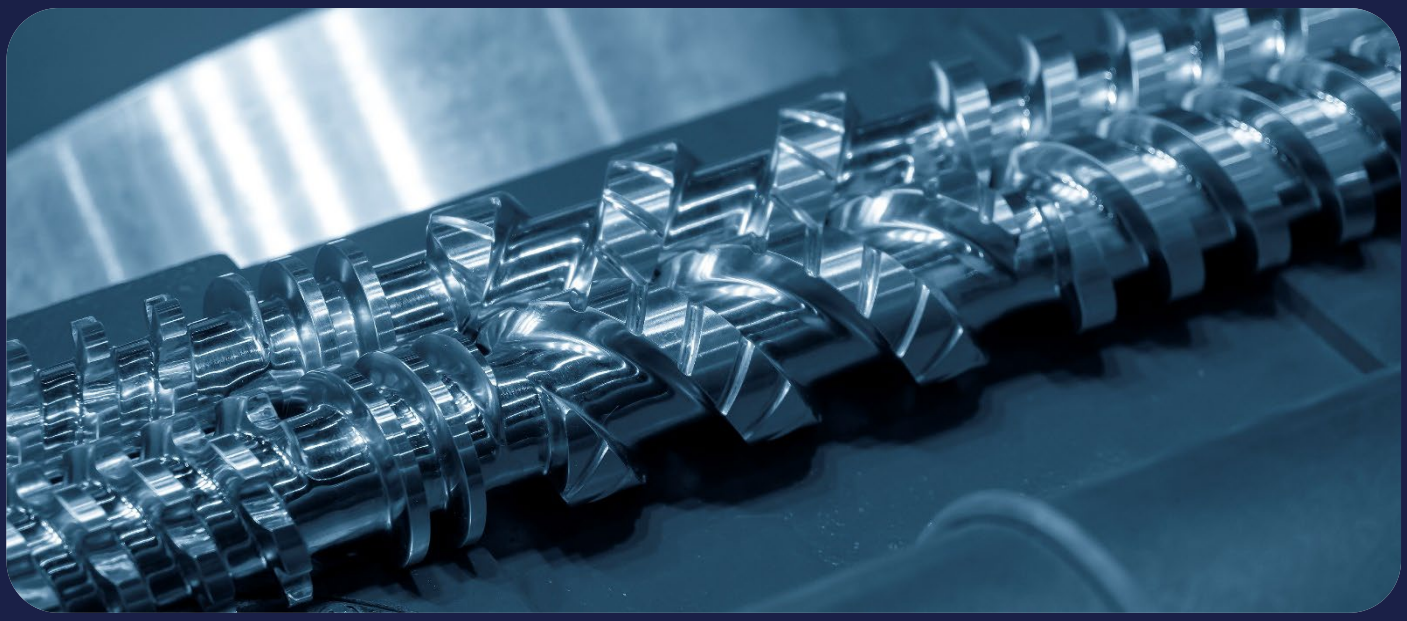


Extrusion Processes

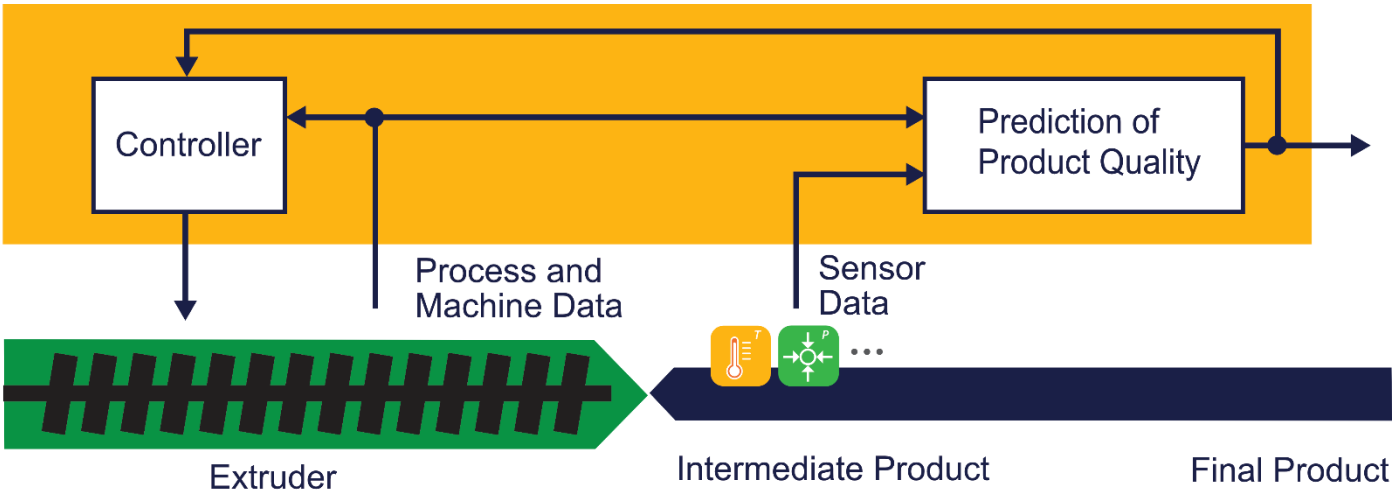
Algorithms for predicting quality parameters in manufacturing processes

