SINCPRO
Self-learning Model for INtelligent Predictive Control System for Crystallization PROcesses

IMS Project No. 01006

- A tool for the rigorous and hybrid modeling of crystallization processes that can be used (a) for parameter estimation (b) for optimization of design and operation (c) starting point for model-based control applications;
- An observer/feedback system based on hybrid models made of a rigorous mechanistic model and an empirical model (e.g. Extended Kalman filter; horizon approach, self-learning, intelligent (learning) operating system);
- A control toolbox consisting of a Model Predictive Control applicable to a wide range of crystallization processes.

Summary

The optimization of crystallization processes, one of the most important production and separation processes in the chemical and pharmaceutical industry, is a difficult task. The design and operation of crystallization processes is still often considered more an art than a science and a great technological gap has appeared between crystallization and other unit operations encountered in the chemical process industries, where advanced modeling, optimization and control techniques are applied routinely. Industrial crystallizers are seldom operated under automatic control schemes. The process is operated at the conditions that are supposed to lead to desired product quality, without an on-line automatic direct control of product quality. This leads to non-reproducibility, unacceptably low product qualities and to remarkable production inefficiencies.

The objective of the SINC-PRO project is to drastically increase the efficiency and effectiveness of crystallization processes achieving a "first-time-right production", reducing costs and energy consumption, increasing safety and environmental constraints. This objective will be achieved by developing advanced techniques for on-line control of industrial crystallizers operating in both continuous and batch mode. To this aim, an innovative, integrated control system will be developed, consisting of:

1. A tool for the rigorous and hybrid modeling of crystallization processes that can be used (a) for parameter estimation (b) for optimization of design and operation (c) starting point for model-based control applications;
2. An observer/feedback system based on hybrid models made of a rigorous mechanistic model and an empirical model (e.g. Extended Kalman filter; horizon approach, self-learning, intelligent (learning) operating system);
3. A control toolbox consisting of a Model Predictive Control applicable to a wide range of crystallization processes.

The relatively few researchers working continuously in the field of industrial crystallization at an international level has enhanced the possibility to establish a world-

wide community in which there are constructive working relations among researchers of North America, Japan and the most developed European Countries. SINC-PRO wishes to build on this basis and establish a solid and complementary international research community on crystallization processes involving industrial parties and research centers from three different IMS regions: European Union, Japan and Switzerland. SINC-PRO will join together industrial end-users of crystallization processes, research centers and developers of modeling, optimization and control software, in order to achieve the proposed objectives and meet the market demands: crystals with a consistently high purity grade and suitable size range. The joint effort in research and development between research teams on a world-wide scale will dramatically speed up the realization of research results that are of great importance to the chemical and pharmaceutical industry involved in the production of solid products.

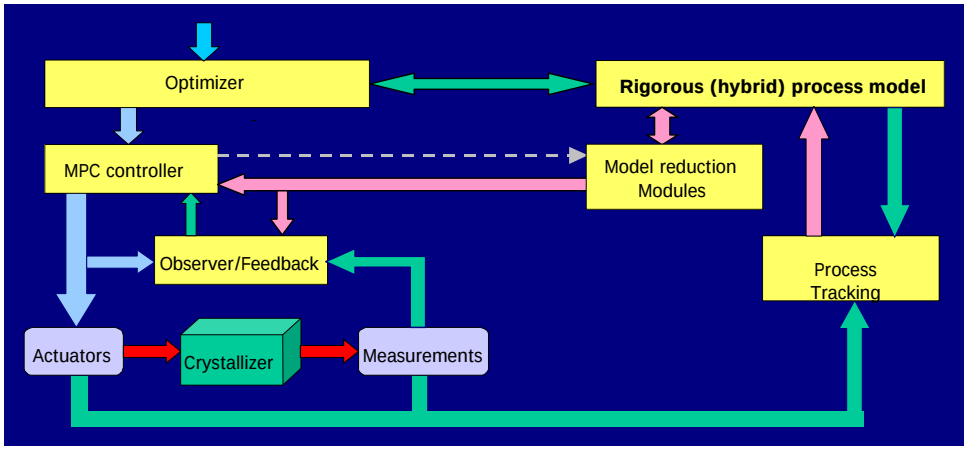

Figure: Innovative features of SINC-PRO system

Partners

Partner Name	Short Name	Type (I/R/O)[1]
Japanese Consortium		
Mitsubishi Chemical Co.	MCC	I
Tsukishima Kikai Co. Ltd.	TSK	I
Iwate University	Iwate	R
Nagoya University	Nagoya	R
Nagoya Institute of Technology	Nitech	R
Osaka City University	Osaka	R
Kyushu University	Kyushu	R
Swiss Consortium		
Roche Ltd.	Roche Vitamins	I
ETH Swiss Federal Institute of Technology Zurich	ETHZ	R
Mettler-Toledo GmbH, AutoChem	Mettler Toledo	I

Partner Name	Short Name	Type (I/R/O)[1]
European Consortium		
IPCOS Technology B.V.	IPCOS	I
DSM Research B.V.	DSM	I
Intelligent Systems Modeling and Control NV.	ISMC	I
Process Systems Enterprise Ltd.	PSE	I
Purac Biochem BV.	Purac	I
Kemira Oyj.	Kemira	I
Danisco Sugar OY	Danisco	I
Roquette Italia SpA	Roquette	I
Technische Universiteit Delft	TUD	R
Università di Roma “La Sapienza”	UR	R
Labor Srl.	Labor	R
Innova SpA	Innova	O

[1] I: Industry; R: Research Institution/University, O: Other