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Numerical Study of Laminar Mixed Convection Heat Transfer Enhancement Using Nanofluids Over a Finned Flat Plate

A Thesis

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Abstract

Jet cooling is a method of cooling, where fluid is forced through a nozzle or orifice and directed towards a surface that is required to be cooled where it has the ability to achieve high heat transfer coefficients. A single jet configuration is an effective way to enhance heat transfer but recently several studies were focused on the effect of using nanofluids instead of air or water since the solid particles immersed in the nanofluid have higher thermal conductivity than regular fluids.

This Present Study is dedicated to study the effect of nanofluids on impinging jet over a flat plate fitted with ribs. The governing equations continuity, momentum and energy equation are solved for two dimensional flow using a FORTRAN code based on Patankar's SIMPLE algorithm with Line by line TDMA. The effect of using Cu-Water nanofluid blend is studied upon varying parameters such as the solid volume fraction ϕ , jet width (w), jet to plate spacing ratio(H/W),fin's aspect ratio (a/b) , number of fins ,Reynolds number (Re) and Richardson number for the effect of buoyancy on the heat transfer rate .The study was conducted for Reynolds number ranging from $50 < Re < 350$,different Richardson number (Gr/Re^2) ranging $0.1 < Ri < 1$, fin height to jet width ratio $(b/w) = 3,4,5$, plate spacing to jet width ratio $(H/w) = 12, 15, 18, 21$. The Results are presented in comparison with pure water for various nanofluid particle concentration.

The results indicated that increasing the concentration of nanoparticles lead to the increase in Nusselt number which means increase in heat transfer rates. Also, increasing the rib's height will improve the heat transfer for lower values of Reynolds number only, but when Reynolds number is increased the heat transfer is decreased relatively for 0.06 Cu-particles. Finally, The ribs have significant effect on heat transfer rates where vortices are formed behind the ribs which leads to an increase in the average Nusselt number across the plate.