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# Thermal Performance Analysis of Al2O3 - Water Nanofluid as a Coolant in Nuclear Applications

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The thermal performance of plasma facing components in a fusion reactor receiving high heat fluxes could be enhanced significantly by using nanofluid which are suspensions of 0.001-10% nanoparticles of <100nm size. Nanofluids show a promising heat transfer enhancement compared to the base fluid. Water-based nanofluids have the potential to deliver much improved high heat flux cooling while retaining all the advantages of water. The exciting prospect of nanofluids has motivated this investigation into their suitability as coolants of a fusion reactor.

This paper intends to present a theoretical investigation on energetic feasibility of Al2O3/water nanofluid as coolant streaming inside a smooth horizontal tube. Existing experimental results are utilized to compute the thermo-physical properties, heat transfer coefficient and pumping power of nanofluid. The heat transfer coefficient ratio i.e. the ratio between heat transfer coefficients of nanofluid to the same of base fluid has been calculated from the existing correlations at constant Reynolds number. The derived mathematical model of heat transfer coefficient ratio was validated with data available in existing literatures. The pumping power ratio which is the ratio of pumping power required for nanofluid flow to the same required for basefluid flow has been estimated. The effective increase in heat transfer coefficient makes nanofluid more promising than water for ultrafast cooling in nuclear applications. However, the effective increase in pumping power due to dispersion of nanoparticles in its base fluid makes it unfavorable for efficient heat transfer applications.

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