

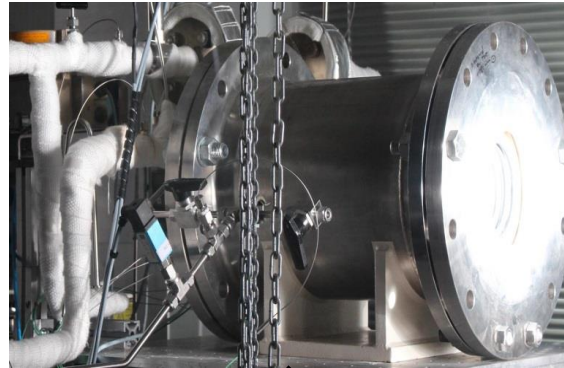
3RD INTERNATIONAL WORKSHOP ON CARNOT BATTERIES 2022

Improving cycling behavior of packed bed thermal energy storage by
using redox materials

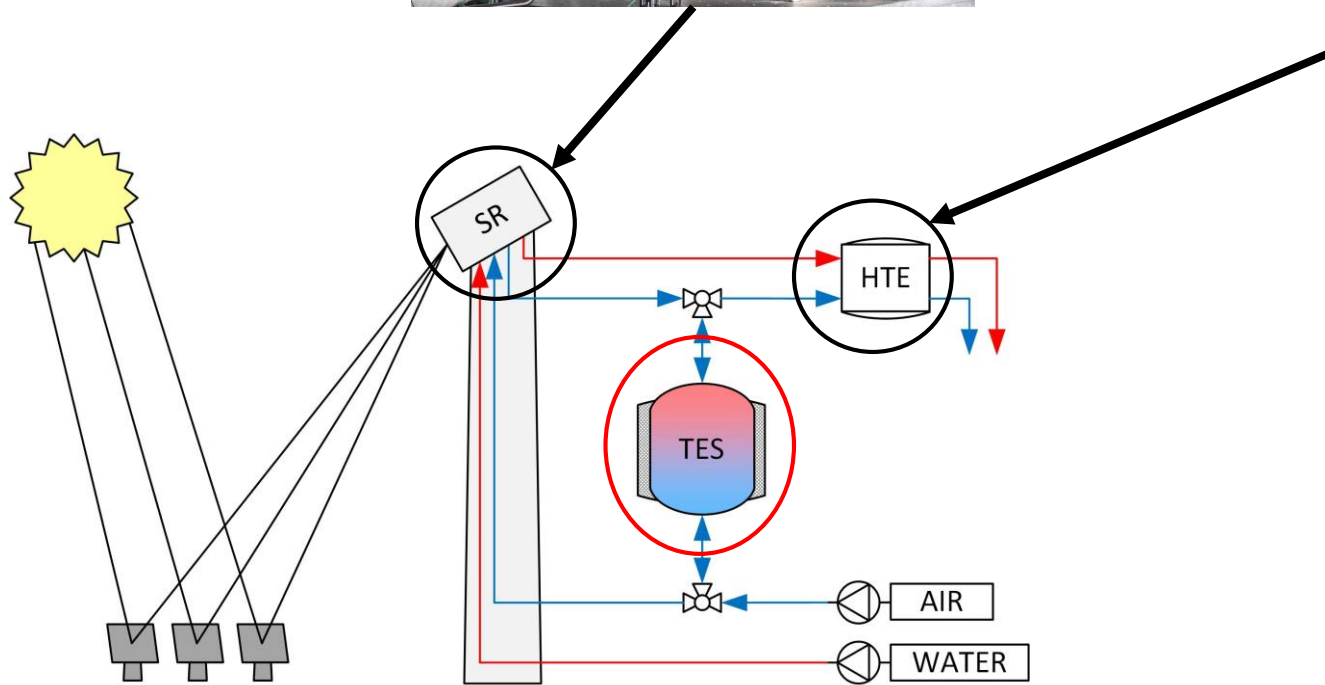
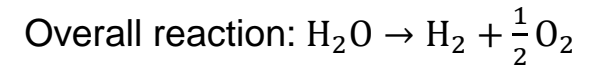
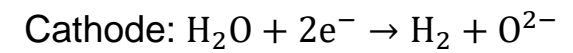
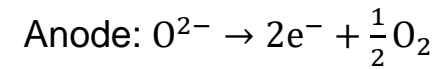
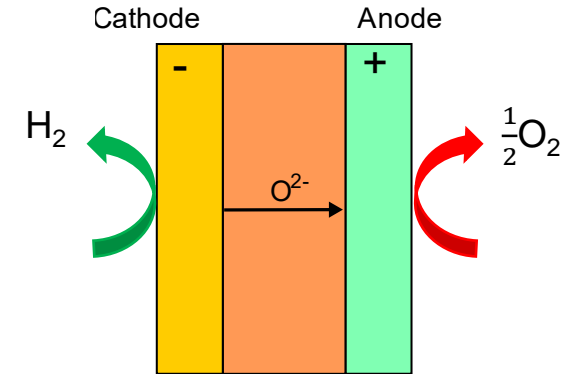
Timo Roeder, Yasuki Kadohiro, Kai Risthaus, Nathalie Monnerie



