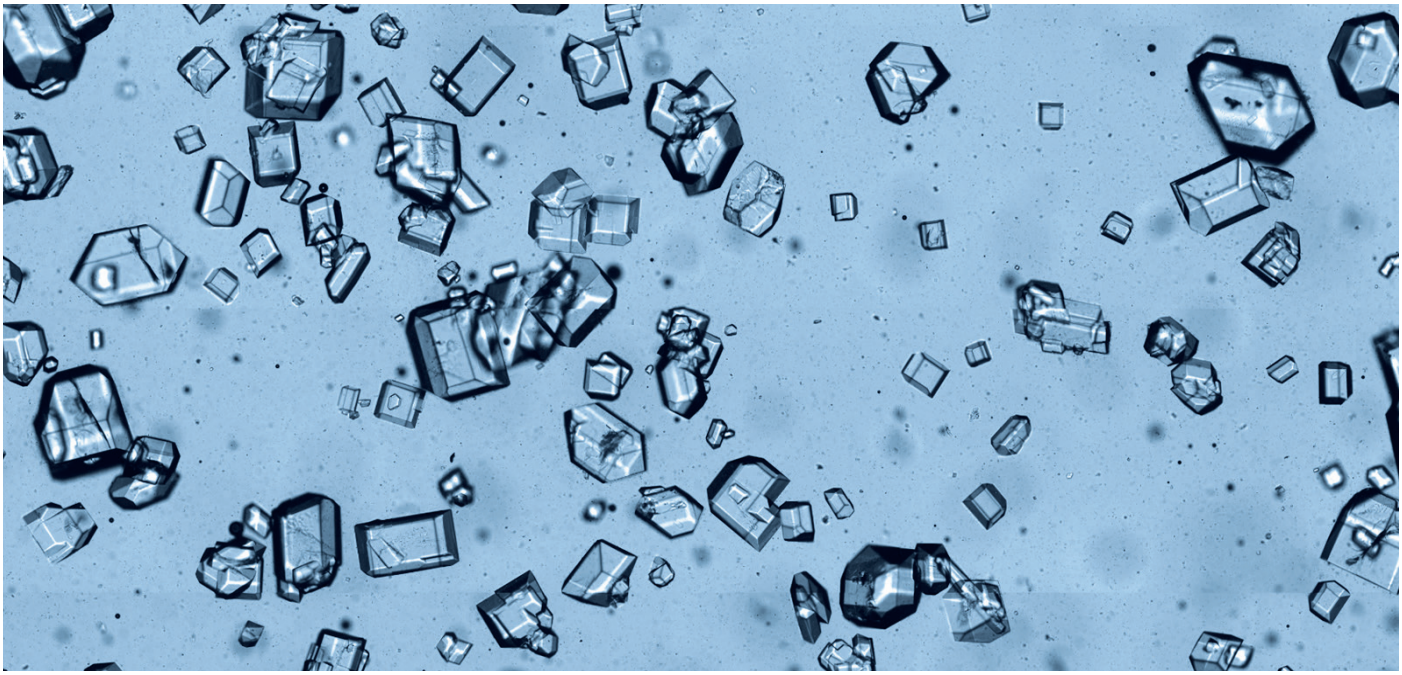
SeedMaster-4

SUPERSATURATION BASED CRYSTALLIZATION CONTROL



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Why crystal quality issues must be fixed



A poor crystal size distribution leads to product quality issues and a high recirculation rate, wasting energy, time and water. It decreases the yield of crystallization, leaving excess sugar in the molasses. The issues caused by the presence of fines and conglomerates can be really painful.

Supersaturation

The cause of poor crystal quality is often excessive supersaturation. Being the driving force behind both nucleation and crystal growth, this is the most important parameter of crystallization. The definition of supersaturation is straightforward:

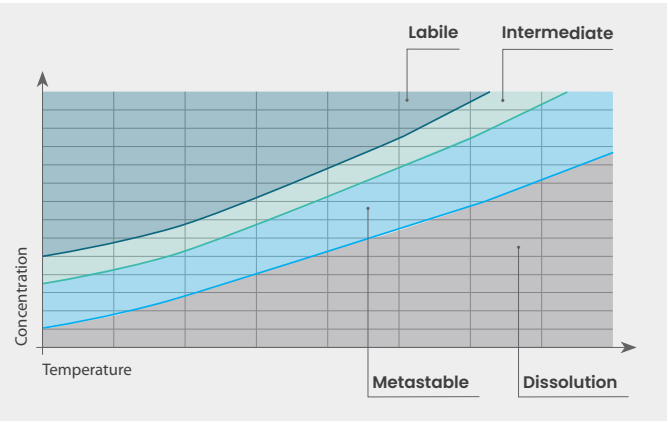
$$Supersaturation = \frac{Sugar\ dissolved}{Sugar\ needed\ for\ saturation}$$

