Catalytic reforming of oxygenated hydrocarbons for the hydrogen production: An outlook

Mohammad Tazli Azizan[a,b], Aqsha Aqsha[a,b], Mariam Ameen[a,b], Ain Syuhada[b], Hellgardt Klaus[c], Sumaiya Zainal Abidin[d] & Farooq Sher[e]*

[a] HiCoE, Center of Biofuel and Biochemical Research (CBBR), Institute of Sustainable Building (ISB), Universiti Teknologi PETRONAS, Perak, Bandar Seri Iskandar, Tronoh, 31750, Malaysia
[b] Department of Chemical Engineering, Universiti Teknologi PETRONAS, Bandar Seri Iskandar, Perak, Tronoh, 31750, Malaysia
[c] Chemical Engineering Department, Imperial College London, South Kensington, London, SW7 2AZ, United Kingdom
[d] Chemical Engineering Department, Universiti Malaysia Pahang, Gambang Lebuhraya Tun Razak, 26300, Gambang, Pahang, Kuantan, Malaysia
[e] School of Mechanical, Aerospace and Automotive Engineering, Faculty of Engineering, Environmental and Computing, Coventry University, Coventry, CV1 5FB, United Kingdom

ABSTRACT

The catalytic steam reforming of oxygenated hydrocarbons has been holding an interest in scientific societies for the past two decades. The hydrogen production from steam reforming of glycerol, ethanol and other oxygenates such as ethylene glycol and propylene glycol are more suitable choice not just because it can be produced from renewable sources, but it also helps to decrease the transportation fuel price and making it more competitive. In addition, hydrogen itself is a green fuel for the transportation sector. The studies on the production of hydrogen from various reforming technologies revealed a remarkable impact on the environmental and socio-economic issues. Researchers became more focused on glycerol steam reforming (GSR), ethanol steam reforming (ESR) and other oxygenates to investigate the catalyst suitability, their kinetics and challenges for the sustainability of the oil and gas production. In the present work, the authors critically addressed the challenges and strategies for hydrogen production via GSR, ESR and other oxygenates reforming process. This review covers extensively thermodynamic parametric analysis, catalysts developments, kinetics and advancement in the operational process for glycerol, ethanol and few other oxygenates. This detailed investigation only highlights the steam reforming process (SRP) of these oxygenates at the laboratory experimental stage. It was found that from this review, there are many technical issues, which lead to economic challenges. The issues are yet to be addressed and thus, these particular applications require faster accelerations at the pilot scale, taking into the consideration of the current pandemic and economic issues, for a safer and greener environment.

KEYWORDS

Catalysts; Hydrogen production; Oxygenated hydrocarbons; Partial oxidation; Steam reforming

ACKNOWLEDGEMENT

The authors would like to present special acknowledgement to Universiti Teknologi PETRONAS, Imperial College London, and to the Commonwealth Scholarships Commission, United Kingdom, for the funding of PhD study for the main author at Imperial College London, UK. The authors also would like to acknowledge the Yayasan Universiti Teknologi PETRONAS for funding the YUTP-FRG (015LC0–091) research grant as the continuation of work from the initial study.