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INTEGRAL TRANSFORMS ANALYSIS OF THREE-DIMENSIONAL MASS TRANSFER IN THE TRANSESTERIFICATION PROCESS IN MICROREACTORS

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ABSTRACT The main objective of this study is to investigate the factors that influence the conversion of triglycerides during the transesterification reaction in microreactors of rectangular cross section. A three-dimensional nonlinear coupled mathematical model, which governs the concentrations of the species involved in the transesterification reaction, is obtained from the general mass transfer equation with assumptions of steady state, isothermal system and constant physical properties. The kinetic equations are obtained assuming consecutive, elementary and reversible second-order reactions and they are written as source terms in the mass transfer equations for the species. The two-dimensional velocity profile is analytically obtained for fully developed stratified laminar flow of two immiscible Newtonian fluids. The Generalized Integral Transform Technique (GITT) is applied to the partial differential equations system and a hybrid numerical-analytical solution is obtained through the mixed symbolic-numerical computational platform *Mathematica* 9.0. A comparison with literature data for the limiting case in which the system can be approximated by a parallel plates microchannel is performed. The influence of residence time, dimensions of the microreactor, and temperature of the system, are critically analyzed. It is observed that higher triglyceride conversion rates are achieved for larger residence times and system temperatures, as well as for lower values of the microreactor height.