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Maximum temperature analysis in a Li-ion battery pack cooled by different fluids

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Abstract

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The use of Li-ion battery in electric vehicles is becoming extensive in the modern-day world owing to their high energy density and longer life. But there is a concern of proper thermal management to have consistent performance. Therefore, proper cooling mechanism to have a good life and reliability on the battery system is necessary. The main objective of this analysis is to assess the maximum temperature that causes thermal runaway when the battery pack is cooled by several fluids. Five categories of coolants are passed over the heat-generating battery pack to extract the heat and keep the temperature in the limit. Different kinds of gases, conventional oils, thermal oils, nanofluids, and liquid metals are adopted as coolants in each category. This analysis is a novel study which considers different categories of coolant and conjugate heat transfer condition at the battery pack and coolant interface. In each group of coolant, five types of fluids are selected and analyzed to obtain the least maximum temperature of battery. The flow Reynolds number (Re), heat generation (Q_{gen}), and conductivity ratio (Cr) are other parameters considered for the analysis. The Nusselt number for air and water as coolant with increase in Re is studied separately at the end. The maximum temperature is found to increase with Q_{gen} and decrease for Re and Cr. Thermal oils, nanofluids, and liquid metals are found to provide maximum temperature in the same range of 0.62 to 0.54. At the same time, gases have nearly the same effect at different values of Re and Cr. © 2020, Akadémiai Kiadó, Budapest, Hungary.

SciVal Topic Prominence

Topic: Battery Pack | Lifepo4 | Thermal Management

Prominence percentile: 99.863

Author keywords

Conductivity ratio | Conjugate | Coolants | Heat generation | Li-ion battery | Maximum temperature

Indexed keywords

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Engineering uncontrolled terms: Conductivity ratio | Conjugate heat transfer | Consistent performance | Conventional oil | Cooling mechanism | High energy densities | Maximum temperature | Thermal runaways

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