Syngas production via bi-reforming of methane over fibrous KCC-1 stabilized ni catalyst

Farooqi, Ahmad Salam[a, b]; Adnan, Siti Nur Fatihah Binti[a]; Setiabudi, Herma Dina[c]; Muhammad, Syed Anuar Faua'ad Syed[d]; Ismail, Shahrul[e]; Aslam, Sameen[f]; Abdullah, Bawadi[a, b]

[a] *Chemical Engineering Department, Universiti Teknologi PETRONAS, Seri Iskandar, 32610, Malaysia*

[b] *Centre of Contaminant Control and Utilization (CenCoU), Institute of Contaminant Management for Oil and Gas, Universiti Teknologi PETRONAS, Seri Iskandar, 32610, Malaysia*

[c] *Faculty of Chemical and Process Engineering Technology, College of Engineering Technology, Universiti Malaysia Pahang, Pahang, Gambang, Kuantan, 26300, Malaysia*

[d] *School of Chemical and Energy Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, UTM Skudai, Johor, Skudai, 81310, Malaysia*

[e] *School of Ocean Engineering, Universiti Malaysia Terengganu, Terengganu, Kuala Nerus, 21030, Malaysia*

[f] *School of Physics, Universiti Sains Malaysia, Gelugor, Penang, 11800, Malaysia*

ABSTRACT

Bi-reforming of methane (BRM) technology has the potential to serve as an alternative energy source while also mitigating greenhouse gas emissions. However, the main hurdle in the commercialization of BRM is catalyst deactivation. In this study, the ultrasonic-assisted impregnation method was utilized to prepare a Ni-based catalyst supported on fibrous KCC-1 and tested in the BRM process. The prepared catalysts were characterized by XRD, BET, FESEM and TPR-H2 techniques to determine the textural and morphological properties of the catalyst. The catalytic performance was tested in a tabular fixed-bed continuous reactor at 800 °C with a stoichiometric feed ratio of 3:2:1 for CH4: H2O: CO2. For high nickel loadings, it was discovered that agglomerates of the Ni-active phase form on the surface of the support. The catalysts with a 10 wt% Ni content produced the best CO2 (79.2%) and CH4 (82.1%) conversions, as well as an optimum H2/CO = 1.62 ratio.

KEYWORDS

Catalyst; Fibrous silica; Greenhouse gases; Impregnation; Methane reforming

ACKNOWLEDGEMENTS

The authors would like to thank the Collaboration Research Fund (CRF) grant no: 015MD0-010 for providing the financial support and thanks to Universiti Teknologi PETRONAS for providing the research facilities.