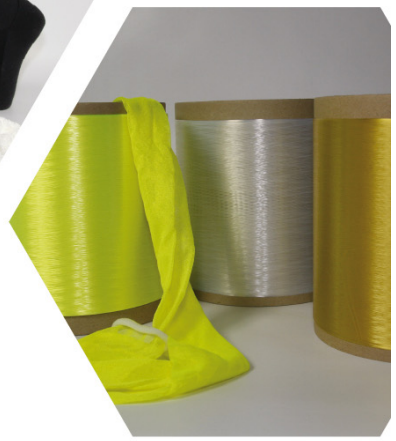
Thermoplastic Heat Storage Materials for diverse Applications




4th Swiss Symposium Thermal Energy Storage

Stefan Reinemann, 20.01.2017
Head of plastic research

TITK POLYMERE VIELFALT

Lucerne University of Applied Sciences and Arts
HOCHSCHULE LUZERN

Structure

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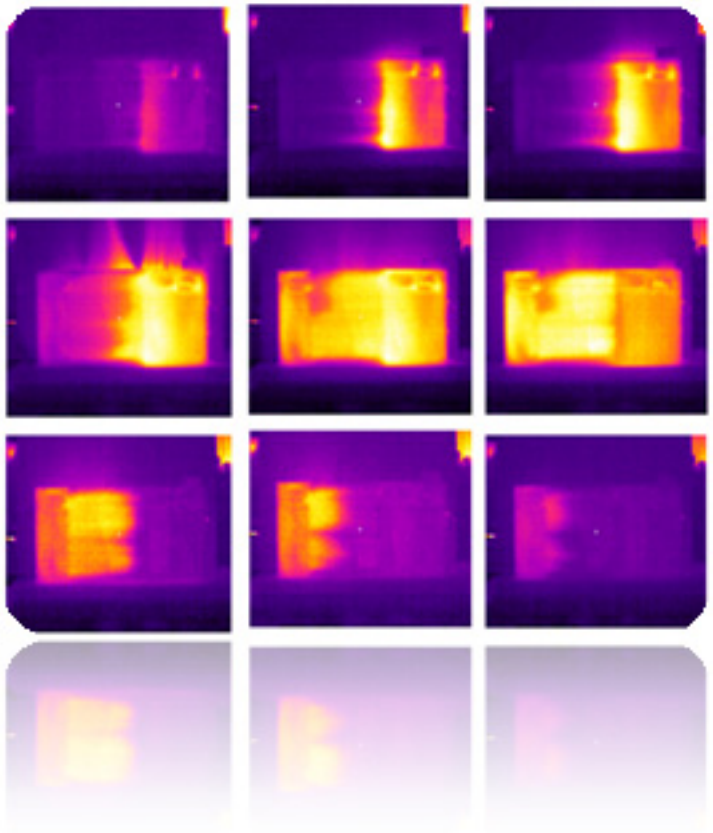


1. Information about TITK

TITK-Group: (200 employees)

OMPG mbH

- accredited test laboratory DIN EN ISO / IEC 17025
- testing services for textiles, fiber composite materials, polymers etc
- 30 employees

TITK e.V.

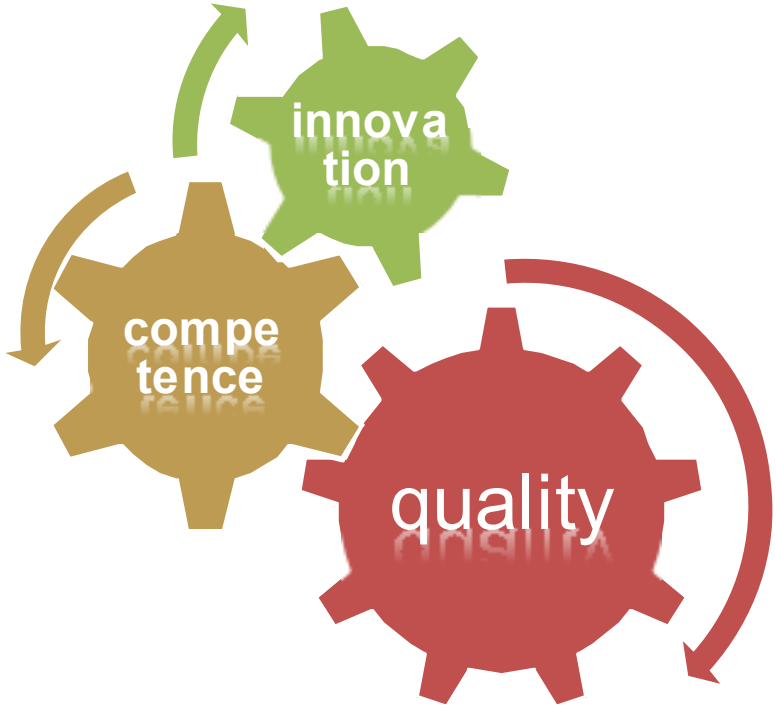
- competence:
  - → natural polymers
  - → composite materials
  - → synthetic polymers
  - → functional polymers
- 140 employees

