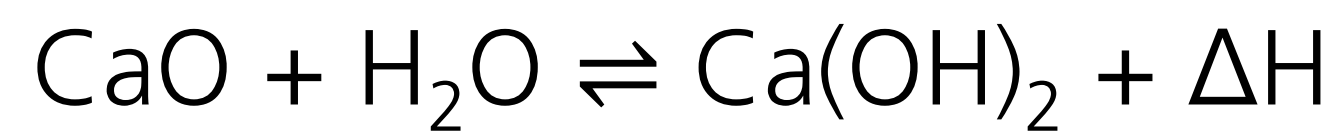
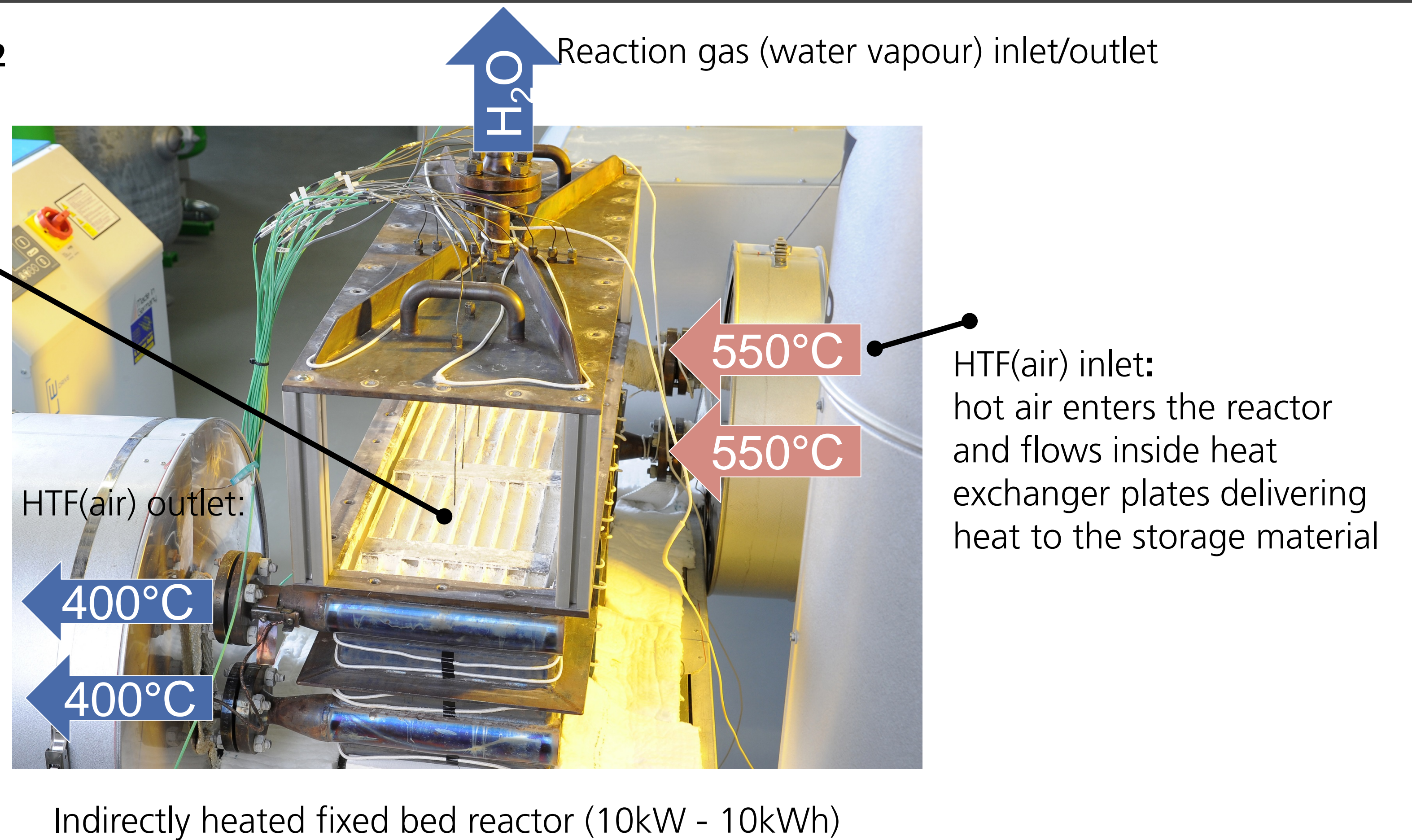


