Bio-hydrogenated diesel production from palm oil with process integration of hydrogen production and hydro-processing

Chaiwat Prapainainar
Department of Chemical Engineering
King Mongkut's University of Technology North Bangkok
Bangkok, Thailand
chaiwat.r@eng.kmutnb.ac.th

Suwimol Wongsakulphasatch
Department of Chemical Engineering
King Mongkut's University of Technology North Bangkok
Bangkok, Thailand
suwimol.w@eng.kmutnb.ac.th

Suttichai Assabumrungrat
Department of Chemical Engineering
Chulalongkorn University
Bangkok, Thailand
suttichai.a@chula.ac.th

Paweena Prapainainar
Department of Chemical Engineering
Kasetsart University
Bangkok, Thailand
fengpwn@ku.ac.th

Abstract

Bio-hydrogenated diesel (BHD) or green diesel is a second generation liquid fuel that can be synthesized through hydrodeoxygenation reaction of fat and its derivatives. It has been expected to replace petroleum diesel and biodiesel due to structure stability and low sulphur. Nevertheless, BHD production still has limitation on the ground of high price for hydrogen feed. Thus, this study report feasibility study of an integrated process of hydrogen production and hydro-processing. The integrated process used refined bleached deodorized palm oil (RBDPO) as a feed. RDBPO was hydrolyzed to produce palm fatty acid (PFA) and glycerol. Glycerol was then fed to sorption-enhanced steam reforming to generate hydrogen gas. After that, bio-hydrogenated diesel was synthesized through hydro-processing between palm fatty acid and hydrogen. The simulation model using ASPEN Plus predicted 57.8 wt.% of overall yield of BHD generated and the integrated process can be self-reliable in hydrogen production without using hydrogen from external sources. Subsequently, production cost and economic profitability of the integrated process were estimated to determine the attractiveness on investment. It was found that total capital investment (TCI) of the production plant was M$25.87 and cost of production $0.52 per litre of BHD. Sensitivity analysis of net present value was conducted after that using three variables, namely RBDPO price, BHD price, and gasoline price. This process was compared with BHD synthesized from fatty acid methyl ester, FAME. At an equivalent capacity, BHD produced from PFA was inferior in term of overall yield, energy consumption and environmental impact.

Keywords: *Bio-hydrogenated diesel, hydro-processing, sorption-enhanced steam reforming*

IEECP'21, July 29-30, 2021, Silicon Valley, San Francisco, CA – USA

D!f: *https://sci-index.com/DAI/2021.99101/IEECP/14526948*