
Annex 24 Material Development for Improved Thermal Energy Storage Systems

Introduction

For the performance of thermal energy storage systems their thermal energy and power density are crucial. Both criteria are strongly depending, beside other factors, on the materials used in the systems. This can be the storage medium itself, but also materials responsible for the heat (and mass) transfer or for the insulation of the storage container.

After a number of thermal energy storage technologies have reached the state of prototypes or demonstration systems a further improvement is necessary to bring these systems into the market. The development of improved materials for TES systems is an appropriate way to achieve this. The material solutions have to be cost effective at the same time. Otherwise the state of the existing technologies can not be brought closer to the market.

In Addition to that the more precise knowledge from pilot and demonstration projects concerning the real boundary conditions of the TES systems is necessary to put up a profile of requirements for the material properties. In a lot of cases these conditions are quite different from the assumptions made in the beginning of the development.

Very important for many applications is a high number of charging and discharging cycles of the TES system. Therefore the stability of all materials in the systems is a very important property. This is valid not only for the storage medium itself, but also for materials used in systems components (container, heat exchanger, pipes, channels...).

The world wide R&D activities on novel materials for TES applications are not sufficiently linked at the moment. A lot of projects are focusing on the material problems related to their special application and not towards a wider approach for TES in general. The proposed Annex should help to bundle the ongoing R&D activities in the different TES technologies.

Material development for latent heat and thermochemical storages

The importance of the optimal storage material is obvious for PCM and thermochemical (e.g. sorption) storages. Here the choice of the suitable material for the storage medium is depending very much on the boundary conditions. The complexity of these systems requires a clear definition of the “optimal material”. Conditions like charging and discharging temperature, available charging power and required discharging power or number of storage cycles are influencing the material choice.

At first the properties of the optimal phase change material or sorbent have to be defined. Following that existing material or potential new development should be found by screening research activities in that field world wide. The most promising materials should be identified and their development should be emphasized.

Material development for sensible TES systems

In all fields of thermal energy storage material problems have to be solved. This can go from the inner surface of UTES systems to the material of an inner heat exchanger in a liquid

absorption storage reactor. All these material questions should be listed and possible solutions should be identified.

Scope and objectives

The general objectives of the proposed Annex “Material Development for Improved Thermal Energy Storage Systems” are to identify state-of-the-art for solving the complete range of material problems, to broaden and co-ordinate the knowledge within the field, and to disseminate information. In particular, research on high capacity storage materials concerning thermal energy and power and the identification and development of better materials for heat transfer and insulation will be encouraged. Potential cost-effective solutions must be identified.

At the end of the annex, present activities within the field are expected to be better coordinated, and initiatives for new activities have been taken.

Collaboration with other parties

Collaboration with other activities in the field should be established. Close contacts to the activities of the new proposed task within the Solar Heating and Cooling IA “Materials for the storage of solar heat” should be installed. Other IAs, like Industrial Energy-Related Technology Systems IETS should be addressed in order to broaden the possible applications (e.g. to higher operation temperatures in contact with the ECES Annex 19).

Suggested Operating Agent

As operating agent for the proposed new annex ?? is suggested.

Work Program – Main Activities and Time Schedule

Phase 0: January 2008 - June 2008 (Task Definition Phase)

- Invitation to participate
- Kick-off workshop in conjunction with an International Symposium on “Materials in TES” at the ZAE Bayern, in Germany – establishing participants and their combined goal with the annex
- Finalize Annex Objectives, Goals and Work Plan with ExCo
- Finalizing Financing Plans for participants

Phase 1: July 2008 – December 2008

- Collecting information on ongoing activities in the area
- Establishing collaboration activities
- First Workshop and Expert Meeting
- Installing subtasks (PCM, Thermochemical, sensible TES,...)

Phase 2: January - June 2009

- Compile State-of-the-Art of the material R&D for TES
- Identify main goals of future R&D demand
- 2nd Workshop and Expert Meeting

Phase 3: July 2009 - December 2009

- Identify the requirements for “ideal” materials in the subtasks based on experience in Pilot and demonstration projects
- Start of establishing a data base on novel materials and their properties
- 3rd Workshop and Expert Meeting

Phase 4: January 2010 - June 2010

- Establishing a data base on novel materials and their properties
- 4th Workshop and Expert Meeting

Phase 5: July 2010 - December 2010

- Final Report
- Closing the Annex
- Dissemination of Results
- 5th Workshop and Expert Meeting

Activities

- Evaluation of presentation and findings
- Compiling a state-of-the-art report
- Organizing workshops and expert meetings
- Establishing a data base of novel material properties
- Initiate projects related to development of innovative material solutions.

Major outcomes

The major outcomes of the proposed annex will be:

- State-of-the-art report
- Increased awareness of the international activities in material improvement and better co-ordination of these activities.
- Increased activities in the area, preferably through international collaborations
- Data base of novel material properties