A Program to Develop Improved Methods of Storage at Utah-Idaho Sugar

M. Keith Ellis, Vice President, Production
Utah-Idaho Sugar Company

The Utah-Idaho Sugar Company operates factories over a rather wide geographical area. It is necessary that beets be stored in all of our districts for campaigns that start the last week of September and most often last until mid-March. To store beets anywhere for a 180-day campaign is difficult--to find ways to store beets successfully under our wide range of conditions makes the task somewhat more difficult.

Our problem ranges from the Idaho operation that has freezing problems in piles every year to the Washington operation that finds us needing to mow the lawn on Christmas Day on some years. While the problems varied, all too often the end result was the same--modest to severe beet quality losses in piles being stored for processing late in the campaign. The problem ranged from the Idaho beets freezing deep into the piles (upon occasion large piles would freeze completely), only to thaw out in most years before they could be processed, to the State of Washington where beets developed a tough moldy skin on the sides of the piles that became virtually impossible to process. Utah, while not so cold as Idaho and not as warm as Washington, is perhaps our most difficult area, due to the wide fluctuations in its temperature and weather conditions.

In the late 1940s the Utah-Idaho Sugar Company began to experiment with pile covering in our Washington district. A combination of forced air and laminated paper was used to cover a large pile in Brownstown. The degree to which this endeavor failed might best be exemplified by saying that it took over 15 years and a new agricultural department to launch off again in the early 1960s, this time using plastic.

The use of plastic for side covering after many successes and failures became standard in Idaho to prevent the deep frost penetration into the sides of the piles. The use of plastic for side covering in Washington for the prevention of the tough rind build-up also became standard. The successful application of plastic sides in both states came about only after certain techniques were applied. These were: (a) Get covers on ahead of frost. (b) Leave ventilating area at toe of pile. (c) Do not carry the plastic over shoulder of pile. (d) Open and close the ventilating areas on pile toes to keep the sides from heating and/or freezing. While this procedure worked good on most years, some years the results were debatable.

Idaho always had a bad frozen down-draft problem that side covering complicated. Side-covered piles develop larger, deeper, frozen cones than do piles not side covered. This is brought about by the change in the air currents in the pile. We hated to give up the advantages of side covering and thus in 1964 I began to devise a plan that would prevent down drafts from forming in a pile.

The early work on the Brownstown pile and our own experimentation of laying plastic flat on the pile tops proved another technique was mandatory.

After researching all of the early work I concluded that air circulation was needed between the beets and the cover. In order to affect this, a roof or canopy was constructed on a series of rafters laid on top of the beet pile. The rafters were spaced 10 feet apart and were about 4 feet high at the gable, sloping down to the shoulder of the pile. An open area ran to the full length of the gable. This area was about one foot wide and could be closed or opened depending on the weather.

This first endeavor covered about 4,000 tons of beets. At the conclusion of the season I had proven several things:

1. It was possible to control down drafts in beet piles.

2. It was possible to keep frost out of piles using 6 mil plastic in conditions where temperatures often dropped below zero.

3. It was possible to grow the most exotic colored molds ever seen by man.

4. It was possible to keep a beet in a fairly solid state of condition for long periods of time but still be virtually impossible to process due to loss of purity, sugar and high raffinose and/or invert.

5. It is possible to completely alienate the factory superintendent.

In the fall of 1965, we started again, only this time we made the following changes:

1. Increase the height of the canopy to 6 feet at the gable.

2. Leave at least 6 inches of air space above the shoulder.

3. Widen the air vent in the gable to 3 feet.

4. Leave the gable vent open whenever possible closing only during danger of frost.

We once again covered 4,000 tons of beets and learned the following lessons:

1. Don't leave the gable vent open in high winds.

2. A 100-foot by 80-foot plastic canopy will sail off from the top of a beet pile if wind gets under it and it will sail for quite some distance.

