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Lean APC in practice

Model-based predictive control at Wacker Chemie in Burghausen

Chemical industry: Advanced Process Control

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The lean APC features from SIMATIC PCS 7 are an effective and cost-efficient way to process optimization.

Plant description

The chemical plant operated by Wacker Chemie AG in Burghausen, Germany, manufactures basic material for construction chemicals that is used primarily in the manufacture of adhesives and paints, but also as an additive in the manufacture of paper and film.

The basic material is produced by a reaction of ethylene, acetic acid, oxygen and a catalyst in a continuous, homogeneous gas phase process. The behavior of the distillation columns is characterized by the close interconnection of actuating, closed-loop control and disturbance variables and by large time constants.

Task

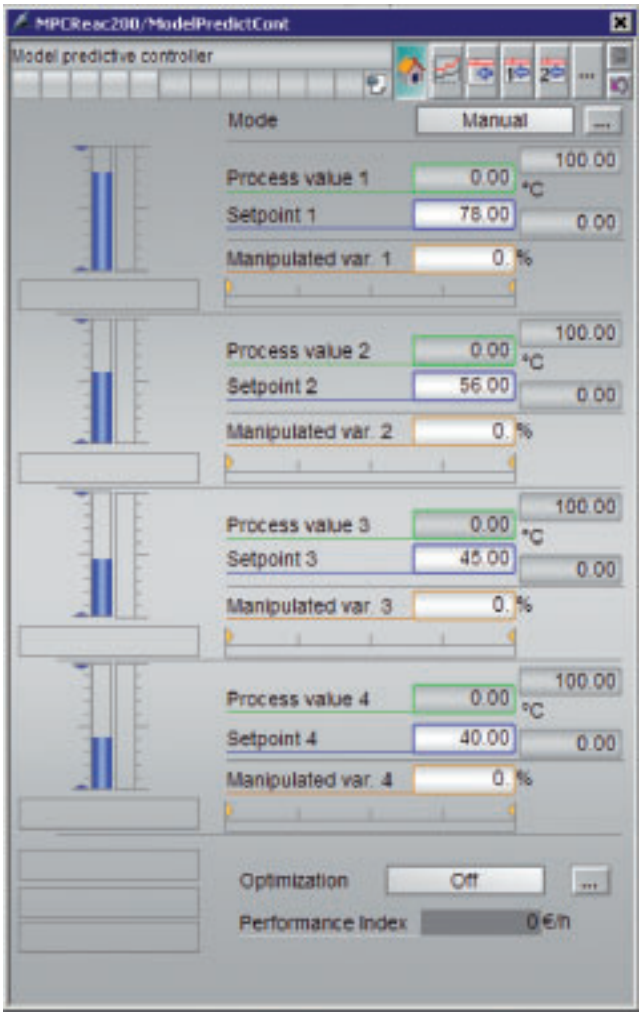
To ensure optimum operation of the column, the process requires frequent intervention and has to be manually adjusted. Using Lean APC, Wacker Chemie wanted to optimize the process control and achieve a more constant operating mode. A closed-loop control was used that is based on a class of closed-loop control algorithms designated “model predictive control” (MPC).

A control based on predicative algorithms with enhanced simplicity was used. It has no online optimization and few regulating variables.

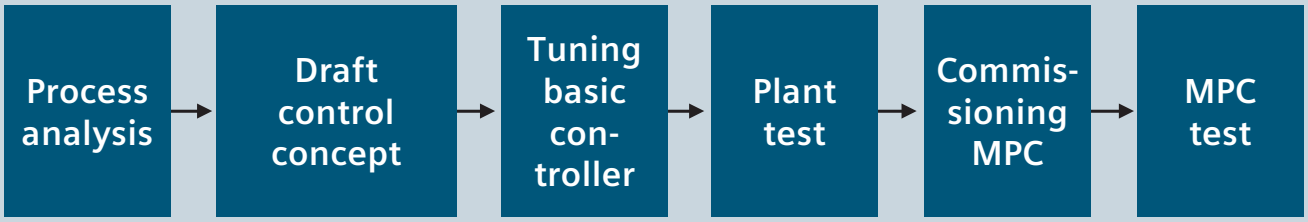
These lean predicative controls (Model Predictive Control [MPC]) require only a few matrix multiplications for the online calculation of the regulating variables and therefore less computing. Due to that, these controllers can be implemented like conventional PID controllers as a function module on a component close to process.