smartpolymer GmbH

- Marketing and production of the TITK developments
- CellSolution® Functional fibers
- smartFlock® flocked applications, …
- 30 employees

1. Information about TITK

TITK - the material research institute for polymer materials

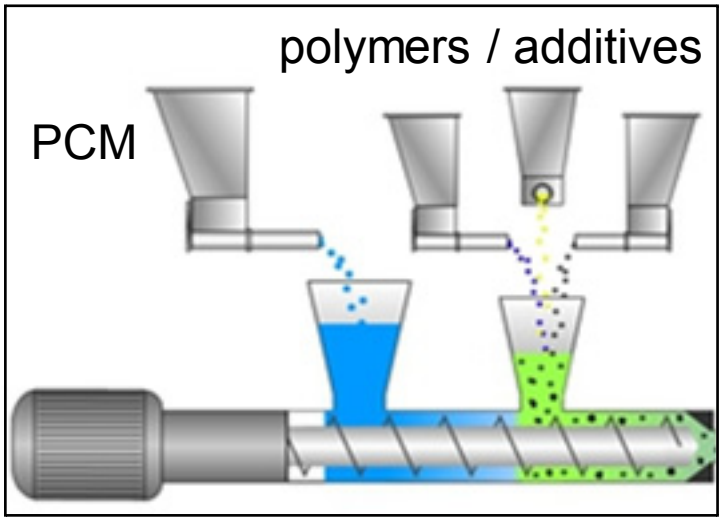


- establishment 1991
- research partners for companies in the field of materials research
- TITK is specialized in modifying polymers

2. Properties Energy Storage Material

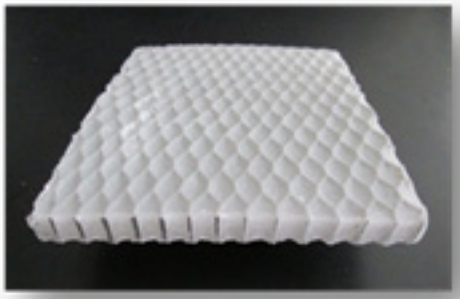
PCM-Compound

- Physical binding of the (liquid) paraffin in a polymeric network structure
- Large heat transfer area (up to 1 m² / l)
- Very high input and output power
- Flow and cycle stable
- High heat capacity up to 180 J/g (50Wh/kg)
- Water or air as a heat transport medium
- Various melting ranges from -4 to 82˚C
- Thermoplastic processability



