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Semi-Analytic Method in Fast Evaluation of Thermal Management Solution in Energy Storage System

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Abstract : This article presents the application of the semi-analytic method (SAM) in the thermal management solution (TMS) of the energy storage system (ESS). The TMS studied in this work is fluid cooling. In fluid cooling, both effective heat conduction and heat convection are indispensable due to the heat transfer from solid to fluid. Correspondingly, an efficient TMS requires a design investigation of the following parameters: fluid inlet temperature, ESS initial temperature, fluid flow rate, working c rate, continuous working time, and materials properties. Their variation induces a change of thermal performance in the battery module, which is usually evaluated by numerical simulation. Compared to complicated computation resources and long computation time in simulation, the SAM is developed in this article to predict the thermal influence within a few seconds. In SAM, a fast prediction model is reckoned by combining numerical simulation with theoretical/empirical equations. The SAM can explore the thermal effect of boundary parameters in both steady-state and transient heat transfer scenarios within a short time. Therefore, the SAM developed in this work can simplify the design cycle of TMS and inspire more possibilities in TMS design.

Keywords : semi-analytic method, fast prediction model, thermal influence of boundary parameters, energy storage system
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