Future Fuels (FF) & Engineering Thermodynamics (TT)

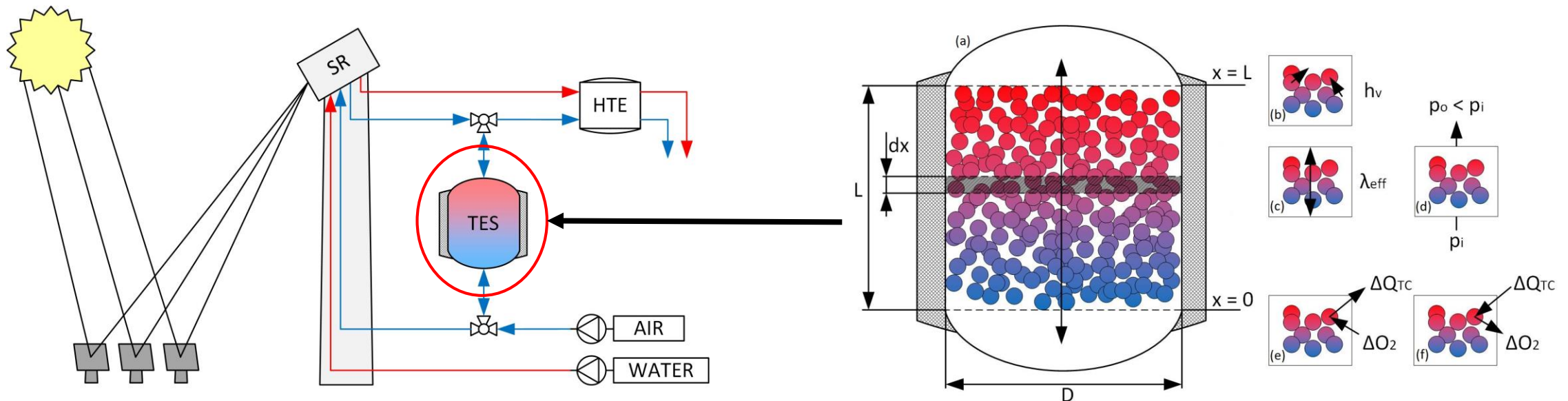


SOEC (700-1000°C)



