Optimization of biodiesel production using a stirred packed-bed reactor

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Abstrak

The use of waste cooking oil (WCO) as feedstock and in microwave heating technology helps to reduce the cost of biodiesel. In this study, a continuous flow transesterification of waste cooking oil (WCO) by microwave irradiation for biodiesel production using calcium oxide (CaO) as aheterogeneous catalyst, calcined from cockle shells, is used. The catalyst was packed inside a plastic perforated container mounted on a stirrer shaft and inserted inside the reactor. The thermocouple inside the reactor was connected to a temperature controller and microwave power input to maintain the temperature. Response surface methodology (RSM) was employed to study the relationships between power input, stirrer speed and liquid hourly space velocity (LHSV) on the WCO methyl ester (WCOME) conversion at a fixed molar ratio of methanol to oil of 9 and a reaction temperature set at 65oC. The experiments were developed using the Box-Behnken design (BBD) for optimum conditions. The transesterification of the WCO was produced at 72.5% maximum WCOME conversion at an optimum power input of 445 W, stirrer speed of 380 rpm and LHSV of 71.5 h-1 . The energy consumption in a steady state condition was 0.594 kWh for the production of 1 litre WCOME, for this heterogeneous catalyst is much faster than conventional heating.