2. Properties Energy Storage Material



FOILS | POWDER | INJECTION MOLDING | COMPOSITE BODY

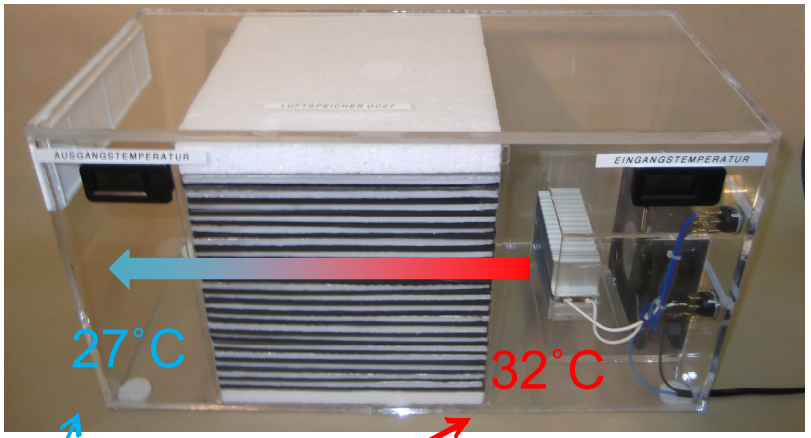
PCM-POLYMER-STORAGE GRANULES

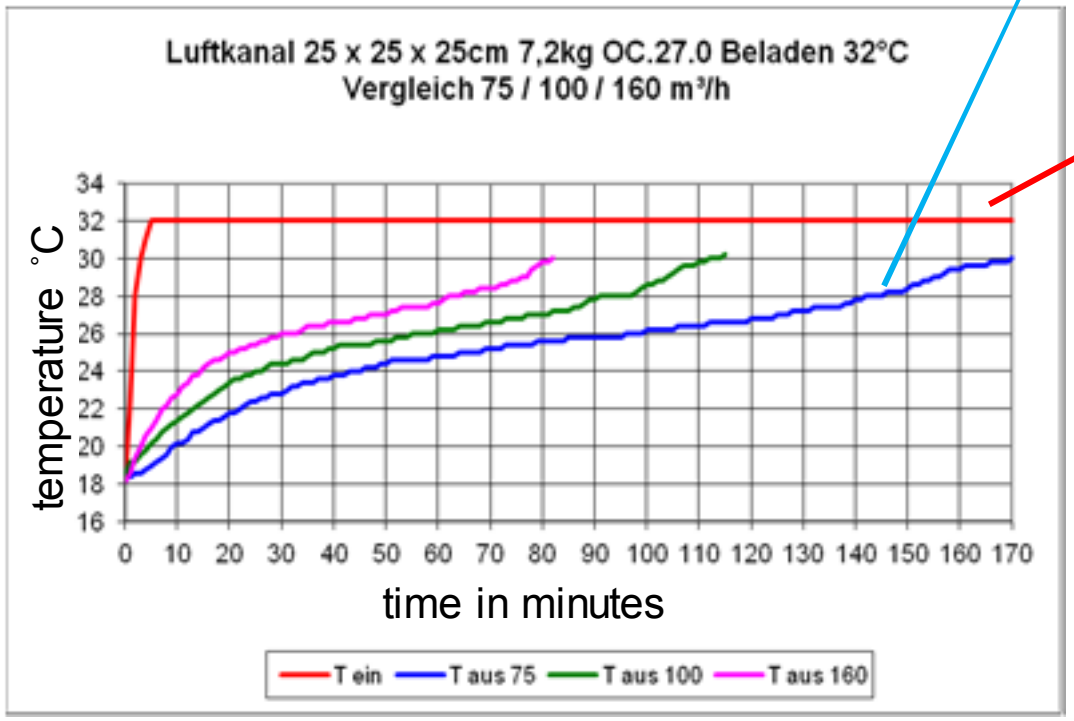
ERLY HARVEST	HOUSEHOLD APPLIANVES and COMFOR PRODUCTS	PHARMACY and MEDICINE
INTELLIGENT BUILDING	ENERGY TECHNOLOGY and SOLAR	FOOD and PACKAGING
TEXTILES	ELECTRONICS and ELECTRICAL ENGINEERING	AUTOMOTIVE and TRANSPORT

3. Technical Application

air conditioning unite

- Compensation of air temperature fluctuations
- storage of waste heat





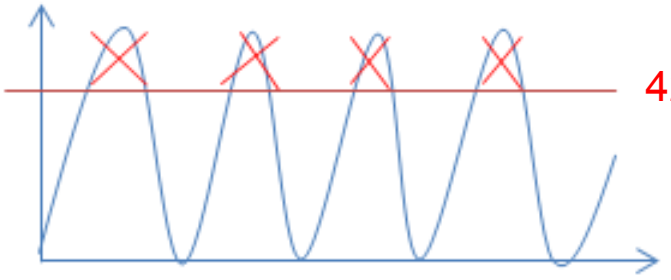
- Simulation of the loading behavior as a function of the outside temperature and the volume flow

