**Review of results in sugar crystallization obtained at the University of Chemical Technology in Prague**

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***Highlights***

* Physical and chemical properties of sucrose and sugar solutions
* The growth kinetics of sugar crystals in pure and impure sugar solutions
* Simulation and mathematical modeling of new processes and technologies
* Experimental work for industry and cooperation with industrial partners

This paper represents a summary of most important research activities in sucrose crystallization, in which the Department of Carbohydrates and Cereals, part of the University of Chemistry and Technology (UCT) Prague, have been focused over the last 25 years. A wide range of these projects has been carried out in cooperation with many research institutes, universities and industrial partners.

These activities can be divided into four main research areas that are interconnected and support each other.

**1st area: Physical and chemical properties of sucrose and sugar solutions**

The main condition for a successful control of the crystallization process is knowledge of physical properties of sucrose, other sugars and their impure solutions. At the beginning, it was necessary to obtain and verify these data experimentally. The most important properties to measure were: *(a)* density of sugar solutions (cooperation with Prof. Dandar, STU Bratislava); *(b)* solubility of sugars in technical sugar solutions (cooperation with Dr. Parkin, the British Sugar Research Centre in Norwich); *(c)* the effect of impurities on a shape of sugar crystals (cooperation with prof. Mantovani and Prof. Vaccari, University of Ferrara); and *(d)* the increase of boiling point of sugar solutions (Dr. Sarka, UCT Prague). This work involved a modification and/or design of new experimental devices. The most important data and results have been published in professional and scientific papers; included in the SUGAR TECHNOLOGY MANUAL (authors: Bubnik, Bruhns, Kadlec, Urban); and presented in congresses, such as CITS, ESST and AvH.

**2nd area: The growth kinetics of sugar crystals in pure and impure sugar solutions**

This area included work on gathering kinetic data that describe the growth of sugar crystals under conditions simulating the industrial environment. Equations describing the crystallization process have been suggested and verified using the data obtained from the 1st research area. Newly designed and built experimental equipment have been also used in laboratory and pilot plant trials.

Ultrasonic techniques for measurement of properties of sugar solutions and suspensions as well as US methods for determination of the metastable zone width have been developed and applied for sucrose crystallization control.

In cooperation with Prof. Mathlouthi from the Universite de Reims Champagne-Ardenne, a new image analysis method has been developed for control of the crystal formation and evaluation of crystal size distribution in crystallization processes.

**3rd area: Simulation and mathematical modeling of new processes and technologies**

Physical data about sugar solution properties and kinetic equations became an indispensable condition for further work on creation of new technological diagrams; simulation and modeling of processes; and not least, design of new manufacturing process diagrams for industrial partners. These activities were carried out under the European project Copernicus SUCLEAN that has been focused on raw juice crystallization and design and modeling of new sugar processing diagram. Partners in this project were: University of Ferrara, UMIST Manchester (Dr. Klemes), UCT Prague and Politechnika Warszawska Fillie Plock (Prof. Urbaniec). An essential part of the research was a study of application of membrane filtration (MF and NF) for purification of sugar solutions before crystallization carried out in cooperation with LSU Baton Rouge, USA.

**4th area: Experimental work for industry and cooperation with industrial partners**

The fourth part of our activities involves application of experimental data in measurement and modeling of processes in real sugar manufactures. Significant cooperating partners were VUC Prague (continuous crystallizer, Dr. Gebler), sugar factory TTD Dobrovice and other Czech sugar plants, ZVU Hradec Kralove, Czech Technical University Prague, and the Mikropur Company Hradec Kralove (Dr. Pridal).