Thermochemical Heat Storage based on $\text{CaO}/\text{Ca}(\text{OH})_2$



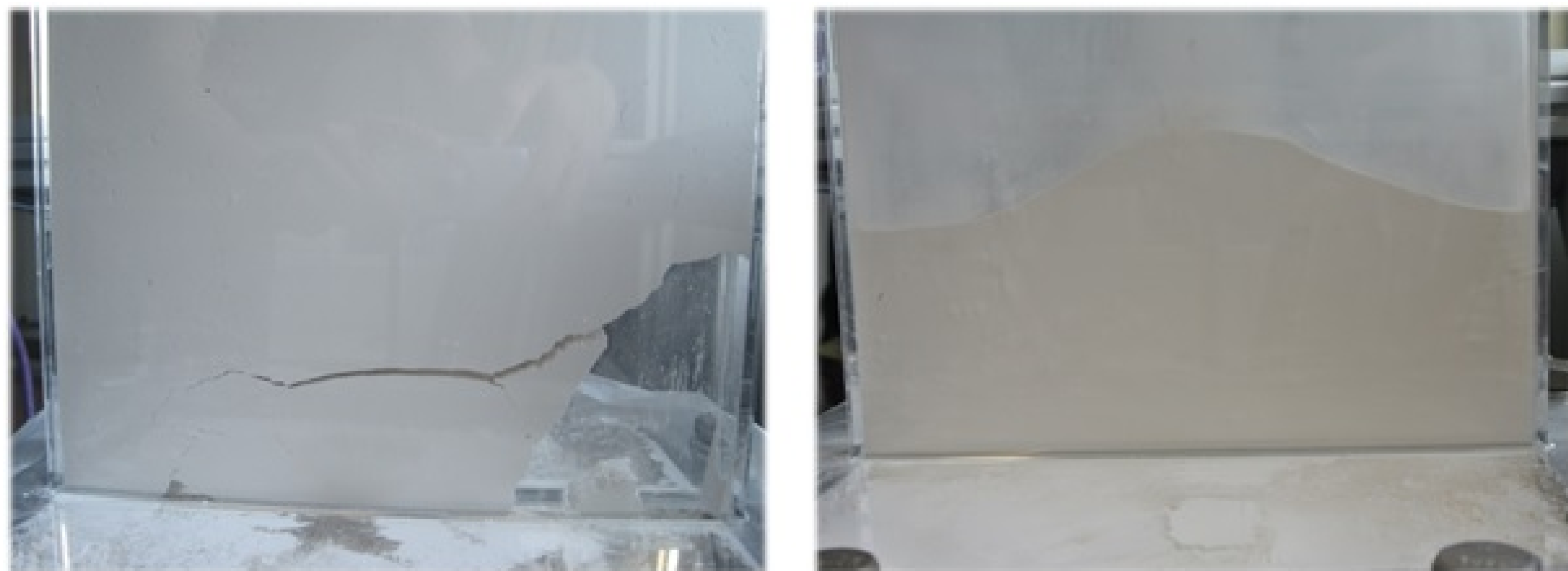
- High energy density (0,4 kWh/kg)
- Low material cost (50 €/t)
- Fast reaction kinetics
- Temperature of reaction 400-550°C (CSP – Plants)
- Demonstrated in pilot scale (10kW – 10kWh)

In order to be able to realize large-scale thermal energy storage systems based on calcium hydroxide two crucial points need to be addressed. First: The separation of power and capacity by means of a moving bed reactor. Second: Operation modes need to be examined in order to develop efficient system integration strategies.

