

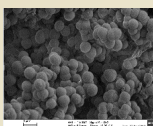
Smart Textiles Based on Innovated Encapsulated Solutions

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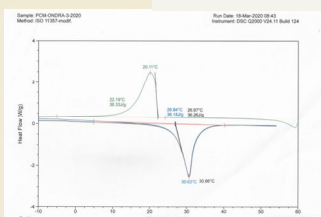
Smart multifunctional textiles containing PCM (phase change material) thermoresponsive systems were prepared and evaluated. Microcapsules with siloxane-based polymeric wall and PCM core (dodecanol-laurate) were synthesised by *in situ* emulsion polymerization process with the dry content of 12% in total and PCM 7,72% content in the water-based capsules suspension. By DSC analysis the basic characteristics like transition temperature 22-30°C and latent heat 131,6 J/g of the capsules incl. the onset decomposition temperature > 200°C were determined. The PCM microcapsules suspension thickened to 76% (50,1% PCM core) was applied on 3D polyester knit surface by coating technique (knife against roller) for preparation of smart thermoregulation / thermoinsulation textile structure. The PCM coated layer was localised strictly on the 3D knit surface without any penetration in the air-gap thermoinsulating structure. Herewith the combination of thermoinsulation and thermoregulation properties was achieved. The heat transport properties were tested by thermocamera and contactless thermometer.

PCM capsules preparation by *in situ* emulsion polymerization process

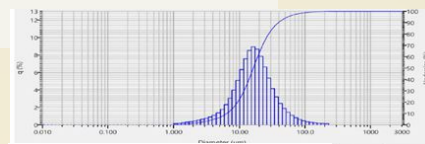


PCM capsules properties

- Wall: siloxane polymer from alkoxyisilane precursors
- Core: dodecanol-laurate, 66% of weight of capsule
- Spherical shape
- Median size: 30,57 µm (ISO 132320:2009)
- White water-based suspension, solid content: 12% (as prepared)
- Transition temperature: 22-30°C
- Latent heat: 131,6 J/g (dry capsules)



DSC analysis of PCM capsules: determination of thermal transition temperature and latent heat



HORIBA Laser Scattering Particle Size Distribution Analyzer LA-950	
Median size	: 30.57186 (µm)
Mean size	: 34.38008 (µm)
Mode size	: 36.5989 (µm)
Span	: 1.7810
Diameter on cumulative %	: (2)10.00 (%) - 9.1300 (µm)
	: (9)90.00 (%) - 63.5783 (µm)

PCM capsules application on 3D knit by coating

- Material: 100% PES 3D knit, 205 g/m², thickness 1,77 mm
- Coating paste formulation: SBR polymer, PCM capsules content: 30,62%, viscosity: 60 dPa.s (Haak viscotester 2 Plus)

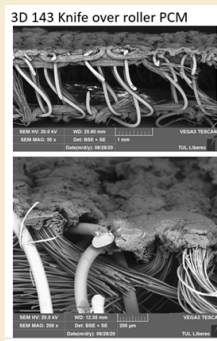


Thermoinsulation & Thermoregulation multifunctional knit for protective clothing



Continuous R2R Werner-Mathis line (width 45 cm):

1. Prehydrophobization by fluorocarbon impregnation
2. Application of PCM formulation by coating – 2 steps:
 - knife against roller (0,4 mm gap)
 - drying 120°C, 0,5 m/min
 - cross-linking 140°C, 0,37 m/min
 - dry add-on: 80 g/m²
 - PCM capsules content: 22,66 g/m²

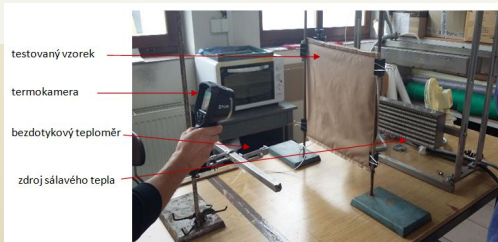


Thermoinsulating air-gaps

PCM layer located on the 3D knit surface

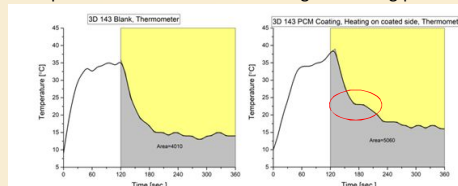
Testing of heat transfer by measuring of temperature of textile surface during the cooling phase after the heating of the textile by a radiation heat source

- Thermocamera FLIR E5
- Contactless thermometer
- Radiation heat source: IR-heater Krelus, temperature 35°C, power 2,5 kW



- testovaný vzorek
- termokamera
- bezdotykový teploměr
- zdroj sálavého tepla

Temperature of 3D knit surface during the cooling phase



3D knit with blank coating

3D knit with PCM coating

TF060000 SMARTTHERM:

Intelligent thermoregulatory fibers and functional textile coatings based on temperature resistant encapsulated PCM

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Technology Agency of the Czech Republic