3. Technical Application

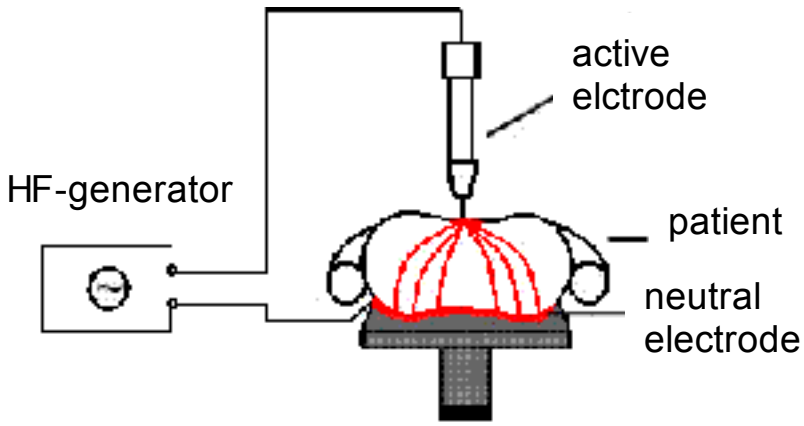
PCM-Neutral Electrode

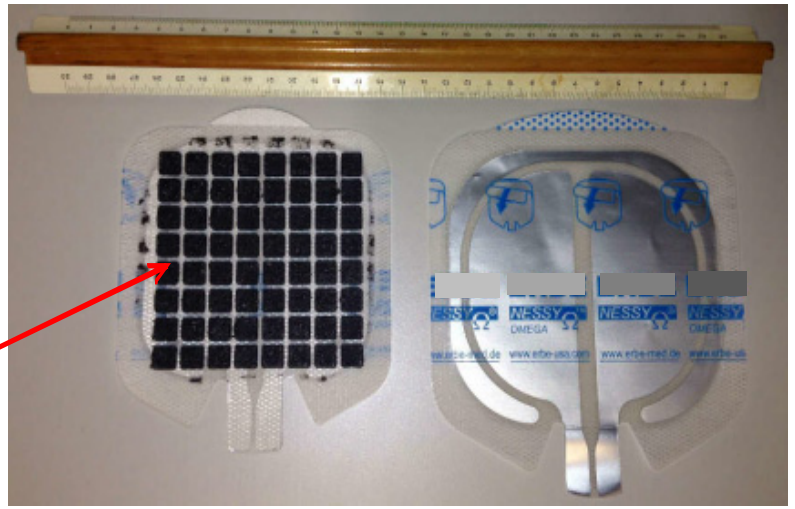
- neutral electrode
  - ➢ use: HF-surgery
  - ➢ Bleeding sting due to obstruction of the affected vessels
- High transition resistances between skin and electrode
  → danger of scalding
- task PCM-Compound

  → Peakcutting



42°C





→ 1/3 reduction neutral electrode

→ use in children (small circumference)

3. Technical Application

PCM-prosthesis

- improved wearing comfort by using PCM-based prosthetic materials
- prevention of heat accumulation in the area between the prosthesis and the body surface

- ➢ sweat → skin irritation, odour, slipping of the prosthesis
- ➢ development of a flexible PCM mat

