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Hydrothermal behavior of different hybrid nanofluids in a dimpled tube heat exchanger

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Abstract

The thermal and fluid flow performance of three types of hybrid nanofluid (HNF) inside a dimpled tube was investigated. The water with a dual mixture of Cu particles combined with CuO, TiO_2, and Al_2O_3 nanoparticles (NPs) is used as heat transfer fluid (HTF). The fluid flow and heat transfer were studied numerically using the two-phase mixture and sensitivity analysis was made to reveal the effect of the Reynolds number (*Re*) and solid volume fraction (ϕ) of HNF on the Nusselt number (*Nu*), friction factor and overall thermal performance factor. The results demonstrated that under the investigated *Re* number of 30,000 to 50,000 and ϕ=0.5% to 1.5%, the highest heat transfer improvement is for Cu-CuO/water HNF and the lowest is for Cu-TiO_2/water; also, the improving effect of ϕ increase is more considerable at lower *Re* numbers. Between different HNFs, the quotient of f/f_0 is the highest in the case of Al_2O_3—Cu/water HNF. The highest value of thermal performance factor is dedicated to HNF of CuO—Cu/water followed by Al_2O_3—Cu/water and Cu-TiO_2/water which average 1.065, 1.055, and 1.039, respectively; also, this factor for Al_2O_3—Cu/water has the lowest sensitivity to ϕ change and for Cu-TiO_2/water has the lowest sensitivity to change of *Re* number.