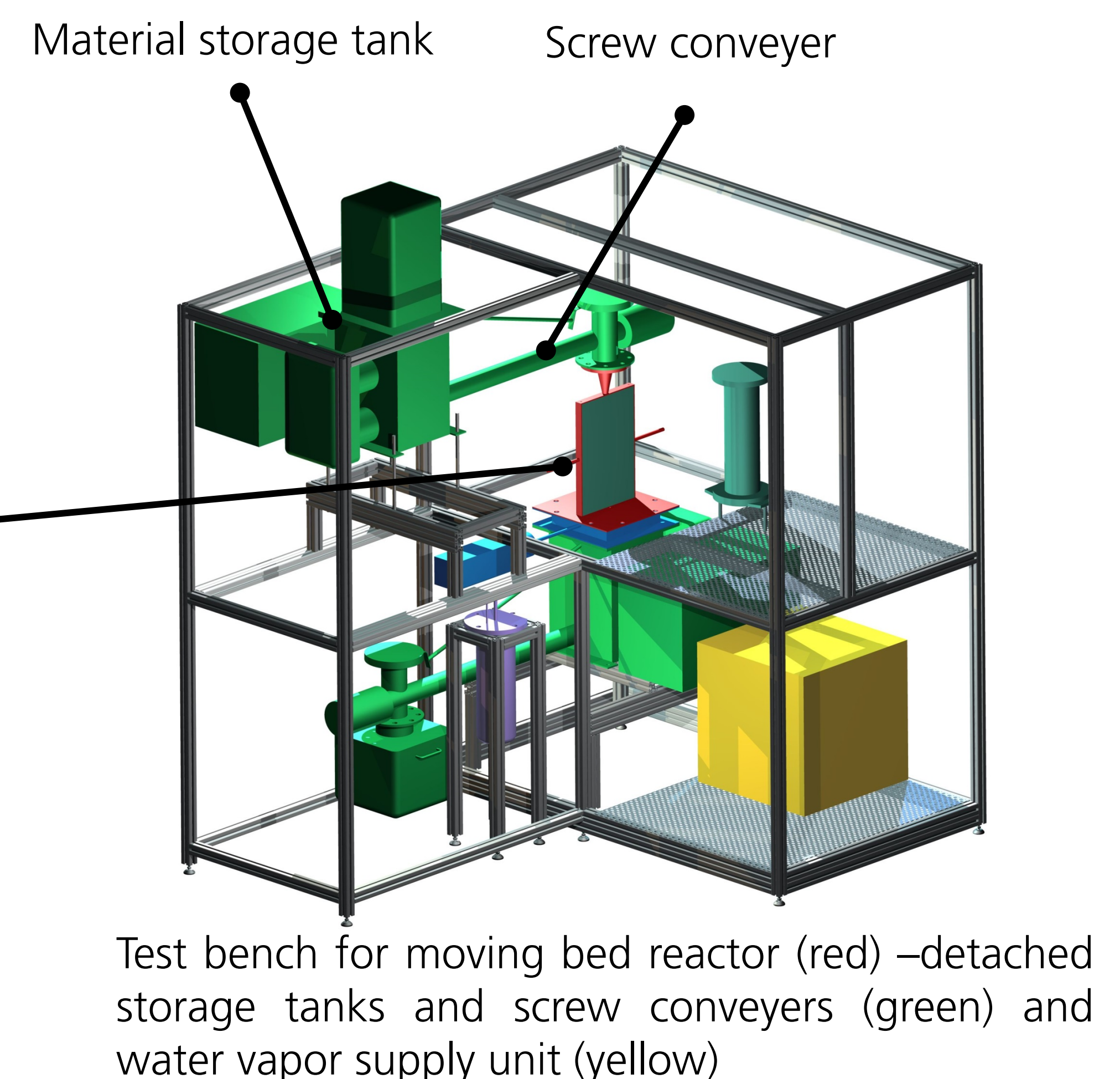


Development of a moving bed reactor:

Pure $\text{Ca}(\text{OH})_2$ is a very cohesive powder hence a free flow through a reactor geometry is difficult to realize. One approach to improve flowability is to coat the surface with nanoparticles. This reduces adhesion forces between single particles and enhances flowability. Different mixtures of $\text{Ca}(\text{OH})_2$ and nanoparticles haven been synthesized and the flow behavior of the modified material has been tested.