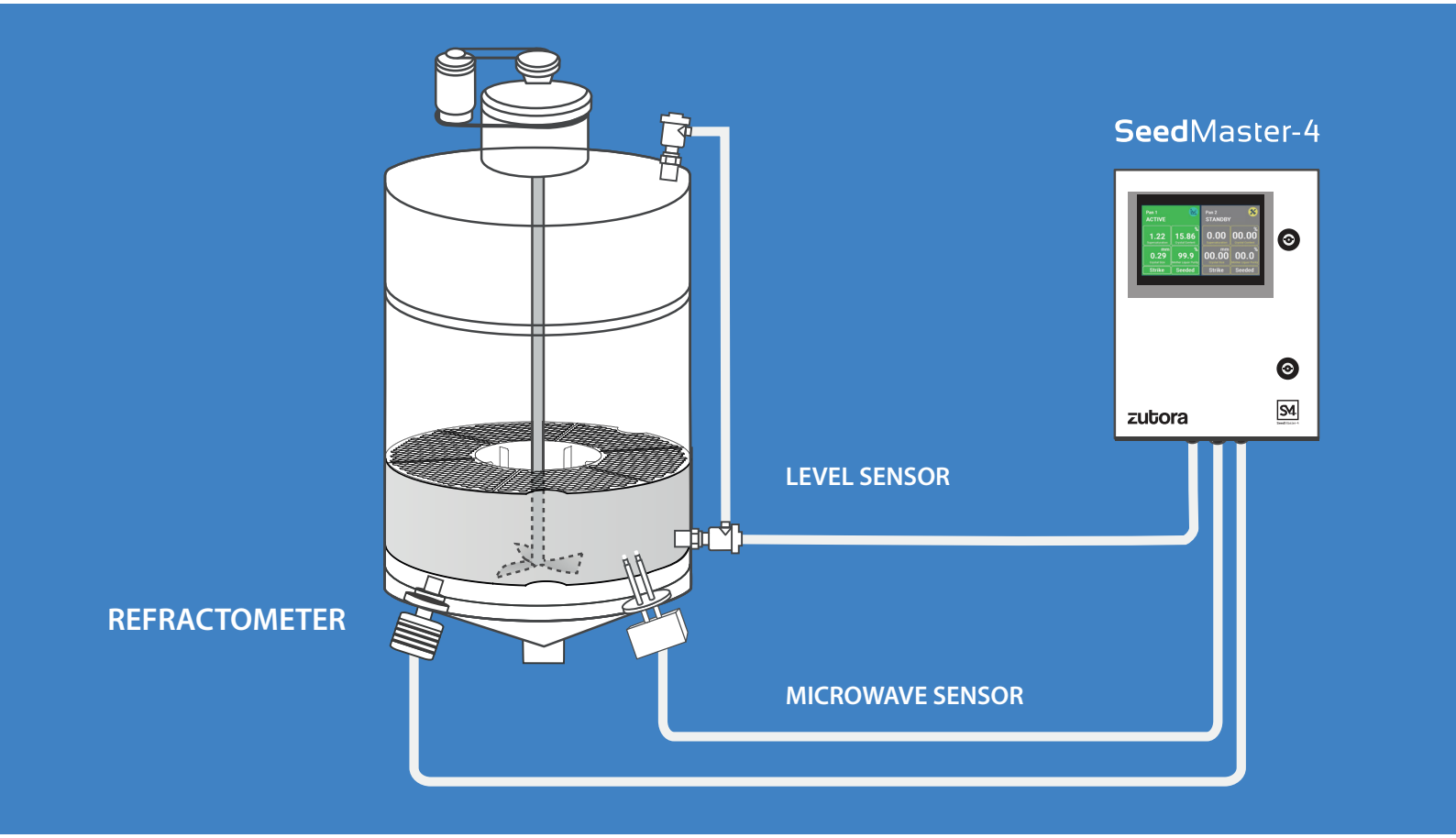
However, supersaturation is influenced by several factors, all of which must be considered in order to provide an accurate, inline signal of it.