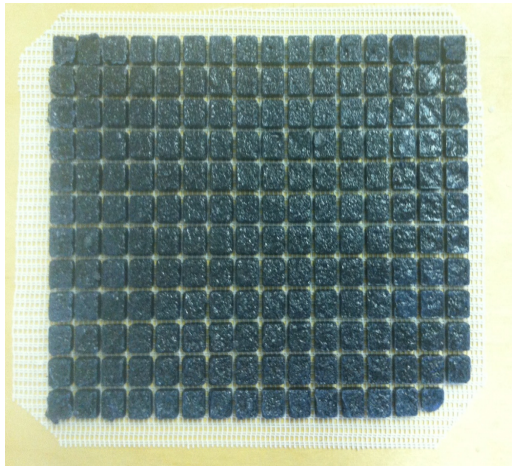


diagram: part of enthalpy

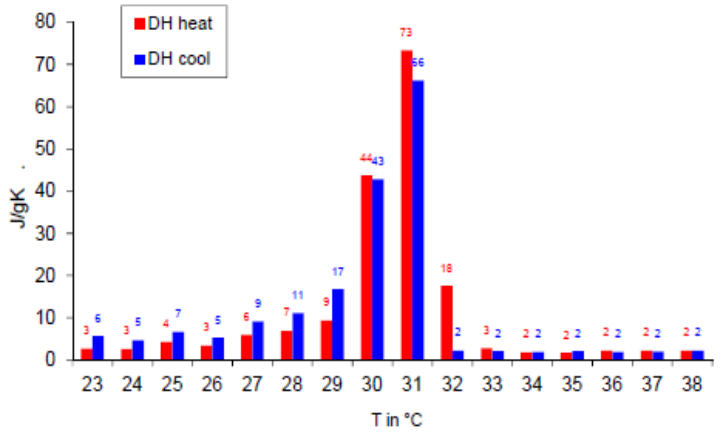
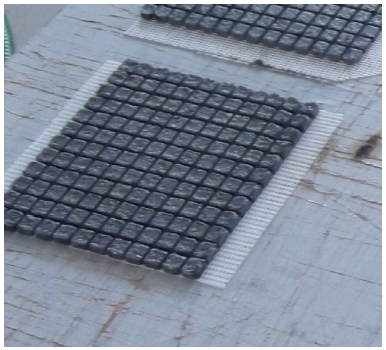


table: part of enthalpy

OC31.1.7.10 Ott	heat	cool	heat	cool
T in °C	Warmekapazitat in J/g		Warmekapazitat in kJ/l	
23	3	6	2	5
24	3	5	2	4
25	4	7	4	6
26	3	5	3	5
27	6	9	5	8
28	7	11	6	10
29	9	17	8	15
30	44	43	39	38
31	73	66	66	60
32	18	2	16	2
33	3	2	2	2
34	2	2	2	2
35	2	2	1	2
36	2	2	2	2
37	2	2	2	2
38	2	2	2	2
Summe:	182	182	164	163

3. Technical Application

PCM-prosthesis: prototype



PCM-sleeve, Ts = 31˚C, with graphite

negative form of the prosthesis with PVA-coat

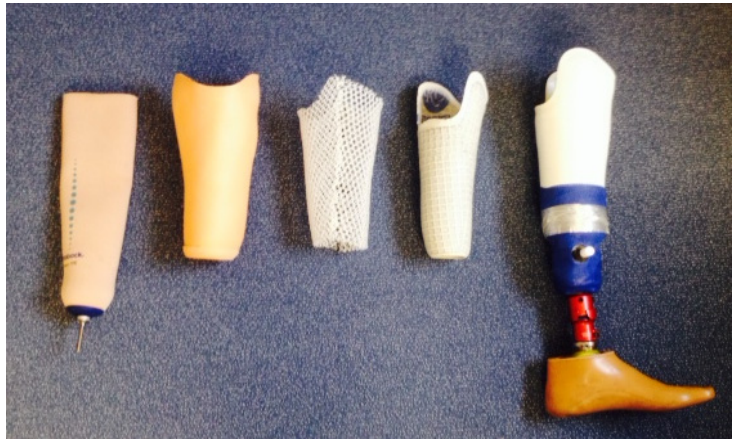
Coating of a further, stable textile stocking and the PCM-sleeve

