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COMPUTER SIMULATION OF MIXED CONVECTION FLOW OF NANOFLUIDS PAST A CONTINUOUSLY MOVING VERTICAL PLATE

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ABSTRACT In the present paper, a computer simulation based on a homogeneous flow model has been performed to investigate the buoyancy-aided mixed convection flow of nanofluids past an isothermal continuously moving vertical plate, as in hot extrusion. Finite difference techniques have been used. The flow is considered as steady, laminar and two-dimensional. An elliptic non-boundary-layer type formulation has been used. Stream function, vorticity transport and energy equations have been solved simultaneously to obtain flow and temperature fields. The nanofluids considered are: Alumina-Water, Titania-Water and Copper-Water. A detailed parametric study showing the effect of volume fraction of nanoparticles (1%-5%), Richardson number (0-20) and plate velocity (0.001 m/s-0.1 m/s) on the flow and temperature fields, enhancement factor and effectiveness lent a good physical insight into the mixed convection of nanofluids. The study reveals that Alumina-Water nanofluid gives rise to highest enhancement factor among the three. In the mixed convection regime ($0.1 < Ri < 10$) the enhancement factor (that is, the ratio of average heat transfer coefficient in nanofluid to that in base fluid) reaches a minimum value at the plate velocity of 0.01 m/s. However, for $Ri = 20$ which signifies the free convection regime the enhancement factor continuously increases with the plate velocity. Effectiveness which is the ratio of average heat transfer coefficient to the power required to pull the plate, falls with increase in plate velocity for all Richardson numbers. Alumina-Water is the least effective nanofluid whereas Copper-Water nanofluid stands out as the most effective.