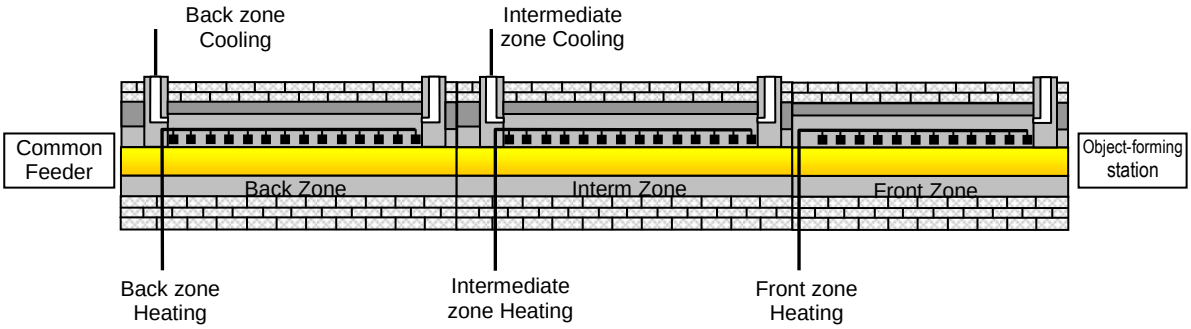
PCR

Application of Model-based predictive control to the temperature control of the three zones of a glass furnace feeder at ARC International in France

A feeder is the channel through which the molten glass is distributed to the object-forming stations. It is important that the glass reaches the tools at the specified viscosity i.e. at the correct temperature. Each of the dozen of glass furnaces has around ten feeders.
The feeder is split down into 3 zones and each zone outlet temperature is to be controlled carefully in order to satisfy a given profile along the channel.

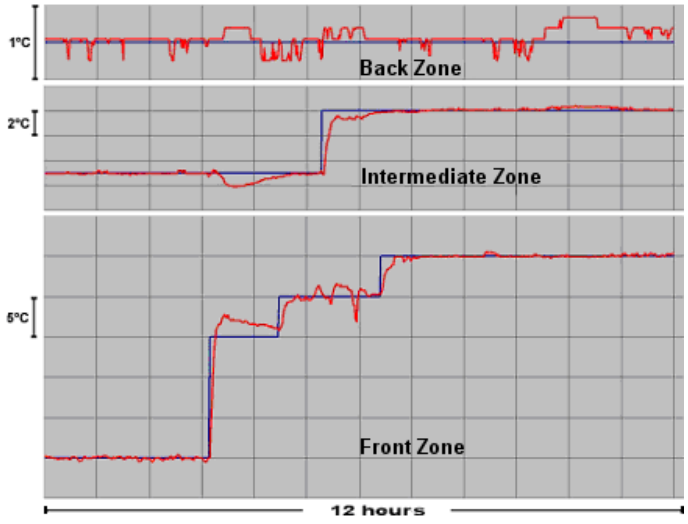
The temperature control of the feeder zones is usually performed by simple PID controllers acting on the heating and cooling actuators (gas burners and air blowers) in each of the three zones.



The application is given two purposes: the improvement of the control performances during production transitions and energy savings during normal operation.

One of the difficulties comes from the quite different dynamics of the relationships between the actuators (heating and cooling) and the temperatures. Another one is the variation of these dynamics with the feed rate which may change by a ratio 2.
The predictive control technology was selected as it is based on a model of the process which represents correctly these dynamics. Added to the usage of a dynamic model, an advantage is the fact that the control parameters are not tuning parameters (as the factors P, I and D in the regular PID controller), but specified closed loop behaviour: the closed loop time response. The PCR control library belongs to that technology and the smart Split-Range module takes benefit of the prediction capability.

The controller model is identified from collected plant tests, using the PCR control design tool on a PC and the control architecture is designed and tested in simulation before being embedded into the SIEMENS PLC.



The gas consumption is reduced thanks to a better management of the heating and cooling actuators which do not move back and forth any more.
During production switches (change of the specified temperature profile) and when changing the feed rate, the time required for reaching a new stabilised operating point is also reduced.
The better temperature performances lead to a more stable quality of the products.
The pay-out-time, based on the energy saving only, is less than 10 months.

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