Success Story
COMET

FFG

imPACts
Industrial Methods for Process Analytical Chemistry

ImPACts
Industrial Methods for Process Analytical Chemistry - From Measurement Technologies to Information Systems
Programme: COMET – Competence Centers for Excellent Technologies
Programme line: K-Projects
COMET subproject, duration and type of project:
imPACts, 09/2014 – 08/2018, multi-firm

Fully automated process control – powered by Infrared Spectroscopy

As a part of the research project imPACts which covers a broad selection of methods for process analytics, a fully-automatic method for process control of chemical reactions was developed and implemented. The aim is to determine the desired endpoint of a batch in the production of melamine formaldehyde resins for decorative surfaces and mineral wool at the company Metadynea Austria GmbH. Before the two K-Projects "PAC" and "imPACts", it was necessary to take quite a number of samples per batch and analyse those manually. The need for this analysis was now completely substituted with Near-infrared spectroscopy. The determination of the endpoint of a batch is automatically conducted using chemometric analysis of the IR spectra. This enables the employees to focus on other valuable tasks.

IR-Measurement system & Chemometrics

At the production site of Metadynea Austria an FTNIR spectrometer is connected to immersion probes in three reactors via optical fibres. The spectra are measured every couple of seconds during the melamine formaldehyde (MF) and phenol formaldehyde resin (PF) condensations. Those measurements are performed automatically without the need to draw samples. In addition other parameters are gathered too, such as process temperature and pressure. The so called chemometric models (for the experts: Partial Least Squares regression) are calibrated using historical data. They analyse the spectra and provide required process parameter (Turbidity point, Fig. 1) to the process control system. With this info provided, the state of the condensation can be followed in real-time and used to control the process during condensation and to define the endpoint of the batch.

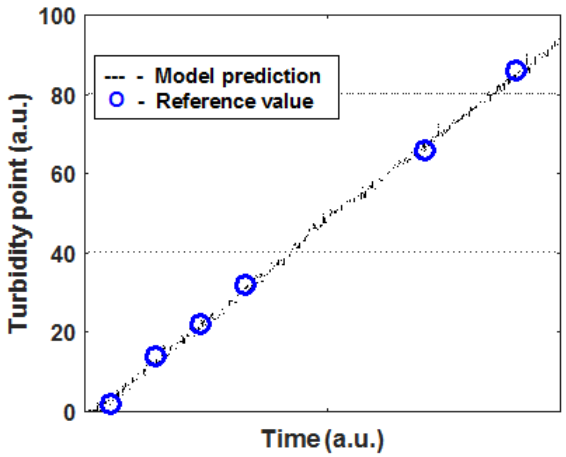

Figure 1: Turbidity point predicted using PLS-models (black dots) plotted together with off-line reference measurements (blue circles).

bmwfw Federal Ministry of Science, Research and Economy
bmvit Austrian Ministry for Transport, Innovation and Technology

Challenges

The condensation process of MF and PF resin (Fig. 2) takes place at high temperature. The condensation continues in the cooling phase until a limiting temperature is reached. It is necessary to consider this impact when determining the endpoint of the reaction in order to reach the required quality of the product. In addition, the condensation must be regularly controlled, which earlier was conducted by an employee via manual measurements. This time consuming but necessary task can be replaced with spectroscopic and statistical methods.

Figure 2: Resins manufactured by Metadynea Austria GmbH.

The chemometric models have to deliver precise, reliable and stable results. In the K-Project imPACts these requirements have been reached, despite the continuous deviation in the raw material quality and the small variations in the measurement conditions, e.g. in the sensor optics. Multiple test runs have proven the functionality and robustness of the new measurement system.

Impact and effects

Due to the implementation of the fully-automatic process control the highly qualified employees can be appointed to other important tasks. Prior to the implementation, an employee was constantly occupied with taking samples and analysing them. Only a short time separated two samples – which was difficult to be used efficiently. Moreover, the implementation of the new process control has led to more efficient process control as well as better product quality and thus to optimum customer satisfaction.

Figure 3: One production site from Metadynea Austria GmbH in Krems.

Contact and information
K-Project imPACts

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