

Simulation and Design of Lithium Ion Battery Packs for the Altitude Conditions in Northern Chile

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Abstract

One of the most noticeable effects in loss of performance and capacity of thermal systems is produced by altitude. This causes that the density of a compressible fluid and the atmospheric pressure are considerably reduced, causing a decrease in electrical power and thermal systems. Given this, the packages of lithium ion batteries that use forced cooling by a compressible fluid, are directly affected losing cooling capacity, and decrease in performance.

In this research, the impact of temperature and altitude over sea level, in the design of a pack of lithium ion batteries using forced cooling is quantified.

In support of the thermal behavior of the Batteries & Fuel Cells Module, COMSOL Multiphysics® is used with its Heat Transfer and CFD module. The dimensional and physical parameters of the packing were established as control variables on the effect that would have on the altitude in variables such as the density or pressure of the fluid; this serves in the selection of materials for the solid part as the fluid that passes through the packaging, since the cells of commercially available lithium-ion batteries have different compounds inside, so it is necessary that the specific heat is used as definition parameter in our design in COMSOL®. The specific heat for lithium-ion cells has a value between 700 and 1000 [J/Kg-K] depending on the working temperature of the cells.

The domain of the cooling fluid is defined as air under normal conditions, assuming a laminar fluid under stationary conditions, the reference pressure indicates the altitude conditions considered in this investigation. The entanglement sequence of our system is controlled by the initially assumed physics, considering a normal element and node size. The most relevant results obtained in the simulation in COMSOL® show temperatures between 20 to 37 °C to 4000 meters above sea level.

Figures used in the abstract

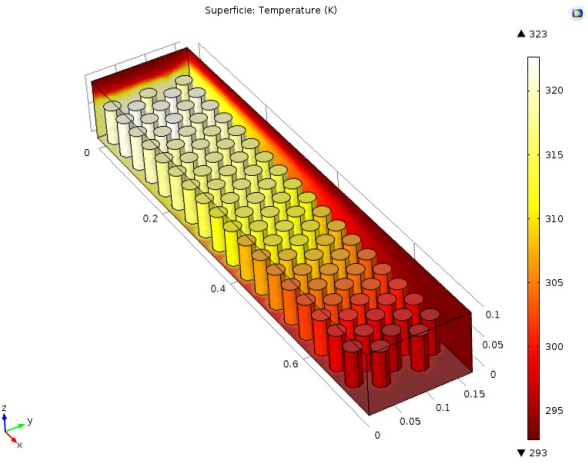


Figure 1: Temperature in packing.