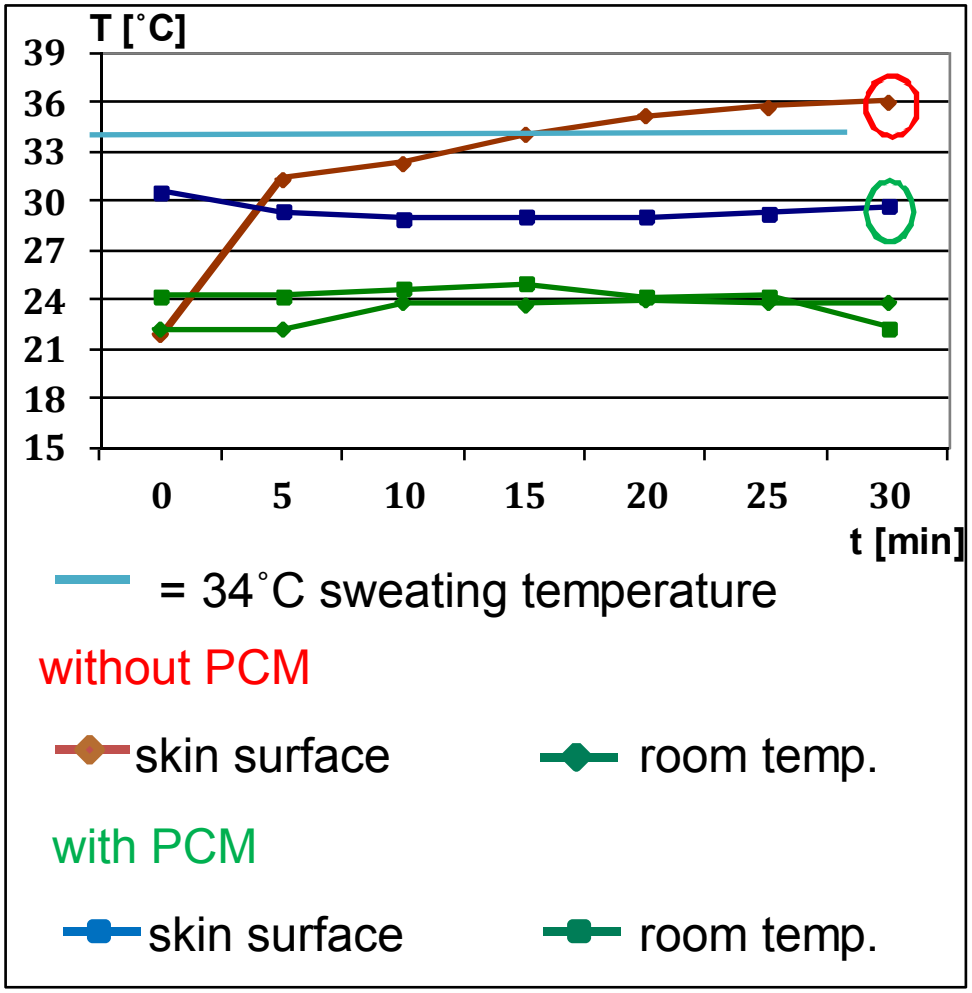
fixed embedding of the PCM with cast resin

