Since 2015 a large scale demonstration plant of the Storasol High Temperature Thermal Energy Storage System (HTTRESS) developed and patented by enolcon is in operation at the University of Bayreuth. With a storage capacity of up to 1.6 MWh and a charging capacity of up to 1.8 MW, the system is successfully in operation. In this poster first operational results of the charging and discharging process are shown, including the operation of a connected Organic Rankine Cycle (ORC). Furthermore the parameters of the adaptable storage design are presented as well as results of design supporting CFD simulations.

**High Temperature Thermal Energy Storage**

**ORCTES Demonstration Plant:**
- Storage of high temperature thermal energy in 2 storage modules
- Temperature range: 150 °C to 600 °C
- Storage material: silica sand (grain size: 1-3 mm)
- Number of parallel packed bed layers: 6 per module
- Heat transfer media: air
- Close-meshed temperature measurement system
- Interface to an ORC process for electricity production

**Operational Results**

**Charging Behavior:**
- Typical behavior with fast temperature increase at the front part of the layers at the beginning of the charging process. After reaching a certain temperature level, the temperature is increasing slowly. The temperature in the middle and rear part of the layers show the same but time delayed behavior. The temperature gradient at the end of the layer is slightly lower compared to the front.
- Charging with different temperatures between 250°C and 600°C shows the same behavior.
- A higher mass flow results in a faster charging process.

**Discharging Behavior – Operation of ORC:**
- Stable and reliant operation of the ORC-plant was demonstrated.
- While the HTTRESS is discharged, an air flow on a constant temperature level is directed to the ORC-plant.
- Operation on different load cases is easily possible; with increasing air flow, the discharging power of the thermal storage is increased, while remaining on a constant temperature level.
- Within the ORC-plant, preheating, evaporating and superheating of the working fluid was demonstrated.

**Modular Concept**
- The Storasol HTTRESS is a customizable storage system. A major advantage is its module based concept, which allows different arrangements of storage modules. As conclusion the modules can be charged and discharged in the following ways:
  - parallel (high charging/discharging power),
  - sequential (high charging/discharging capacity).
- In Concentrated Solar Power (CSP) applications, where the produced energy is varying all day long (with the varying DNI) the parallel charging approach can be used to achieve a fixed and optimal charging power of the HTTRESS. With this setup, an optimal charging behavior with an optimal efficiency can be achieved.

**Adaptable Design**

**Supporting CFD**
- Based on the experimental results a detailed CFD simulation of the storage module was developed.
- The simulation results confirm various experimental results, e.g.:
  - faster charging process with higher mass flow rate,
  - effect of perpendicular barriers against flow bypass after subsidence of storage material.
- CFD simulations can be used in the future design set-up. The model can support the development of new storage layouts and the analysis of the influence of design changes or new storage materials.

**Conclusion**
- The ORCTES facility demonstrates the up-scaling ability of the Storasol HTTRESS and its applicability in various technologies including CSP and electricity generation in combination with an ORC.
- The storage layout with a model based concept allows a methodical approach to storage design by changing defined design parameters.
- Based on the measurement data a CFD model of a storage layer is developed to analyze effects of storage design changes.

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