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Model based temperature control of batch reactors

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In case of batch reactors the most important controlled variable is temperature, since in the manufacturing processes of high-value-added products in pharmaceutical, fine chemical, polymer and food industry insufficient control might produce off-grade product that can cause significant financial loss or in pharmaceutical industry it can result an unusable batch. Therefore an important area of research is the temperature control of batch reactors.

The temperature control of batch reactors are mainly carried out in the industry with cascade PID controllers. The difficulties that arise in the temperature control are mainly caused by the discontinuous nature of operating modes and the multiple operations of the reactors. The controller has to work properly in case of drastically changing, ramped and constant set-points during the different modes of operations.

According to our experience the quality of the slave control loop (jacket temperature control) fundamentally restricts the quality of complex control solutions. The varying operating points and constraints cause the PID algorithms to work ineffectively, thus model based algorithms are needed to be developed and used that can be customised to specific practical conditions, operate reliably and can be implemented in commercially available DCS (Distributed Control System).

The development of the so-called PCC (Predictor Corrector Controller) controller was started in the beginning of the nineties in our department. This algorithm is an extension of the IMC (Internal Model Control) structure where an inverse model considering the constraints is used and by the feedback of the model error adaptation ability is also built in.

The performance of the model based reactor temperature controller was developed and tested on a pilot batch processing unit located in our laboratory. The test results showed good performance of the controller, which allows industrial implementation.

Keywords – predictor corrector control, batch reactor, temperature control