2019 HIGHLIGHTS

Task 58 – Material and Component Development for Thermal Energy Storage

THE ISSUE

More than half of our primary energy resources are used to generate heat. Therefore, technologies for increasing the share of sustainable heat sources and for improving the efficiency of thermal systems are of key importance. Thermal energy storage technologies are needed for both – to match the intermittent supply of sustainable heat and cold and to optimize the thermal system performance. Present thermal energy storage technologies based on water perform well, but on a relatively low level of efficiency, particularly for long-term storage. These systems can only be improved marginally thus new materials and systems are needed to enable a breakthrough.

OUR WORK

This joint project with the IEA Energy Conservation through Energy Storage Technology Collaboration Programme (ECES TCP) focuses on furthering the understanding and development of PCM and TCM materials, the development of measuring procedures for characterization and test methods for validating the performance of PCMs and TCMs as well as the development of effective design approaches for specific components.

Task experts from both materials research and storage applications are collaborating on the different levels of the storage system, components, materials and testing, and characterization. The work is divided into two parallel tracks – thermochemical (TCM) and phase-change (PCM) materials.

The main objectives of the Task are to develop and characterize storage materials to enhance TES performance, to develop materials testing and characterisation procedures, including material testing under application conditions, to develop components for compact thermal energy storage systems, and finally to map and evaluate the TES application opportunities concerning the requirements for the storage material.

Participating Countries

Austria
Canada
Switzerland
Germany
Denmark
Spain
France
Italy
Netherlands
Sweden
Slovenia
Turkey
United Kingdom

Task Period	2017 – 2019
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KEY RESULTS IN 2019

Ultra-compact Heat Storage for the Production of Hot Water

A consortium of French R&D institutes and industries is developing an innovative concept for the storage and heat exchange that is modular, ultra-compact, and low-cost.

The work is done in the nationally funded EUROPA project and is aiming at demonstrating the system, that is based on a phase change material.

Each storage module couples a honeycomb panel containing the PCM with two separate planar heat exchangers located on both sides of the cavity. These exchangers ensure the charge (storage + direct transfer) and the discharge (release + direct transfer) simultaneously or not.

The present step in the development is the choice of the best PCM and the design of two types of heat exchangers.

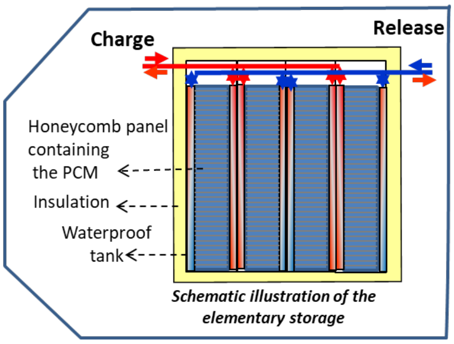

Figure 1. Schematic view of the PCM storage module.

Improved Sorption Materials Developed

A number of research institutes have been working on the development of sorption materials with improved storage properties. The class of materials is the so-called composites, which are combinations of a porous material, like zeolite, that is impregnated with a salt hydrate. The combination has added value, as the salt hydrate has a vulnerable mechanical structure, which is compensated by the very stable zeolite, while the addition of the salt hydrate increases the storage capacity of the zeolite. The improvement of the storage capacity can be seen in Figure 2, showing the storage capacity of pure sorption materials (in black) and the composites (in blue). The new materials open up new possibilities for developing even more compact thermal energy storage devices.

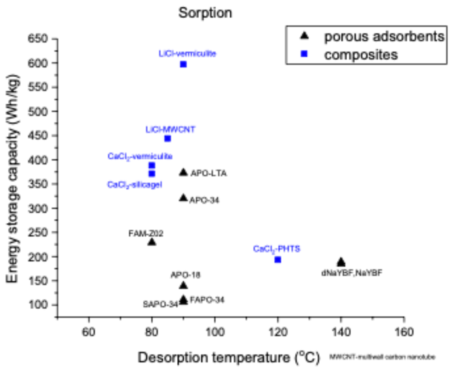

Figure 2. Energy storage capacity of traditional porous materials (black) and of novel composite materials (blue).

PCM with Targeted Properties by Mixing of Components

At the ZAE research institute in Bavaria, Germany work is aimed at designing phase change materials with targeted melting temperature by calculating the proper mixture of different salt hydrates.

The method uses theoretical models for the transition from solid to liquid for so-called binary mixtures, one salt hydrates plus water. The calculation method is expanded to determine the behavior of ternary systems, composed of two salt hydrates and water. Challenge with these systems is to determine the proper stable mixture composition, as there exist a number of 'pseudo' stable mixture compositions. The method was verified by experiments and can now be used for a design of PCM mixtures with a targeted melting temperature. Further experiments with a targeted mixture are needed to determine the long-term stability of the new PCM.

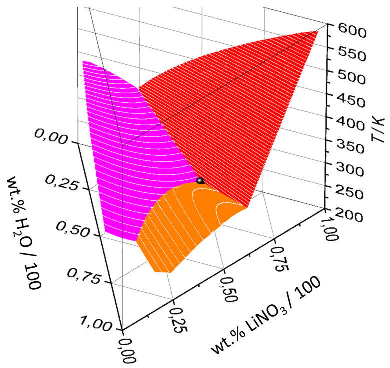

Figure 3. Phase diagram indicating the melting temperature of the ternary mixture as a function of the water fraction of the two salt hydrates.