



Performance of an up-flow anaerobic sludge bed (UASB) reactor for treating landfill leachate containing heavy metals and formaldehyde

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ABSTRACT

Municipal solid waste landfill leachate is of serious environmental concern and is treated using various methods, mostly involving biological treatment. In the present study, an up-flow anaerobic sludge bed (UASB) was used for the treatment of matured landfill leachate that contains heavy metals (As, Fe, Ni, and Cd) and formaldehyde (FA). The organic loading rate (OLR) to the UASB, as measured by the chemical oxygen demand (COD), was gradually increased from 0.125 to 2.5 kg m⁻³ d⁻¹. The process performance of the reactor was characterized in terms of pH, COD removal, volatile fatty acid (VFA) production and methane composition. Results showed that with a hydraulic retention time of 4 d and an OLR of 0.125 kg COD m⁻³ d⁻¹, up to 79.04% COD removal efficiency was observed. However, when the OLR was increased gradually from 0.375 to 2.5 kg COD m⁻³ d⁻¹, the COD removal efficiency decreased to 9.33%, suggesting that the accumulation of heavy metals may have inhibited the methanogenic microorganism activity. Under the high COD loading conditions, the heavy metal and FA concentrations were 9.40 (As), 0.43 (Fe), 0.50 (Ni), 12.80 (Cd) and 8.60 (FA) mg L⁻¹. The removal of Cd, Ni and Fe was almost constant regardless of the OLR (around 36% for Cd, 32% for Ni and 29% for Fe). As and FA displayed a degree of removal at low OLR (40% and 17% at 0.125 and 0.833 kg COD m⁻³ d⁻¹, respectively), but at high OLR (2.5 kg COD m⁻³ d⁻¹), both As and FA decreased dramatically (3.83% and 7.81%, respectively).

Keywords: Formaldehyde; Heavy metals; Landfill leachate; UASB

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