Performance of a UASB reactor for low-strength wastewater treatment under different hydraulic loading rates

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Received 5 January 2018; Accepted 3 August 2018

ABSTRACT

Upflow anaerobic sludge blanket (UASB) reactors have been used widely to treat high-strength wastewater. In this study, UASB reactor was operated in order to determine organic matter removal and methane production from low-strength synthetic and real wastewater. Also the optimum value of several parameters, specifically organic loading rates (OLRs) and hydraulic retention time (HRT), were investigated. While feeding synthetic wastewater, removal efficiencies of soluble chemical oxygen demand (SCOD) were around 97%, and methane production was around 0.2 L CH$_4$/g SCOD removed. Its methane content was 73% at HRT of 6.1 h (OLR of 1.8 kg chemical oxygen demand [COD]/m$^3$ d). With real domestic wastewater, removal efficiencies of SCOD were found to be 62%. Biogas production was 0.5 L/d, of which the methane content was 55%. At HRT of 5.7 h, methane gas yield was 0.19 L CH$_4$/g SCOD removed, indicating that optimum HRT is around 6 h in synthetic and real wastewater condition. In both conditions, biogas and methane production decreased with the decrease of HRT. At all HRT conditions, the decrease of pH was not observed; however, washout of volatile fatty acid increased with decrease of HRT. Compared with UASB fed with high-strength wastewater, it was found that HRT was most important parameter for the operation of UASB fed with low-strength wastewater. In addition, utilization of COD for biogas production and for cell production accounted for 68% and 14% at HRT of 6.1 h for synthetic wastewater, respectively.

Keywords: Hydraulic retention time; Low-strength wastewater; Methane gas yield; Upflow anaerobic sludge blanket; Organic loading rate