

## BEET STORAGE FORUM

R. E. Watkins – Leader

### PRESENTATIONS:

#### **R. E. WATKINS – AMERICAN CRYSTAL SUGAR COMPANY**

Over the past two years American Crystal has expanded their precooling and deep freezing capabilities by nearly 1 million tons. The latest design consists of "modules" which are large tank-like structures that house a single fan to provide air to five or six ducts which run under the sugarbeet piles. One design consists of a 25 hp 61,000 cfm fan that provides air to five ducts on 12 foot centers resulting in 20 cfm of air per ton of beets in the pile. A modified design uses a 30 hp 76,500 cfm fan to provide air to six ducts on 10-foot centers resulting in 25 cfm of air per ton of beets.

The ducts are 30 inch diameter galvanized corrugated pipe with 3.75 inch holes punched on 1 foot centers at the 4:30 and 7:30 positions. This allows air to move away from the pipes before it migrates upward through the pile and also minimizes beets covering the air distribution holes. The ducts are connected to the plenums and placed across the 226 foot wide piling site. There is a 10 foot gap in the center of the pile between the ducts, and no end caps are used. The first 25-foot duct does not have air distribution holes.

Several years ago American Crystal conducted a study to determine pile roughness which is the increase in surface area due to undulations on top of the piles. The undulations are caused when the piler is moved and become more pronounced as the distance the piler moves is increased. Pile roughness ranged from approximately 4.0% to 9.3% with an average of 7.0%. If the pile tops could be leveled, there would be a 7% decrease in surface area which would reduce the amount of "rim beets" on the pile. Several different pieces of equipment were tried over the past several years with varying degrees of success. The last two years all of American Crystal's piles including the storage sheds have been leveled using a Bombardier trail groomer with a 14 foot front blade. This unit does an excellent job leveling the tops of the piles in one or two passes with minimal beet damage. The trail groomer is also used to slope the ends of the piles which are covered with a tarp after the piles are frozen along with carrying the tarps to the top of the piles for deployment.

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#### **DEL TRAVELLER – AMALGAMATED SUGAR COMPANY**

In the Idaho area there is not enough cold weather in the winter to freeze the beets for long term storage so a different approach must be taken. That approach involves keeping the beets cool at a nearly constant temperature without freezing. Amalgamated has both controlled outside and building storage facilities. The outside facilities consist of an angle iron frame which is covered with a plastic

material and a 48 inch 15 hp 25,000 cfm fan installed on the side. The opposite side is pushed up to the 38 inch corrugated steel ducts that were placed under the pile during the piling operation. Holes are then cut in the plastic for the ducts and attached with duct tape and a band. This system is designed to provide about 25 cfm of air flow per ton of beets in the pile.

After the beets in the pile are cooled to 35-40°F, a cover is placed over the pile. The covers are 54 inches wide with a rope incorporated into the edges so they can be easily tied together. Eighteen inch diameter half-moon flaps are then cut into the cover every 3 feet. The half-moon flaps open when the fans are operating to let the air escape and then close when the fans stop so freezing air cannot enter the pile. The system appeared to work well this year with no freezing on the top of the pile and minimal freezing along the sides.

The two new buildings constructed at Paul, Idaho, are 850 feet long, 204 feet wide, and will each hold about 80,000 tons of beets. This system is able to maintain the beet temperature between 37 and 40°F. One building has a humidification system to decrease dehydration of the beets in storage and also decreased air temperature by 5 to 6° to aid in cooling. The air ducts under the floor are square concrete with 2 inch wide, 11 inch long holes on the top every 15 inches apart. This allows for an even air flow through the beets. Eleven fans on each side of the building force the air through the under floor duct work. Exhaust vents on the ends of the buildings allow air to escape, and there are provisions to recycle air from above the beets back to the fans to be mixed with outside area. This allows the system to operate when outside temperatures are below the desired storage temperatures.

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#### **KEN DAHL – SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE**

Southern Minnesota has one pile that is ventilated with forced air, and the beets are frozen as soon as weather permits. The main strategy for long term storage is to maintain a pile height of 18 feet to quickly dissipate heat from the pile. If there is a large crop, pile heights are raised to 19 or 20 feet. The 220 foot wide piles are split as quickly as possible by removing a 50 foot wide section from the center of the pile which amounts to about half of the beets. All piles are leveled using a trail groomer to help even out the air flows from the pile which seems to help pile cooling. A few sites have narrow piles on which one side of the pile is removed. It has been found that the beets store better if the downwind side of the pile is removed.

When the middle of November arrives, about 8 inches of straw is blown on the sides of the piles. The straw appears to reduce the depth of the rim beets by about half with the straw covered areas having 1-1½ feet of rim beets and the uncovered areas having 2-3 feet. The straw is raked off before the beets are hauled to the factory for processing.

Pile direction appears to have an effect on storageability. North-south piles seem to store better than east-west piles, probably due to the sun hitting the long south side of an east-west pile. It is also better to have the piler moving towards the north when the beets are being piled. If piling is stopped, the north end beets do not warm up and dehydrate as rapidly as the south end beets do.

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### **QUESTIONS and ANSWERS:**

Q: Does the factory have any problems with fresh beets?

A: *K. Dahl* – The factory prefers aged beets. In prepile from September 1 to October 5 the beets are usually harvested about three days ahead. If temperatures are very warm, there will be less beets harvested ahead. It appears that if the beets are three days old, the factory does not have problems.

Q: What do you do with the straw removed from the piles?

A: *K. Dahl* – When the straw is removed, it usually comes off as a straw-beet-snow mix. This is land applied, and it takes 10-15 acres per piling site to spread the mixture.