prosthesis with PCM

3. Technical Application

PCM-prosthesis: test

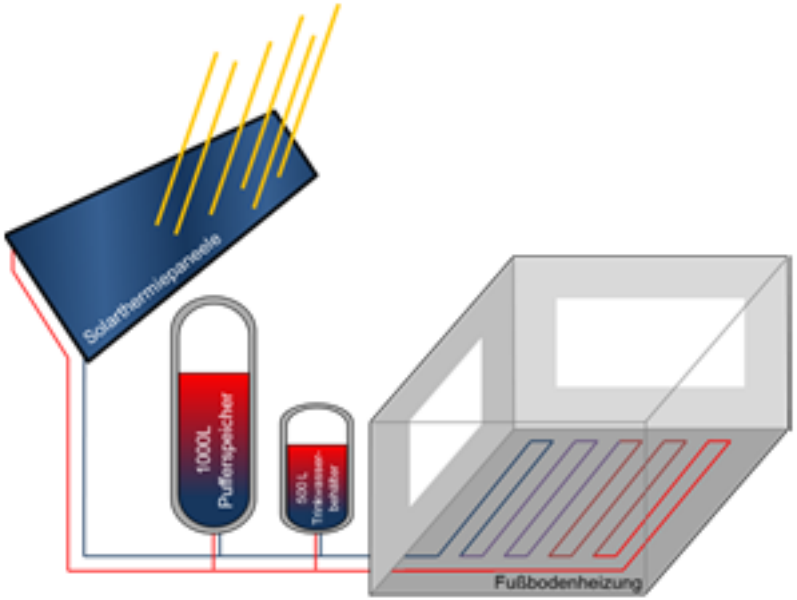




→ after 30min: no reaching of the sweating temperature – sweating-free

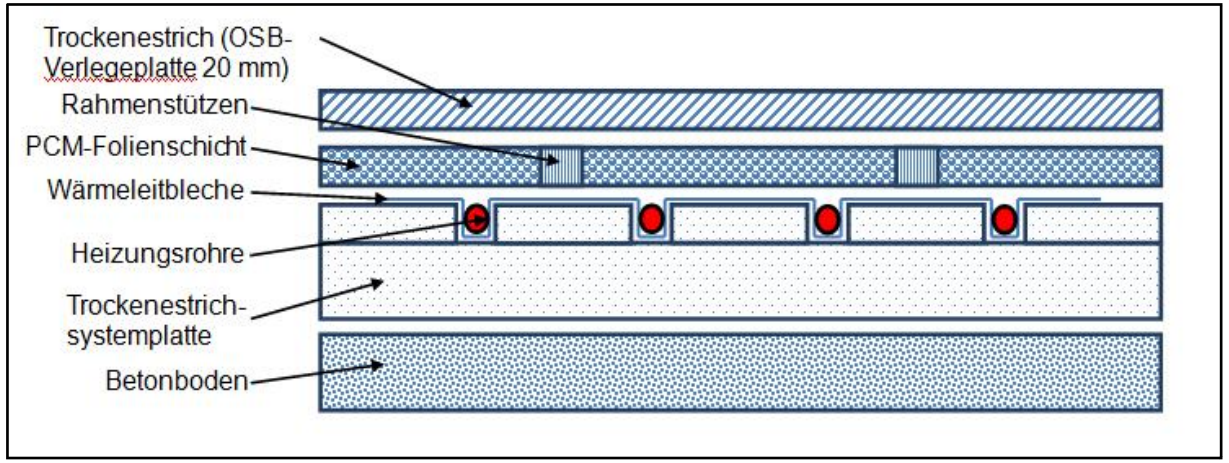
4. Reference Objects

- Construction of a test facility for storing solar heat in PCM memories
  - → granulate storage
  - → underfloor heating
- use of granules and foils



4. Reference Objects

Underfloor heating with storage



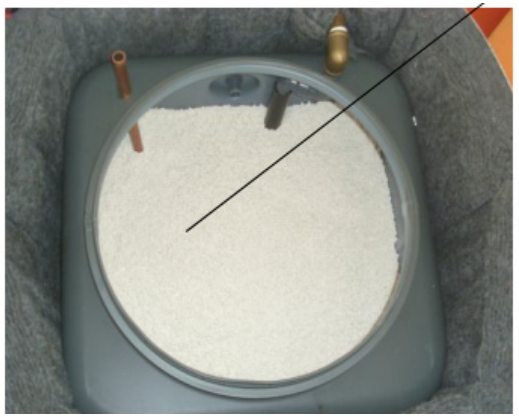
- easy construction → conventional floor heating with wood construction
- dimensioning: 14h heating with 40W/m² → 15mm PCM-foils, Ts = 31˚C
- operation: loading at day, unloading at night

4. Reference Objects

PCM granulate storage

- work area: temperature range 32 - 47˚C
  - ➢ PCM-storage up to 4 times higher capacity

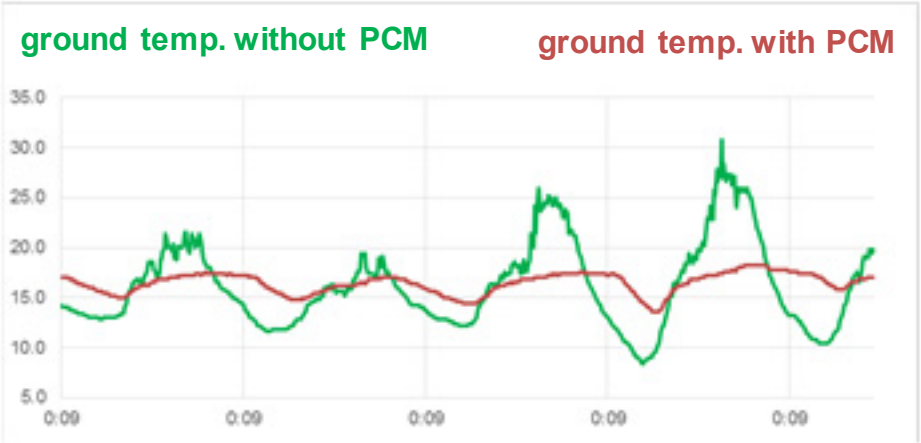
T-range	delta T	water kWh	PCM kWh	factor
47-32°C	15K	12,18	23,96	**1,97**
47-37°C	10K	8,12	23,44	**2,89**
47-40°C	7K	5,68	22,78	**4,01**



