Thermoplastic Heat Storage Materials for diverse Applications

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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

<table>
<thead>
<tr>
<th>FOILS</th>
<th>POWDER</th>
<th>INJECTION MOLDING</th>
<th>COMPOSITE BODY</th>
</tr>
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<tr>
<td><strong>PCM-POLYMER-STORAGE GRANULES</strong></td>
<td><strong>ERLY HARVEST</strong></td>
<td><strong>HOUSEHOLD APPLIANVES and COMFOR PRODUCTS</strong></td>
<td><strong>PHARMACY and MEDICINE</strong></td>
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<td><strong>INTELLIGENT BUILDING</strong></td>
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<td><strong>TEXTILES</strong></td>
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<td></td>
<td><strong>AUTOMOTIVE and TRANSPORT</strong></td>
</tr>
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</table>
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

→ 1/3 reduction neutral electrode
→ use in children (small circumference)

42°C
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

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**Diagram: part of enthalpy**

**Table: part of enthalpy**
3. Technical Application

**PCM-prosthesis**: prototype

- PCM-sleeve, $T_s = 31^\circ$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

![Prosthesis images]

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

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Graph showing the skin surface room temperature with and without PCM:

- **Without PCM:**
  - Skin surface temperature
  - Room temperature

- **With PCM:**
  - Skin surface temperature
  - Room temperature

Additional notes:

- = 34°C sweating temperature
- skin surface
- room temp.
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 $\rightarrow$ conventional floor heating with wood construction
- dimensioning: 14h heating with $40W/m^2 \rightarrow 15mm$ PCM-foils, $Ts = 31^\circ C$
- 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

<table>
<thead>
<tr>
<th>T-range</th>
<th>delta T</th>
<th>water kWh</th>
<th>PCM kWh</th>
<th>factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>47-32°C</td>
<td>15K</td>
<td>12,18</td>
<td>23,96</td>
<td>1,97</td>
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<tr>
<td>47-37°C</td>
<td>10K</td>
<td>8,12</td>
<td>23,44</td>
<td>2,89</td>
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<tr>
<td>47-40°C</td>
<td>7K</td>
<td>5,68</td>
<td>22,78</td>
<td>4,01</td>
</tr>
</tbody>
</table>
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!