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Heterogonous Nanofluids for Nuclear Power Plants KHALID ALAMMAR, King Saud University — Nuclear reactions can be associated with high heat energy release. Extracting such energy efficiently requires the use of high-rate heat exchangers. Conventional heat transfer fluids, such as water and oils are limited in their thermal conductivity, and hence nanofluids have been introduced lately to overcome such limitation. By suspending metal nanoparticles with high thermal conductivity in conventional heat transfer fluids, thermal conductivity of the resulting homogeneous nanofluid is increased. Heterogeneous nanofluids offer yet more potential for heat transfer enhancement. By stratifying nanoparticles within the boundary layer, thermal conductivity is increased where temperature gradients are highest, thereby increasing overall heat transfer of a flowing fluid. In order to test the merit of this novel technique, a numerical study of a laminar pipe flow of a heterogeneous nanofluid was conducted. Effect of Iron-Oxide distribution on flow and heat transfer characteristics was investigated. With Iron-Oxide volume concentration of 0.009 in water, up to 50% local heat transfer enhancement was predicted for the heterogeneous compared to homogeneous nanofluids. Increasing the Reynolds number is shown to increase enhancement while having negligible effect on pressure drop. Using permanent magnets attached externally to the pipe, an experimental investigation conducted at MIT nuclear reactor laboratory for similar flow characteristics of a heterogeneous nanofluid have shown upto 160% enhancement in heat transfer. Such results show that heterogeneous nanofluids are promising for augmenting heat transfer rates in nuclear power heat exchanger systems.

Khalid Alammar
King Saud University

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