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Intensification of Heat Transfer Using AL_2O_3-Cu/Water Hybrid Nanofluid in a Circular Duct Using Inserts

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Abstract : Nanotechnology has created new opportunities for improving industrial efficiency and performance. One of the proposed approaches to improving the effectiveness of temperature exchangers is the use of nanofluids to improve heat transfer performance. The thermal conductivity of nanoparticles, as well as their size, diameter, and volume concentration, all played a role in influencing the rate of heat transfer. Nanofluids are commonly used in automobiles, energy storage, electronic component cooling, solar absorbers, and nuclear reactors. Convective heat transfer must be improved when designing thermal systems in order to reduce heat exchanger size, weight, and cost. Using roughened surfaces to promote heat transfer has been tried several times. Thus, both active and passive heat transfer methods show potential in terms of heat transfer improvement. There will be an added advantage of enhanced heat transfer due to the two methods adopted; however, pressure drop must be considered during flow. Thus, the current research aims to increase heat transfer by adding a twisted tap insert in a plain tube using a working fluid hybrid nanofluid (Al_2O_3-Cu) with a base fluid of water. A circular duct with inserts, a tube length of 3 meters, a hydraulic diameter of 0.01 meters, and tube walls with a constant heat flux of 20 kW/m² and a twist ratio of 125 was used to investigate Al_2O_3-Cu/H_2O hybrid nanofluid with inserts. The temperature distribution is better than with conventional tube designs due to stronger tangential contact and swirls in the twisted tape. The Nusselt number values of plain twisted tape tubes are 1.5–2.0 percent higher than those of plain tubes. When twisted tape is used instead of plain tube, performance evaluation criteria improve by 1.01 times. A heat exchanger that is useful for a number of heat exchanger applications can be built utilizing a mixed flow of analysis that incorporates passive and active methodologies.

Keywords : nanofluids, active method, passive method, Nusselt number, performance evaluation criteria
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