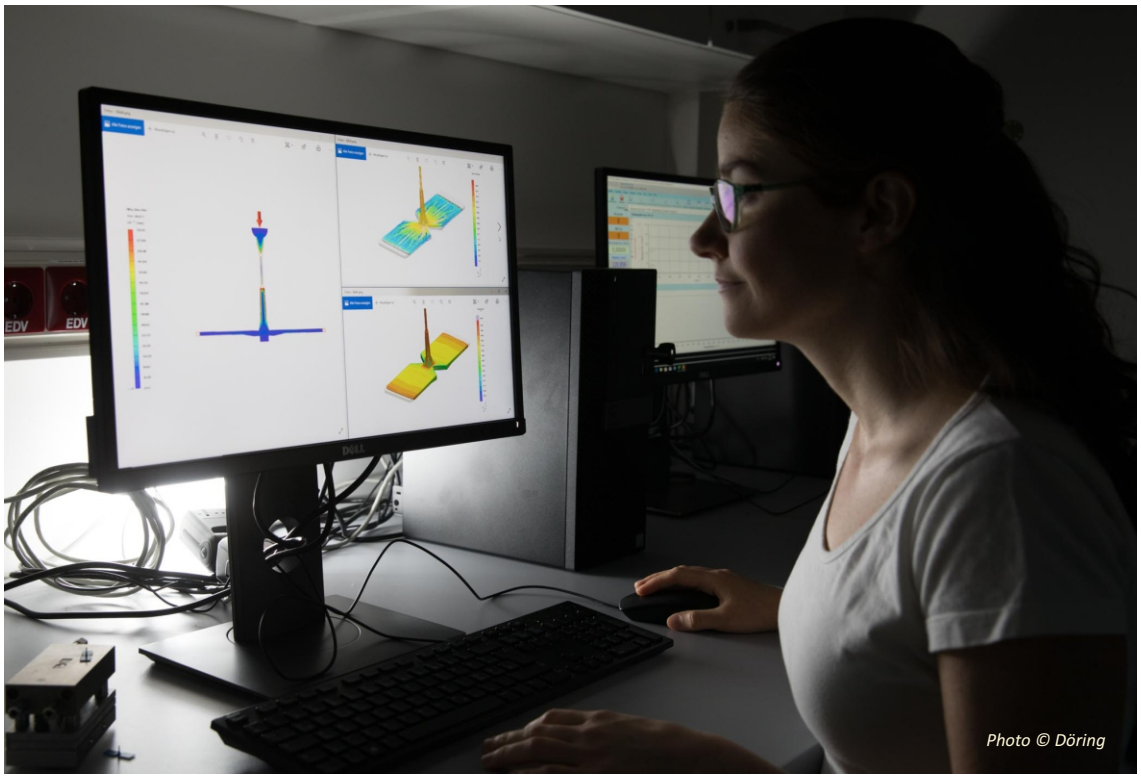
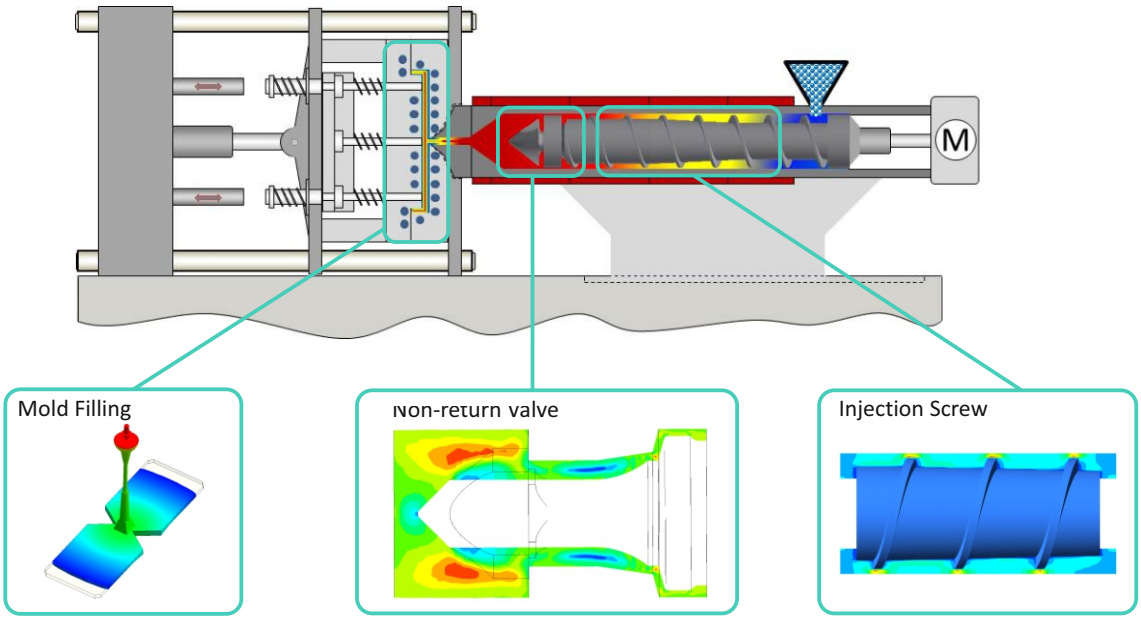
Leibniz-Institut
für Polymerforschung
Dresden

