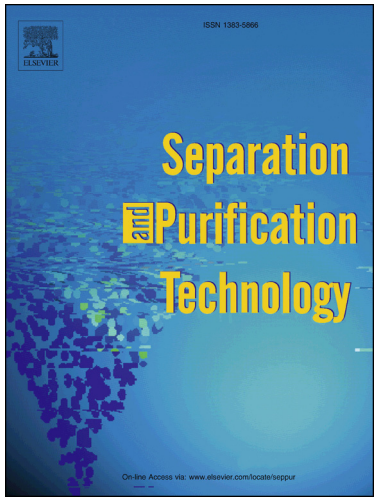

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Improving the production of propyl and butyl esters-based biodiesel by purification using deep eutectic solvents

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ABSTRACT

This study provides an alternative biodiesel manufacturing process that is less energy intensive combined with a more environmentally benign purification step. This was achieved by replacing methanol as the traditional alcohol source with longer chain alcohols, namely propanol and butanol. These alcohols reduce mass transfer limitations resulting in high purities of fatty acid propyl ester (FAPE) and fatty acid butyl ester (FABE). Transesterification of soybean oil using long chain alcohols was conducted at 6:1 (alcohol to oil) ratio, 0.66 wt% of sodium alkoxide catalyst and at room temperature for 5 minutes. After evaporating the excess alcohol, the FAPE and FABE contents were found to be 81.7 wt% and 89.8 wt%, respectively. The FAPE and FABE were then purified for first time by two different types of deep eutectic solvents (DESs); glycerol-based DESs (DES1 to DES3) and ethylene glycol-based DESs (DES4 to DES5). The results indicated that DES5 and DES6 were most effective for improving FAPE and FABE contents. They were successful in extracting the glycerol completely from FAPE and FABE at 3:1 DES:biodiesel ratio. Furthermore, molar ratios of 1:1 DES5:FAPE and 0.5:1 DES5:FABE were selected as minimum ratio for FAPE and FABE purification, which could fulfil the EN14214 and ASTM D6751 requirements for ester and glycerol contents. It was possible to recover 70% of choline chloride using acetone as anti-solvent, suggesting that DES can be recycled.

Keywords: Fatty acid propyl ester; Fatty acid butyl ester; Transesterification; Deep eutectic solvents; Separation; Purification.

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