Computational fluid dynamic application in scale-up of a stirred-batch reactor for degumming crude palm oil

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Abstrak

The research aims to scale up a small-scale stirred batch reactor to a large-scale stirred batch reactor in order to degum crude palm oil for use as a raw material in biodiesel production. The scale-up is based on the similarity of fluid Reynolds numbers in the two differently sized reactors. To achieve this aim, computational fluid dynamic modeling and simulations of the two reactors were performed. A small-scale palm oil degumming process was carried out in a 250 cc autoclave reactor using a magnetic stirrer at 500 rpm. The simulation results of this small reactor yielded a fluid Reynolds number in the range of 5 to 3,482. The large-scale reactor proposed in this research is 1.25 m3 in volume and is equipped with two impellers: a pitched blade impeller and a Rushton turbine impeller. The pitched blade impeller is placed over the Rushton turbine impeller. They are rotated at 100 rpm. Under this setting and operation, the resulting fluid Reynolds number was in the range of 486 to 202,000. This result indicates that the large-scale reactor was able to reproduce the reaction performance obtained in the small-scale reactor.