Transesterification of sunflower oil in a trickle-bed reactor packed with a CaO catalyst

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Transesterification of sunflower oil with methanol to form biodiesel was performed in a countercurrent trickle-bed reactor, using calcium oxide particles 1-2 mm in diameter as a packed, solid base catalyst. Although biodiesel production generally requires a reaction temperature below the boiling point of methanol to maintain a heterogeneous liquid-liquid reaction, in the present study the reaction temperature was varied from 353 to 413 K to confirm the progress of transesterification in a gas-liquid-solid phase reaction system. Oil droplets released from a thin tube flowed downward, while vaporized methanol flowed upward in the bed. The effects of reaction temperature, methanol vapor and oil flow rates, and bed height on the fatty acid methyl ester (FAME) yield were investigated. The FAME yield was not significantly affected by the methanol flow rate. However, the oil residence time in the reactor, which was controlled by changing both the oil flow rate and the bed height, had a significant effect on the FAME yield. In addition, the FAME yield increased with reaction temperature and was maximal at 373 K due to the change in residence time associated with reduced oil viscosity at higher temperatures. The FAME yield was 98% at a reaction temperature of 373 K when the methanol and oil flow rates were 3.8 and 4.1 mL/h, respectively.