Improved thermophysical characteristics of a new class of ionic liquid + diethylene glycol/Al_2O_3 + CuO based ionanofluid as a coolant media for hybrid PV/T system

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ABSTRACT

The purpose of this experimental research is to develop a new class of nanofluid as a replacement of conventional water based nanofluid for medium temperature range as PV/T coolant application. For the first time, hybridized Al_2O_3 + CuO nanoparticles were dispersed into the binary mixture of ionic liquid (IL) and diethylene glycol (DEG) without the addition of any stabilizing agents or surfactants. The formulated Ionanofluid posed excellent dispersion stability together with better thermal stability compared to water-based nanofluid, as evidenced from thermosgravimetric analysis. The experimental thermal conductivity assessment showed a maximum of 41.8 % enhancement together with a 31 % penalty in pressure drop at 0.15 wt% concentration. A hybrid PVT system is constructed to numerically examine the effect of Ionanofluid as an active cooling medium under the COMSOL Multiphysics environment. Ionanofluids as coolants in a PVT panel showed a maximum of 69 % thermal efficiency at 0.15 wt% Al_2O_3 + CuO, higher than 63 % (0.10 wt% Al_2O_3 + CuO), 58 % (0.05 wt% Al_2O_3 + CuO), and 56 % (pure IL + DEG). The PV panel temperature was reduced

from 65 to 40 °C when IL + DEG was replaced with 0.15 wt% Al_2O_3 + CuO. At the same concentrations, an electrical efficiency of nearly 12.7 % was observed, representing a 29.91 % improvement over IL + DEG at a flow rate of 4LPM. The formulated Ionanofluid performed thermally better than water but somewhat lower than water-based nanofluids like MWCNT/Water. Nevertheless, Ionanofluid's electrical efficiency was better than MWCNT/Water. Ionanofluid can be a viable alternative to water-based nanofluids for medium-temperature-based coolant applications.

KEYWORDS
Electrical efficiency; Ionic liquid; PVT; Thermal efficiency

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