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Offering a channel for cooling three lithium-ion battery packs with water/Cu nanofluid: An exergoeconomic analysis

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Abstract

This study focused on addressing the heat generation issue in Lithium-Ion battery packs (LIBPs). By simulating three LIBPs arranged in series within a duct, the momentum and energy conservation equations were solved using Computational Fluid Dynamics (CFD) to investigate cooling performance on the LIBPs' temperature. To enhance cooling, copper oxide nanoparticles were added to pure water to improve the thermal conductivity of the working fluid. Various cases were simulated to examine the effects of Reynolds number at inlet and volume fraction of copper oxide nanoparticles on flow parameters (streamlines, vortices, pressure drop) and heat transfer parameters (temperature distribution, maximum and average temperature of each LIBP) within the duct. Also, this study analyzed exergoeconomics by considering exergies and initial investment. The results demonstrate that increasing the volume fraction from 0 to 4% at Re=60 reduced the maximum temperature of LIBP 1, 2, and 3 by 2.19°C, 2.26°C, and 2.64°C, respectively, while it had no remarkable impact on the maximum temperature of LIBPs for bigger Reynolds numbers.