

POWERFLOW FOR ELECTRONICS AND BATTERY COOLING



3DEXPERIENCE®

Applicable Industries: Automotive, Motorsports, Commercial Vehicles, Off-Highway Vehicles & Trains

Vehicle electrification is one of today's main engineering research and development challenges. Despite the technology still being in its infancy, hybrid and electric drive vehicles are here to stay and the battery system is one of the critical components. It must provide sufficient power to give usable daily range, last 10 years or more, be as small and lightweight as possible, yet be safe from fire or the release of hazardous materials. Maintaining the batteries within a strict operating temperature range is essential to meet vehicle range and battery lifetime requirements. Increasing globalization is leading to vehicles or vehicle platforms that must operate in extremely wide operational temperature ranges, which further amplifies the challenge.

Technical Challenges

Thermal management is the main issue affecting battery performance, lifetime, and safety. Lithium-ion batteries must operate within the required temperature limits (between 15° C and 40° C, with a 2° C temperature variation within the cell module). Battery operational temperature limits are quite different from the ambient air temperature or temperatures of other underhood components. Because hybrid and electric vehicles often have the electric drive motors distributed to the wheels, the batteries can be packaged anywhere in the vehicle — typically in very confined spaces with little cooling airflow. The engineering knowledge base for traditional battery cooling that has been built over the years no longer applies, and engineering organizations are struggling to find practical and cost-effective solutions.

SIMULIA Solution

SIMULIA has a comprehensive solution to battery thermal management that enables you to evaluate thermal performance at the cell, module, and pack levels. PowerTHERM's optional battery cell module predicts the 2D temperature distribution on the cell surface as a function of battery current, giving a more accurate prediction of heat rejection. At the battery module level, the cell temperature distribution is coupled with PowerFLOW's highly accurate transient simulation of the cooling flows within the battery module, which enables you to optimize the internal design to achieve minimal temperature gradients. You can extend such analysis to the entire battery pack, and evaluate its thermal interactions with other components in the vehicle and with electronic systems that control the battery operation.

Using the SIMULIA solution for battery cooling, you can:

- Estimate battery thermal performance under vehicle installed conditions for a wide range of vehicle operating conditions.
- Improve the design of the battery module/pack for better efficiency.
- Rapidly analyze various battery packaging concepts against thermal operating ranges and the trade-offs with other requirements (such as weight distribution and aerodynamic drag).