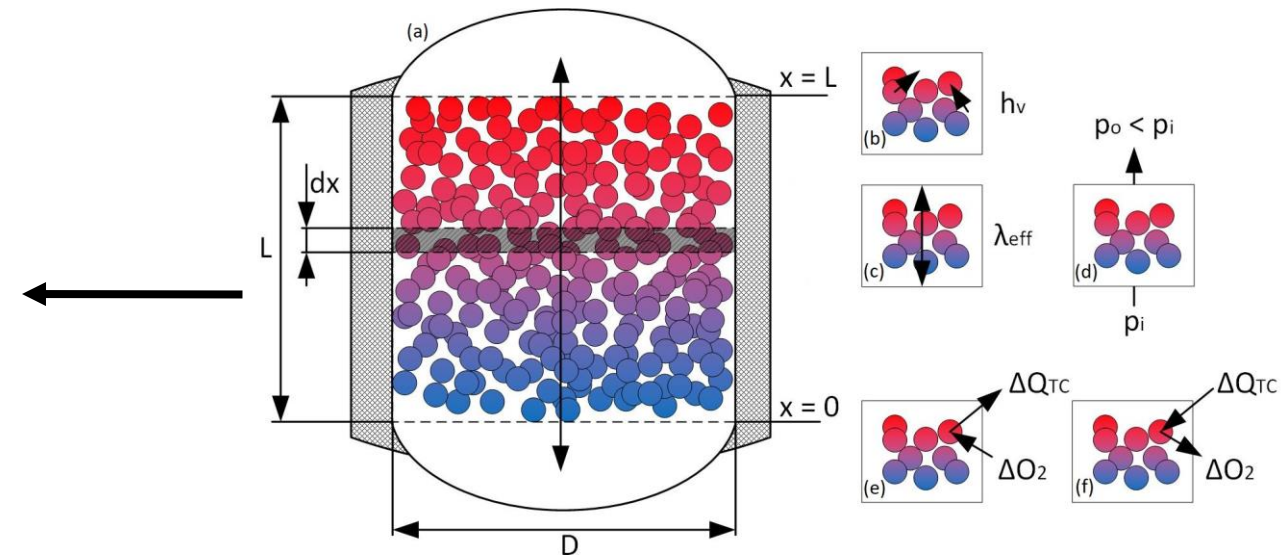
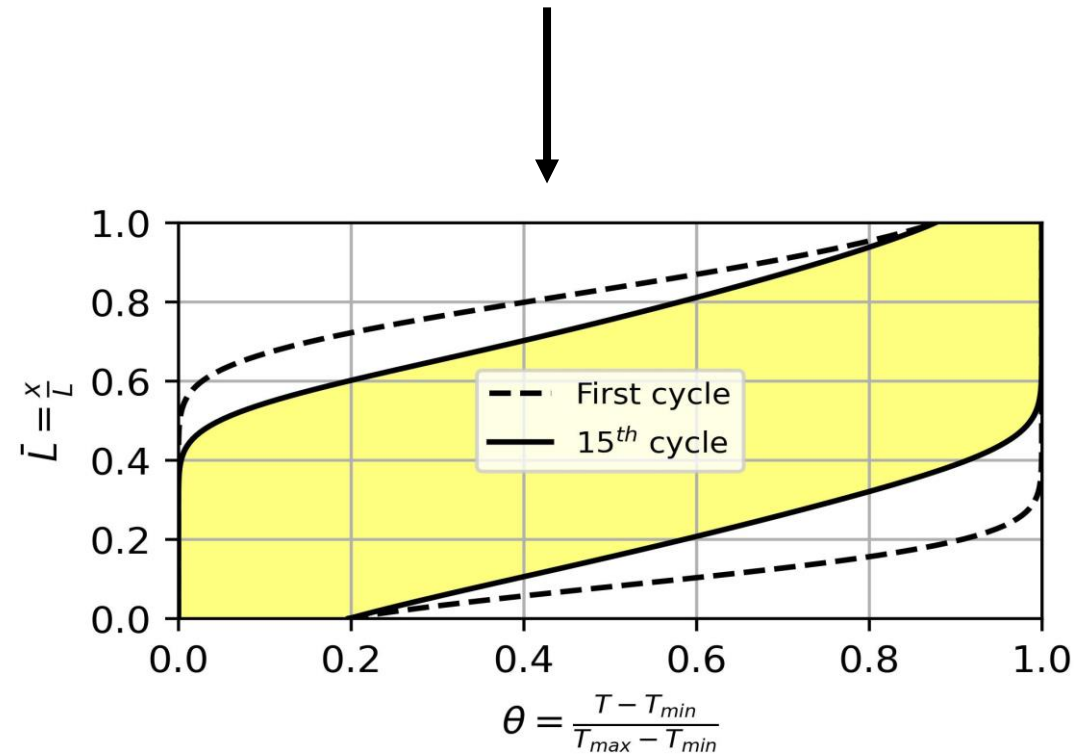
Thermal Energy Storage – Model Description

