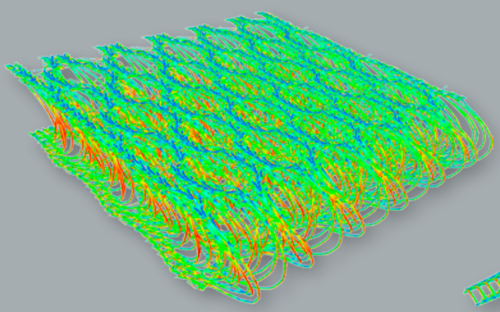

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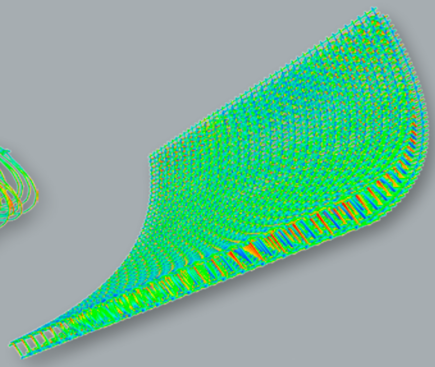

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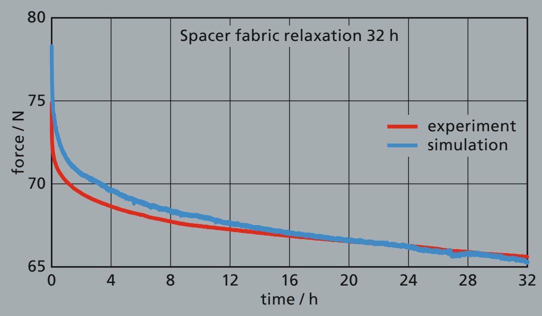

3

SIMULATING THE MECHANICAL PROPERTIES OF KNITTED SPACER FABRICS

1 *Compression calculation of a spacer fabric*

2 *Bending calculation of a spacer fabric*

3 *Comparison of simulated and measured relaxation curve of spacer fabrics under compression*

Spacer fabrics are double knit textiles, in the form of plates or shells that consist of two separate layers of knit fabrics joined by vertical monofil yarn. We simulate spacer fabrics in various projects, for example, the areas of application include the materials used in mattresses and seats.

The properties of spacer fabrics are characterized by diverse parameters, such as the in-plane period, the thickness, and the height of the fibers. We can calculate, for example, the effective stiffness and permeability. To reduce the computing effort, we use algorithms for homogenization and dimension reduction. The spacer fabric is represented by an equivalent, elastic, two-dimensional shell.

The resolved microstructure is stored for use in the flow simulation to calculate the effective permeability. The relationship between the geometric parameters and the load determines how much bending or tension is placed on the fiber at the micro level.

Spacer fabrics are highly resilient, flexible, and strong

One advantage of spacer fabrics is their superior decompression. This means these materials are highly resilient, flexible, and strong when subjected to an external pressure load. In the simulation process, we first build the complex structure of the spacer fabric, resolving all the bonds of the spacer filaments. Subsequently, we simulate the tensile, shear, compression and bending properties using TexMath – software we developed for modeling and analyzing textile fabrics.

DFG Project: Modeling the structural properties of 3D spacer fabrics

The characteristics are generated from the knitting pattern and the yarn's known force elongation curve, cross section, and frictional properties. Using TexMath, we analyze the textile spatial variations of permeability in different directions caused by the outer-plane compression of the structure. This is also a part of a collaborative project with the Technical University of Dresden with the name "Modeling of mechanical and filtration properties of 3D spacer fabrics" and funded by the German Research Foundation (DFG).

Another research question is to what degree the fiber torsion contributes to the overall effective viscoelastic properties. Our investigations show that the relaxation time of the spacer fabrics coincides with the relaxation time of the monofil, as presented in Fig. 3.