Procedure

The MPC controller was essentially implemented by the local EMR plant engineer (see next page for procedure). This initially included the analysis of the column and its mode of operation. A simplified closed-loop control concept was then drawn up. The subordinate basic control loops were already well adjusted, so that to a large extent no tuning of the controller was necessary. Before putting the MPC into service, disturbance tests were performed on the column. On the basis of the results (disturbance responses) a model was then identified and the controller was parameterized.



Operator display with MPC faceplate



Simplified procedure for the implementation of the MPC controller

As a tool, the lean multiple variable controller from the standard SIMATIC PCS 7 library was used. This multi-variable MPC processes as many as four positioning and control variables as well as a measurable disturbance variable in one standard function block.

This was an ideal application for the model predictive multi-variable control, as it exploits a very high proportion of the potential for improvement in normal operation of continuous plants. In the case of the dehydration column, this involves a controller with few open and closed-loop variables, for which the lean APC from Siemens is ideally adapted. Finally, Wacker Chemie attaches great importance to low engineering and maintenance costs.

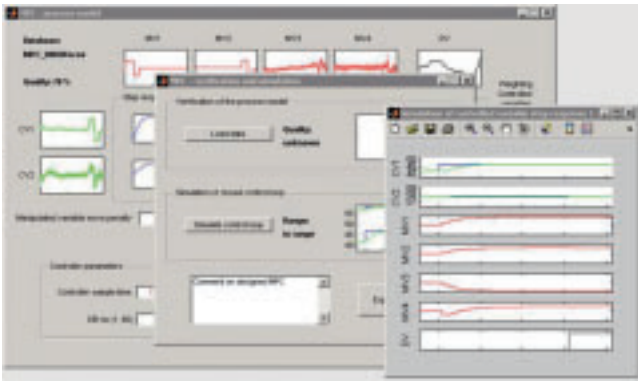
The closed-loop control encompasses the column, air cooling, reboiler and post-condensation. The closed-loop, actuating and disturbance variables used are: concentration, temperature, reflux ratio, steam infeed, as well as column feed and external temperature.

Easy and safe integration into SIMATIC PCS 7 control system

The basic procedure for the commissioning of a predictive controller is based on the computer-aided commissioning of PID controllers, for which only a few steps are required. This is easily implemented by means of "drag & drop" and signal interconnection in the SIMATIC Manager, the central project administration. The operator block as well as all messages are generated automatically by SIMATIC PCS 7. Once the block has been loaded into the plant during operation, the MPC can be tested.

The models from the disturbance responses and the parameterization of the MPC are readily implemented with the aid of the MPC configurator. The project engineer receives the result displayed in the form of the transmission functions and the model qualities.

The MPC configurator also generates the SCL source that is then incorporated in the SIMATIC Manager. The fully functional model predictive controller for the column is then available to the plant operator.



MPC configurator in SIMATIC PCS 7

The plant operators at Wacker Chemie soon became acquainted with the operation, as the "look and feel" of the MPC controller corresponds to that of a conventional PID controller. For the commissioning phase, an additional button was installed which enables the operators to switch back quickly to the control structure already familiar to them.

Conclusion: Lean APC is not witchcraft

Using Lean APC and the new controller solution, Wacker Chemie has succeeded in keeping the critical header concentration more stable at the column. As a result, fewer manual interventions are required. The success of the MPC controller used here lies in the improvement of the adjustment of disturbance variables and shorter adjustment times.

Practice has shown that the Lean APC functions embedded in SIMATIC PCS 7 offer an effective and cost-efficient opportunity for using APC. The success of Lean APC is also apparent even in smaller applications. Thus, the people at Wacker Chemie in Burghausen are already considering further applications.

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