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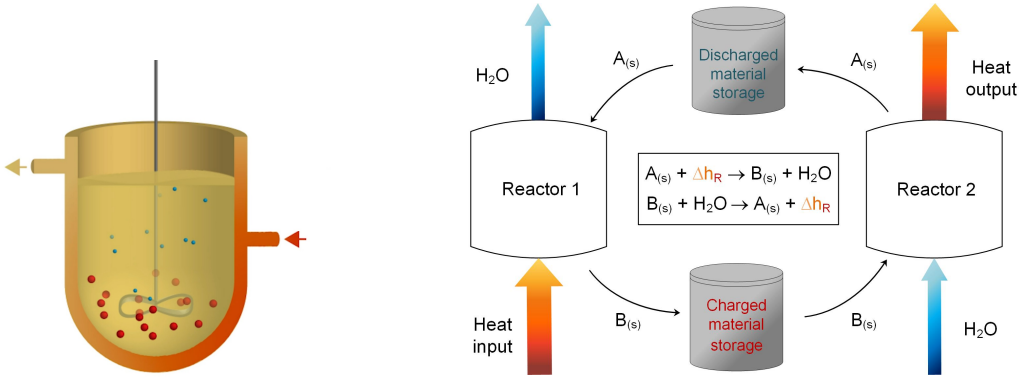
Thermochemical Energy Storage in a Suspension Reactor

Centrepiece of the proposed thermochemical energy storage (TCES) system is the novel, scalable suspension reactor. In the suspension reactor excess heat is used to activate a solid heat storage material. Like electricity stored in a battery, the stored heat can be released on demand. During the storage period no insulation is required, and the reversible chemical reaction allows many charging cycles without losses. With this type of solid heat storage even seasonal periods can be bridged, effectively making the presented technology a sustainable and climate-friendly heat storage system, that provides emission-free heating.

BACKGROUND

As a result of the global increase in energy demand, climate change and geopolitical developments, energy storage has gained in importance. The concept of thermochemical energy storage (TCES) is an important development in this field. TCES utilises the reaction enthalpy of reversible chemical reactions.

The working principle sequence of the new suspension reactor consists of the following steps: charging, storing and discharging. During the charging phase, the heat input activates the solid storage material, releasing only pure water. The active solid can easily be stored, and when the stored heat is needed again later, the storage material is recombined with the water and the heat is released immediately. The thermochemical cycle is thus complete and can be restarted by applying heat. In practice, the focus lies on the low-temperature range from 70°C to 200°C, depending on the TCES system used. The suspension reactor allows scale-up from small household applications to industrial scale.



Images: Schematics of the suspension reactor (left) and the TCES-cycle (right)

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Different types of salt hydrates or boric acid, for example, can be used as thermochemical storage material. The gas/liquid-solid reaction such as the boric acid/boron oxide or salt hydrate system for thermochemical heat storage is carried out in a suspension reactor. The suspension medium, in this case a heat transfer medium (e.g. refined rapeseed oil, mineral oil-based thermal oil, silicone-based thermal oil), allows optimised heat transfer within the reactor and also provides a protective layer for the solids during the chemical reaction. The gas phase (e.g. water) created during the reaction for heat storage is separated and condensed in order to feed this liquid phase back into the suspension for heat recovery.

ADVANTAGES

- High energy density
- Low material cost
- Perfect cycle stability
- Non-hazardous
- Scale-up easily possible
- Unlimited storage time

REFERENCE:

M055/2020

APPLICATIONS:

- Heat storage in a low-temperature range (<200°C)
- Household solutions (Heating and domestic water) up to industrial applications

KEYWORDS:

- Heat Storage
- Thermochemical Energy Storage (TCES)
- Long-time storage
- Emission-free energy storage
- Reversible chemical reactions

Click here for the video

IPR:

AT patent granted
International patents pending

OPTIONS:

- License agreement
- Pilot projects
- R&D cooperation

DEVELOPMENT STATUS:

Laboratory scale; Prototype testing

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