BIODIESEL PRODUCTION USING SUPERCRITICAL METHANOL

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Recent experimental studies on non-catalytic transesterification have shown that high reaction rates, which justify the commercial application of this process, can be obtained if the operating conditions are above the critical pressure and temperature of the alcohol. Even though it is generally agreed that temperatures above 550 K and high alcohol/oil ratios are required to obtain high conversions and high reaction rates, there is disagreement among the different authors regarding the operating pressure, the assumed phase conditions, the use of co-solvents and the justification of the sudden increase of the rate of reaction with temperature. In this work, the reactor phase transitions were directly observed in a double windowed cylindrical reactor and the conversion to ethyl esters was measured. Density studies of alcohol and vegetable oil mixtures (initial molar ratio of 40:1) were also carried out to determine the increase of pressure with temperature and to estimate the residence time on continuous reaction mode. Then experimental studies on a continuous reactor are being carried out to obtain a better control of operating conditions and reactants residence time. Previously, the optimization of the process conditions was carried out based on a statistical design of experiments where the key process variables were studied. In these studies different oils, crude and refined are studied. Also the effect of using methanol or ethanol on the rate of reaction and efficiency of conversion are considered. The present results confirm preliminary studies that indicate that high conversions can be obtained at pressures of 10-15 Mpa at temperatures between 570 and 600 K using a molar ratio of 39. From direct observations and the modeling of the phase behavior, a better understanding of the supercritical ethanol transesterification process is obtained as well as the confirmation of the phase equilibrium predictions based on the GCA-EOS model.