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THE PERMEABILITY EFFECTS OF COPPER-NANOFLUID FLOW WITH USING THE POROUS MEDIA MODEL

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ABSTRACT To increase heat transfer performances in heat exchangers, heat transfer media play important roles and are improved continuously. Nanofluids, combinations of base fluids and nanoparticles, are one of the media which are developed progressively, especially by enhancing the nanofluid and nanoparticle properties. This work focused on studying permeability effects of the Cu-water nanofluid flows. The mathematical model of the nanofluid flow has been developed as the steady flow of the fluid with nanofluid properties through the porous medium of the Cu nanoparticles. The simulated nanofluid flow was under fully developed laminar flow condition through a rectangular pipe as in electronic applications. The governing equations written in terms of the 3D dimensionless variables were solved through an in-house program by using the finite volume method with the SIMPLE algorithm. Since the nanoparticle arrangement was simulated as the porous media, so effects of the porous properties; permeability and thermal conductivity of Cu, were studied. From results, the calculated convective heat transfer coefficients with using the mixing thermal conductivity model; Yu and Choi model coupled with Maxwell model, as the model of the fluid flowing through the Cu porous medium, were closer to the coefficients obtained from the experimental work than those with using other mixing models. Then, the best mixing model was brought to investigate the effects of the Cu permeability values, from 1.17×10^{-11} to 2 m^2, the simulated results from 1.17×10^{-11} to 0.001 m^2 were approaching to the experimental results, noted that the Cu permeability was found at 1.17×10^{-11} m^2. The developed model using the mixing thermal conductivity model with the porous media and the suitable permeability assumption could improve the model performance and supported its excellent potential in the nanofluid simulation as the porous media.

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KEY WORDS: nanofluid, laminar flow, porous media, permeability, copper