Influence of Recirculation Flow Rate on the Performance of Anaerobic Packed-bed Bioreactors Treating Potato-Waste Leachate

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A. Mshandete, M.Murto, A.K. Kivaisi, M.S.T. Rubindamayugi & B. Mattiasson

Abstract

The performance of anaerobic, packed-bed bioreactors treating leachate from potato waste was evaluated in terms of organic loading rate (OLR) as well as the recirculation flow rate. Two 1 litre bioreactors, filled with porous glass beads as biofilm carriers and with continuous recirculation flow rates of 10 ml min^{-1} and 20 ml min^{-1} respectively, were used in the experiment. The OLR applied to each bioreactor was increased stepwise from 4 to 12 kg chemical oxygen demand (COD) $m^{-3}d^{-1}$ by increasing feed flow rate. The methane yields decreased with increasing OLR in both bioreactors. The methane yield for the bioreactor with the lower recirculation flow rate ranged between 0.10 and 0.14 m^3CH_4 kg COD^{-1} removed, while for the other bioreactor it was 0.14–0.20 m^3 CH_4 kg COD^{-1}removed. Both bioreactors demonstrated stable COD removal which was around 95% for the bioreactor with lower flow of recirculation while for the other it was 92%, over a range of OLRs of 4–8 kg COD $m^{-3}d^{-1}$. The bioreactor with the lower recirculation flow rate showed operational stability when a high OLR, namely 12 kg COD $m^{-3}d^{-1}$, was applied, while the other one became overloaded. There was an accumulation of volatile fatty acids which gave a corresponding drop in pH because the system had a low buffering capacity and this thus ultimately led to process failure. This study demonstrated the suitability of a packed bed bioreactor operated at lower recirculation flow rate for treating leachate from potato waste.

Keywords: Porous Glass Beads, Organic Loading Rate, Methane, Potato Rejects