- Cloud shading periods
- Day & Night Operation



Problem of Thermocline energy storage

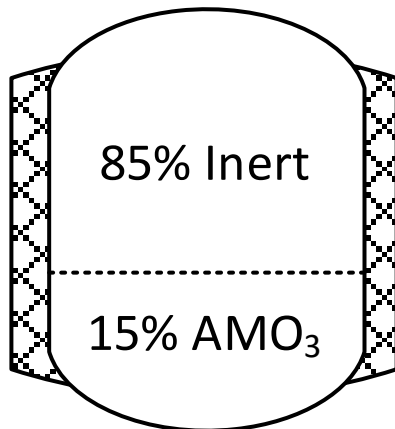
- Thermal degradation after consecutive charge and discharge cycles
- Using non-reactive material only



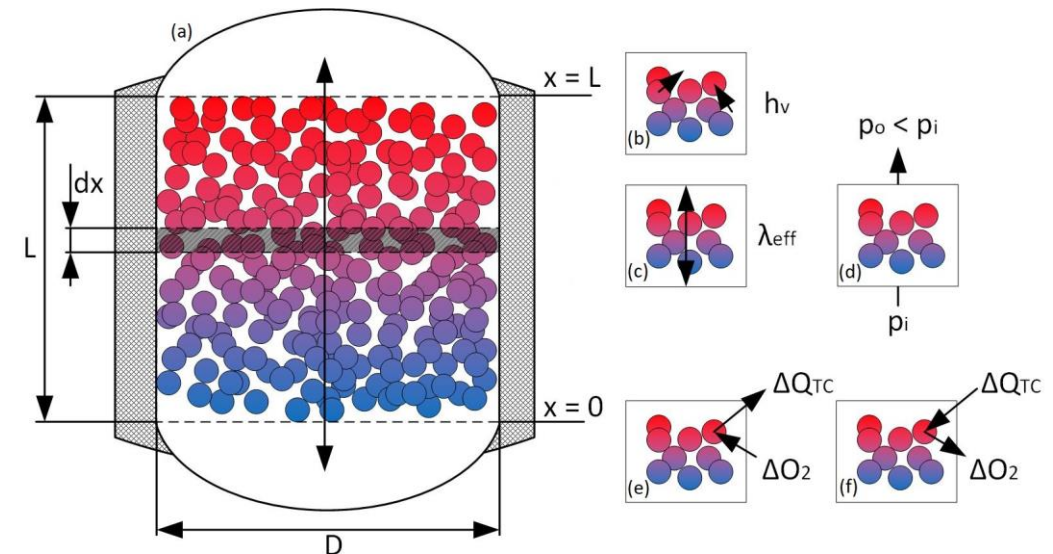
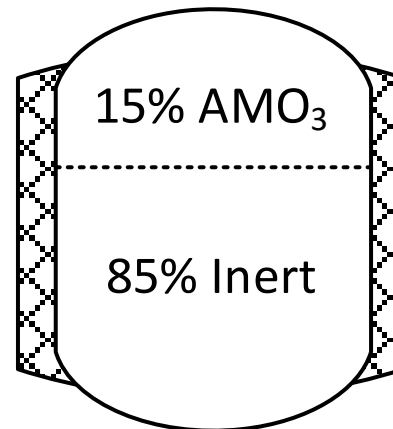
Cascaded thermal energy storage

- Passive thermocline control through reactive / latent heat
- Redox Reactive Perovskites

