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Optimization of hydrogen production from steam reforming of biomass tar over Ni/dolomite/La_2O_3 catalysts

Abstract

Industrially, the endothermic process of steam reforming is carried out at the lowest temperature, steam to carbon (S/C) ratio, and gas hourly space velocity (GHSV) for maximum hydrogen (H_2) production. In this study, a three-level three factorial Box-Behnken Design (BBD) of Response Surface Methodology (RSM) was applied to investigate the optimization of H_2 production from steam reforming of gasified biomass tar over Ni/dolomite/La_2O_3 (NiDLa) catalysts. Consequently, reduced quadratic regression models were developed to fit the experimental data adequately. The effects of the independent variables (temperature, S/C ratio, and GHSV) on the responses (carbon conversion to gas and H_2 yield) were examined. The results indicated that reaction temperature was the most significant factor affecting both responses. Ultimately, the optimum conditions predicted by RSM were 775 °C, S/C molar ratio of 1.02, and GHSV of 14,648 h^{-1}, resulting in 99 mol% of carbon conversion to gas and 82 mol% of H_2 yield.

Keywords

Biomass tar; Hydrogen; Ni/dolomite/La_2O_3 ; Optimization; Response surface methodology; Steam reforming