Design and performance evaluation of sustainable process combining hydrotreating and hydrogen generation for biojet fuel production from palm oil

Siriporn Boonsuk¹*, Worapon Kiatkittipong², Kanokwan Ngaosuwan³, Doonyapong Wongsawaeng⁴, Suttichai Assabumrungrat¹

¹Center of Excellence on Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
²Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University, Nakhon Pathom 73000, Thailand
³Department of Chemical Engineering, Faculty of Engineering, Rajamangala University of Technology Krungthep, Bangkok 10120, Thailand
⁴Department of Nuclear Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand

*E-mail: Siriporn.B@student.chula.ac.th

Abstract: This research work proposed a sustainable hydrotreating process for a production of biojet fuel, whereas H₂ could also be produced simultaneously. Palm oil is one of the most potential feedstock for renewable fuel production in Thailand, and is the target resource in this study. Two potential processes were proposed; hydrogenolysis of triglycerides + steam reforming (SR) of propane by-product (I) and hydrolysis of triglycerides + aqueous phase reforming (APR) of glycerol by-product (II). For the H₂ production, the APR of glycerol was operated at 300°C and 50 bar while the SR of propane was operated at 525°C and 8 bar. The obtained H₂ were employed for biojet fuel production which are consisted of several reactions; hydrogenolysis, hydrogenation, deoxygenation, isomerization and hydrocracking. Studies of hydrogen consumption, hydrogen generation and energy consumption by various deoxygenation reaction pathways via decarboxylation, decarbonylation and hydrodeoxygenation were carried out. The system self-sustainability is considered as it can sustain itself without external support of hydrogen and heat. The result found that process heat integration is necessary for efficient operation of the combined process.

Keywords: Hydroprocessing; Bio jet fuel production; Palm oil; Hydrogen; Sustainable