Jordan University of Science and Technology

Validation of the Local Thermal Equilibrium Assumption in Forced Convection of Non-Newtonian Fluid Through a Porous Channel

Authors: S. A. Khashan and M.A. Al-Nimr

Abstract: n this paper, we assess the validity of the local thermal equilibrium assumption in the non-Newtonian forced convection flow through channels filled with porous media. For this purpose, the problem is solved numerically using local thermal non-equilibrium and non-Darcian models. Numerical solutions obtained over broad ranges of representative dimensionless parameters are utilized to map conditions at which the local thermal equilibrium assumption can or cannot be employed. The circumstances of a higher modified Peclet number, a lower modified Biot number, a lower fluid-to-solid thermal conductivity ratio, a lower power-law fluid index, and a lower microscopic and macroscopic frictional flow resistance coefficients, are identified as unfavorable circumstances for the local thermal equilibrium (LTE) condition to hold. Quantitative LTE validity maps that reflect the proportional effect of each parameter as related to others are presented.