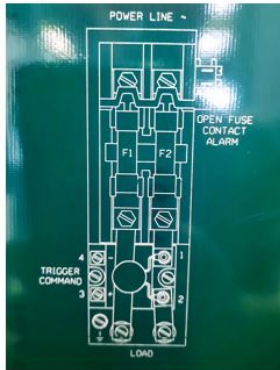
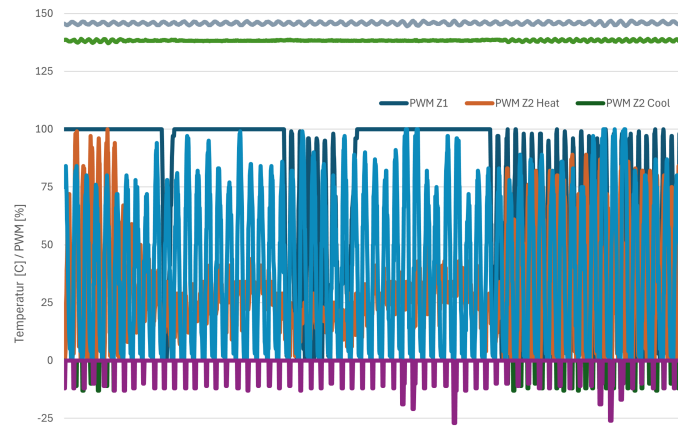


Optimization of Extruder Control

Brugg Kabel Manufacturing AG owns cable production facilities equipped with an extruder. An extruder heats plastic pellets so that they become liquid and can be applied as an insulating sheath onto a cable. The objective is to optimize the energy-intensive heating process in terms of energy consumption while maintaining quality.



Old, used hardware that has reached its end of life.
(source: Roman Seiler Brugg)



PWM Recording and Evaluation in Excel
(source: Roman Seiler Brugg)

Hardware

Firstly, the status quo of extruder control was analyzed: Which components are being used, and what are their characteristics? Secondly, a research was done in order to identify possible new, improved components. Based on these analyses, the previous hardware was rebuilt with new components in order to offer better reliability and error detection.

Software

A simulator of the control loop was developed in MATLAB/Simulink based on the specifications and data of an extruder to better understand its characteristics and gain insights. Also, a PWM recorder that stores a PWM signal on a USB stick was programmed. The controller was implemented on a Siemens PLC. Additionally, controllers with extended functions were programmed.

Analysis

The measurement results of the PWM recording and the power profile recorded by a PQ analyzer are analyzed. In combination with the insights from the hardware and software analysis, new control parameters are defined.

Findings

- With the modification of the hardware of the 120/3 system, it became evident that new components bring some advantages while maintaining the usual level of reliability. Significant progress was especially made in the area of error analysis.
- The simulation revealed the complexity of the process. To replicate it, many properties must be considered. However, to create an understanding, an approximation is sufficient.
- A standard range can be determined for the PID parameters of extruders, indicating how they should be approximately set to ensure a stable control value. $P \in [2; 6]$, $I \in [300; 500]$, $D \in [50; 100]$.
- Compensating for mutual interference using advanced controllers will, if at all, only result in a few percent of energy savings. On the other hand, the possibility of completely turning off the extruder heater or implementing a weekend shutdown often promises greater potential and easier implementation.
- The PWM signal recording and the load profile indicate that energy is lost when switching back and forth between heating and cooling. Therefore, it is often advisable to set up a gentle cooling system that overshoots only slightly.

Project Team:

Roman Seiler

Client:

Brugg Kabel Manufacturing AG, Brugg

Coach:

Prof. Martin Pischtschan