

Topic: Modeling of Continuous Biodiesel Production from Esterification of Oleic acid in the Presence of Solid Catalysts

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ABSTRACT

The continuous packed bed operation of biodiesel production toward the esterification of fatty acid was studied by a simulation using COMSOL software in order to optimize the operate conditions for maximizing FAME yield. The factors studied in the present work included the effects of temperature, methanol/oleic acid molar ratio and feed flow rate. Additionally, the effects of catalyst amount and molecular sieve adding on the system performance were also investigated. The developed models were based on isothermal, no pressure drop, heterogeneous and tree- dimensional continuous packed bed. The simulation results generally consisted of the percent conversion of oleic acid and concentration profiles along the reactor length at different conditions of each factors.

The simulation results revealed that the conversion had increased with increasing amounts of the catalyst, from which the conversion reached to around 93 % and remained constant when the mass percent of catalyst rose up to 10% base on oleic acid weight. For the effects of temperature and methanol/ oleic acid molar ratio, the simulation indicated that the increments of temperature and methanol/ oleic acid molar ratio can increase and speed up the conversion rate of oleic acid. On the contrary, the simulation results of effect of feed flow rate showed that the conversion increased with decreasing of flow rate due to at the lower flow rate, the oleic acid has longer residence time in the reactor. The highest conversion was 98% which obtained by simulation at 120°C, methanol/ oleic acid molar ratio of 16:1 and 1L/h of feed flow rate. Lastly, when molecular sieve was added inside the reactor, the conditions could be optimized to 100 °C with methanol/ oleic acid molar ratio of 5:1 which the conversion of oleic acid can reach to 99% due to water as by-product that produced during operating process was adsorbed by molecular sieve, resulting the equilibrium of the esterification reaction more shifted to the side of the products.

Keywords: Biodiesel, Free fatty acid, Esterification, Molecular sieve.