Heat Generation And Released Model From Lithium Ion Battery Packs

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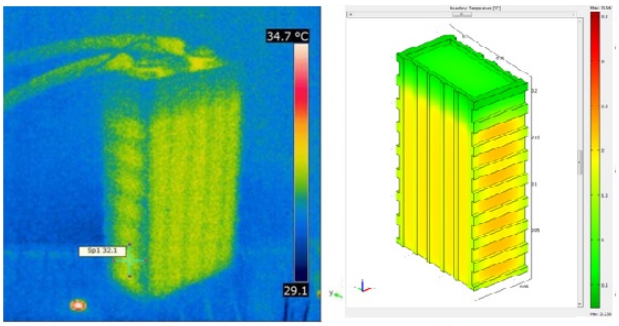
Abstract

In underground mining industry, the heat generated from a number of different sources impacts directly the operation cost. Ventilation facilities are required to keep the mine temperature under the comfortable zone. One of the major sources of heat in this ambient are the diesel machinery. For this reason, and as a measure to reduce the pollution levels, several machineries are being substituted by the electric versions counterparts. The main question is, what is the heat magnitude difference between the electric and diesel version? In this paper, one of the electrical vehicle components selected for the study is the battery pack. Both experimental and simulation evaluations are conducted as an effort to answer this question.

The simulation is based on COMSOL software. This software provides the capability for the mathematical description of heat generation in the battery core, which is based on electric thermal models, and its release to the environment, modeled through classical heat transfer equations, mainly radiation and convection. The simultaneous simulation of heat generation with heat loss, allows for a dynamic analysis of how the lithium ion cells thermally behave under different usage modes, for charging, and discharging under different current values, and ambient temperature.

This study will provide valuable information for the mining industry, in order to understand the impact of underground electric vehicles in this environment. For further studies, other components can be analyzed too, such as electrical motors, chargers, and DC/DC converters. Through the virtual simulation in programs like COMSOL, and through experimentation, the overall thermal impact of these units can be obtained. Not only that, the importance of this paper is not limited to this application, but since electric vehicles represent the future of mobility, and lithium ion cells are the most common method of high performance energy storage, the findings of this study can be extrapolated to other areas too.

Figures used in the abstract



(a) experiment (b) simulation

Figure 1 : Li Ion Battery Thermal Behavior.