Zones of supersaturation

If the level of mother liquor supersaturation is below 1.0, the solution is not saturated and crystals will dissolve. When the supersaturation level exceeds 1.0, the solution enters the metastable zone, which is ideal for crystallization. Within this zone, higher levels of supersaturation lead to faster crystal growth. However, if supersaturation becomes too high, it will cross into the intermediate and labile zones, where spontaneous and secondary nucleation occurs, compromising crystal quality.

To produce high-quality crystals, supersaturation must be maintained within the metastable zone throughout the entire batch process.





For all applications

SeedMaster-4 works with:

- **Cane sugar**
- **Beet sugar**
- **Lactose**
- **Dextrose**

The system can be used with both high and low purity applications, such as:

- **Refinery pans**
- **Raw sugar crystallization (A, B, or C)**
- **Molasses exhaustion, C massecuite cuts**

In high purity applications, the main benefits of the system include improved product crystal quality and yield, along with reduced energy and water usage. When used in low purity applications, such as C massecuite cuts, the key advantage is the significant reduction in final molasses purity.

Supersaturation-based control

While the basic SeedMaster models monitor supersaturation along with other key crystallization parameters, the versions with the control option implement a sophisticated, supersaturation-based crystallization control system. When used with vacuum pans, SeedMaster can control:

- **Steam,**
- **Vacuum,**
- **Syrup Feed,**
- **and Seeding**

to maintain supersaturation in the optimal range. In the case of cooling crystallizers, SeedMaster controls temperature and seeding.

Key Parameters in Real Time

Zutora SeedMaster-4 serves two batch vacuum pans or cooling crystallizers simultaneously. It provides reliable, online data on:

- **Supersaturation**
- **Crystal Size**
- **Crystal Content**
- **Mother Liquor Purity**

To provide accurate supersaturation signal, all parameters of the supersaturation function must be monitored. Feed syrup quality parameters must be provided by the operators or the factory control system. Mother liquor purity is calculated by the SeedMaster-4. The rest are collected from the accurate measuring instruments installed on the pan:

- **Mother liquor concentration,**
- **Temperature,**
- **Total solids,**
- **Level.**

Ideally, the instrumentation of the pan should include:

- **Process refractometer,**
- **Microwave probe,**
- **Level sensor.**

Harvest high-quality crystals

Consistency in crystal size is a key quality parameter that can affect the overall quality rating of the sugar product. Product crystals should match the desired target size with a very narrow distribution (low CV). Supersaturation-based control enables this to be achieved, consistently in every batch.

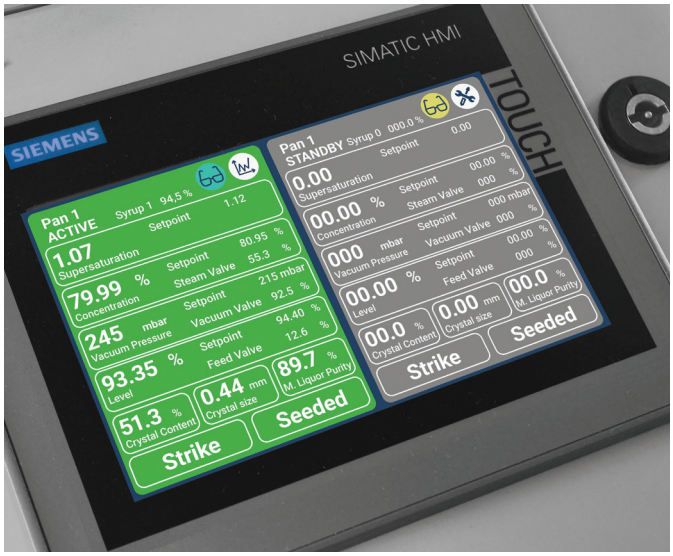
Reduce water consumption

There is no need to use water to dissolve fines during the crystallization process. If supersaturation is maintained in the metastable zone, no fines will form to dissolve.

The overall crystal surface area is significantly smaller in a batch where crystals are uniform compared to a batch containing many fines. In batch centrifuges, where crystals are washed to remove residual syrup from the surface, this results in reduced water demand.

Enhance molasses exhaustion

If a batch contains many fines, these will escape through the openings of the centrifuges along with the run-off syrup. These fines end up in the final molasses and increase its purity and thus also the losses of the factory. With supersaturation-based control the purity of the final molasses can be reduced significantly.

