



The efficiency of anaerobic baffled reactor (ABR) for wastewater prepared from chicken manure

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Abstract

This research aimed to examine the effectiveness of anaerobic baffled reactor (ABR) for treating wastewater prepared from chicken manure. The biodegradable ability (BOD_5/COD) of synthetic wastewater which was prepared from chicken manure was 0.55, this implied that the synthetic wastewater was fairly high biodegradable. The COD removal efficiency was in the range of 87.56-92.79%. The ABR also treated some physical characteristics i.e., color and turbidity.

Keywords: Anaerobic baffle reactor (ABR), COD removal, Chicken manure

1. Introduction

Anaerobic waste treatment is a promising technology due to its better energy saving than aerobic treatment process because no oxygen supply is required in the system. The other advantages of this technique are low production of excess sludge and its byproduct, methane gas, is used as an alternative energy [1].

Anaerobic Baffled Reactor (ABR) is an anaerobic waste treatment technology modified from Rotating Biological Contactor (RBC) in which its rotating discs are removed and baffles are inserted along the chamber instead. There are many advantages of the ABR, e.g., no mechanical moving parts, low sludge production, high stability for shocking loads [2]. The efficiency of ABR depends on many factors, i.e., organic matters in wastewater, treatment operations, toxic substances. This research aims to examine the effectiveness of anaerobic baffled reactor for treating wastewater prepared from chicken manure.

2. Materials and methods

2.1 Reactor configuration

The rectangular reactor which was made from transparent acrylic material was used as ABR. The laboratory scale ABR with working volume of 10 liters was separated into five compartments (Figure 1.). The ABR reactor was connected to the storage tank of chicken manure wastewater the flow rate of which was controlled by the peristaltic pump.

2.2 Synthetic wastewater preparation

Chicken manure was collected from a poultry farm in Khon Kaen Province, and dried under sunlight. The coarse dry chicken manure was ground and passed through mesh No.16. The fine grain dry chicken manure of 50 g was mixed with 10 liters of water and was filtered with cloth net to remove solid residue. The chicken manure wastewater characteristics are presented in Table 1.

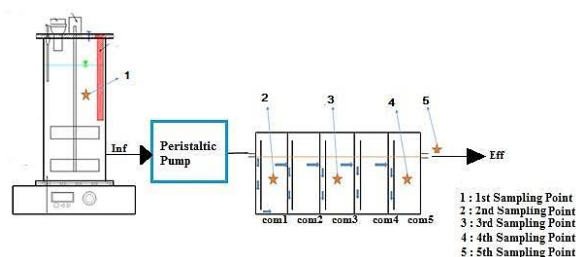


Figure 1 Schematic diagram of anaerobic baffled reactor

Table 1 Characteristics of wastewater prepared from chicken manure

parameters	range	average
pH	7.8-6.6	7.6
TKN (mg/L)	78.8-67.71	70.5
TSS (mg/L)	397.8-246	357
BOD (mg/L)	256-234	244
COD (mg/L)	663-569	616

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2.3 Start up and operation

Anaerobic sludge from a cover lagoon where its substrate is fresh chicken manure was used as seed sludge in the ABR. In the early stage, the seed sludge of 5 liters was mixed with 20% of synthetic wastewater concentration. Next, the volumetric wastewater was gradually increased to 100% of its loading.

2.4 Analytical methods

During the experiment, the samples were collected from wastewater storage tank and outlet. The analysis parameters, i.e., pH, biological oxygen demand (BOD), chemical oxygen demand (COD), Suspended Solids (SS), and TKN, were measured following the standard method [3].

3. Results and discussion

3.1 Wastewater characterization

From the biodegradable ability analysis of the prepared chicken manure wastewater, the results showed that BOD5 and COD were 244 mg/l and 414 mg/l. The BOD5/COD relationship was found to be 0.55. This implied that this synthetic wastewater was fairly high biodegradable when the ratio was compared with other researchers' results, i.e., 0.66-0.72 [4] and 0.77 [5]. The parameters might result from the fact that the wastewater in this research was prepared from dry chicken manure, whereas other studies used fresh chicken manure. The other characteristics were examined, i.e., pH, Total Suspended Solids (TSS), and TKN, and the results were 7.6, 357 mg/l, and 70.5 mg/l, respectively.

3.2 ABR efficiency

After twelve days of the start-up with the hydraulic retention time (HRT) of 12 days (with the flow rate of 20 L/day), the system entered into a steady state. The water samples had been continuously collected for 18 days. The COD removal efficiency was in the range of 87.56-92.79%. (Figure 2.). The physical characteristic of influent and effluent was presented in Figure 3 which the influent showed significant high color and turbidity whereas the effluent showed lower color and turbidity than the influent. It illustrated that the ABR also treated color and turbidity.

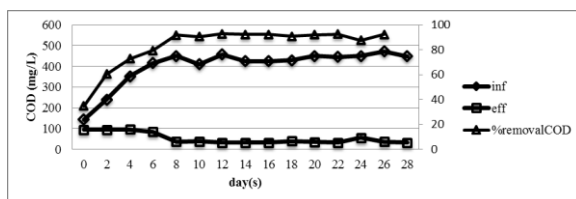


Figure 2 Efficiencies of ABR performance with HRT 12 days



Figure 3 Physical characteristic of (a) influent and (b) effluent

4. Conclusion

The ABR in this research successfully treated wastewater which was prepared from chicken manure. The reactor showed high efficiency to treat COD and it also showed capability to treat color and turbidity. For further study, the efficiency of TKN and nitrate removal should be examined.

5. Acknowledgements

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6. References

- [1] Gopala Krishna, GVT, Kumar P, Kumar P. Treatment of low-strength soluble wastewater using an anaerobic baffled reactor (ABR). *Journal of Environmental Management* 2009;90(1):166-176.
- [2] Barber WP, Stuckey DC. The use of the anaerobic baffled reactor (ABR) for wastewater treatment: a review. *Water Research* 1999;33(7):1559-1578.
- [3] American Public Health Association (APHA, AWWA, LWPCT). *Standard Methods for the Examination of Water and Wastewater*. 18th ed Washington: APHA; 1995.
- [4] Gangagni Rao A, Sasi Kanth Reddy T, Surya Prakash S, Vanajakshi J, Johnny J, Annapurna J, et al. Biomethanation of poultry litter leachate in UASB reactor coupled with ammonia stripper for enhancement of overall performance. *Bioresource Technology* 2008;99(18):8679-8684.
- [5] Atuanya EI, Aigbirior M. Mesophilic Biomethanation and Treatment of Poultry Waste-Water Using Pilot Scale UASB Reactor. *Environmental Monitoring and Assessment* 2002;77(2):139-147.