Title: Thermochemical energy storage with Calcium Hydroxide, experimental demonstration of storage system for decentralized heat supply in buildings.

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Abstract:

The reversible reaction of Calcium Hydroxide to CaO and water vapour is very promising for thermochemical energy storage. The storage material is cheap, abundantly available and completely environmentally friendly. Energy-wise the potential lies in the loss free storage period and an energy density several times higher than conventional thermal storage technologies. For these reasons the reaction system has been investigated by several research groups over the past decade addressing different aspects on material, reactor and storage system level. Nevertheless, unfavorable material properties like cohesiveness, agglomeration tendency and large volume changes during the reaction impede the development of cost efficient and easily scalable thermochemical reactors. Our main approach to overcome these drawbacks are to work on both sides, improving the material properties on one hand and to develop reactors with improved functionality.

One outcome of our current work is a novel reactor concept based on the principle of a mechanically induced fluidized bed. The concept uses rotating shovels which induce a mechanical fluidization of the storage material inside the reactor. The principle helps to prevent agglomeration, facilitates the gas transport to and from the reacting particles and enhances the heat transfer coefficient between the particles and the heat exchanging wall of the reactor. With the operation of two different reactors based on this concept we could successfully demonstrate the energy storage process: The electrical charging of the storage material as well as the thermal discharging in kW scale. For these reactors we also developed a pilot storage system, including storage containers for a 100kWh thermal energy and automated transport of the material to and from the reactor. We integrated the pilot system in a research building environment and demonstrated the operation outside the laboratory successfully. To improve the overall systems performance and the function of sub components we also investigated different enhanced forms of the storage material: larger granules with a nanocoating for stabilization and hard compacted briquettes. This presentation will outline the operation of the storage system, characterizing the performance, efficiency and analyzing the impact and functionality of different novel forms of the storage material. We will discuss the general potential and outlook of energy storage based on Calcium Hydroxide.