

Experimental Analysis on Heat Transfer Enhancement in Double Pipe Heat Exchanger Using Al₂O₃/Water Nanofluid and Baffled Twisted Tape Inserts

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Abstract : Heat transfer augmentation techniques ultimately results in the reduction of thermal resistance in a conventional heat exchanger by generating higher convective heat transfer coefficient. It also results in reduction of size, increase in heat duty, decrease in approach temperature difference and reduction in pumping power requirements for heat exchangers. Present study deals with compound augmentation technique, which is not widely used. The study deals with the use of Alumina (Al₂O₃)/water nanofluid and baffled twisted tape inserts in double pipe heat exchanger as compound augmentation technique. Experiments were conducted to evaluate the heat transfer coefficient and friction factor for the flow through the inner tube of heat exchanger in turbulent flow range ($8000 < Re < 60000$). It is observed that the equation of Dittus-Boelter applicable for turbulent flow regime shows good agreement with the experimental values for smooth tube. The effect of rectangular, circular, triangular baffled twisted tape having twist ratio (y/w) 4.2 and twisted tapes without baffles of twist ratio (y/w) 4.2 and 5.2 were studied. Experiments were conducted for both water and Alumina/water nanofluid. Al₂O₃ nanoparticle of 22nm size were purchased, characterized and dispersed in de-ionized water to form stable suspension containing 0.1% volume concentration of nanoparticles. The results showed that there is noticeable enhancement in the heat transfer coefficient with the use of baffled twisted tape and nanofluid. It is also observed that the friction factor for nanofluid and water is almost the same. It is found that the enhancement of heat transfer coefficient by using rectangular baffled twisted tape and nanofluid is about 20%. Performance evaluation criteria were found for water and nanofluid and it was observed that rectangular baffled twisted tape performs better than other twisted tapes. The maximum value of performance evaluation criteria for nanofluid is obtained as 2.62 at Reynolds number 8483 for rectangular baffled twisted tape.

Keywords : enhancement, heat transfer coefficient, friction factor, twisted tape, nanofluid

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