# How to optimize the process of polymer extrusion

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Extrusion is a process widely used in the polymer processing industry. It

involves pushing material through a die with a specific cross-sectional shape, resulting in products like profiles, thin sheets, films and tubes. However, the shape of the final product (the so-called extrudate) is highly influenced by a phenomenon called swell. Ph.D. candidate Michelle Spanjaards has developed a numerical model that reduces this problem. She will defend her thesis at the department of Mechanical Engineering on Friday 21 of January.

Precision is extremely important for extrudates, to make sure they have exactly the desired dimensions. However, extrudates tend to expand once the fluid leaves the die, due to internal stresses in the material, leading to suboptimal products.

Usually, this problem is solved using an experimental trial-and-error approach, a process that is unsustainable because it produces unnecessary material waste. It is also time-consuming and thus inefficient and costly.

## Predicting the right shape

To meet this challenge, Michelle Spanjaards at the research group Polymer Technology has developed a numerical model that can predict the shape of the extrudate, and optimize the shape of the die in order to obtain an extrudate with the desired dimensions. In particular, she developed a transient 3D Finite Element model for viscoelastic fluids emerging from complex shaped dies.

She combined this method with a real-time active control scheme, to numerically solve the inverse problem of three-dimensional die design for extrudate swell. A feedback connection is established between the finite element method and the control scheme.

Results show that this is a promising approach to design dies for

viscoelastic extrusion flows. Once you have a stable controller it optimizes for the desired extrudate shape independent of what desired shape you choose.

**More information:** Modeling and optimization of polymer extrusion: research.tue.nl/en/publication … of-polymer-extrusion

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