62.0, 54.4 and 48.2 % of BOD reduction, respectively). This may be due to the increased dissolved oxygen resulting in increased the activity of microorganism. The BOD removal efficiency of 98.98 % was achieved by Vishnumurthi [5] in the treatment of domestic waste water through diffused aeration system inoculated with mixed cultures.

Figure 2 shows the changes in COD of the wastewater during batch aeration. Biomethanated CPWW aerated continuously (24 hr) recorded the maximum COD reduction of 68.6 %. The treatments without aeration recorded the least COD reduction (24.5 %) compared to the aeration treatments. This may be due to the increased dissolved oxygen in the biomethanated CPWW through diffused aeration. Due to enhanced oxygen supply, the aerobic decomposition of remaining organic matter was increased by microbes resulted in the higher COD reduction.

Changes in TS of the wastewater during batch aeration are illustrated in Fig. 3. Similar to COD and BOD reduction, the maximum TS reduction of 49.3 % was recorded in biomethanated CPWW aerated continuously (24 hr). This may be due to the continuous degradation of organic substances present in the CPWW by microorganisms and the settling down of degraded material in the bottom of the aeration system. This is in accordance with the findings of Choudhurry *et al.,* [6], who obtained a TS reduction of 54 % in the treatment of Kraft paper mill effluent through sequence batch aeration system. Table 1 presents the changes in the characteristics of biomethanated CPWW after batch aeration experiment. Among the different treatments, continuous aeration (24 hr) performed better in reducing the pollution load, recording 74.5 %, 68.6 % and 49.3 % reduction of BOD, COD and TS, respectively.

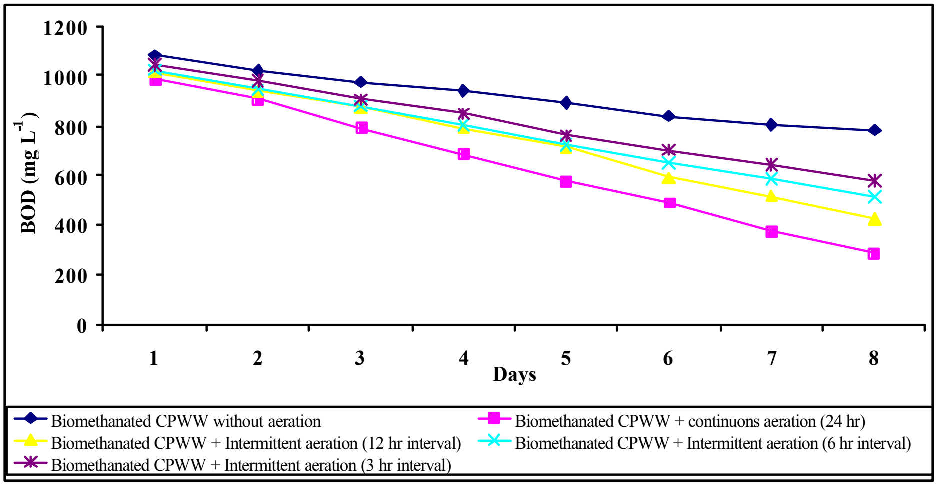

Fig. 1: Changes in BOD (mg L^{-1}) of the biomethanated coffee processing wastewater during batch aeration

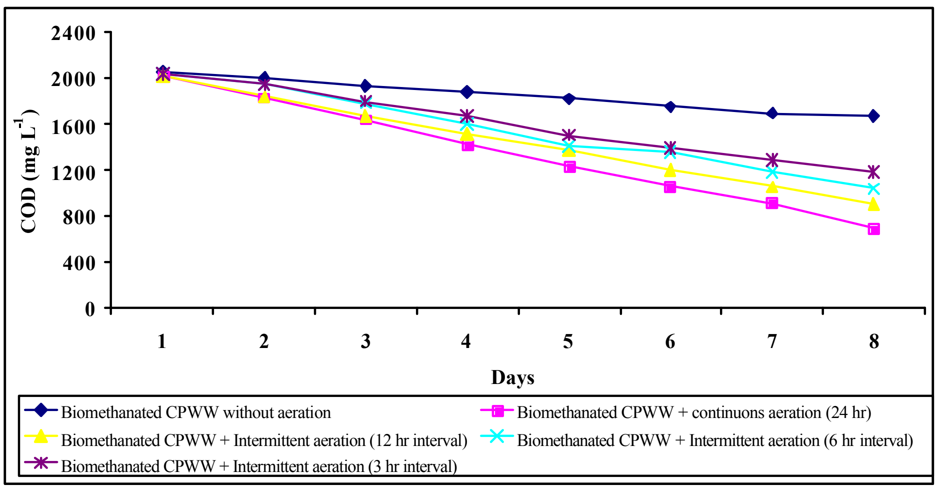

Fig. 2: Changes in COD (mg L^{-1}) of the biomethanated coffee processing wastewater during batch aeration

