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Impacts of blackwater co-digestion on biogas production in the municipal wastewater treatment sector using pilot-scale UASB and CSTR reactors

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ABSTRACT

The performance of two pilot-scale anaerobic reactors for blackwater co-digestion was studied as an attempt to investigate the transition of current wastewater infrastructures to source-separated sanitation. The focus of this study was to assess the feasibility of blackwater co-digestion at conventional wastewater treatment plants. Two scenarios were investigated; in scenario one, blackwater was co-digested with municipal sewage sludge in a 630 L continuous stirred-tank reactor (CSTR). In scenario two, blackwater was digested alongside high-strength municipal wastewater (concentration peak) in a 720 L upflow anaerobic sludge blanket (UASB) reactor. For CSTR operation, increasing methane yields from 222 to 332 L CH_4 kg/$COD_{removed}$ were achieved by enhancing the blackwater fraction at the reactor inlet from 0% to 35% (% total influent load as COD_{BW}/COD_{tot}). The observed COD removal ranged from 60% to 78% at 0.9–1.6 kg COD/(m^3·d). For UASB operation, COD removals of 57%–67% were reported at COD loading rates of 6.1–8.4 kg/(m^3 d). Removal of organic matter was successfully carried out in both reactors, yet blackwater co-digestion alongside raw sludge (CSTR) proved to be more advantageous to the plant in terms of overall biogas production. The results also indicate that municipal digesters can be successfully integrated in transition strategies for resource-oriented sanitation, thus potentially increasing energy utilization in the plant.

Keywords: Anaerobic treatment; Biogas yield; COD removal, Source-separated sanitation systems; Transition states

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