Synthesis and thermal performance of bio-based graphene, metal oxides and their composites in different flow passage heat exchangers

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Abstract

In the wake of the energy crisis, the transportation of energy with the application of heat exchangers has become a vital issue. The present research focuses on the enhancement of heat transfer performance of heat exchangers by the application of highly efficient heat-exchanging liquids. The scientists have done a remarkable number of works and research on alteration of heat transfer surfaces, process parameters and flow passage configurations, and many others. However, only limited works reported about heat exchanging liquids and their modifications. This research focuses on the synthesis and the application of more efficient nanoparticle-based heat-exchanging liquids such as ZnO and bio-based functionalized graphene for heat exchangers.

Different types of synthesized nanofluids were experimentally tested in a single tube and annular flow passage heat exchangers with different regimes and multiple ranges of Reynolds numbers. Heat transfer enhancement of about 30 percent was observed when using metal oxides and composites of oxides and about 40 percent when using carbon-structured and their composites-based nanofluids, with low enhancement in the pumping power. As the new bio-based synthesized nanofluids have shown a noticeable enhancement of heat exchanger performance, it can be considered as a high-performance heat exchanging liquid for future generation heat exchangers.

***Keywords*:** *Zinc oxide, Bio-based functionalized graphene, Pumping power, Heat transfer, Flow regime, Friction loss, Nanofluids.*