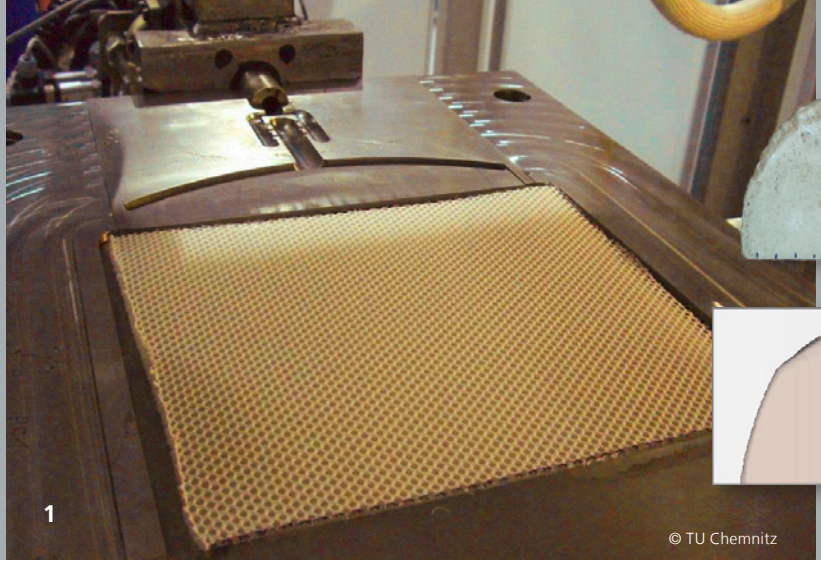

1

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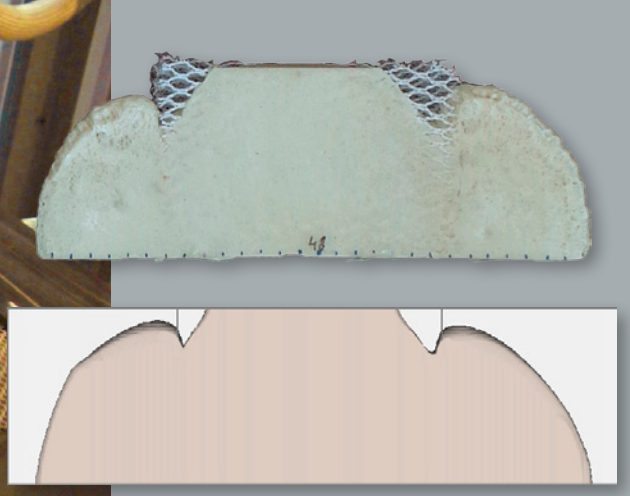

2

RIM PROCESS OF POLYURETHANE FOAMS TO DEVELOP COMPOSITE MATERIALS

Composite structures are considered to be lightweight and stable. Textile reinforced composites materials made from polyurethane (PU) foams are perfect candidates due to their enhanced physico-mechanical characteristics. Using FLUID software module of our CoRheoS simulation platform, we can simulate the form filling process.

1 *RIM process of a PU foam with spacer fabric*

2 *Comparison of the filling fronts in an infiltration study*

PU foams are complex and difficult to study

In the RIM process (RIM - Reaction Injection Molding) of PU foams, a polymer mixture is injected into a mold in which the material develops over a period of time from a low molecular weight emulsion to a complex polymer foam matrix via polymerization.

The expanding foam exhibits complex physical behavior during the production phase, which is initiated by premixing adequate reactants followed by gas and heat creation as well as evolution of material properties resulting in PU foam formation. This makes PU foams extremely difficult to study.

Developing optimal simulation tools for industrial applications

We design mathematical models that describe the dynamics of expanding foams and apply them to study the RIM process of PU foams. Using our FLUID software, we carry out relevant numerical studies to understand and evaluate the foam expansion process. In this way, we are able to predict the required amount of material to completely fill the mold as well as optimize the foam process and mold design.

In order to investigate the expansion process in textile structures, especially, knitted spacer fabrics, we use TexMath to determine the relevant permeability tensors. TexMath is an in-house developed software product for the modeling and analysis of textile materials. The spatial variations of the tensors caused by unequal compression of the structure can be analyzed by TexMath (see left page).

We then use this data in FLUID and extend our numerical studies to predict the foam expansion through knitted textiles. Our findings (see figure) are in strong agreement with the experimental data obtained at the Department of Lightweight Structures and Polymer Technology at Chemnitz University of Technology. In summary, we provide simulation tools for efficient industrial application that help in the optimization, manufacturing, and development of composites.