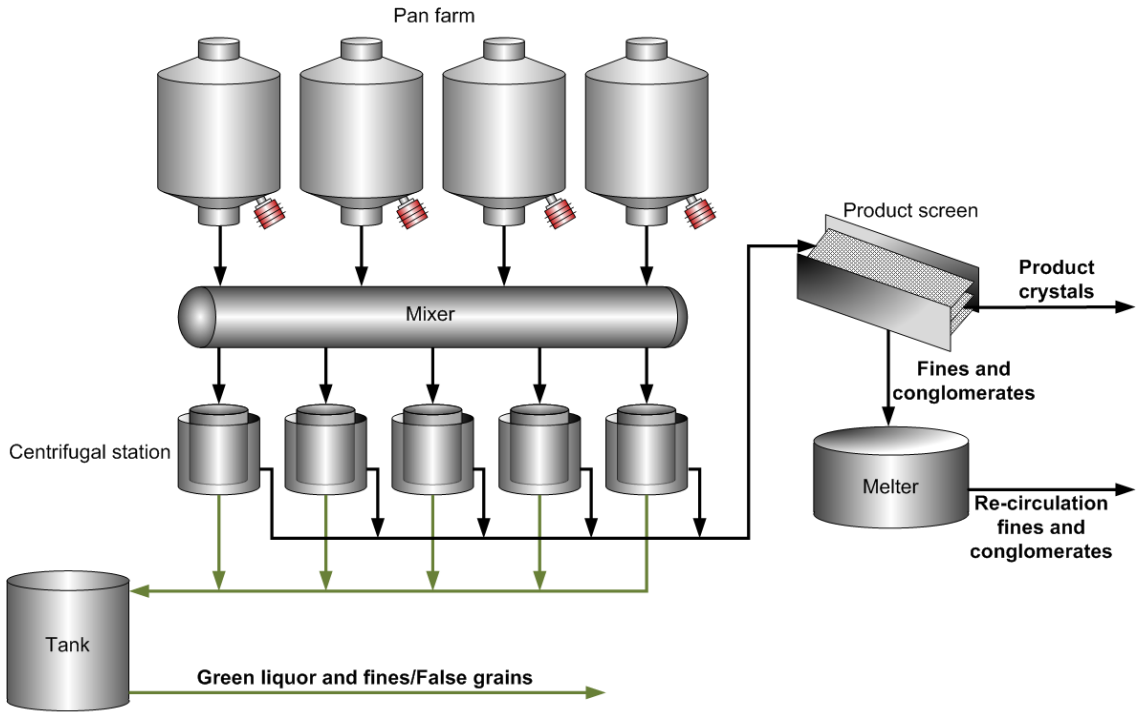
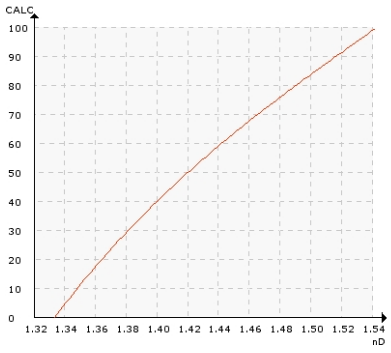


BEET SUGAR

Typical end products

Beer brewing, beverages, betaine, uridine, alternative fuel (biobutanol), pastries, preserves, sausages, sweets, confectionery, ice-cream, liqueurs, etc.

Chemical curve: R.I. per BRIX at Ref. Temp. of 20˚C



Introduction

The crystallization process takes place in vacuum pans, which boil the thick juice. When the juice reaches the correct concentration, it is “seeded” with sugar crystals, which provide the nucleus for larger crystals to grow. When the crystals reach the required size, the process is stopped and the resultant mixture of crystal sugar and syrup – known as massecuite – is spun in centrifuges to separate the sugar from the mother liquor. The sugar crystals are washed and, after drying and cooling, are conveyed to storage silos.

Application

Crystallization has a major effect on product quality and production costs. Supersaturation is the driving force of crystallization and crystal growth, and the speed of crystallization depends on this parameter. Excessive superaturation results in poor crystal quality (fines and conglomerates). These crystals are melted, concentrated, re-circulated and crystallized again, which leads to a waste of time and energy, decreased yield of sugar per strike, increased water usage and increased production costs.

Therefore, the K-Patents Process Refractometers are commonplace in automatic control of sugar crystallization nowadays. No matter what seeding practice is used (in batch crystallization either shock seeding or full seeding), the K-Patents Process Refractometer can be used to monitor supersaturation over complete strike of crystallization.

Control of Crystallization

Supersaturation is a multivariable function of several parameters of the liquid phase only (syrup or mother liquor). Crystals can grow only if supersaturation is

larger than 1.0. Supersaturation is the property of the solution, which in case of a solids-liquid mixture, is like the massecuite. It depends solely on the parameters of the liquid phase (mother liquor). This means that the required liquid parameters have to be measured selectively and any contribution from the varying crystal contents should be disclosed. The K-Patents Process Refractometer only measures the liquid concentration. This is due to the Refractive Index measurement principle, which is not influenced by undissolved crystals.

Instrumentation and Installation

The K-Patents Process Refractometer PR-23-GP sensor is installed in the crystallizer through a flange or clamp connection.

Despite the use of stirrers in crystallizer, circulation of the massecuite becomes sluggish when the crystal content increases. This means that syrup/mother liquor concentration and temperature, which have large influence on supersaturation, will not be the same in the full massecuite volume.

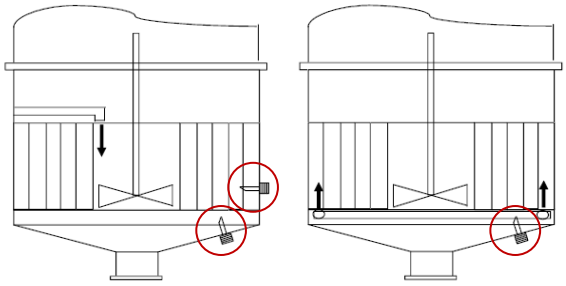


Fig. 1 Recommended sensor locations.

The following should be taken into account when selecting the K-Patents sensor location:

1. Install sensor in location, where the measured sample is representative for the largest volume of the syrup or massecuite. Avoid closeness to the feed syrup entry and above the calandria (see Fig. 1). Too short a distance from the entry point may result in poor data. A possible fast drop of measured concentration after opening the feed valve should be considered.

2. Supersaturation increases with decreasing temperature if syrup/mother liquor concentration is kept constant. Therefore, the highest supersaturation is where the temperature is at its lowest. It is at its lowest on the surface of the massecuite, while it is at its highest just above the calandria. However, the rising surface cannot be followed with the sensor. In practice, the temperature in the pan bottom is fairly close to the surface temperature, and feed syrup often enters the downtake just above the calandria or at the lower end of the downtake.

These are not ideal designs because of the increasing difference between the density of the massecuite and that of the feed syrup. This is due to the increasing crystal content, where the syrup entering the pan reverses direction and flows upwards in the downtake, working against the much needed circulation of the massecuite.

A better solution would be for the syrup to enter the pan under the calandria through a circular ring pipe. The feed should be distributed and directed upwards at several locations around the pan wall. This solution improves massecuite circulation and provides a good location for K-Patents refractometer sensor under the feed pipe.

Instrumentation	Description
	K-Patents Process Refractometer PR-23-GP is an industrial refractometer for crystallizers and cookers. Installation through a flange or clamp connection.
Measurement range:	Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 Brix.