Q: How many years can the tarps that cover the piles be used?

A: *R. Watkins* – The tarps are only used one year and are discarded. Growers pick them up to cover hay and straw piles. We tried to save a tarp a couple of years ago and spent more on labor to remove the ice and snow than the cost of a new tarp.

A: *D. Traveller* – The tarps Amalgamated uses can be used more than one year if they are carefully removed.

Q: What is the cost of the tarp material?

A: *R. Watkins* – It runs about 10 cents per square foot.

*D. Traveller* – It cost about 12 cents per square foot, but it has the rope incorporated into the edge by the manufacturer.

Q: What is the value of pile leveling?

A: *R. Watkins* – The work we did indicated that on the average there was about a 7% increase in the pile surface due to the roughness. If the rim beets were 12 inches thick, this would amount to about \$600,000 for American Crystal. This does not take into account any advantages of more uniform cooling and reduction in vent areas where the beets deteriorate.

Q: How do you remove the ducts from the frozen pile when the beets are loaded?

A: *R. Watkins* – A backhoe is used that has a claw with three fingers. This is used to tear the frozen beets down the face of the pile. The beets are removed from above the duct by the loader so the backhoe operator can reach around to the back side of the duct and roll it out on top of the claw. There is some damage depending upon the operator which can range from 2-3% that need some repair up to about 10%.

Q: What is the effect of diseases on sugarbeet storageability?

A: *R. Watkins* – The work that Dr. Roger Wyse conducted in the 70's indicated that any time a beet was under stress the respiration rate (sugar loss) was increased. Also beets with lower sugar had higher respiration rates. With Cercospora we are really getting hit twice with the beets being under stress due to the disease and also they usually have a lower sugar content.

Q: Why do you deep freeze the beets?

A: *R. Watkins* – Sugarbeets usually store fairly well until about January 15. After that internal organisms within the beet appear to become active, and internal rots develop along with increased enzymatic activity which increases sugar losses. If the beets are frozen in mid-December and held at 8-10°F or below, all sugar losses are stopped and there are no additional losses during the storage period. This allows us to lengthen the processing season to over 250 days. In Amalgamated's case there is not enough natural cold air to freeze the beets so other alternatives must be considered. They keep the beets inside storage facilities at a rather constant 37-40°F to minimize respiration losses.

Q: Can you pile beets that are at a higher temperature than normal if ventilation is available?

A: *R. Watkins* – During this past harvest we allowed growers to continue harvesting when beets were above 55°F but below 65°F if the beets could be piled over culverts or in buildings where ventilation was immediately available. This system worked well with no problems with storage. We also had some extra culverts that we put under some piles that did not have fans for ventilation. It appeared that the culverts alone allowed the pile to cool rather quickly when compared to a normal pile. Plans are to study this aspect more over the next couple of years.

An experiment was conducted to determine the feasibility of placing culverts under the pile only during periods of warm temperatures. A chevron design for placing the culverts under the pile was used rather than a straight design so the culverts would follow the arc of the piler boom. The beets are still in storage, but there were no early storage problems with this system.

Q: Does the size of the roots affect storageability or storage losses?

A: *R. Watkins* – The roots must be sufficient size so they don't pack together and restrict air flows. Peter Regitnig did research work relating plant population to root size and found that as population increased the size of the roots decreased which could present storage problems when the roots are small. If there are cases where large, medium, and small roots are mixing at a piling site, the spaces between the roots seem to fill in and severely restrict air flows and cooling. It seems that at sites where growers generally have higher population, the roots do not store as well. There were a couple of papers presented on growing beets at very high plant populations. I think the storage aspect of this practice should be studied before recommending high populations to growers.

Q: What is the effect of second tares on the storageability?

A: *R. Watkins* – Second tare is the dirt, etc. that goes into the pile. In general this material is concentrated in the shoulders of the pile and severely reduces air flow and cooling. Usually if hot spots develop, they are in the shoulders. Even with ventilation there are problems in cooling this area of the pile because the air either escapes from the side or the top. The last place that cools is the shoulders of the pile.

Q: Does everyone use infrared flyovers to monitor sugarbeet piles?

A: *P. Pfenniger* – This tool is used exclusively so there are no temperature probes or walking of piles unless something shows up on the infrared scan. Monitor Sugar levels the piles and strips the sides rather than splitting by

removing the center of the pile. Piles are piled toe to toe so the toes and sides of two piles are removed at the same time. This system removes the areas of high dirt accumulation first. Monitor also removes the end where the pile starts first to remove the areas where most of the dirt has accumulated. Most piles are 20 feet high.

Q: Southern Minnesota has tried both stripping and splitting. What are the advantages of splitting?

A: *Ken Dahl* – Southern Minnesota found that when piles were stripped there were more hot spots and regrowth than when they were split. This is probably due to the shoulders being partially frozen when they were stripped so little was gained. Also the center beets are the best so they want to process the best beets first. Splitting also seems to aid in faster cooling.

Q: How soon should the shoulders be removed?

A: *P. Pfenniger* – As soon as possible. Do not do any stripping after the end of November. It appears that areas of beets that are disturbed after the end of November store very poorly.

Q: Does everyone take the ends of the piles off first?

A: *P. Pfenniger* – Most companies do. Crystal and Southern Minnesota do not.

Q: Why not take ends first?

A: *K. Dahl* – This would delay the process of pile splitting. We feel the most important thing is to get the piles split.

A: *P. Pfenniger* – This tool is used exclusively to thin the temperature of the pile. It is not used to remove the ends of the pile. The ends of the pile are removed by hand or by a separate tool. The ends of the pile are removed by hand or by a separate tool. The ends of the pile are removed by hand or by a separate tool.

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