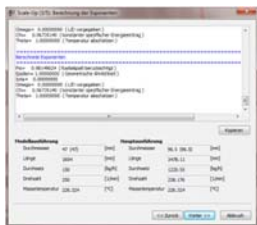


## Further program functions

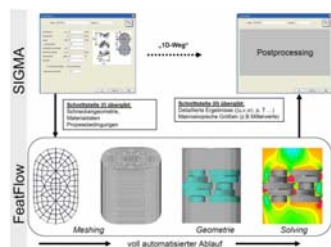
Using SIGMA with a scale-up module, it is possible for the user to transfer processes at the laboratory scale onto production machines. This is achieved by using model laws which are based on the principle of similarity.



Scale-up module

In addition to this, SIGMA provides a tool for the statistical design of experiments (DoE) with which relevant target and influencing values can be defined. According to the chosen statistical model, the matrix for the experiment's design is automatically created and each operating point is calculated. Hence the graphical evaluation of the result and a simple determination of the optimal operating point for the considered screw concept results.

Using the program version from SIGMA 8 onwards, it is possible for the user, initially for fully-filled conveying elements, to view the sub-process in a detailed numerical way. For this purpose, the conveying element to be considered is decoupled and the flow is calculated numerically with the program FeatFlow (in cooperation with the TU Dortmund).



Integration FeatFlow and SIGMA

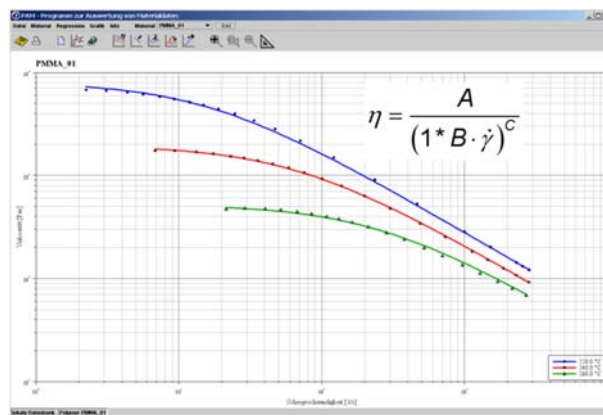
Thus, a detailed understanding of the process variables can be gained inside this element, e.g. shear and temperature peaks.



The Paderborn Material database - PAM - is a software tool used to administer and evaluate material data in the field of polymer engineering. PAM was developed at the professorship for polymer engineering at the University of Paderborn (KTP). With the aid of PAM, the material data is made available for a SIGMA simulation.

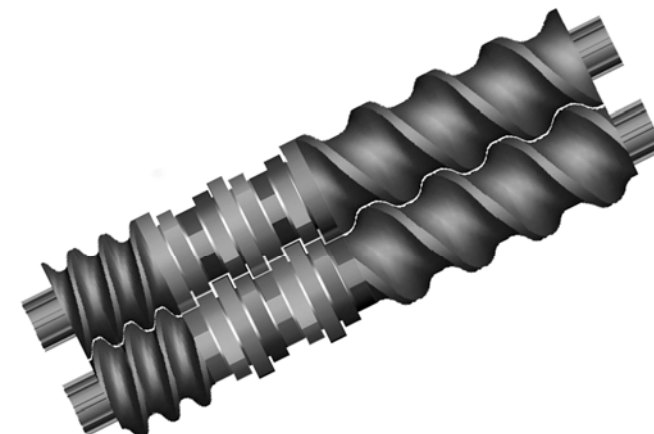
## Overview of the features in PAM:

- Administration of material data
- Import and export of material and mixing data
- Import of measured values or their manual input
- Evaluation of measurement data with various regression functions
- Search for and compare various polymers



Viscosity graph

## Simulation of Co-Rotating Twin-Screw Extruders



Prof. Dr.-Ing. Elmar Moritzer  
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## Contact

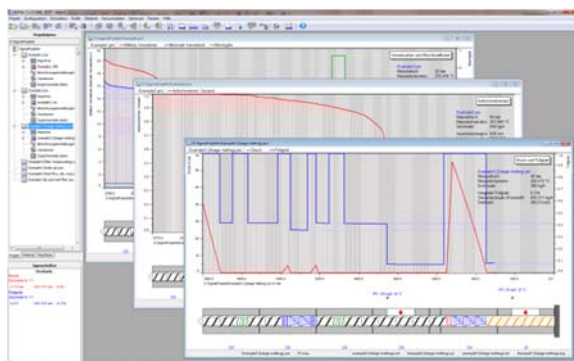
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**SIGMA** is a joint research project involving various leading industrial companies and the professorship for polymer engineering of the University of Paderborn. This software is a program that simulates compounding and processing using co-rotating twin-screw extruders. The aim of the development is to rapidly evaluate the machine's global behaviour and to optimise both the barrel and screw configurations as well as the process parameters.



