Contribution ID: **790** Type: **Poster Presentation**

Functional design of porous systems by systematic patterning of flat knits

Tuesday, 23 May 2023 16:10 (1h 30m)

The porous properties highly determine the physical properties of materials like density, stiffness and flow transport properties. This poster wants to contribute to the question whether knitted pore systems can be designed and optimized for highly functional garments like sportswear or be used as functional carriers in technical products or processes. In a new combined wicking and drying experiment, textile fabrics are investigated concerning their transport properties. The vision of this work is, that understanding of the porous properties of knitted fabrics by systematically changing the geometrical properties only by patterning deepens the understanding of the porous system and its transport characteristics

Textiles can be interpreted as porous systems consisting of fibers arranged in repeating patterns. [1] In combination of different materials and textile production processes the structure of textile porous systems can be altered in a huge range. Pores in textiles can be systematically described on the scales fiber, yarn and fabric. Micropores occur on the fiber scale, Mesopores occur on the yarn scale and macropores on the fabric scale respectively. [2] For knitted fabrics, especially macropores with pore sizes of 100 µm and higher can be systematically altered by the patterning in the knitting process.

This poster focusses on non-standard porous patterns which are designed to have different amounts of pores on the meso- and macroscale. Previous work in this field is is focussed on standard patterns like single jersey, double jersey and rib patterns (e.g. [3]) and considers only porosity as porous property Therefore, we introduce an extended model for knitted fabrics which is parametrized with the yarn characteristics and the patterning and gives effective parameters like pore size distribution, fabric density and thickness. For experimental validation, different patterns which gradually differ in meso- and macropore distributions are knitted on an automated flatknitting machine and analyzed via automated imaging. The porous fabric properties are then correlated with the results from the new combined wicking-drying experiment.

The new experiment is presented and its results can be transferred to other fabric technologies. The poster should give an inspiration for function driven design by the concept of textiles as porous media. The geometrical parameter space and the relation to effective mass transport properties can initiate and accelerate development processes with knitted fabrics in a broad field of applications like tissue engineering.

Participation

In-Person

References

[1] A. Mark, B. Bauer, and G. Gresser, Quantification of hierarchic multimodal pore structures in textiles by the example of knitted fabric structures. 2015.

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[3] Y. Yang, 'Chen Liqun, N. Tayyab, Z. Peihua, and F. Amjad, "Influence of fabric structure and finishing pattern on the thermal and moisture management properties of unidirectional water transport knitted polyester

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Session Classification: Poster

Track Classification: (MS22) Manufactured Porous Materials for Industrial Applications