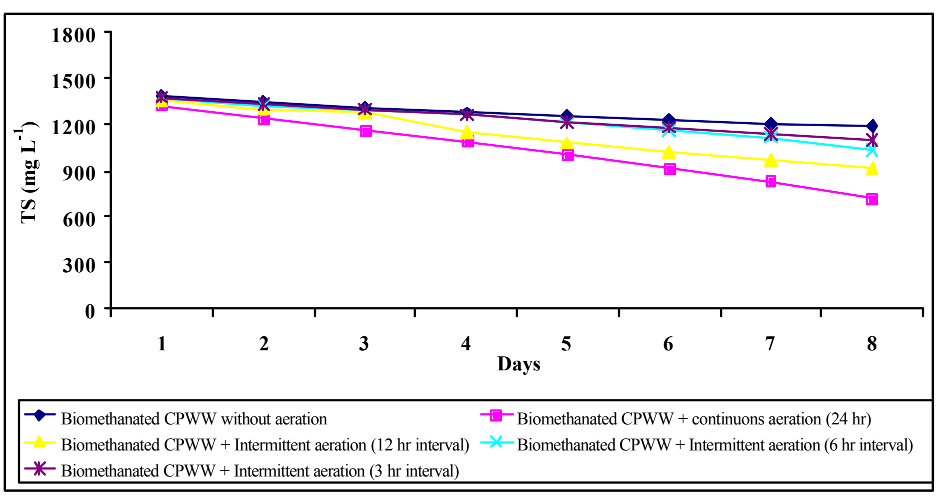

Fig. 3: Changes in TS (mg L^{-1}) of the biomethanated coffee processing wastewater during batch aeration

Table 1: Changes in characteristics of biomethanated CPWW after batch aeration experiment

Parameters	Without aeration	Continuous aeration (24 hr)	Intermittent aeration (12 hr)	Intermittent aeration (6 hr)	Intermittent aeration (3 hr)
pH	6.51	7.20	6.80	6.78	6.65
EC (dSm^{-1})	0.41	0.23	0.28	0.32	0.35
BOD reduction (%)	30.3	74.5	62.0	54.4	48.2
COD reduction (%)	24.5	68.6	59.1	52.9	46.6
TS reduction (%)	16.2	49.3	35.5	27.4	22.8

CONCLUSION

From the results it could be concluded that a batch aeration system can satisfactorily reduce the level of pollutants as post treatment in biomethanated coffee processing wastewater using Upflow Anaerobic Hybrid Reactor (UAHR). Hence, the anaerobic treatment through UAHR as core treatment followed by batch aeration as the post treatment system is considered as suitable treatment system for the coffee processing waste water as an eco-friendly approach.

ACKNOWLEDGEMENT

The authors thank the Government of India, Coffee Board, Chickmagalur, Karnataka, India, for financing this work through a Project on “Bio-processing technologies for the value addition of coffee processing wastes”.

REFERENCES

1. Shanmukhappa, D.R., R.P. Ananda alwar and C.S. Srinivasan, 1998. Water pollution by coffee processing units and its abatement. Ind. Coffee, 10: 3-9.
2. Frankin, R.J., 2001. Full scale experiences with anaerobic treatment of industrial waste water. Wat. Sci. Tech., 44(8): 1-6.
3. Sousa, J.T., A. De Van Haandel and A.V.A. Guimaraes, 2001. Post-treatment of anaerobic effluents in constructed wetland systems. Wat. Sci. Tech., 44(4): 213-219.
4. APHA, 1992. Standard methods for examination of water and wastewater. 16th Edition (Pub.) American public Health Association, Washington, USA.
5. Vishnumurthi, R., 2004. Sequencing batch reactor: An efficient alternative to waste water treatment. In: Proc. of National seminar on emerging treatment technologies for high and medium strength waste waters, Mysore, January, pp: 36-54.
6. Choudhury, S., R. Rohella, M. Manthan and N. Sahoo, 1998. Decolourization of kraft papermill effluent by white- rot fungi. Indian J. Microbiol., 38: 221-224.