Hydrogen-rich syngas production via steam reforming of palm oil mill effluent (POME) — A thermodynamics analysis

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ABSTRACT

In current paper, thermodynamics study of palm oil mill effluent (POME) steam reforming was performed to investigate its feasibility for syngas production. By using the minimi-zation of total Gibbs free energy method, the thermodynamic simulation is executed to study the effect of reaction temperature (573—1173 K) on product yield (Y_i) and syngas ratio (H_2:CO). Based on preliminary analysis, the POME liquor composed of 99.73% water and 0.27% organic contents by mole. Complete conversion of POME's organic contents is accomplished regardless of reforming temperature. However, the equilibrium constant reveals that not every organic constituent in POME are reformed into syngas via steam reforming at ≤673 K, so their disappearance hints at the occurrence of thermal decom-position. The steam reforming of all organic contents in POME is only viable at ≥773 K. From POME steam reforming at 573—1173 K, H_2-rich syngas (H_2:CO ratio = 25—3457) is produced. For syngas production, the optimum temperature is 1073 K because it gives highest Y_{syngas} (58348 μmol syngas/mol POME) with a $Q_{required}$ of 12.05 kJ/mol POME. In a nutshell, the POME steam reforming is an alluring process that viable for syngas produc-tion as it potentially mitigates the environmental issue inflicted by palm oil processing.

Keywords: Thermodynamics; Steam reforming; Palm oil mill; effluent Hydrogen

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Introduction

By its versatility and accessibility, electrical energy is opted as the universal energy carrier, which facilitates the expenditure of primary energy (from renewable or non-renewable sources) in electric-powered services via the law of conservation of energy. Hitherto, the electricity was generated via the combustion of non-replenishable fossil fuels (crude oil, coal, and natural gas); nevertheless, the use of fossil energy was

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