Graphical user interface

### Calculation possibilities

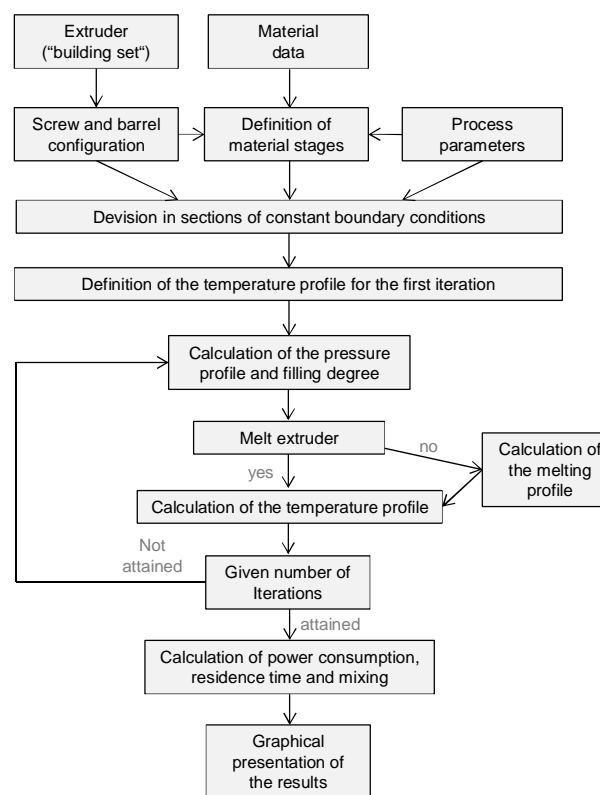
Using SIGMA, the following calculations are currently possible:

- pressure and filling degree,
- melting behaviour,
- temperature profile,
- power consumption,
- residence times,
- degree of dispersion,

Apart from the calculation for "pure" polymers, SIGMA also incorporates models for estimating the behaviour for polymer blends and polymer/filler compounds. Using SIGMA, so-called pre-mix processes as well as split-feed processes can be simulated.

### Calculation procedure

The calculation procedure is shown in the figure below. The central elements of a simulation are the pressure and filling degree, the melting and the temperature calculations. Based on these calculations all other essential parameters can be computed to evaluate and optimise the screw configuration.

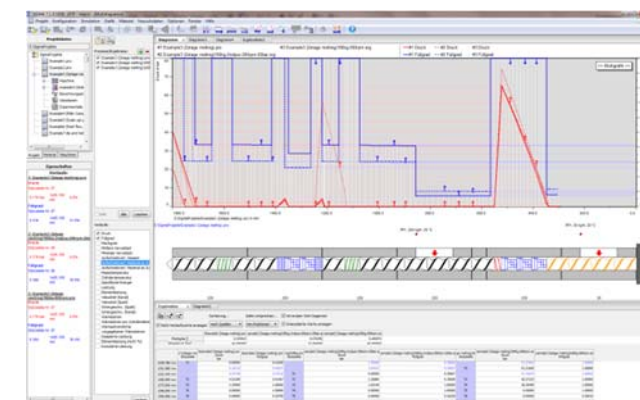


Calculation procedure

### Simulation results

The results of the simulated calculations can be depicted in tables of data as well as graphically in the form of diagrams along the screw length. The graphical output is designed in such a way that the profile of one parameter is depicted along the screw length. Using this kind of plot, it is possible to evaluate individual screw zones and, if necessary, thereby easily modify the screw design.

To compare and evaluate the effect of various influencing parameters, a so-called variation module is implemented in SIGMA. Here, all the parameters which influence the process can be varied. All variations of the processes can be computed and be subsequently compared in multigraphics.



Multigraphics

### Technical details

- Supported barrel elements: Standard barrels, feeding barrel, venting barrel, measuring plates, spacer plates
- Supported screw elements: Conveying and reconveying elements, pushing flight elements, kneading blocks, shoulder kneading blocks, eccentric kneading blocks, screw mixing elements, tooth mixing elements, blister elements, distance elements, V-mixing elements