World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:8, No:11, 2014

Temperature Fields in a Channel Partially-Filled by Porous Material with Internal Heat Generations: On Exact Solution

Authors : Yasser Mahmoudi, Nader Karimi

Abstract : The present work examines analytically the effect internal heat generation on temperature fields in a channel partially-filled with a porous under local thermal non-equilibrium condition. The Darcy-Brinkman model is used to represent the fluid transport through the porous material. Two fundamental models (models A and B) represent the thermal boundary conditions at the interface between the porous medium and the clear region. The governing equations of the problem are manipulated, and for each interface model, exact solutions for the solid and fluid temperature fields are developed. These solutions incorporate the porous material thickness, Biot number, fluid to solid thermal conductivity ratio Darcy number, as the non-dimensional energy terms in fluid and solid as parameters. Results show that considering any of the two models and under zero or negative heat generation (heat sink) and for any Darcy number, an increase in the porous thickness increases the amount of heat flux transferred to the porous region. The obtained results are applicable to the analysis of complex porous media incorporating internal heat generation, such as heat transfer enhancement (THE), tumor ablation in biological tissues and porous radiant burners (PRBs).

Keywords : porous media, local thermal non-equilibrium, forced convection, heat transfer, exact solution, internal heat generation
Conference Title : ICTHT 2014 : International Conference on Thermophysics and Heat Transfer
Conference Location : London, United Kingdom
Conference Dates : November 28-29, 2014