IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 4, June 2025
Impact Factor: 7.67

Li-ion Battery Pack Thermal Control using Air and Liquid Cooling Techniques

Amrutesh Arun Kolhe[1], Dr. Rahul Agrawal[2], Harshal Shelar[3], Dr. Sunil Magan More[4]
Nilima Bhamare[5], Bhimrao Dabhade[6]
Final Year Student, Department of Electrical Engineering[1]
Professor, Head of Electrical Engineering Department[2]
Assistant Professor, Department of Electrical Engineering[3,4,5,6]
Guru Gobind Singh College of Engineering & Research Centre, Nashik, Maharashtra, India

Abstract: *Thermal management plays a critical role in ensuring the safety, performance, and longevity of lithium-ion (Li-ion) batteries, especially in high-capacity applications such as electric vehicles and energy storage systems. This study presents the design and comparative evaluation of a Battery Thermal Management System (BTMS) for a 48V, 24Ah Li-ion battery using both air cooling and liquid cooling techniques. The primary objective is to maintain the battery cell temperatures within an optimal operating range (20°C–40°C), preventing thermal runaway while enhancing overall efficiency and lifecycle performance. An integrated thermoelectric module (Peltier device) is incorporated to enable both heating and cooling functions, controlled via temperature sensors and a microcontroller-based system. Liquid cooling demonstrated a higher heat transfer coefficient and more uniform temperature distribution, making it suitable for high-load conditions. In contrast, air cooling was found effective under moderate loads due to its low cost and ease of implementation. Experimental results indicate that while liquid cooling offers superior heat dissipation and temperature uniformity, air cooling remains a simpler, more cost-effective alternative for moderate thermal loads. The research provides valuable insights into hybrid BTMS configurations and their impact on battery thermal stability, making it relevant for EV and stationary battery applications.*

Keywords: Li-ion Battery, Battery Thermal Management System (BTMS), Air Cooling, Liquid Cooling, Thermoelectric Cooling, Peltier Module, Heat Dissipation, Temperature Regulation

DOI: 10.48175/IJARSCT-27616