Simulation of Polymer Processes



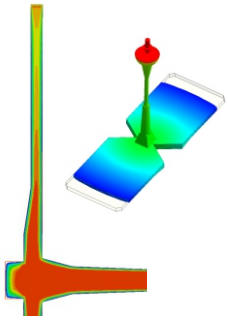
Simulation is a very useful tool in the understanding, development and optimization of polymer processes. Simulation allows the visualization and quantification of the flow of a polymer within a process. In the context of the Leibniz-Institut für Polymerforschung Dresden e.V. (IPF), where there is a focus on materials development, simulation helps to understand the link between the material properties and the process. The main areas of research involve the simulation of the injection molding process, general flow phenomena in polymer processes and the simulation of mixing and compounding.
Integrative simulation of the relevant polymer processes is also targeted. The first steps towards achieving this challenging objective are to understand the assumptions, limits and remaining challenges of the simulation of individual process steps and then to link them to each other.

The Path to Integrative Simulation

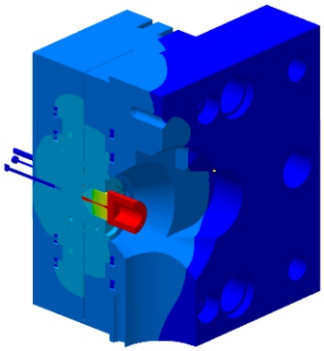


Injection Molding

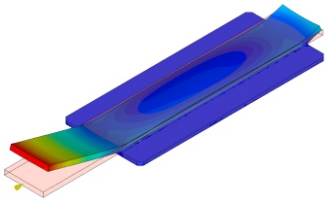
The simulation of the injection molding process is a well-established and highly industrially relevant topic. Injection molding is a complex time dependent process where rheology, heat transfer, compressibility, crystallization and solidification all play an important and inextricably linked role. Due to their influence on the structural properties in the injection molded part, the factors mentioned above are also relevant for the final properties of the part (e.g. shrinkage and warpage behavior). Simulation gives a deeper insight into these complex effects and is therefore essential for effective process design and optimization.



Mold filling behavior

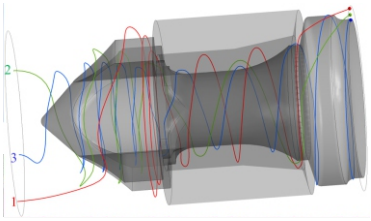


Mold filling behavior

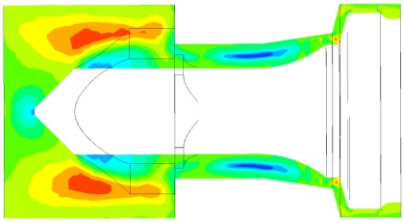


Shrinkage and Warpage Analysis

General Flow in Polymer Processing



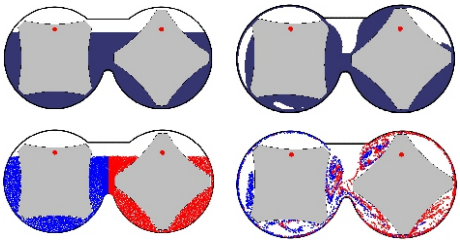
Flow in an Injection Molding Machine
Non-Return Valve



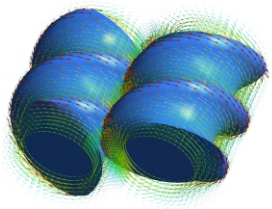
Mixing Index in an Injection Molding Machine
Non-return Valve

Mixing and Compounding

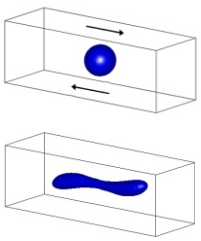
To achieve the desired product performance it is commonplace to include additives in a polymer and/or to blend polymers with which each other. In general a crucial element to realizing the full potential of the additives or polymer blend is to achieve a high level of distribution and dispersion. The simulation of mixing in polymer processes is a field in its own right where there are still many challenges and unanswered question requiring research.



Two polymers mixing in partially filled mixer



Velocity field in a twin screw extruder



Single polymer drop in a shear field

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Literature

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