Project Goal

Around the globe the goal of lowering the energy consumption for heating buildings has led to an increasing demand of insulation materials for buildings. These materials include insulation panels made from extruded polymers such as polystyrene (XPS). These insulation boards based on polystyrene are foamed during an extrusion process using carbon dioxide as a blowing agent. The resulting foam consists mainly of relatively small closed cells and thus has advantageous properties in terms of mechanical strength and thermal conductivity.

Due to variations in the extrusion process as well as changes of the thickness of the target material, however, the insulation boards produced can also vary considerably and the desired mechanical and thermal properties cannot always be obtained. It is therefore necessary to continuously monitor the extrusion process by determining the desired quality measures, i.e., mechanical strength and conductivity of the insulation boards produced are determined. This is currently done mainly by manually taking samples from the production line and performing laboratory experiments on these samples to determine the quality parameters. Due to the fact that the aging of the material has a significant influence on the quality parameters, these laboratory tests can only be carried out after a certain period of time has elapsed since the sampling.

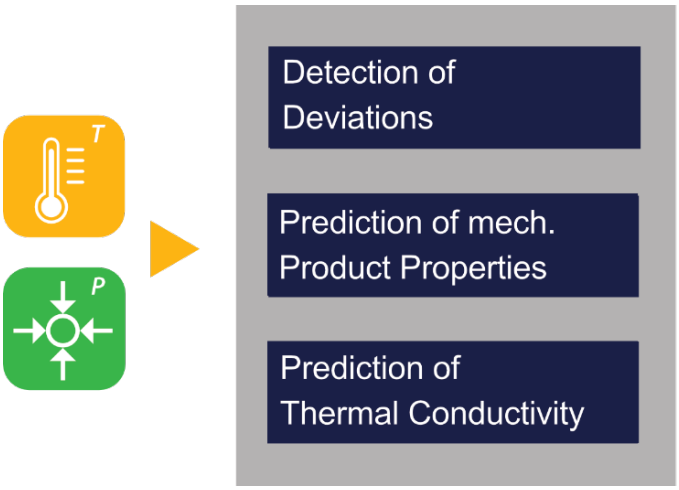
Therefore, the entire batch produced in the meantime may have to be thrown away if laboratory tests show that the production process did not run properly. The goal is that with a knowledge-based system and automatic supervision the quality can be increased directly during production.



Procedure & Solution

The selected approach is to reach a **detection of deviations** from the expected working me-thod using an extruder model specially develo-ped for this project. The extruder model uses sensor values for pressures, temperatures and material flow, which are provided by sensors attached directly to the machine.

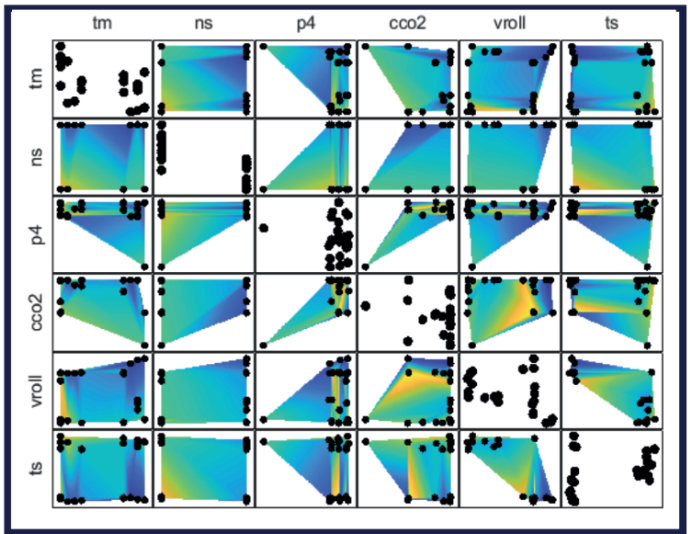
This allows then a **prediction of the mechanical product properties** like density, compressive strength and compressive rigidit on the basis of dielectric and acoustic sensor measurements.



In addition, our approach allows **a prediction of the thermal conductivity** based on the predicted material properties and a novel thermal conductivity sensor developed by one of our project partners.

Results & Benefits

- Experiments show that extruder model can be used to detect malfunctions
- Acoustic sensor readings seem to be sufficient for predicting mechanical properties



Representation of the relationship between all physical quantities in the Ramler plot

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