Developments in thermochemical heat storage

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Overview thermochemical reactions/materials

Thermochemical energy storage - publications

Documents by year

Year


0 100 200 300 400 500 600

Documents
Sorption storage (TES) - publications

Documents by year

Year


Documents

0 5 10 15 20 25 30 35

IEA SHC32
IEA SHC42
IEA SHC58
Sorption storage process types

Liquid sorption – Sodium hydroxide (NaOH)

**NaOH considered as sorbent**
- Allowing for high volumetric energy storage
- Low cost / high availability storage material (50wt%: 180 $/m^3, i.e. ~ 0.5-0.8 $/kWh)

**LiBr-H$_2$O and LiCl-H$_2$O are potential alternatives**
- Higher costs
- Competing with Li batteries
Development roadmap

Physical scale

2014-2016

2017

2018

2019

2020

Time

COMTES pilot plant

Redesigned of heat and mass exchanger

Lab-scale testing

Heat and mass exchanger upscaling

ehub / NEST demonstrator plant

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Spiral finned tube HMX - Lab-scale test rig


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Liquid sorption modelling / building integration

Seasonal load shifting / CO2 emission reduction


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Technology Development

- Power Unit: Tube Bundle - Heat and Mass Transfer Unit
- Absorber - Desorber (A-D)

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Power and Concentration Change

- **Characterisation of the 5 falling film A/D HMX** were carried out in both absorption and desorption modus
  
  => exchanged power, concentration difference as well as heat and mass transfer coefficients and process efficiency
  
  each HMX are the main output.
  
  => **Absorption Discharging: temperature lift** $\Delta T (T_A - T_E) = 35$ K ($T_E$ 15 °C) & $\Delta c = 10$ wt.%

- **Optical characterisation** opened the view to some HMX weakness and initiated the start to develop versions with optimised geometries

- **Encouraging results** obtained with the optimised mesh wrapped tube geometry (up to 25 % more power compared to the reference smooth tube geometry in absorption - discharging - mode)
Liquid sorption storage – Falling film HMX

**Design of a laboratory test rig**

- Design and construction of a test rig dedicated to the investigation on heat and mass exchangers as key components of an storage system
- Accurate control and monitoring of the process parameters of the heat and mass exchanger units and the lye feed (subsystem)
Liquid sorption storage

**Major learnings:**

- Challenging to meet the goals of **high concentration difference while achieving sufficiently large power densities**
- There are still **mass transfer mechanisms/effects** taking place in the HMX which are **not fully understood/exploited** yet
- There is the **potential for low cost equipment** and further process optimisation will further improve this

**Further research**

- Further experimental assessment and **systematic performance improvement** of HMX design
- Building integration simulations, hardware-in-the-loop testing, **real-scale implementation and demonstration**
Thank you for your attention...

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