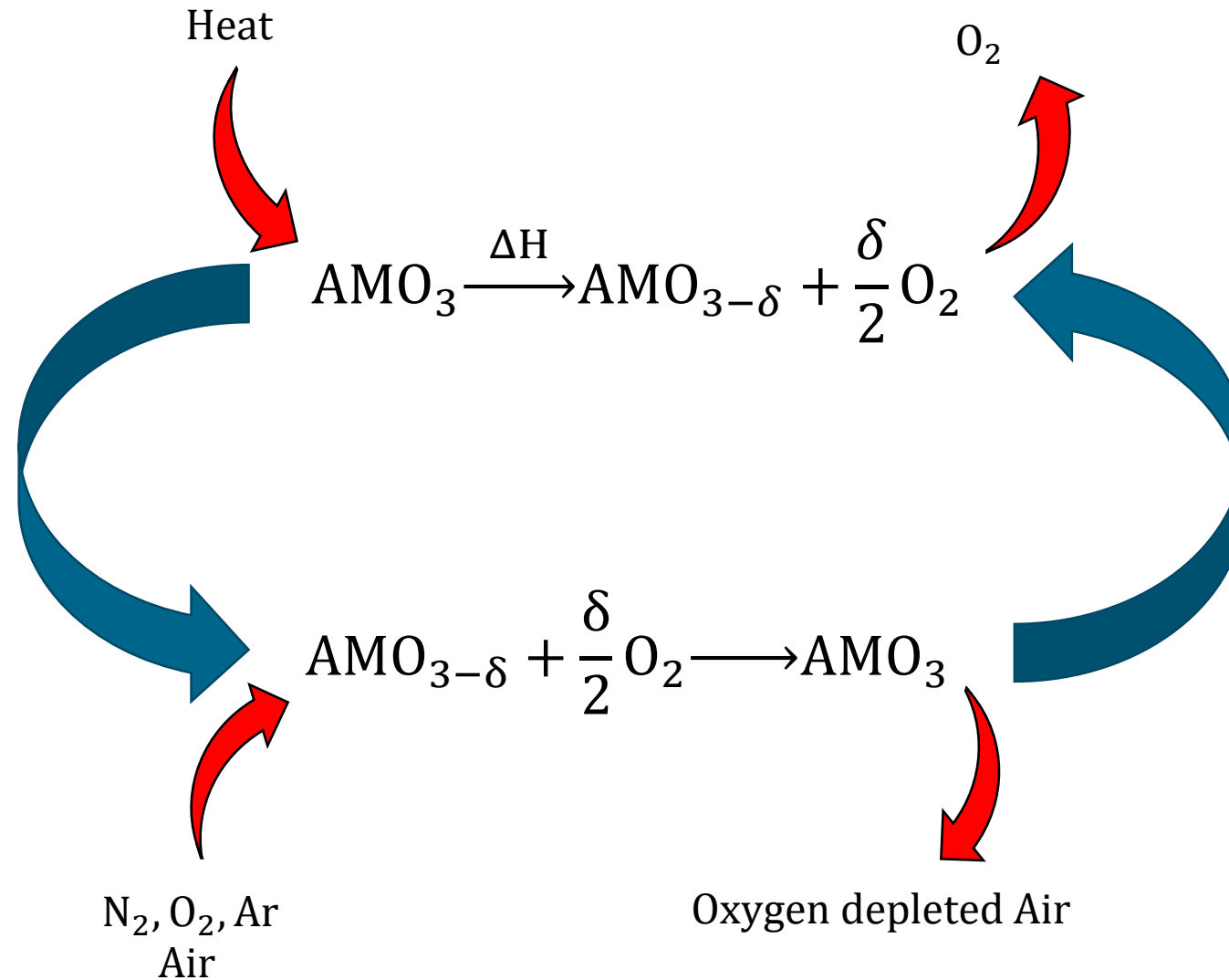
End of Charge



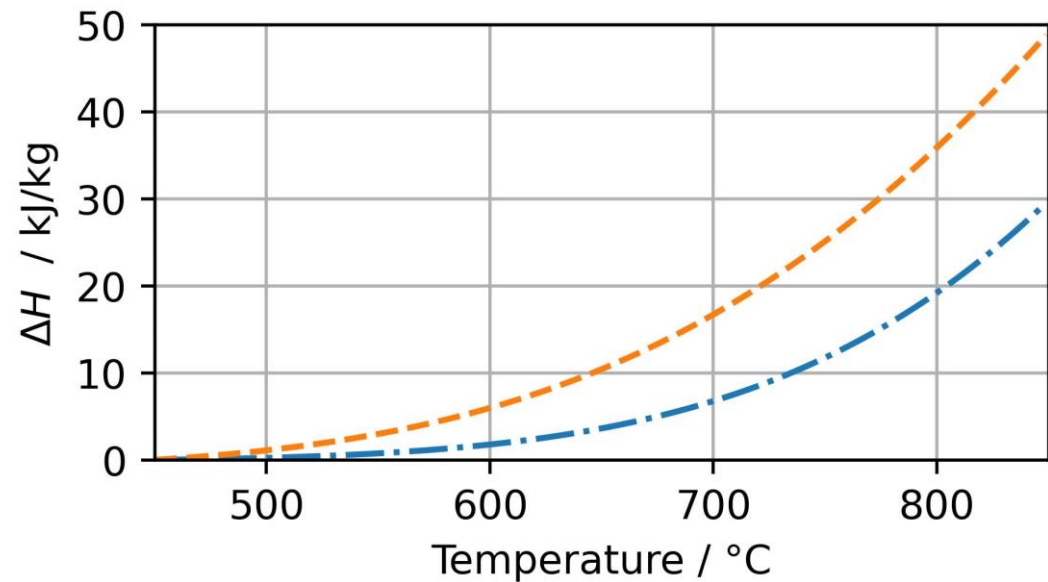
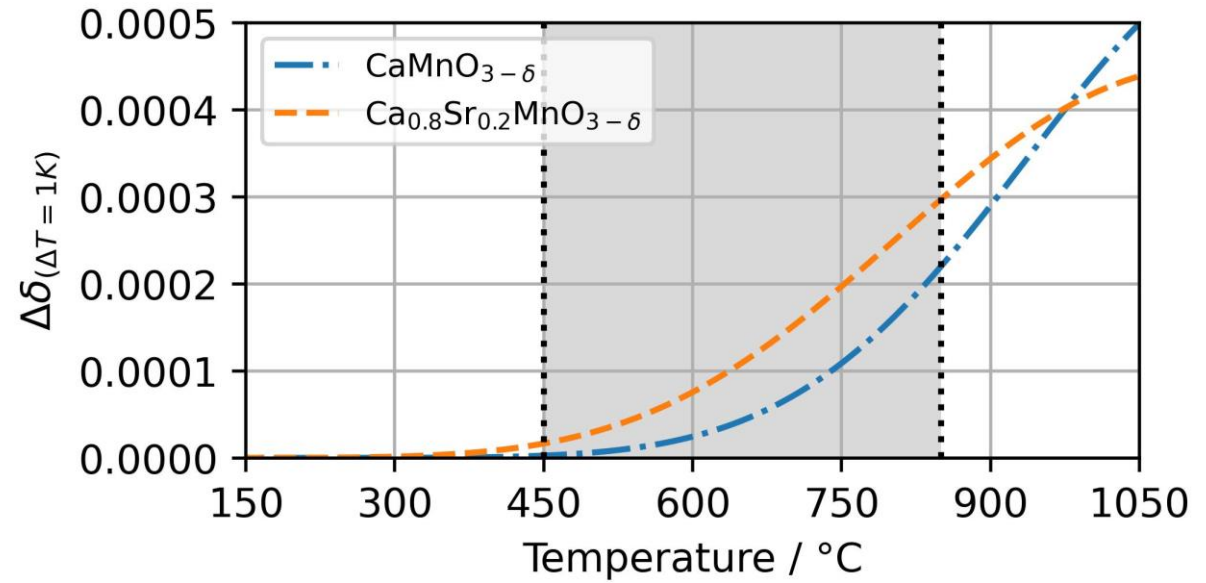
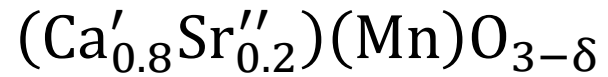
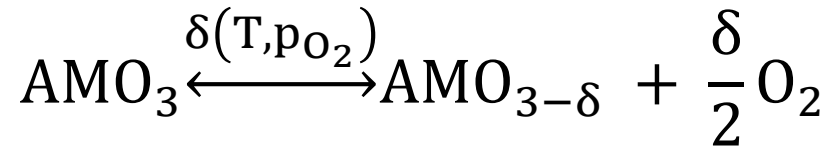
End of Discharge