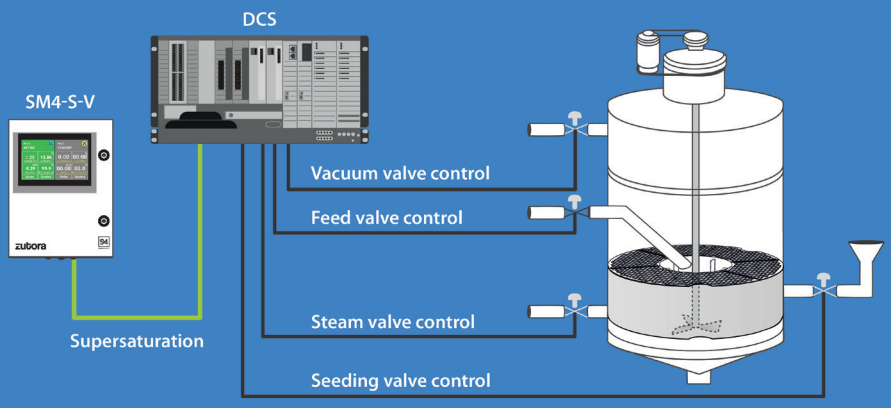


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SUPERSATURATION-BASED BATCH PAN CONTROL WITH SEEDMASTER-4

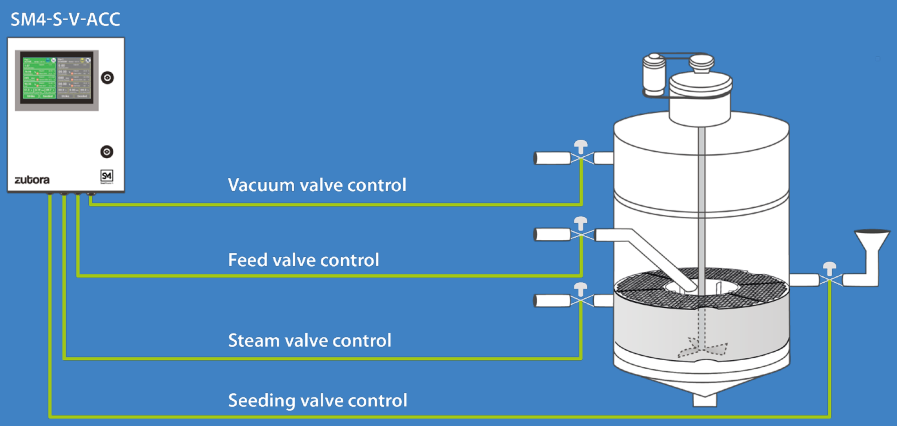
SM4-S-V – SUPERSATURATION SETPOINT SIGNAL

SM4-S-V monitors supersaturation throughout the whole batch. Based on this signal, a control of the steam, vacuum, feed syrup and seeding valves can be implemented on the factory DCS.



