2022 HIGHLIGHTS

Task 67 – Compact Thermal Energy Storage Materials Within Components Within Systems

THE ISSUE

In general, thermal storage leads to a better use of renewable sources, increases thermal systems efficiency or improves the thermal comfort in buildings. For example, with thermal energy storage the use of solar heat can be extended to periods in which there is less or not sufficient sunshine. Compact thermal energy storage materials have special characteristics that enable storage applications beyond the commonly used water thermal storages. Heat can be stored in a more compact way. Thermochemical storage materials (TCMs) can store heat at a large range of temperatures and over a long period, virtually without losses. Phase change materials (PCMs) can store heat at specific temperatures, providing constant temperature heat sinks or sources.

There is a broad range of possible applications for compact thermal energy storage: from keeping temperatures of transported goods constant to the seasonal storage of solar thermal energy in dwellings.

The challenge is to couple the compact thermal storage materials development work to the targeted applications. The material performance needs to be understood, materials need to be tested in application boundary conditions and the material performance, in combination with properly designed components, should be tuned to the desired system performance in the application.

OUR WORK

The purpose of Task 67 is to push forward the compact thermal energy storage (CTES) technology developments to accelerate the market introduction of these technologies through the international collaboration of experts from materials research, components development and system integration, and industry and research organizations.

The main objectives of the Task are to 1) better understand the factors that influence the storage density and the performance degradation of CTES materials, 2) characterize these materials in a reliable and reproducible manner, 3) develop methods to effectively determine the State of Charge of a CTES, and 4) increase the knowledge base on how to design optimized heat exchangers and reactors for CTES technologies.

Participating Countries

Austria

Canada

Denmark

France

Germany*

Italy

Netherlands

Norway

Portugal

Slovenia*

Spain

Switzerland

Turkey*

United Kingdom

United States*

**Participating through the IEA Energy Storage TCP*

Task Period	2021– 2024
Task Leader	Wim van Helden, AEE INTEC, Austria
Email	w.vanhelden@aee.at
Website	http:task67.iea-shc.org

KEY RESULTS IN 2022

Material Characterization

The determination of material properties is not straightforward. Measurement of the properties should give consistent results; therefore, standardized procedures need to be developed and tested via round-robin tests. In Task 67, participating experts started with four round-robin test groups: 1) Thermal conductivity and thermal diffusivity, 2) Specific heat capacity of powdery materials, 3) Enthalpy change due to sorption or chemical reaction, and 4) Thermal expansion, density, and viscosity determination. First, material density results on a paraffin PCM with a melting temperature between 53 °C and 58 °C were obtained with different measurement methods: computer tomography, oscillating u-tube, and Archimedes' principle. Depending on sample preparation in the solid phase and method-dependent uncertainties lead to deviations of the evaluated density (see Figure 1). When additional measured data from other institutes are available, the results will be compared to evaluate the different measurement procedures.

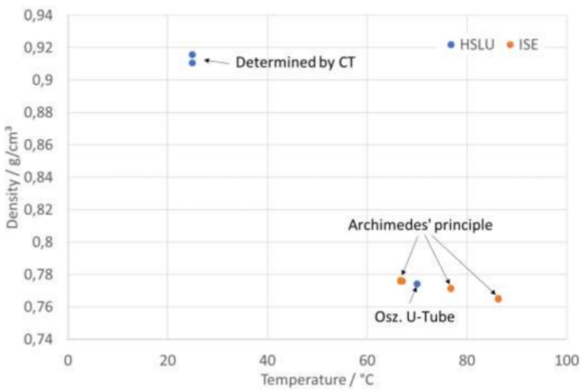

Figure 1. First density round robin results on a paraffin based on CT/osc. u-tube and archimedes principle

Improved Compact Thermal Energy Storage Materials

Different thermal storage applications demand different storage materials with tailored features. There are many methods to modify the properties of existing compact thermal storage materials, some of which are depicted in the figure below. From this inventory, the experts in Task 67 are working to understand the underlying mechanisms that determine the property changes with the objective of tuning the thermal storage properties to match the application requirements. This includes, for example, designing materials with the highest energy storage densities, with amplified thermophysical properties, while also evaluating different encapsulation methods (shape stabilized materials) to reduce the cost of the storage system.