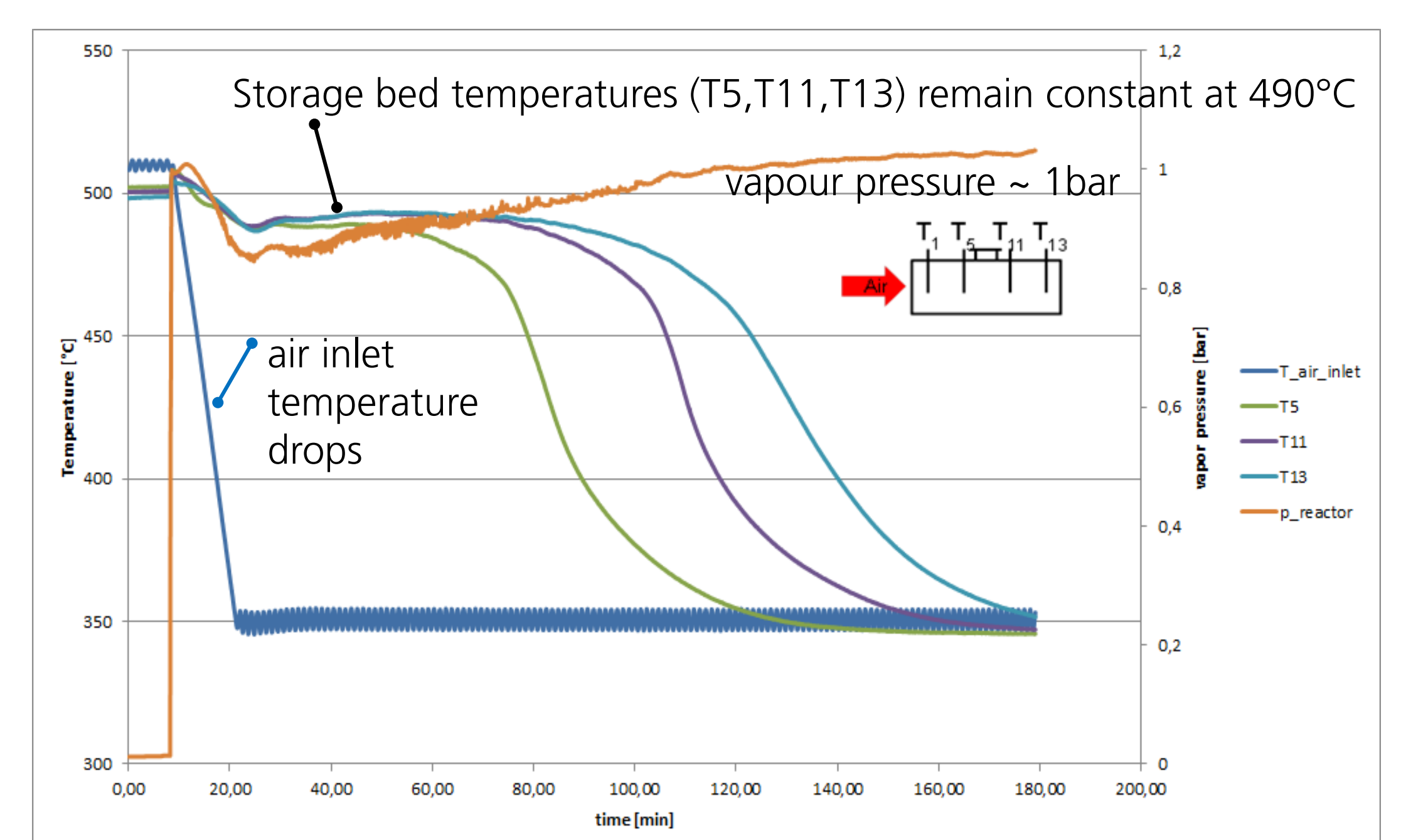


Flow behavior of pure (left) and modified (right) $\text{Ca}(\text{OH})_2$ in lab-scale reactor under ambient conditions



Operation modes of fixed bed reactor:

To develop process integration strategies different operation modes have been investigated with the pilot scale fixed bed reactor. The figure on the right shows the buffer storage mode: initially the air inlet temperature drops (p.e.: due to cloud coverage in a CSP-Plant) and simultaneously water vapor is supplied to the reactor to drive the exothermal hydration of calcium oxide to calcium hydroxide. For the following 100 min. a constant temperature level of 490°C was observed in the storage bed.



Experimental characterization of operation modes of a $\text{Ca}(\text{OH})_2$ thermochemical energy storage (fixed bed reactor)

Summary + Outlook:

- ✓ Coating $\text{Ca}(\text{OH})_2$ with nanoparticles improves flowability
- ✓ Homogenous flow has been realized under ambient conditions
- ✓ Moving bed concept has been proven for hydration and dehydration
- ✓ Storage discharge performed at a constant temperature (fixed bed)
- Reaction gas transport in a moving bed is currently investigated
- Experimental characterization of different operation modes(max. temperatures, pressures)
- Development of process integration possibilities

