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Investigating the Steam Generation Potential of Lithium Bromide Based CuO Nanofluid under Simulated Solar Flux

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Abstract : Nanofluid-assisted steam generation is rapidly attracting attention amongst the scientific community since it can be applied in a wide range of industrial processes. Because of its high absorption rate of solar energy, nanoparticle-based solar steam generation could be a major contributor to many applications, including water desalination, sterilization and power generation. Lithium bromide-based iron oxide nanofluids have been previously studied in steam generation, which showed promising results. However, the efficiency of the system could be improved if a more heat-conductive nanofluid system could be utilised. In the current paper, we report on an experimental investigation of the photothermal conversion properties of functionalised Copper oxide (CuO) nanoparticles used in Lithium Bromide salt solutions. CuO binary nanofluid was prepared by chemical functionalization with polyethyleneimine (PEI). Long-term stability evaluation of prepared binary nanofluid was done by a high-speed centrifuge analyser which showed a 0.06 Instability index suggesting low agglomeration and sedimentation tendencies. This stability is also supported by the measurements from dynamic light scattering (DLS), transmission electron microscope (TEM), and ultraviolet-visible (UV-Vis) spectrophotometer. The fluid rheology is also characterised, which suggests the system exhibits a Newtonian fluid behavior. The photothermal conversion efficiency of different concentrations of CuO was experimentally investigated under a solar simulator. Experimental results reveal that the binary nanofluid in this study can remarkably increase the solar energy trapping efficiency and evaporation rate as compared to conventional fluids due to localized solar energy harvesting by the surface of the nanofluid. It was found that 0.1wt% CuO NP is the optimum nanofluid concentration for enhanced sensible and latent heat efficiencies.

Keywords : nanofluids, vapor absorption refrigeration system, steam generation, high salinity
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