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Supplier's case study

Supersaturation-based control of sugar crystallization

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Poor crystal size distribution is a common issue in the sugar industry, leading to higher recirculation rates, increased energy and water consumption, and a lower yield, as well as an increased loss of sugar in the final molasses. Achieving high-quality crystals with low CV and optimal MA values requires carefully designed and controlled crystallization processes, with supersaturation being one of the most critical parameters.

We contributed to the implementation of supersaturation-based crystallization control systems for both beet and cane sugar products operating in batch vacuum pans and cooling crystallizers. The focus in all these cases was on selecting and maintaining an optimal supersaturation setpoint that ensures superior crystal quality. However, ideal supersaturation setpoint curves differ for high and low feed syrup purities. What works well in a refinery pan may not be suitable for raw beet sugar A product and may be totally ineffective for C product in a cane sugar mill. Here, we present a modern solution for crystallization control that yields high-quality crystals, enhances molasses exhaustion, and optimizes the consumption of water and energy.

CUSTOMER CASES

We focus on two customer cases in this document. Both involve cane sugar mills in Mexico.

Sugar Mill #1: SeedMaster-4 installed on C product pan

In Sugar Mill #1 reducing the purity of final molasses was the main objective. Originally, they operated a cooling crystallizer after the C batch pans, but due to technical reasons it was shut down permanently. Without the cooling crystallizer the exhaustion of molasses was not as effective. SeedMaster was installed to help reduce the amount of wasted sugar.

The C product boiling scheme in Sugar Mill #1 consists of multiple strike cuts (Figure 1):

- The first batch (called "4 feet") is seeded with slurry. At the end of boiling, it is divided into two halves.
- The second batch (called "2 feet") continues with one half of the first one. Therefore, two of this type are boiled. At the end it is also divided into two.
- The third batch (called "massecuite") continues with one half of a second batch. Four of these are boiled.

We installed a process refractometer, microwave sensor and Zutora SeedMaster SM4-S-V-ACC to the C batch pan. SeedMaster can track and store the changes of mother liquor purity through the different cuts, which is very important in supersaturation calculations – especially with low purity feed syrups. The task of all SeedMaster models is calculating supersaturation inline. The SM4-S-V-ACC model also includes an advanced control system, capable of controlling the steam, vacuum, feed syrup and seeding valves. By these it keeps supersaturation within an optimal range throughout the whole batch, yielding high quality crystals. With the improved CV and MA values more sugar can be harvested at the centrifuges and the amount of fines escaping through the openings of the centrifugal screens is significantly reduced. This leads to a lower purity of final molasses.
At Sugar Mill #1 we managed to reduce the purity of final molasses from 37.1% to 34%.

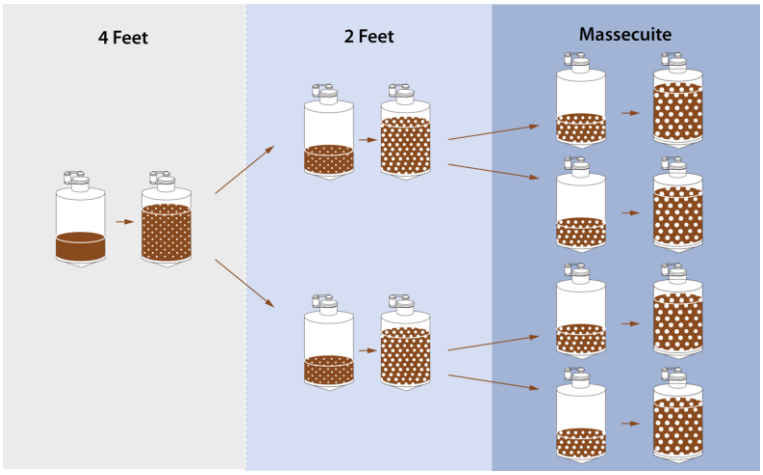

Figure 1. C product boiling scheme at Sugar Mill #1.

Sugar Mill #2: SeedMaster-4 installed on multi-purpose pans

In Sugar Mill #2 our customer had issues with crystal size; the B product crystals were too small and had a high CV.

We installed SeedMaster SM4-S-V-ACC on two batch pans (Figure 2). The operators use these two crystallizers for different products, so SeedMaster influences multiple steps of the overall process.

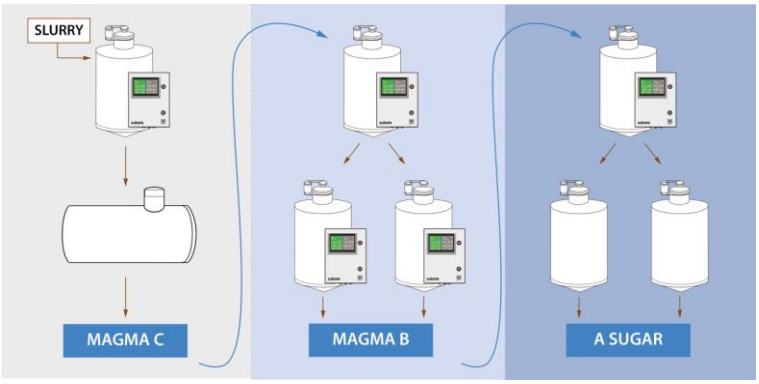

Figure 2. Overall boiling scheme of Sugar Mill #2, and the steps equipped with SeedMaster.

The main focus of our customer was on the B product crystals, so they performed many tests and measurements on that part to see the difference between traditional control and SeedMaster control. The microscope photos in Figure 3 show the significant reduction of fines.

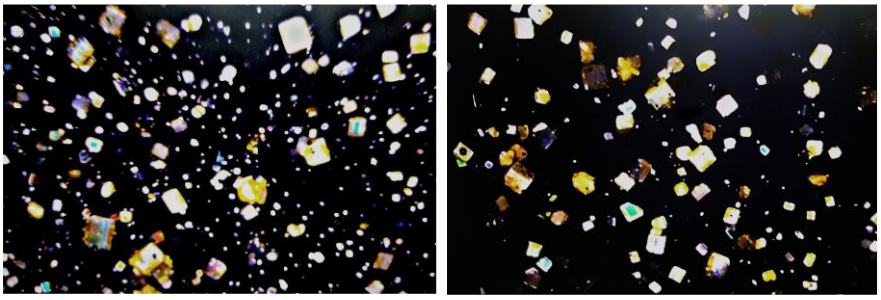

Figure 3. B product crystals produced from the same magma in the same pan with traditional control system (left) and SeedMaster (right).

The MA and CV measurements also showed a significant difference:

	MA	CV
Target	350-400	<40
Traditional Control	272.8	51.4
SeedMaster Control	353.4	42.6

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