Task 67

Standardizing Thermal Energy Storage Measurement Procedures

Round Robin Tests and Materials Database

The IEA SHC Programme and the IEA Energy Storage Programme began collaborating in 2009. In this third joint Task on Compact Thermal Energy Storage: Materials within Components within Systems (SHC Task 67/ES Task 40), the objective is to accelerate the market introduction of Thermal Energy Storage (TES) materials. Over the past three years, one critical area of work has been developing and validating standardized TES measurement procedures for Phase Change Materials (PCM) and ThermoChemical Materials (TCM) and maintaining material databases.

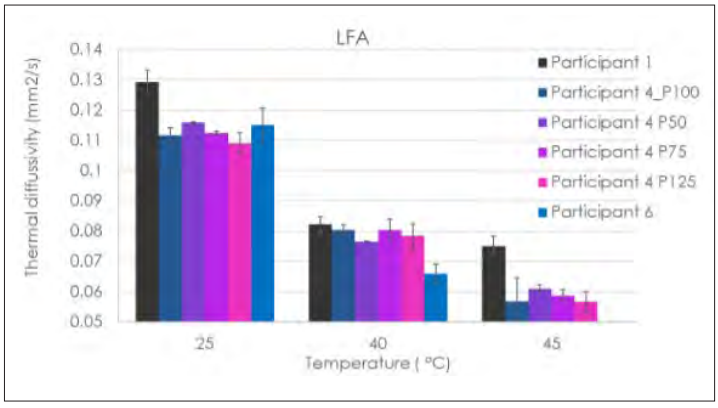
In the second joint Task, Material & Components for Thermal Energy Storage (SHC Task 58 /ES Task 33), new TES materials were found or developed in research projects of the Task participants. Now, in SHC Task 67/ES Task 40, participants are continuing to validate measurement procedures to identify the main physical or chemical parameters.

Several round robin tests have been conducted to evaluate thermal properties like thermal conductivity, thermal diffusivity, specific heat capacity, sorption enthalpy, density, and viscosity of different PCM and TCM candidates. Depending on the material type and measurement method, different measurement procedures were developed, tested, and evaluated to receive comparable results among the round robin participants.

As Task Subtask A leader Daniel Lager notes, “the round robin tests not only harmonized participants’ measurement procedures, allowing them to compare results for the different thermophysical properties of TES materials. The tests also opened the door to discussions on the cross-cutting topic of ‘measurement uncertainty’ to better understand the actual measurement accuracy and uncertainty of the collected results.”

In one of the round robins regarding the thermal transport properties, a PCM with a melting temperature between 53 and 58 °C (Paraffin CAS No. 8002-74-2, Product No. 327204) was analyzed in detail. In sum, 16 institutions from 9 countries participated in this activity using different measurement methods.

Figure 1 shows an example of a round robin result of the thermal diffusivity results based



▼ **Figure 1. Thermal diffusivity results based on the Laser Flash method (left) and sample preparation routine for a special liquid sample holder system (right) of the Paraffin PCM.**

continued on page 24

on Laser Flash measurements on the Paraffin, as mentioned above. In this round robin, one of the big challenges was to harmonize the sample preparation routine and the actual experiment parameters to receive comparable results among the participants. This was the case, particularly at temperatures around 50 °C. Transparency and softening of the paraffin sample led to difficult measurement conditions for the Laser Flash method.

To support the round robin testing, Task participants have been maintaining the Thermal Energy Material Database developed in the previous Tasks (https://thermalmaterials.org/). New data and structure will be added in the future. One structural change is linking existing databases, such as the slPCMlib (https://slpcmlib.ait.ac.at/) database. At this time, the Task is seeking bids from software development companies and looking for funding to implement the changes.

The Task will end in September 2024, but there is no doubt that this critical work on better understanding the application of uncertainty assessments based on applicable standards will continue. And hopefully, additional projects will be initiated to establish a comprehensive, updated, and user-friendly database for the material properties of thermal energy storage materials based on the inputs from the work of the IEA SHC and IEA ES Task experts.

Article contributed by Dr. Daniel Lager of AIT Austrian Institute of Technology GmbH and leader of SHC Task 67/ES Task 40 Subtask A: Material Characterization and Database.