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Guest Editorial

Thermal energy storage is a key element for solar thermal applications and is of fundamental significance for improved thermal management in the sectors of industrial process heat and power generation. A characteristic of thermal storage systems is that they are diversified with respect to temperature, power level and heat transfer fluids for charging and discharging and that each application is characterized by its specific operation parameters. This requires the understanding of a broad portfolio of storage designs, media and methods.

Today, available heat storage technologies suffer from insufficient energy densities, limited efficiency and reliability and investment costs, which are still too high. Such shortfalls are obstacles to a more wide-spread use and market penetration. To close this gap, material engineering issues as well as design and system integration aspects are in the focus of the relevant research and development efforts world-wide.

This special issue of JSEE reflects the above situation. It contains 14 papers from 11 countries covering a broad range of measures on how to make thermal energy storage more reliable, efficient and—most importantly—more cost effective.

Approximately two-thirds of the contributions focus on storage applications for heating and cooling, which indicates that this area is a real hot spot with current R&D activities. Included are passive PCM storage approaches (Castellon et al. and Konuklu et al.) to improve thermal comfort in buildings as well as different sensible and PCM storage concepts for active solar systems. While sensible storage is the most common option for large-scale centralized storage systems (Ochs et al. and Choubani et al.), PCM storage is considered to be the most suitable solution to improve existing small-scale water storages (Martin et al. and Nallusamy et al.) or to be integrated in a solar heat pump heating system (Trinkl et al.). Furthermore, thermo-chemical heat storage is treated (v. Essen et al.), which is currently coming up in the research community as a new emerging concept to realize compact storage systems for seasonal storage. The second new research topic—the use of multi-functional fluids for absorbing solar radiation and storing of heat—is also included (Tyagi et al.).

Heat storage for concentrating solar technology—the second important field for solar thermal applications—is treated by the remaining third of the papers. Improvement of the commercially available molten salt storage technology (Gabrielli et al.) for parabolic trough plants as well as an alternative concrete storage concept (Laing et al.) are considered. For the next generation of trough plants with direct steam generation, PCM storage is being under development as the most attractive solution. The paper of Steinmann et al. deals with material and design concepts to overcome the bottleneck of PCM storage—the non-sufficient heat conductivity of salt phase change media. The impact of latent heat storage integrated within high temperature receiver-reactors is investigated by Kodama et al. The important and overall question how to investigate thermo-physical properties and to characterize the new composite PCM based storage materials is also treated (Palomo et al.). Finally, the beam down concept (Ben-Zvi et al.) offers the potential to think about new design approaches for ground based directly radiated receiver-reactors or thermal energy storage units.

Heat storage for solar systems is currently receiving increasing interest in the R&D policy of several countries—e.g., in the US, Spain, France, Germany, and the EC. The number of contributions to JSEE in this area is expected to significantly increase.

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