

Batching for Food & Beverage Processors: Liquefying Granulated Sweeteners

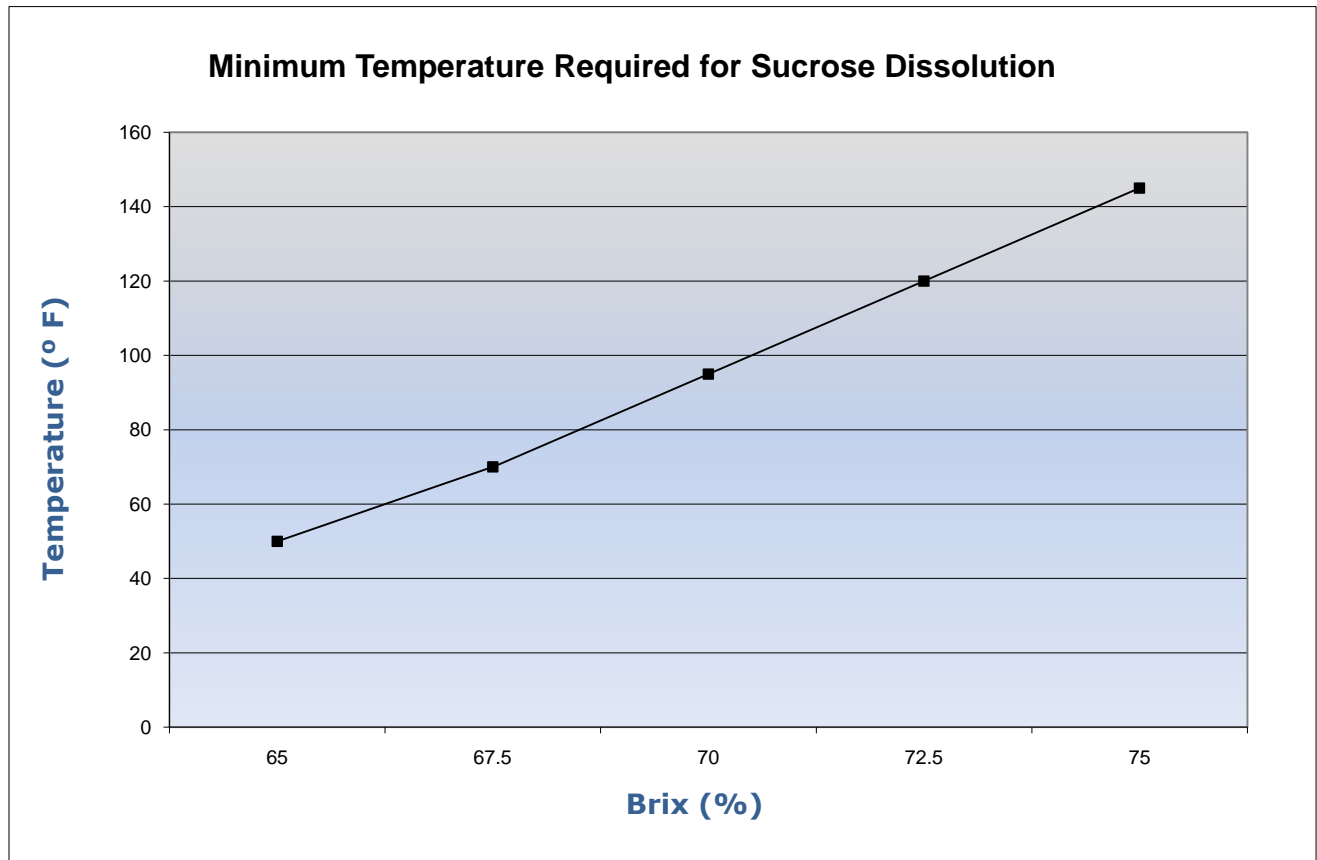
Many technical papers focus on sweeteners from the food science perspective, but this paper revolves around opportunities for food and beverage processors to cut costs by efficiently utilizing granulated sweeteners (pure sucrose, fructose, or dextrose) instead of procuring these sweeteners in liquid form.

