

## **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  $151.86 \pm 10.8$  and  $22.27 \pm 1.1$  mL/gCOD<sub>initial</sub> 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  $515.5 \pm 31.05$  mgNH<sub>4</sub>-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  $535.25 \pm 41.5$  to  $238.33 \pm 17.6$  mgNH<sub>4</sub>-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 ( $R^2 > 0.9761$ ).

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

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