Application of Dynamic Simulation Approaches for Practical Improvement of Process Operation in Chemical Industry

Dr. Moritz Wendt, Volker Butz, *Gordana Hofmann-Jovic, Michael Strack*

Infraserv GmbH & Co. Knapsack KG

How can dynamic simulation tools be an efficient help in industrial practice?

In general, concepts for process operation in industrial plants are designed according to certain operation points corresponding to a previously planned production rate. The single control loops and their corresponding set point values are mostly determined during the planning period in the framework for Basic or Detail Engineering. The control parameters (i.e. PID parameters) are usually set up during the start-up period and determined by a combination of heuristic rules and standardized step response tests. Dynamic simulation tools based on rigorous models are only occasionally used at this stage.

However, during the process operation strong deviations from the nominal operation point often occur. Commonly, the plant operator needs to cope with strong fluctuations in boundary conditions, load changes and even changes in operating points. This often causes instabilities of control loop and process behavior, which eventually leads to temporary violations of product specifications. Particularly for those cases, the utilization of detailed dynamic simulation models, which simultaneously considers the thermodynamic effects, the reaction kinetics and the fluid dynamics, can help.

This presentation focuses on the pointed application of dynamic simulation approaches at selected examples of real industrial plants. At first, distinction needs to be made between already existing plants and those, which are still to be planned. As for the former case, an example of a gas reaction process in a tube reactor with changing feed conditions and then of a distillation process with changing set point values will be illustrated. As for the latter one, a bio-methanol synthesis, where load changes are caused by fluctuations of electricity prices, will be introduced.

As for already existing plants in operation the main targets are usually the development of alternative automatization strategies going along with the evaluation of already existing strategies. This work is based on detailed dynamic process models, which may have the advantage of being accurately validated by fitting

uncertain model parameters to real process data. This fine adjustment of the dynamic process model can be seen as one of the most important challenges during the project. With help of powerful tools such as Aspen Dynamics a high number of alternative options can be tested and evaluated in a relatively short time. The optimization of automatization strategies is usually restricted to the current plant design since options for constructional alterations are considered unlikely at this stage.

For plants, which are still in the planning period, there are more degrees of freedom for constructional parameters. On the other hand the dynamic process model is in general not as accurate as a model validated with real process data and hence it will be rather used for general feasibility studies of control concepts than for detailed parameter fitting of control loops. This procedure will be shown at the example of bio-methanol synthesis.

With help of the illustrated examples a general procedure with focus on efficient application of dynamic simulation models as support for designing automatization strategies in chemical industrial plants will be introduced.