INTERNATIONAL JOURNAL OF GREEN ENERGY
https://doi.org/10.1080/15435075.2017.1334659

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Dry reforming of methane over oil palm shell activated carbon and ZSM-5 supported cobalt catalysts

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ABSTRACT

In this study, cobalt supported oil palm shell activated carbon (Co/OPS-AC) and ZSM-5 zeolite (Co/ZSM-5) catalysts have been prepared for dry reforming of methane. Cobalt ratios of 6.0 and 14.0 wt% were deposited via wet impregnation method to the OPS-AC and ZSM-5 catalysts. The catalysts were characterized by XRD, N_2 adsorption–desorption isotherms, BET surface area, SEM, FESEM-EDX, TPR-H_2, and TPD-NH_3. The dry reforming of methane was performed using a micro reactor system under the condition of 10,000 ml/h.g-cat, 3 atm, CH_4/CO_2 ratio of 1.2:1.0 and temperature range from 923 K to 1023 K. The gaseous products were analyzed by gas chromatography (GC) with thermal conductivity detector (TCD) and further quantified to determine the conversions of CH_4 and CO_2, and the yields of CO and H_2. Experimental results revealed both catalysts exhibited lower conversions of CO_2 and CH_4 with the increase in temperature from 923 K to 1023 K. The reduced conversions may be due to the formation of carboneous substance on the catalyst known as coking. Comparatively, Co/OPS-AC gave higher conversions of CO_2 and CH_4 as well as higher yields of H_2 and CO as it has a higher surface area than Co/ZSM-5 which subsequently rendered higher activity for the reforming of methane. With the increasing cobalt loadings and reaction temperature, OPS-AC(14) catalyst exhibited improved activity and H_2/CO ratio. Based on these results, cobalt supported OPS activated carbon catalyst was suggested to be more effective for CO_2 and CH_4 conversions.

KEYWORDS

Activated carbon support; cobalt catalyst; methane dry reforming; oil palm shell; ZSM-5 support

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