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Hydrogen enrichment of biogas by catalytic reforming over MgO promoted Ni catalyst supported on Al_2O_3

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Hydrogen (H_2) enrichment of biogas through catalytic reforming is an attractive technique to produce energy efficient gaseous product. Since biogas has a lower heating value as compared to natural gas, therefore, H_2 enrichment will enhance its energy content. Biogas dry reforming was studied over magnesium oxide (MgO) decorated nickel (Ni) catalyst supported on aluminium oxide (Al_2O_3). The catalyst was prepared by wet impregnation technique and characterized by XRD, H_2-TPR, BET, and FESEM. The reforming tests were carried out in a fixed bed downflow reactor, within a temperature range of 650-850°C at 1bar. The synthesized catalyst performance was compared with pure Ni nanopowder at a weight hour space velocity (WHSV) of 20,000 $NmLg^{-1}h^{-1}$. The increased reaction temperature showed a positive effect on reactant (CH_4 and CO_2) conversions and product (H_2 and CO) yields for both tested catalysts. At 850°C, the maximum CH_4 and CO_2 conversions of 60.0 and 82.1%, respectively, were obtained on a pure Ni catalyst with 25.5% of H_2 enrichment. Whereas, with Ni0.1/(Mg0.1-Al0.9) catalyst, 38.0% of H_2 enrichment was identified with 79.7 and 96.2% of CH_4 and CO_2 conversion, respectively. Thus, 10 wt% Mg promoted catalyst showed improved catalyst performance when compared to pure Ni with maximizing H_2 proportion in biogas.

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