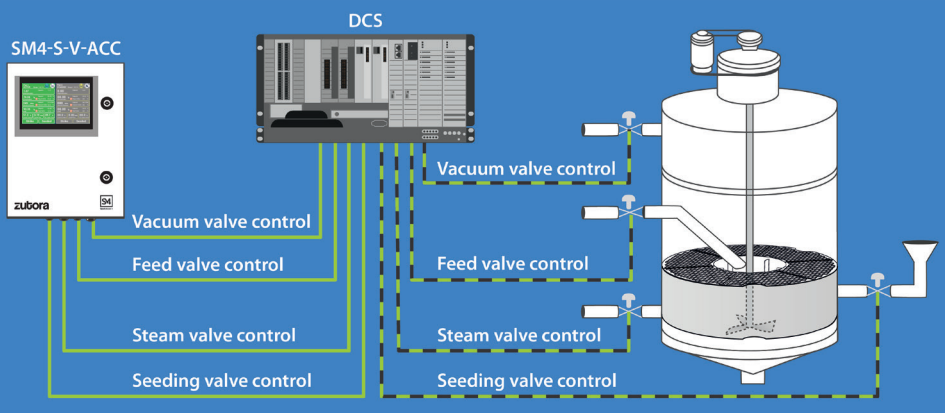
SM4-S-V-ACC – DIRECT BATCH PAN CONTROL

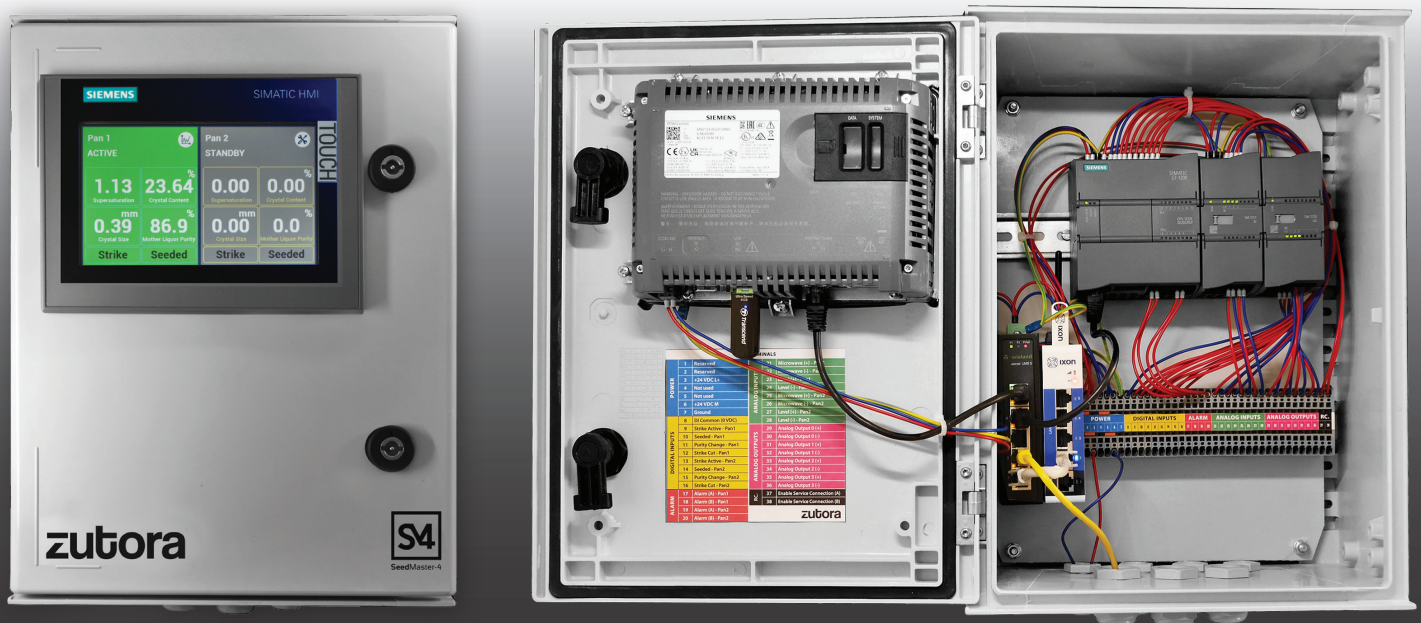
SM4-S-V-ACC implements an advanced, supersaturation-based crystallization control. It can control the valves of steam, vacuum, feed syrup and seeding in order to maintain supersaturation in the optimal range, thus ensuring superior crystal quality.



SM4-S-V-ACC – INDIRECT BATCH PAN CONTROL

It is also possible to connect the valve-controlling outputs of SM4-S-V-ACC to the factory DCS. The control system can decide whether to forward these commands to the valves – thus giving the control to the SeedMaster, or to take the control in case of unexpected scenarios.





Models

Models for beet and cane sugar	
SM4-S-V	For batch vacuum crystallizers
SM4-S-V-ACC	For batch vacuum crystallizers, includes the advanced control for crystallization
SM4-S-C	For batch cooling crystallizers
SM4-S-C-ACC	For batch cooling crystallizers, includes the advanced control for crystallization

WE OFFER ALL COMPONENTS

Get a complete package from Zutora, including the process refractometer and microwave probe. We deliver high-quality instruments from European manufacturers.

Instruments	Description
Process refractometer VAISALA 	The Vaisala Polaris PR53GP Process Refractometer is a heavy-duty instrument with non-weld body construction for diverse applications. It features the Vertical Image Detection algorithm, specially designed for operation in crystallizers. A built-in wash nozzle helps keep the prism clean.
Microwave sensor HARRER KASSEN 	Designed exclusively for sugar industry applications, the German Harrer & Kassen HK6 microwave sensor is the optimal solution for total solids measurement in vacuum pans. It features cleaning tubes that help keep the antennas clean.