Redox Reaction

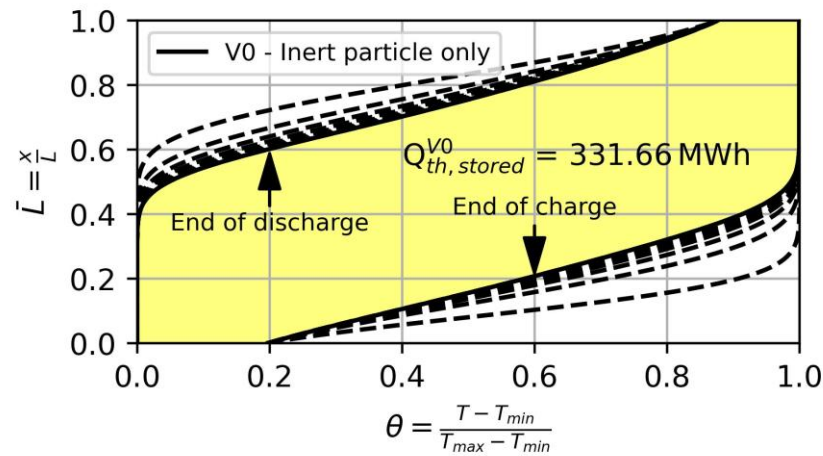


Perovskites

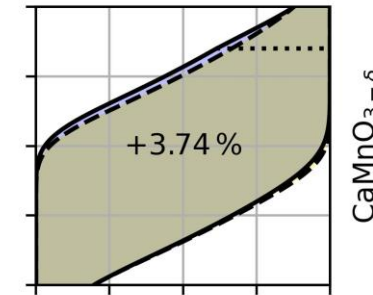
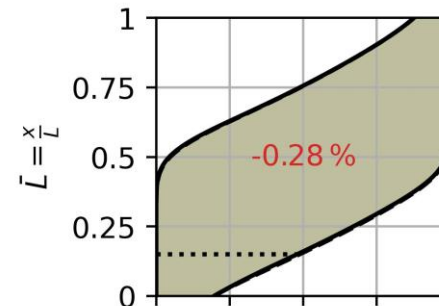
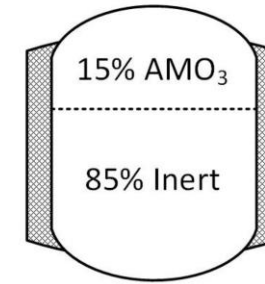
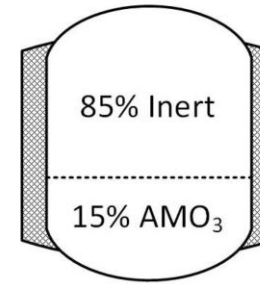


