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Optimization of Sequential Thermophilic Bio-Hydrogen/Methane Production from Mono-Ethylene Glycol via Anaerobic Digestion: Impact of Inoculum to Substrate Ratio and N/P Ratio

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Abstract : This investigation aims to assess the effect of inoculum to substrate ratio (ISR) and nitrogen to phosphorous balance on simultaneous biohydrogen and methane production from anaerobic decomposition of mono-ethylene glycol (MEG). Different ISRs were applied in the range between 2.65 and 13.23 gVSS/gCOD, whereas the tested N/P ratios were changed from 4.6 to 8.5; both under thermophilic conditions (55°C). The maximum obtained methane and hydrogen yields (MY and HY) of 151.86±10.8 and 22.27±1.1 mL/gCODinitial were recorded at ISRs of 5.29 and 3.78 gVSS/gCOD, respectively. Unlikely, the ammonification process, in terms of net ammonia produced, was found to be ISR and COD/N ratio dependent, reaching its peak value of 515.5±31.05 mgNH4-N/L at ISR and COD/N ratio of 13.23 gVSS/gCOD and 11.56. The optimum HY was enhanced by more than 1.45-fold with declining N/P ratio from 8.5 to 4.6; whereas, the MY was improved (1.6-fold), while increasing N/P ratio from 4.6 to 5.5 with no significant impact at N/P ratio of 8.5. The results obtained revealed that the methane production was strongly influenced by initial ammonia, compared to initial phosphate. Likewise, the generation of ammonia was markedly deteriorated from 535.25±41.5 to 238.33±17.6 mgNH4-N/L with increasing N/P ratio from 4.6 to 8.5. The kinetic study using Modified Gompertz equation was successfully fitted to the experimental outputs (R2 > 0.9761).

Keywords : mono-ethylene glycol, biohydrogen and methane, inoculum to substrate ratio, nitrogen to phosphorous balance, ammonification
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