Harnessing renewable hydrogen-rich syngas from valorization of palm oil mill effluent (POME) using steam reforming technique

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ABSTRACT

Valorization of palm oil mill effluent (POME) over a sol-gel synthesized lanthanum nickel trioxide ($LaNiO_3$) catalyst via steam reforming pathway was investigated from 573 to 1173 K. The blank run (steam reforming) at 873–1173 K neutralized the acidic POME with complete total suspended solids (TSS) removal, which accomplished >88% chemical oxygen demand (COD) removal, >97% 5-days biochemical oxygen demand (BOD_5) removal, and >95% decolourization. From 773 K onwards, $LaNiO_3$greatly enhanced syngas production from POME steam reforming. The principal role of $LaNiO_3$ was to enhance the syngas production. The XRD, FESEM-EDX, and TPO results of spent $LaNiO_3$ were also correlated with gaseous product profiles to scrutinize its catalytic effects. At an optimum temperature of 873 K, catalytic POME steam reforming over $LaNiO_3$ generated 73.91 µmol/min of H_2-rich syngas (H_2:CO ratio of 107.88). Withal, the aforesaid system was able to neutralize the acidic POME feedstock and eliminate its TSS content while reduced 98.38% COD, 99.10% BOD_5, and 99.52% colour intensity.

KEYWORDS:

Lanthanum nickel trioxide; Palm oil mill effluent; Steam reforming; Syngas; Valorization