Temperature and time are the two major factors to consider when batching or liquefying granulated sweeteners.

Temperature

First, consider that as the percent solids of sweetener in water increases, the minimum temperature must also increase to completely dissolve the sweetener. Figure 1 shows that in order to completely dissolve 67.5 Brix sucrose, a minimum water temperature of 70°F is required. For 65 Brix, a minimum water temperature of 47°F is required. These are also the minimum temperatures required to maintain the sweetener in solution.

Figure 1



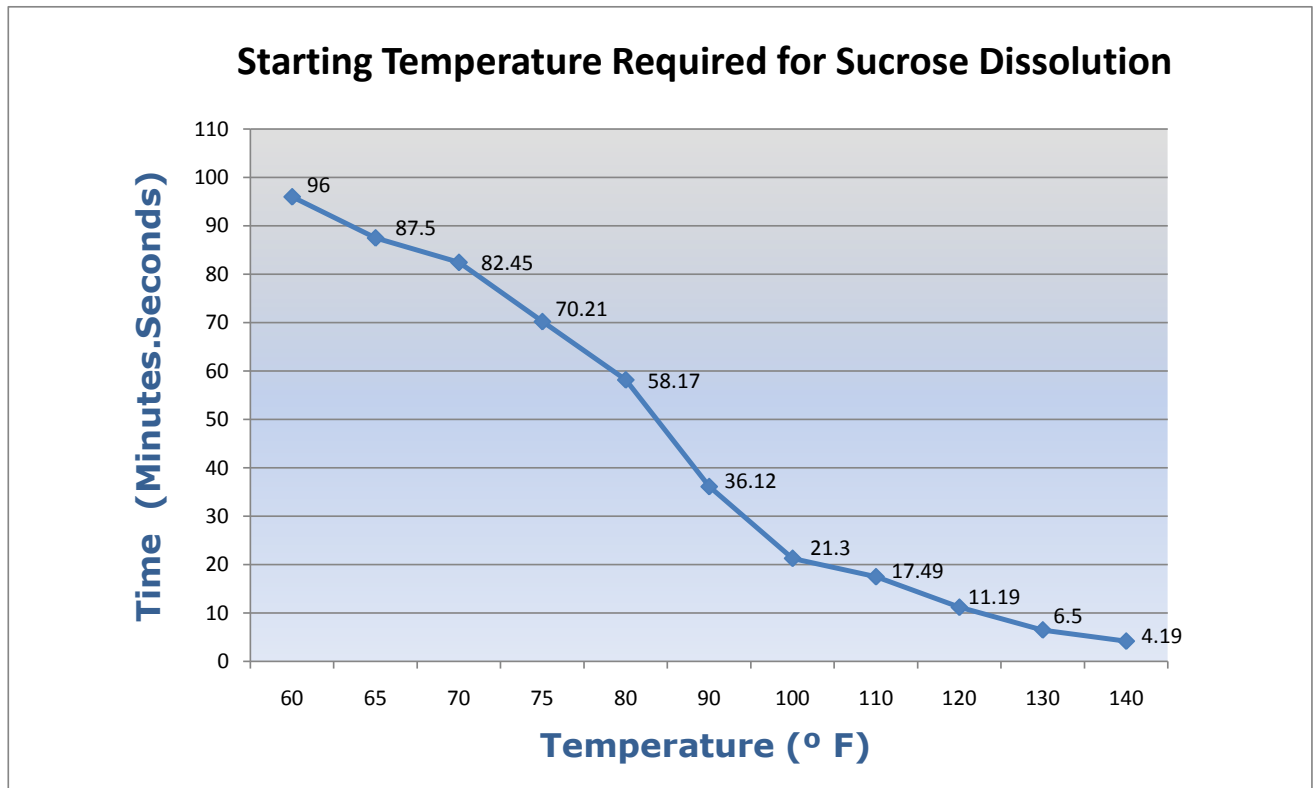
Time

Once the desired Brix level is selected, a system must be designed to allow time for the sweetener to completely dissolve after it has been added to the liquid. Figure 2 demonstrates the time it takes for 67.5 Brix granulated sucrose to completely dissolve, and this required time cannot be reduced with



higher shear levels. To achieve these levels, the crystals must be completely deagglomerated (lump-free) and a rapid particle velocity must be maintained through the liquid until it completely dissolves. Crystals that remain on the bottom of the vessel can remain for hours and may never dissolve.