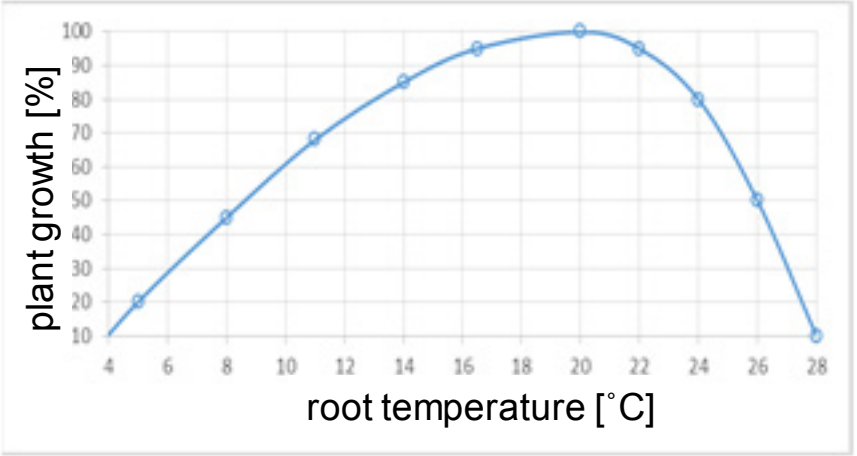
5. Current Research Projects

Tempering of plant roots with PCM-textile mats

course of the ground temp. with/without PCM



plant growth as a function of root temp.



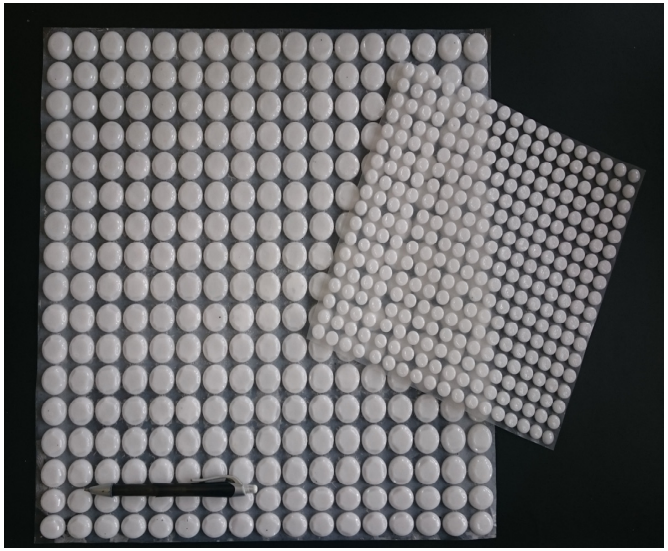
- 2 Identical greenhouses
- sowing at 7.12.15
- after 3 months : different growth behavior with and without PCM mats

→ reduction vegetation period

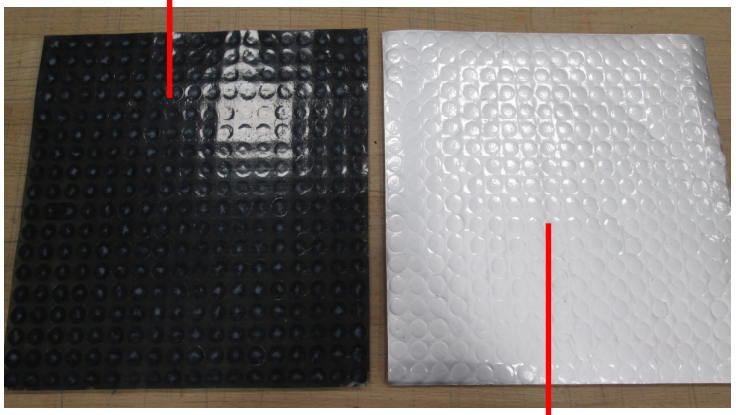
5. Current Research Projects

PCM transport foil

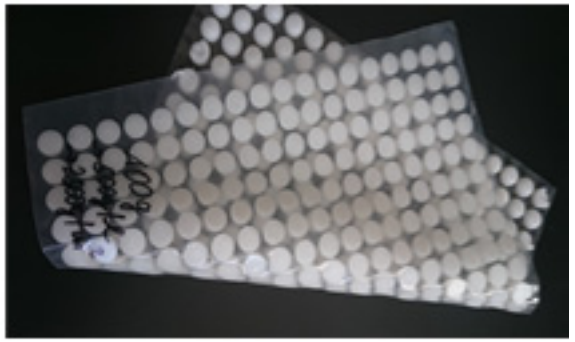
- ✓ flexibility
- ✓ cycle stable
- ✓ can be assembled
- ✓ surface structuring



graphite + burl shape
→ performance increase



Al-lamination → reflection layer



Thank you for your attention!