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Numerical simulation of the thermal-hydraulic performance of solar collector equipped with vector generators filled with two-phase hybrid nanofluid Cu-TiO_2/ H_2O

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Abstract

In this research, the effect of vortex generators (VGs) with various geometric shapes and Cu-TiO_2/H_2O nanofluid (NF) on thermal-hydraulic (TH) performance, energy efficiency and exergy of a solar collector (SC) has been perused. In this research, the turbulent flow regime (TFR) was used to study the stated parameters. The QUICK algorithm is used for the discretization of the equations. According to the assumption of a TFR, the flow behavior of Cu-TiO_2/ H_2O NF in the *Re* range of 4000–16,000 was studied. In addition, the k-ω SST model was utilized to modelling the turbulent flow. Also, due to considering the NF as two-phase, the Eulerian two-phase method was used for modeling. Two-phase hybrid NFs with Cu and TiO_2 nanoparticles in solid volume fractions of SVF=1, 3, and 5% were modeled. The findings of the research illustrate that convective heat transfer (CHT), Nu_{avg} (average Nusselt number), and pressure drop (PD) increase with the increase of the inlet velocity of Cu-TiO_2/ H_2O NF flow. In addition, the results of PEC evaluation indicate that the adding VGs and changing their placement states is desirable in terms of PEC. In the SC along with the case D turbolator and SVF= 5 %, the exergy efficiency increases by 45.87 % with the increase of the Reynolds number (*Re*) from 4000 to 16,000.