

CARLSON, JEFFREY L.* , BRENT MUEHLBERG and UPASIRI SAMARAWEERA, Minn-Dak Farmers Cooperative, 7525 Red River Road, Wahpeton, ND 58075. **Experiences with Processing Sugarbeets Frozen for Long Term Storage.**

ABSTRACT

In the Red River valley, sugarbeet processors deep-freeze beets to arrest respiration and deterioration. This allows them to process beets harvested in fall as late as May or June the following year. To freeze the beets, processors use the extremely cold winter air passing through the beet piles either by forced ventilation or natural convection. Some of the storage piles are outside and some in sheds. For extra-long storage, processors cover the piles with plastic tarps to protect the beets from the elements. As long as the beets remain frozen, their sugar content and quality remain constant.

There are many operational differences in sugarbeet processing between frozen and non-frozen sugarbeets. These include differences in energy consumption, washing, slicing, diffusion, and pulp pressing and drying.

Keeping the flume heated, thawing frozen sugarbeets and lower heat transfer efficiency in the cossette mixer are the major culprits for greater energy use. Once the frozen cossettes thaw, they are mushy and tend to plug the cossette mixer screens. For this reason it is not possible to pack the cossette mixer as tight, resulting in lower heat transfer efficiency. In addition, the frequent slice interruptions experienced when processing frozen sugarbeets, cause the packing of the cossettes in the mixer to loosen up and the heat from the tower is lost to the diffusion juice.

Difficulties experienced in the washhouse when processing frozen sugarbeets include frequent freezing of the flume, frozen chunks of beets, beet-tissue losses, and excess sugar leaching into the flume water. The frozen sugarbeets can be as cold as 5°F (-15°C). To prevent freezing of the flume system, the flume water must be heated up to 50°F (10°C) and always kept moving. Chunks of frozen sugarbeets, not thoroughly broken up during truck loading, can plug the flume, and rock catchers causing slice stoppages.

Freezing and thawing sugarbeets changes the nature of the tissue. It is not resistant to abrasion and will readily slough off if force is applied to it. Up to 8 percent of a sugarbeet can be lost in this manner. In addition, the thawed tissue has lost its integrity allowing cell contents to seep out. The seeping operates both ways and the flume water seeps back into the beet tissue. Measurements of lactic acid in the flume water and in the beet tissue before and after the flume have determined that this beet juice-flume water exchange can get higher than 10 percent of the juice in the sugarbeets.

The high rate of exchange between the flume water and the juice in thawed beet tissue requires exceptional microbiological control in the flume. Minn-Dak accomplishes this through the addition of 8-20 tons per day of calcium oxide, which keeps the pH between 11 and 12. Minn-Dak also maximizes the flume/wash water recycle within the washhouse. This combination allows the flume/wash water to reach a sugar concentration greater than 8 percent. However, the high sugar concentration and lime creates excess foam, which Minn-Dak controls through a variety of chemical and mechanical methods.

The slicing station is more problematic when processing frozen beets than when processing non-frozen beets. Washed, frozen sugarbeets will freeze together in the beet bunker above the slicers, which interrupts slice and is difficult to break loose. As the frozen beets tend to break into small pieces when sliced, the knives must be sharpened more often. Frozen chunks of beets that come through the washhouse often carry stones past the rock catchers and to the slicers. Another difficulty is that the force it takes to slice the frozen beets is enough to force open the rock doors on the slicers when the beets push against them. To prevent this the pressure on the rock doors is set to the maximum allowed. Under this condition, when a rock reaches the slicing station, the door will often not open, ruining an entire knife set.

Cossettes from frozen beets are mushy and small. They have a tendency to plug the screens in the cossette mixer and tower. To combat this cossettes are sliced thick and even into slabs. Minn-Dak employees found that grinding the knives to 90° and sharpening the edge further back improves the knife performance. The pressed pulp is not uniform in size. It contains pieces of broken cossettes and some slabs. This creates difficulty in drying the pulp evenly.

Further improvements to slicing frozen beets under experimentation or consideration include a mechanical chunk breaker for frozen chunks of beets, reclaiming all the lost beet tissue, improved heating of the flume and mechanical devices for breaking up the beets in the slicer bunker when the beets freeze in it.