

A study into syngas production from catalytic steam reforming of palm oil mill effluent (POME): A new treatment approach

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ABSTRACT

This paper reports on the novel application of catalytic steam reforming process to convert palm oil mill effluent (POME) into syngas over a 20wt%Ni/80wt%Al₂O₃ catalyst. The catalyst possessed high degree of crystallinity and was impurity-free, judging from the obtained XRD pattern. Furthermore, the BET specific surface area of catalyst was low (2.09 m² g⁻¹), consistent with smooth surface captured by the FESEM images. CO₂-desorption and NH₃-desorption profiles showed a presence of both acid and basic sites on the surface of catalyst. In the absence of catalyst, about 7.0% reduction of chemical oxygen demand (COD) was achieved at 6.0 mL h⁻¹ flow rate of POME, reforming temperature of 873 K and 20 mL min⁻¹ of N₂-flow. Significantly, the COD reduction shot up to 93.7% in the presence of catalyst and liquid-hourly-space-velocity (LHSV) of POME of 90 mL h⁻¹ gcat⁻¹ at 873 K. The corresponding biochemical oxygen demand (BOD) reduction recorded was 93.8%. However, normalized carbon loss indicates that a high LHSV would favour carbon deposition. In addition to high LHSV, the carbon deposition was also influenced by reaction temperature. High reaction temperature has reduced carbon deposition, as well as organics removal. COD reduction was 99.41% and BOD reduction was 99.52% at 1173 K when LHSV was 60 mL h⁻¹ gcat⁻¹. In the gas phase, four species were consistently detected, viz. H₂, CO₂, CO and CH₄, with H₂ as the major component. The H₂ selectivity increased with both LHSV and reaction temperature.

Keywords:

Palm oil mill effluent; Steam reforming; Syngas; Waste treatment

Introduction

With the increasing population growth, food consumption, particularly palm oil, is also on the upward trajectory. Over the past decades, the production of palm oil is dominated by

Indonesia and Malaysia, with a combined production of 85% [1]. In Malaysia, palm oil industry is the most important agro-based industry, with a total production of 37.2 million tons of crude palm oil for the past two years [2]. Consequently, more arable land has been converted into oil palm plantation,

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