Figure 2



Once temperature and time factors are analyzed, Admix designs a system that introduces the granular sweetener into the solution efficiently and effectively. The sophistication of this system is dependent on the volumes to be produced and the customization of the system.

How Admix Can Help

Without diving into specific designs, we will briefly review some in-tank and inline options.

In-tank batch systems

These systems require manually dumping bags into a vessel equipped with the correct mixer. Factors to keep in mind include:

- The vessel must be at least as tall as it is wide (short or squat vessels are unacceptable) and the process starts with a fairly low water level. For example, 67.5 Brix sucrose weighs approximately 11.23 pounds per gallon, of which around 3.63 pounds is water and 7.6 pounds is granulated sucrose. Thus, if making a 500-gallon batch of 67.5 Brix, you would only be starting with 218 gallons of water and adding 3,790 pounds of granulated sucrose. Mixing impellers need to be submerged (no cavitation) right from the start of sugar addition.



- The agitator must have high flow and moderate shear. High flow is required to maintain the high bulk fluid velocity needed to eliminate settling and sustain reasonable dissolving rates. A minimum bulk fluid velocity of 12-14 FPS is adequate.
- If sweeteners are exposed to high moisture levels, they will form lumps (agglomerates). Without adequate shear, dissolution times will drastically increase. A minimum impeller tip speed of 35 FPS is suggested to ensure rapid deagglomeration.
- The tank or vessel should have a flush bottom outlet as granulated sucrose will collect in a standard outlet and starve transfer pumps.
- As you consider temperature, make sure that your system will maintain the minimum temperature required for the Brix level and desired batch time you are trying to achieve. This will become critical during the cooler seasons of the year when both water and granulated sweetener can be colder. Cold granulated sweetener could drastically drop your water temperature below the minimum required temperature.

Recommended upgrades to this batch system

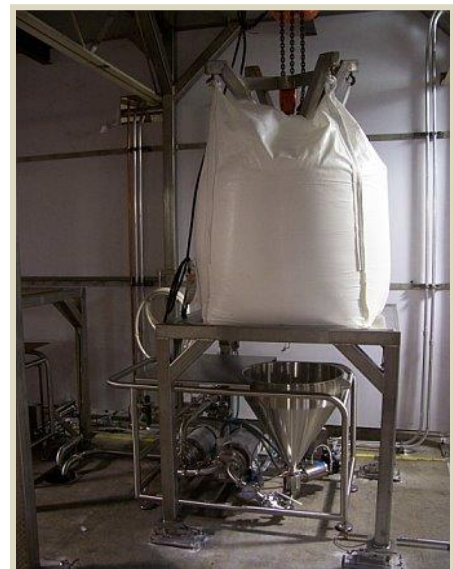
- Mechanical powder feed from bulk bag or from bulk silo directly into the tank
- Tank jacket or inline heat exchanger to achieve & maintain desired temperature

Inline induction systems

Technology has been developed that allows dependable introduction of granular sweeteners directly into a liquid flow stream. In a single pass, these systems are capable of creating 44 Brix. On a recirculation loop, slurries up to 80 Brix are achievable.

