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3D Simulation Of Fatty Acid Methyl Ester Production In A Packed Membrane Reactor

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Abstract

The current work is aimed to simulate the production of high quality fatty acid methyl ester (biodiesel) production from palm oil in a micro porous ceramic membrane reactor. The TiO2/Al2O3 ceramic membrane was used as the separator and catalytic bed. It was packed with potassium hydroxide catalyst supported on palm shell activated carbon. The investigation of component distribution within the system was not possible. Hence CFD analysis was used to predict the distribution of the fatty acid methyl ester and the other by-products in the membrane module. The Brinkman equation was used to simulate fluid flow within the porous media. In addition, the Maxwell–Stefan equation was applied for simulation of reaction kinetics and mass transfer. The combination of the mentioned models was solved mathematically by means of the finite element method and PARDISO algorithm. In addition, the effect of temperature on transesterification reaction has been examined. The CFD results were indicated that increasing the reaction temperature leads to the same conversion in shorter time, or increase in temperature by 10 °C, results in 5% growth of reaction for the same time period. The molar concentrations of each component are also shown in the total system for 85 s and 400 s. As we see from the diagrams, the simulated liquid velocity within the system reaches agreement with experimental results at 8.1% deviation and 0.61% overestimation in the reaction part.