HEAT TRANSFER ENHANCEMENT IN A RADIAL FLOW COOLING SYSTEM USING NANOFLUIDS

Samy Joseph Palm, Gilles Roy* and Cong Tam Nguyen
Faculty of Engineering, Université de Moncton, Moncton, (NB), Canada, E1A 3E9
*Correspondence author: Fax: +1 506 858 4082 Email: royg@umoncton.ca

ABSTRACT A numerical investigation on the possible heat transfer enhancement capabilities of coolants with suspended metallic nanoparticles (in this case Al_2O_3 nanoparticles dispersed in water or ethylene glycol) inside radial flow cooling systems is presented in this paper. The laminar forced convection flow of these nanofluids between two coaxial and parallel disks with central axial injection has been considered. Results clearly indicate that considerable heat transfer benefits are possible with the use of either of these fluid/solid particle mixtures. For a Water/Al_2O_3 nanofluid with a volume fraction of nanoparticles of 7.5%, a 45% increase in the average wall heat transfer coefficient is found for a same Reynolds number. In the case of an Ethylene Glycol/Al_2O_3 nanofluid, the average wall heat transfer coefficient has a 70% increase for a volume fraction of 7.5%. In general, it was found that the local Nusselt number increases with the particle volume fraction and Reynolds number and decreases with an increase in channel height (distance separating the disks). Local heat transfer also changes noticeably with the behaviour of the hydrodynamic field (i.e. flow separation areas). Although considerable increases in heat transfer capabilities are found, associated increases in wall shear stresses are also noticed. Approximately two fold increases in wall shear stress are found in the case of a water/Al_2O_3 nanofluid with a particle volume fraction of 5%.