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Biodiesel fuel is a biodegradable of diesel fuel that is produced through trans-esterification between vegetable oil and methanol. The non-catalytic biodiesel fuel production method called superheated methanol vapor in the bubble column reactor which is used in this research has advantage; no requiring purification before and after reaction, due to the not existing of catalyst, so both initial and running costs are to be reduced. However the reaction rate of biodiesel fuel production is still lower than other method (catalytic method). The previous studies noted that the contact surface between the methanol bubble and the oil acts as the limiting factor for enhancing the reaction rate. The contact surface area is influenced by the bubble size distribution, which in turn affected by the reactor design. Therefore, this study is devoted to the analysis of the bubble distribution in non catalytic reactor to increase the reaction rate of biodiesel fuel production using the Computational Fluid Dynamics (CFD) method. CFD can minimize the experimental design cost and time by simulating various experimental conditions to show a real phenomenon, with a reasonable accuracy and precision.

A transparent reactor using nitrogen and water system were used to verify the CFD modeling. By comparing this model with experiment result using high speed camera, it was found that 3D CFD modeling, turbulent flow and non-equi librium wall function give the best similarity with experimental result. The result proves that the increase of inlet gas velocities increase the gas holdup and contact surface area significantly.

Based on the proper CFD modeling, ten scenarios of treatment and design of obstacle installed in the column reactor were simulated to find the highest contact surface area and reaction rate. Both of simulation and experimental result show that by utilizing of the obstacle in the reactor, contact surface between oil and methanol vapor increase and the reaction rate of biodiesel fuel production also increase by use of the obstacle. The CFD modeling represented well to describe the bubble behavior, and reaction rate was estimated by results of CFD.