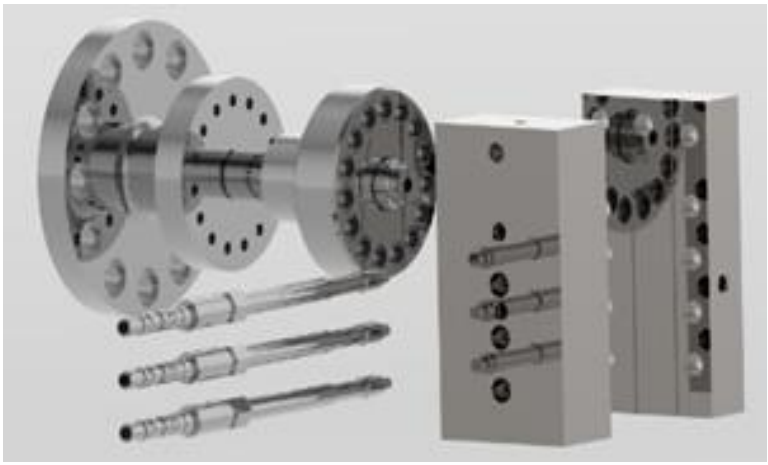
SUCCESS STORY

CHASE
Chemical Systems Engineering

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Centre (K1)

Type of project: Fundamental investigations on foam injection molding of Polypropylene and Polypropylene compounds, 10/19 – 09/23, multi-firm



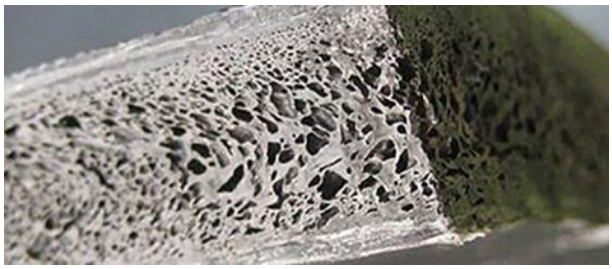
CAD-model of rheology die (© CHASE/Kastner)

FUNDAMENTAL INVESTIGATIONS FOR THE OPTIMIZATION OF FOAMING PROCESSES

PROCESS KNOWLEDGE TOGETHER WITH SIMULATIONS WILL ALLOW FOR A DESCRIPTION OF PROCESSING-MORPHOLOGY-PROPERTIES RELATIONSHIPS

Foam injection molding is one of the most promising candidates for sustainable polymer processing. Advantages are reduced injection pressures, negligible warpage, or cycle time reductions, to name but a few.

The technology has made tremendous progress – yet still, many questions remain unanswered. Our research in the CHASE-project should lead to profound understanding of the fundamental polymer-physical processes, allow for a description of mechanical behavior of foamed parts, and forge the bridge to application related topics and automation solutions (industry 4.0).



Foam injection molded component
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Foaming processes involve the solution of gases in polymers. Injection molding is highly dynamic; However, no conventional methods for the measurement of solubility (i.e., the maximum amount) of gases in polymers under dynamic conditions exist.

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Our development of a novel measurement method based on the compressibility of polymer-gas-mixtures resolves this problem: Mathematical groundwork and numerous trials now enable us to measure dynamic solubility in-line directly on the machine. The Bulk Modulus Method was born.

The economically most important evolution of this method is the reduction of backpressure during production. It entails lower energy consumption, less wear, or, in other words: increased sustainability. Currently, we work on the automation of this optimization. The aim is an autonomous, self-adjusting industry-4.0 injection molding machine.

Process understanding is crucial, understanding processing even more so. Especially the rheology of gas containing polymer melts – e.g., for simulations – is thoroughly investigated at CHASE. Process related data are difficult to obtain and barely available. Therefore, we developed a special rheology die that allows for the measurement of viscosities not only process related but de facto in the process.

Besides investigations on the injection molding machine we are currently developing a high-pressure shear cell. It should allow for investigations of polymer gas-interactions under high pressures/temperatures, the characterization of sealing materials under the presence of gases (e.g., oil drilling) and studies of foaming dynamics (cell formation, growth, etc.). Possibilities of visual inspections make this device a world novelty.

The gained process knowledge together with mechanical simulations will eventually allow for a description of a processing-morphology-properties-relationship. Overall objectives: Targeted process settings based on predefined mechanical properties, a self-adjusting process, increased user friendliness and improved sustainability. After first major steps in year 1, our research will be continued consequently.

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