Parameter study

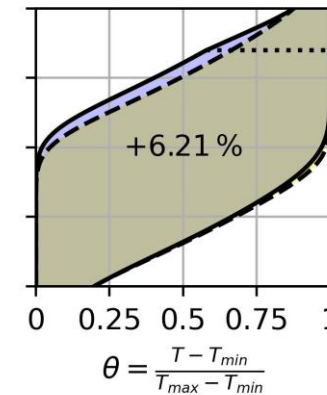
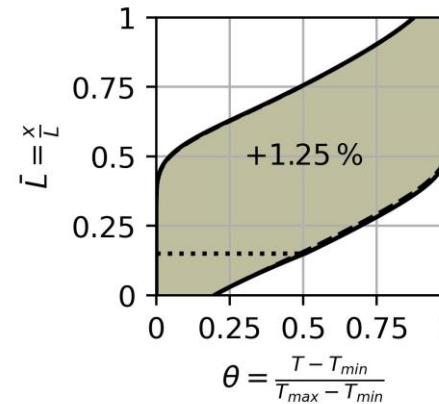
- Base case V0



- Thermocline behavior



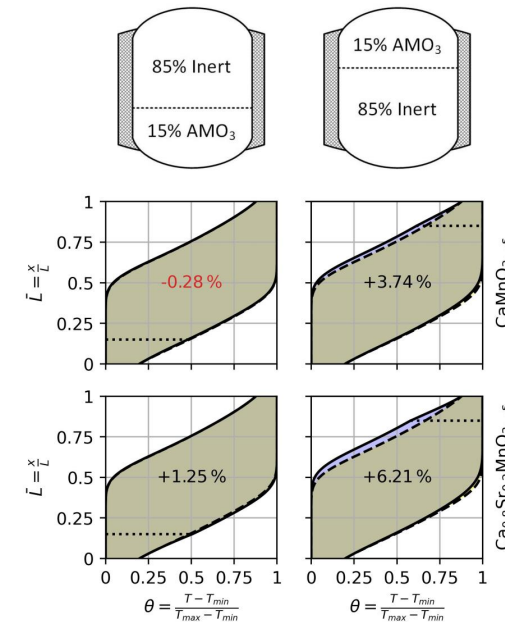
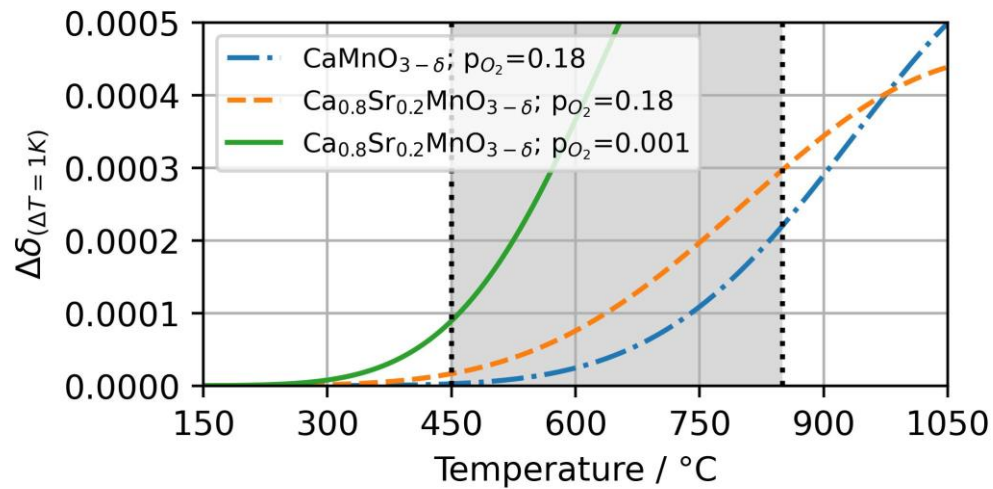
CaMnO_{3-δ}



Ca_{0.8}Sr_{0.2}MnO_{3-δ}

Conclusion & Outlook

- Packed bed thermal energy storage performance is increased



- Operation conditions and material selection must be carried out carefully
- Thermodynamic behaviour is important for process development

THANK YOU FOR YOUR ATTENTION!

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