

The effect of mixing on methane production in a semi-commercial closed digester tank treating palm oil mill effluent

ABSTRACT

The performance of a semi-commercial closed digester tank treating palm oil mill effluent (POME) was studied at four different mixing regimes i.e natural mixing (NM), minimal horizontal mixing (MHM), minimal horizontal and vertical mixing (MHVM) and vigorous mixing (VM). The chemical oxygen demand (COD) removal efficiency recorded satisfactory result at higher than 90% when subjected to the first three mixing regimes but reduced to the lowest of 85% when VM was applied. In the NM, MHM and MHVM experiments, the maximum total volatile fatty acids (VFA) concentration in the digester was recorded below the critical level of 1000 mg L⁻¹. The MHM gave the highest methane productivity at 1.4 m³ m⁻³ d⁻¹ in comparison to NM at 1.0 m³ m⁻³ d⁻¹ and MHVM at 1.1 m³ m⁻³ d⁻¹. This indicates minimal mixing was required to provide good contact between substrate and microorganisms inside the digester and to release the entrapped biogas at the bottom of the digester. The VM on the other hand was discovered to inhibit the methane production process as methane was not produced at the end of the experiment and total VFA concentration was also recorded high at 3700 mg L⁻¹. The high total VFA concentration in the system may have disrupted the syntrophic relationship between acidogens and methanogens and inhibited the methanogenesis.

Keyword: Palm oil mill effluent; Anaerobic treatment; Methane; Biogas; Mixing