Performance of Anaerobic Hybrid Reactor for the Generating Biogas of the High-Strength Fresh Leachate from a Municipal Waste Transfer Station

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INTRODUCTION

Municipal solid waste (MSW) transfer station is a facility to receive the production source of MSW before the waste is transported to landfills. The On-Nut transfer station is the largest transfer station in Thailand, which receives approximately 3,800-4,000 tons of MSW per day from Bangkok. The transfer station's fresh leachate characteristic has a high chemical oxygen demand (COD) concentration and toxin. Chiemchaisri, C., Chiemchaisri, W. et al. (2009) studied Thailand's young leachate characteristic; they found that the pH value was 3.34-6.50. Typically, the On-Nut transfer station's fresh leachate was treated by an anaerobic continuously stirred tank reactor (CSTR). CSTR systems might fail with high organic influent. An anaerobic hybrid reactor (AHR) is mixed up-flow anaerobic sludge blanket (UASB) with up-flow anaerobic fixed film (UAF) for high performance of leachate treatment and biogas production efficiency. This research aims to study the performance of AHR for treating fresh leachate and generating biogas for renewable energy.

MATERIALS AND METHODS

The fresh leachate in the experiments was the raw fresh leachate from the On-Nut waste transfer station, Bangkok, Thailand. The chemical characteristic of fresh leachate had a COD of 100,181 mg/l, BOD_5 of 71,000 mg/l., and pH of 4.36. The lab-scale AHR, which is 20 cm in diameter and 1.0 m in height, is acrylic pipe. The AHR schematic diagram this study is shown in (Figure 1). As carrier material, nylon fiber was hung vertically in AHR. This study was carried for 220 days. The start-up phase took about 60 days with leachate addition. This study was operated OLR period 1 to 30 kg COD/m^3/d. Sludge retention time was adjusted to 15 days.

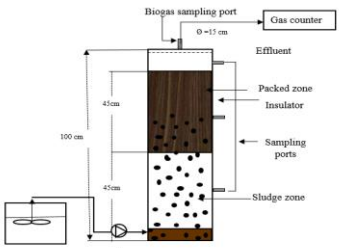

Figure 1 Anaerobic hybrid reactor schematic diagram

RESULTS AND DISCUSSION

The results of AHR

The results of this study are summarized and presented in Table 1. When increasing the OLR in the system, the results show that pH decreases lowest in the range of increasing OLR from 25 to 30 kg / m^3.d. When OLR increases to 20 (kg COD/m^3./d) , Total Volatile fatty acid (TVA) of AHR is unstable. The best methane quality gets from the OLR at rate of 15 kg COD/m^3/d. Total suspended solids (TSS) in the lower systems had the highest concentration. In conclusion, AHR has excellent sediment retention. When OLR increases, the system's volatile suspended solid (VSS) value increases.

Table 1 Anaerobic hybrid reactor performance in this study

Parameters	Reactor Performance deferent OLR (kg/m^3/d)					
	1	**5**	**10**	**15**	**20**	**30**
pH	6.5-8	>8.0	6.5-8	< 7.0	7.0-7.5	7.0-7.5
ALK(mg $CaCO_3$/L)	900-1,700	900-1,700	1,000-1,500	1,000-1,500	Fluctuating	800-1,200
TVA(mg acetic acid/l)	300-650	150-400	< 500	> 500	Fluctuating	Fluctuating
TVA/ALK ratio	< 0.4	< 0.4	< 0.4	> 0.4	>0.5	> 1.2
VSS/TSS	0.2-0.5	0.2- 0.6	0.6	0.6	0.4-0.6	0.4-0.6
% Methane	55.10	51.80	47.80	61.10	54.30	29.00
% COD remover	13-84	61-75	74-76	74-84	84-85	85-86
Stability	Normal	Normal	Normal	Normal	Unstable	Failed

CONCLUSION

This research found the AHR used for treating fresh leachate should control the OLR not more than 20 kg COD/m^3/d. The optimal OLR for operating AHR is 15 kgCOD/m^3/d.with HRT of seven days in ambient temperature conditions. For further studies, highly efficient biogas production with the AHR series should be studied.

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