

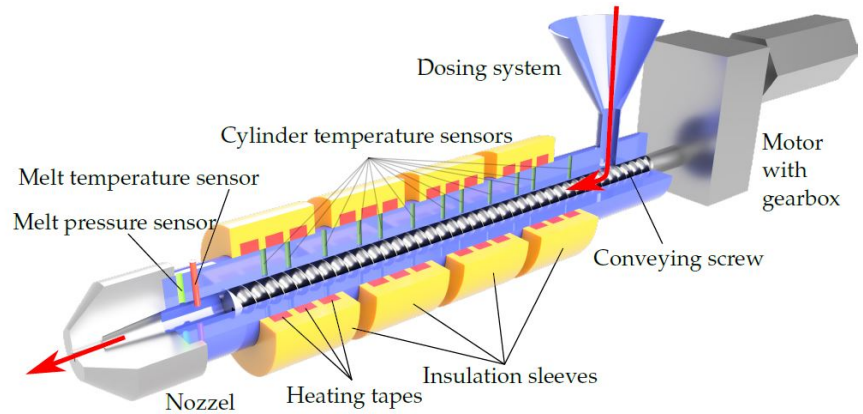
**Pro²Future
Products and Production Systems
of the Future**

Programme: COMET – Competence Centres for Excellent Technologies

Programme line: COMET-Centre K1

Type of project: CoExCo 2
(Cognitive Polymer Extrusion and Compounding 2)

4 years, multi-firm



MODELLING AND CONTROL OF PLASTICS EXTRUSION MACHINES

AN INNOVATIVE MODEL-BASED CONCEPT FOR EFFICIENT AND ENERGY-SAVING PRODUCTION OF PLASTIC ARTICLES

An important process for the **production** of plastic products such as **packaging, pipes etc.** is the extrusion process. In this process, a plastic **granulate** is filled into a machine called an extruder, conveyed through the extruder cylinder by a complex screw and **melted** using pressure and heat. The heat required for melting is generated by friction and heating elements, the pressure by the screw. The **pressure, mass flow and temperature** of the melt are to assume **values** that can be specified at the outlet. **The newly developed control system allows the extrusion process to run faster, more efficiently and in a more environmentally friendly manner, while at the same time ensuring optimal product quality.**

This process should be as energy-efficient and environmentally friendly as possible, but also be able to extrude a wide variety of types of granules in such a way

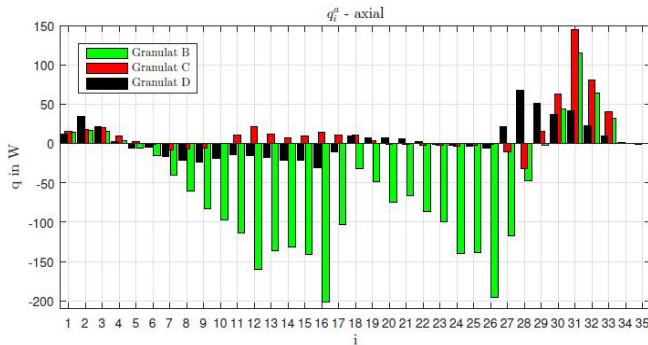
that the end products are of high quality. Today's **challenges** are doing without active cooling and **processing of granules with fluctuating properties, eg. in recycling.** The standard is that experienced staff use recipes to adjust the extruder in such a way that the best possible behavior is achieved under the same conditions. Changes over time due to defects or **changes in the composition** of the granules **cannot be specifically taken into account.** Recipes also have to be created in a complex manner. Modern extrusion is an extremely complex process that varies greatly over time, and the best possible settings have to be learned.

To meet these challenges, **Pro²Future** has developed a new model-based control system together with partners from industry (**Soplar.sa**), the **Institute of Polymer Processing and Digital Transformation** and the **Institute of Automatic Control and Control Systems**

SUCCESS STORY



Technology (both of them JKU-LINZ). The newly developed control system **continuously analyzes** the thermal effect of a **granulate mixture** and **adjusts the pro-**



Heat flow estimation of the Smart Sensor during processing of 3 different granulates on an industrially used extruder.

duction process accordingly, compensating for any fluctuations that occur and thus **ensuring consistently high product quality**. The analysis of the plastic mixture is carried out by a developed **smart sensor**. This

smart sensor is able to **estimate** the **heat flows** that act between the extruded plastic and the extruder.

Impact and Effects

With the innovative **temperature management**, **optimal production conditions** are achieved quickly, thereby **reducing rejects**. By using the **model-based controller**, all essential process variables are recorded, **system-related limitations** are observed and safe operation is thus ensured. This makes it possible to operate well-insulated and thus energy-efficient extruders **without additional cooling devices**.

The **new control system** thus allows **recycled and/or new bio-based material** from the plastics industry to be **processed very efficiently** by **quickly** achieving and maintaining optimal production conditions and has already been demonstrated under production conditions.

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- Johannes Kepler University Linz, Austria
- Soplar sa and others

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