Experimental evaluation and empirical modelling of palm oil mill effluent steam reforming

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ABSTRACT

The current work describes a novel application of steam reforming process to treat palm oilmill effluent (POME), whilst co-generating H_2-rich syngas from the treatment itself. The effects of reaction temperature, partial pressure of POME and gas-hourly-space-velocity (GHSV) were determined. High crystallinity 20 wt%Ni/80 wt%Al_2O_3 catalyst with smooth surface was prepared via impregnation method. Baseline runs revealed that the prepared catalyst was highly effective in destructing organic compounds, with a two-fold enhancement observed in the presence of 20 wt% Ni/80 wt%Al_2O_3 catalyst, despite its low specific surface area (2.09 $m^2\ g^{-1}$). In addition, both the temperature and partial pressure of POME abet the COD reduction. Consequently, the highest COD reduction of 99.7% was achieved, with a final COD level of 73 ± 5 ppm from 27,500 ppm, at GHSV of 40,000 mL/h.g_{cat} and partial pressure of POME equivalent to 95 kPa at 1173 K. In terms of gaseous products, H_2 was found to be the major component, with selectivity ranged 51.0%–70.9%, followed by CO_2(17.7%–34.1%), CO (7.7%–18.4%) and some CH_4 (0.6%–3.3%). Furthermore, quadratic models with high R^2-values were developed.

KEYWORDS:

Palm oil mill effluent; Steam reforming; Syngas; Quadratic models