Cognitive Polymer Extrusion & Compounding

Hybrid Modelling of Pressure-Throughput Relationship for Kneading Blocks in Co-rotating Twin-Screw Extruders

Pro²Future

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MOTIVATION

- **Twin-screw extruders** are one of the most used machineries in **polymer processing**
- Co-rotating twin-screw extruders are typically **operated in starve-fed mode**
- **Back-pressure length** and **material distribution** are key process parameters
- **Kneading blocks** are commonly approximated **as conveying elements**

GOALS

- **Generalized Pressure-Throughput model for kneading blocks**
- For **various** commonly used **offset angles**, **diameter ratios**, **kneading disc sizes** and **undercuts**
- **Easy handling** of the model
- Prediction of the **material and pressure distribution** along the screw

Project FactBox

Project Name CoExCo
Project ID MFP 4.2.1
Duration 48 Months

Area 4.2
Cognitive Production Systems

Project Lead
Mag. Bernhard Löw-Baselli

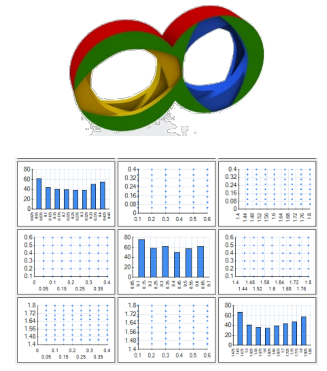
APPROACH

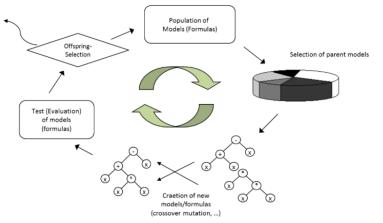
Dimensional Analysis | **CFD-Parametric Study** | **Regression Analysis** | **Validation**

$$\Pi_D = \frac{D_a}{D_k}$$

$$\Pi_{p/L} = \frac{D}{\eta N}\frac{\partial p}{\partial L}$$

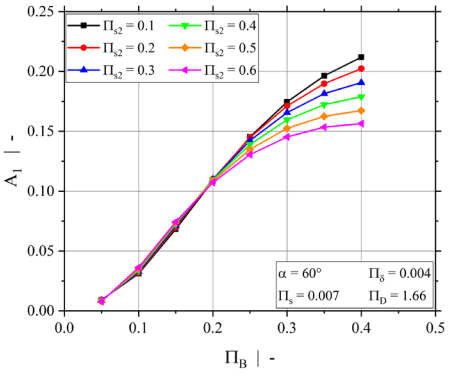
$$\Pi_{\dot{Q}_{Diss}/L} = \frac{1}{D^2 N^2 \eta}\frac{\partial \dot{Q}_{Diss}}{\partial L}$$

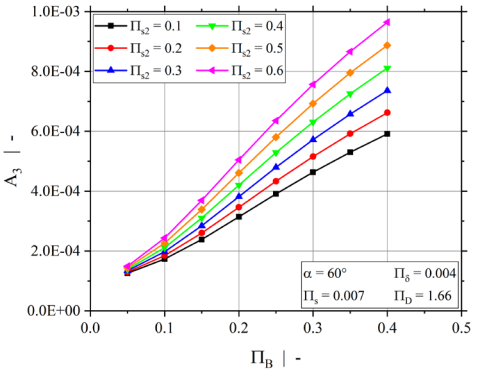




RESULTS

- We developed symbolic **regression models** for the **dimensionless conveying parameters A_1** and **A_3**.
- Our models can be used for e.g. **screw design**, **digital twin**, **model based control** and **process optimization**.





CONTRIBUTION

Scientific contribution
Accurate Pressure-Throughput prediction of kneading blocks
All gap regions were taken into account
First valid modelling approach for non-conveying elements
Novel power consumption model for kneading blocks

Economic contribution
Geometry specifications
Material and Equipment for model validation
Expertise of the twin-screw extrusion process
Guidelines for the range of the parameters

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JKU Johannes Kepler Universität Linz | TU Graz | AVL | Fronius | UAR Upper Austrian Research GmbH | Bundesministerium Verkehr, Innovation und Technologie | Bundesministerium Digitalisierung und Wirtschaftsstandort | FFG Forschung wirkt. | ober österreich | Das Land Steiermark Wirtschaft und Innovation | SFG Neues Denken. Neues Fördern.