International Renewable Energy Storage Conference IRES

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Title:

Heat flux analysis of a latent heat storage

To store thermal energy in a latent heat storage the entire system of phase change material (PCM), heat exchanger, as well as the heat demand and availability have to be regarded in a system context.

With respect to the heat exchanger it is of the essence to deliver sufficient power. In case of latent heat storage this power is a function of the load. A latent heat storage operates at one distinct temperature. Whereas the capacity in a thermal-energy-storage based on sensible heat is indicated by the actual temperature this information is missing in a latent heat storage. The temperature is constant and independent from load! Particularly in case of incomplete charge and discharge the actual capacity is unknown but would be necessary in order to operate the entire system control.

In a latent heat storage plates or tubes are placed or distributed within the container. They are surrounded by PCM. The process of melting and freezing can be described by transient heat transfer, often the modelling is sufficient precise with a quasi-stationary approach. Heat flux is a function of the actual capacity.

The authors will present a technique to measure the current load by direct heat flux measurement on the heat-exchanger surface. Based on this information the prediction of the current capacity becomes available.

As this technique influences the heat transfer itself it is important to compensate by design measurements and calibration. The application of this technique will be explained within an example of a heat-exchanger element with low heat-conductivity and small dimensions. To design the set-up analytical and numerical calculations of the temperature field are necessary. The results are reassessed within an experimental set up and controlled via integral heat balances.

The presentation explains how analytical and numerical calculation of heat transfer will result into a practical approach to measure power and capacity of a latent heat energy storage.

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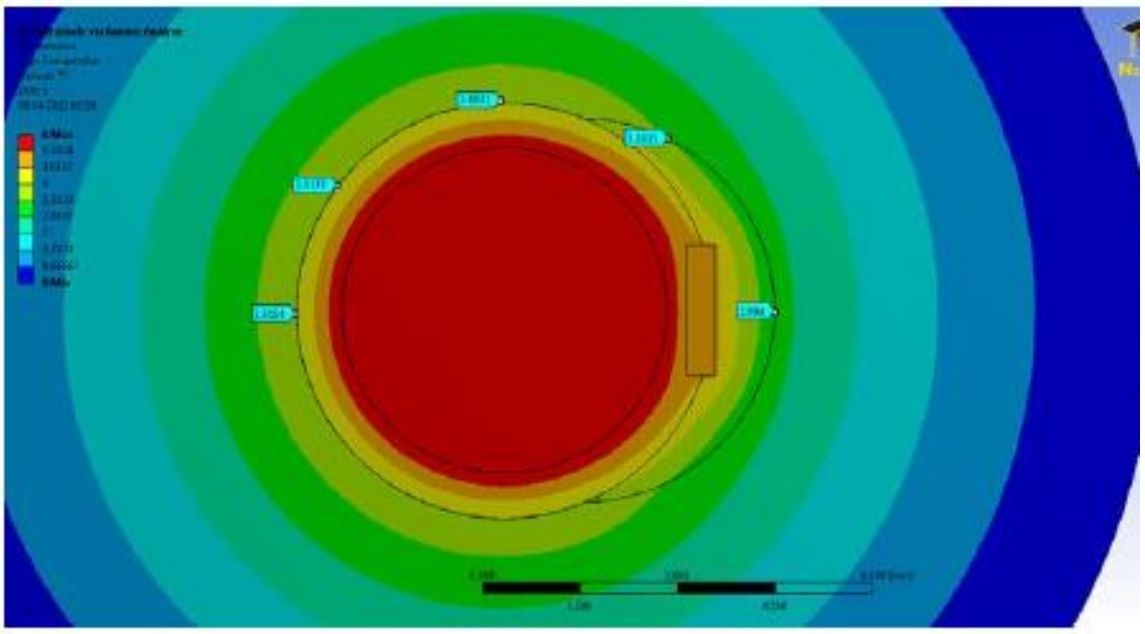

Calculated temperature field of a heat exchanger tube with integrated heat flux sensor surrounded by PCM.