

PCM-Store Project – Workshop

A new validated model of PCM-pillow-plate heat exchanger to show the benefits of TES in any thermal system

Sven Försterling 12. November 2021



TLK-Thermo GmbH

since 2003, 50 employees in 2021, 2 branches + 2 subsidiaries

- Simulation
- Test Benches
- Customized Software
- Training in Aachen
 Modelica 18-19 January
 TIL 20 Jan 2021



TLK-Thermo GmbH | www.tlk-thermo.com | PCM-Store | 12. November 21



TIL Suite

Model library for components of thermal systems

TILMedia Suite



Model library providing thermophysical properties

DaVE

Visualization of simulation results, energy flows and thermodynamic states



Simulator Suite

Simulators for various environments and programs

Interfacing and simulation via FMI



TLK-Thermo GmbH

Motivation

Dynamic simulation models can be used as tool for

- Design of new PCM Store HX concepts e.g. pillow-plate
- Optimization of PCM Store HXs and systems
 - Geometry, System Layout, further components,
 - PCM Material, Cooling fluid, Refrigerant, Costs, payback, ...
- Use for freezing and dairy processes, supermarkets, …

























Motivation







Discharging case with cooling



Contents

Models for pillow-plate and plate storage developed & tested & validated

- Simulation Model
- Measurement data for validation: test rig PhD thesis, Håkon Selvnes
- Validation for Charging & Discharge cases
- Extrapolation of Charging and Discharge







Measurement data

NTNU PhD thesis, Håkon Selvnes





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Experimental characterisation of a cold thermal energy storage unit with a pillow-plate heat exchanger design

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Using CO₂ as refrigerant, water as PCM storage material!





discretization

n-vle = 9

n-sle=5

Measurement data

Test rig

Charging case



Discharge case



Using CO₂ as refrigerant, water as PCM storage material!



Measurement



Charging













Extrapolating using last measurement point until complete charging



Simulation data – Extrapolating

Validation – charging – water – C3-30mm





Summary and Outlook

- Models for pillow-plate and plate storage developed & tested
- Geometry record for pillow-plate
- Heat transfer & pressure drop
- Validation for Charging & Discharge cases
- Extrapolation of Charging and Discharge
- Model ready for complete system simulation
- Model Export via FMU to Matlab, Excel, ... available
- Next step: validation for low-temperature storage with water as working fluid e.g. for heat storage in buildings

Thank you

If you have any questions, please don't hesitate to contact us at <u>www.tlk-thermo.com</u>

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Appendix

Further diagrams and result plots







Simulation data

Validation – discharging – water – D6-30mm

