Cold thermal energy storage with vacuum ice slurry

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Why cold thermal energy storage?

- Cooling/Refrigeration mostly driven by electricity
- ~16% of electricity consumption in Germany for cooling
- 40...60% of electricity consumption in warmer climates
- Cold thermal stores useful energy
- Integration of renewables needs storage, “Power-to-Cold”
How does vacuum ice slurry work?

Schematical structure of the ice slurry generator
Integration in chilled water network

- Electrically driven cold generation
  - Electrical grid, PV, wind or solar power plant, CHP-plant, ...
  - Vapour compression

- Thermally driven cold generation
  - CHP-plant, biomass-plant, solar thermal energy, waste heat, ...
  - Absorption

Water vapour condenser

Centrifugal compressor

Condensate return

Evaporator
  - Ice generation at free surface
  - Ice water mixture (slurry)

Ice slurry

Storage with ice slurry
  - (without heat exchanger)

Water return

Charge pump

External heat exchanger for storage discharge (plate-HEX)

Ice water / ice slurry
  - 0 °C

User

Cold water supply 6 °C

Cold water return 12 °C

Cold water pump

Discharge pump
Pilot project

Vacuum ice slurry storage at campus chilled water network

Main Parameters

- Charging power: 50 kW
- Storage capacity: 350 kWh
- Storage volume: 6 m³
- Discharging capacity: 100 kW
Main results and advantages

- 7 times higher energy density than chilled water storage
- ~30% higher efficiency than block ice storage
- Flexible operation; 0...100% discharging
- Cheap storage medium (PCM)
- Sustainable, using water (R718) as refrigerant

Ice slurry storages combine the advantages of cold water and ice block
What’s missing - Next steps

• Higher capacity per module (50 -> 500 kW)
• Larger storages for longer storage periods
• Ice slurry for district cooling, e.g. reduction of pipe dimensions and pumping power
• Test and demonstration in warmer climates / southern Europe – looking for pilot users and project partners
• Business models / Flexible power tariffs needed
• Application in heat pump technology – water/ice as heat source
More information

www.ilkdresden.de/iceslurry
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