Advantages of inline systems include:

- Rapid rates up to 450 pounds per minute of incorporation of granular sweeteners
- Easy system automation
- Instant feedback is available for control and QA with an incorporated inline Brix meter on the re-circulation loop
- Heat exchangers can easily be installed into these loops
- Sweetener addition can start earlier in the cycle as no “minimum liquid depth” of fluid is required before dry material addition can begin
- Improved ergonomics by eliminating the need to add bags from elevated decks
- Easily adapts to bulk bag or silo source



Bulk bag unloader on load cells discharging into Fastfeed hopper

Purchase Justification and ROI

There are several factors to consider when comparing granulated versus liquid sweeteners:

Difference in ingredient costs (comparative example)

- Processor 'Food & Bev Ltd' uses six tankers per week that hold 4,900 gallons of **67 Brix liquid sucrose**. If cost is \$3.15 per gallon delivered, total cost is **\$15,435 per tank**
- There are 17,949 pounds of water and **36,441 pounds of sucrose** in 4,900 gallons of 67 Brix liquid sucrose
- This customer's price for granulated sucrose in 50-pound bags is \$0.38 per pound delivered (purchasing in bulk bags instead of 50-pound bags will result in greater savings). Therefore 36,441 pounds of sucrose costs **\$13,848** **Potential ingredient savings** = \$1,587 per tanker (\$15,435 minus \$13,848) multiplied by 6 tankers per week multiplied by 50 weeks per year = **\$476,100**



Reduction in transportation costs

The Food & Bev Ltd example considers a delivered price. Typically, transportation costs would be broken out as there may be additional savings based on proximity to the sucrose source, and also whether a facility has a rail siding (granulated can be delivered by lower cost rail; liquid sucrose generally is not).

Reduction of large capacity areas – heated bulk and reserve storage

Depending on Brix level and the type of sweetener used, a minimum temperature must be used to make and store liquid sweetener. When liquid sweetener is purchased in bulk, plants typically have large capacity storage areas consisting of tanks in a "hot room" or that have hot water jackets. All this storage can be eliminated by liquefying granular sugar in a surge/storage tank that typically holds a half-day production requirement. Significant savings comes from heating and cleaning costs, and the elimination of vessels, pumps, piping, and required floor space.



Micro issues

Small batches may reduce insect activity (airborne and crawling) around large silo storage areas. Microbiological activity may be reduced in small batching processes. Ultraviolet, over-tank sterilization apparatus may not be needed where fresh batches of liquid sucrose are constantly available.

Flavor profile

A cleaner flavor profile is likely with on-demand or "fresh" batching operations.

Better temperature control

Small batching capability may allow for more accurate temperature tolerance control that could help processing parameters downstream. Tanker delivery temperatures are not always on the money.

Control over production schedule

Scheduling tankers for delivery is difficult as lead times are often up to two weeks. Estimating when reserve capacity will be available for deliveries is another challenging variable. By making liquid sweetener in-house, you are in better control your production schedule and ingredient reserves.



Admix Solutions

Admix has assisted processors in the beverage, dairy, confection, and prepared food industries in designing and operating efficient granulated sweetener systems that deliver controlled feed rates up to 450 pounds per minute. Our staff understands process pain points associated with sweeteners and our innovative portfolio can save you time and money.



The [Rotosolver in-tank high shear disperser](#) is 3-A compliant and ideal for batch creation offering several advantages over conventional mixers including:

- 30-50% less energy consumption
- Tip speeds 10-20% higher
- 200-600% higher flow rates
- Batch speeds up to 6 times faster

For a low-shear option, the [RotoMAXX II low-speed batch agitator](#) is perfect for hold tanks and also delivers a sanitary 3-A compliant design.



The [Fastfeed inline powder induction and dispersion system](#) not only provides robust powder induction with moderate to very high shear rates, but has operator-friendly features for improved safety and ergonomics.

Like the Fastfeed, the [Optifeed inline powder induction system](#) can also handle wide viscosity and density swings.

Admix offers several options to test your new ingredients, recipes, and formulas. Having tested thousands of ingredients and processes, our applications experts conduct customer testing in our fully-equipped pilot lab almost daily. Schedule today at www.admix.com/lab.

Want to test our mixers at your plant instead? Our robust pool of trial equipment is available to run unlimited test batches of your own product at your own facility for 14 days. The program offers an aggressive Try & Buy incentive, which allows you to apply prorated trial fee credits to final unit prices. Learn more at www.admix.com/trials.



Alternatively, fill out a [brief form](#) and we'll contact you to review your application and provide free customized product quote.

