FIRST RESULTS OF A PILOT INSTALLATION OF A SOLAR THERMALLY DRIVEN COLD STORE

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Agenda

- The project AgroKühl
- Project partners
- Work packages
- The pilot system
- System operation modes
- Results of first measurement period
- Optimisation potential
- Conclusion
The project AgroKühl

Aim:
Development of an integrated solar thermally driven cold storage room for agricultural produce

Background:
- Rising production capacities  → More storage capacities needed
- Outdated technology  → High energy demand
- Resource scarcity  → Increasing energy prices
- Cutting of energy subsidies  → Higher operation costs
- Disrupted cold chains  → Wastage of produce

Increasing demand of reliable and environmental sound cold storage solutions

Project partners

- Kramer GmbH
  Cold storage rooms & insulation
- Fraunhofer ISE
  Solar technologies, monitoring & control, simulation
- Planungsbüro Nürnberger IG mbH
  System engineering
- Kälte Grohmann GmbH & Co. KG
  Refrigeration engineering
- Katholing Bauplan GmbH
  Civil engineering
Work packages

- Market and demand analysis
- Simulation study
  - Pilot plant
- Optimisation
- Design of target size plant

The pilot system

Basic scheme

- 88 m² collector mirror area*
- 12 kW H₂O/NH₃ chiller
- 52 kWh latent ice storage capacity
- 100 m³ storage depot size

*Collector oversized with respect to the chiller, to allow longer measurement periods under German weather conditions
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Absorption chiller and hydraulics

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Cold storage room

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System operation modes

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**System operation modes**

**Preheat**

- Sun is shining
- Collector target temperature not yet met

**Direct cooling**

- Collector at target temperature
- Cooling demand exists
System operation modes

Charging ice storage

- Collector at target temperature
- No cooling demand
- Ice storage not yet fully charged

Discharging ice storage

- Insufficient radiation
- Cooling demand exits
- Ice storage not yet fully discharged
**System operation modes**

**Preheat & discharging ice storage**

- Collector target temperature not yet met
- Cooling demand exits
- Ice storage not yet fully discharged

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**Results of first measurement period**

**Direct cooling**

- Power
- el. Efficiency

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Results of first measurement period

Charging ice storage

Discharging ice storage

Temperatures

Power & Flowrate

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Optimisation potential

- Low viscosity heat transfer fluid in LT circuit
  - Decrease of LT-pump electricity consumption
- High efficiency pump in LT circuit
  - Decrease of LT-pump electricity consumption
- Speed controlled fan of cold storage cooling coil
  - Optimisation of heat transfer and electricity consumption during cooling of the room
- Additional ice storage
  - Higher storage capacity and lower pressure drop during charge and discharge

Conclusions and outlook

- First results are promising
- From optimisation an increase of cooling capacity by 20% at the same electrical power consumption is expected
- Together with the aforementioned optimization measures COPs greater than 12 in direct cooling mode seem to be realistic.
- Upcoming summer: Optimisations will be implemented
- Quasi realistic operation with load profiles in fully automatic mode
- Aim: Gather total energy consumption of the storage for comparison with conventional cold storage rooms
Further information

- For additional information about the project visit www.agrokuehl.com (english version coming soon)

Further questions?

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Thank you for your attention!

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