Abstract

A numerical investigation of hydrodynamic and heat transfer behaviors for Al_2O_3–water nanofluids for laminar confined slot jet impingement is presented. This study has been conducted by considering the nanofluid as Newtonian as well as non-Newtonian for a wide range of solid volume fraction ($0 \leq \varphi \leq 5\%$) and Reynolds number range of (25–300). A single-phase fluid approach was used to model the nanofluid and the Ostwald–de Waele model described the non-Newtonian shear thinning nanofluid behavior has been adopted. A comparison with Newtonian and non-Newtonian nanofluid in terms of heat transfer coefficient, Nusselt number, streamlines and isotherms contours has been performed for the same Reynolds number, jet inlet velocity and the same aspect ratio *H/W*. It has been observed that the rate of heat transfer increases with Reynolds number and solid volume fraction of the nanofluid. Noting that the local Nusselt number is much higher for non-Newtonian nanofluid than Newtonian flow in the entire target surface with a particular enhancement located at the jet axis where a relative increase of 9.8% is evaluated for $\varphi = 5\%$ and $Re = 300$. However, the pumping power results showed a steep increase with the volume fraction for a Newtonian nanofluid case. In fact, the required PP is 1.32, 1.53, 1.99, 2.11 and 4 times greater than the values calculated in case of pure water at $\varphi = 1$, 2, 3, 4 and 5 respectively. At the same value of volume fraction φ, it is noted that the pumping power for a non-Newtonian nanofluid is many times higher than PP required in Newtonian nanofluid case, especially at $Re \leq 200$. Lastly, the correlations for stagnation point and average Nusselt number are provided for Newtonian and non-Newtonian nanofluid.