In 1966 we tried again only this time we made fast closing wooden doors along the air vent in the canopy gable. That year we proved that:

1. It was possible to prevent down drafts in piles.

2. It was possible to keep the pile cool enough to prevent high losses of sugar, purity and spoilage.

3. It was not possible to convince factory superintendents with one year's results.

In 1967 we tried again and I found the following:

1. You can build the best canopy in the world, however, if you don't get the cover on before a freeze it is no good. The canopy warms up the frost and beet deterioration starts immediately.

2. We learned that to remove spoiled beets from beneath a canopy can be difficult, expensive and a delight to any factory superintendent.

In 1968 we moved pile canopy covering onto full-scale piles in Idaho with good success; however, the degree of success was in a straight line with the ability to keep a canopy covered pile cool and still not let frost penetrate the plastic.

In 1969 we moved a new agricultural superintendent into Idaho that had lots of experience with forced air ventilation in Washington State. He began to couple the canopy and air ventilation together with good results. By 1970 this program was moved into all of our districts using the following procedures:

1. Side cover piles with ventilator in toe of pile.

2. Using 55-gallon barrels, place air ducts on 25-foot spacings across the pile.

3. Use a fan capacity to provide 10 cfm per ton of beets.

4. Start the fans as soon as a row of vents are covered and ambient air is as cool as the beet tissue.

5. Start rafters up on pile as soon as there is room for construction.

6. Place plastic on rafters as soon as possible -- this is to prevent any frost in pile.

7. Get beets down to 40° as rapidly as possible.

8. Blow as little as possible thereafter to maintain 40° temperature.

The results were good during this period, but we had problems in logistics such as:

1. Getting enough manpower in the fall of the year.

2. Getting material in the right place and at the right time.

3. The quality of the job of construction.

4. Apathetic circumstance within many of our personnel.

In 1972 we decided that we had one of two choices in our company. Either we had to cut back on contracting and reduce our days of campaign or effectively store beets that would retain sufficient quality to insure good productivity into mid-March.

Our company chose to do the latter and to the effect that a program was undertaken including the following:

We took two routes, and these two routes were -

1. Institute a full-fledged, no-nonsense training program for all of our agricultural personnel. This program would spell out the economics, and how to get the job done. Each man was advised that covering beets according to the program was a condition of employment. We spent all summer training our people how to properly cover a pile. We had a mock-up pile built out of dirt that was 200 feet long, 22 feet high and 140 feet wide at the toe. The pile was covered and recovered. New construction techniques and materials were tried. Each man spent three days total in class and on the pile.

2. The second route was even more radical. We took what we know about potato storage being used on our K2H and Prior Land companies and changed it to fit our beet storage program. Our calculations showed that if we could improve March beet quality to match December beet quality we may be able to afford rigid storage for a limited number of beets late in the campaign.

   A structure 120 feet wide clear span, and 400 feet long was contracted for. The thought being to store 16,000 tons of beets or 4 days of campaign for the Toppenish factory.

   The building was to have the following qualifications:

1. Have a capacity of 16,000 tons.

2. Have a piling height of 22 feet on top.

3. Have walls capable of holding beets to the 12-foot mark.

4. Have an air plenum on each side of the building with air ducts extending from the plenum into the building 60 feet.

5. Have air ducts that were to be 12 1/2 feet apart and placed underground.

6. The air system was to be able to supply 15 CFM per ton of beets and a minimum of 95% humidity, and to be completely automatic in its capability of blending inside with outside air to give and keep a temperature of 38° and 95% humidity in the beet pile.

Our harvest started September 20th last fall. While we had some problems, we effectively covered 650,000 tons of beets with canopies. We side covered an additional 1,000,000 tons of beets. The rigid storage building under contract was not so fortunate. It got bogged down in union strikes, labor shortages, equipment problems, material deliveries, etc. The building was to be turned over for our use on September 20. On November 5 we kicked the contractor out and put the beets in the building while it was still short the roof, doors, insulation and air system. It took about 7 days to fill the building, after which the contractor

started up again. When the subzero weather hit on December 5th we still had no doors, insulation or air conditioning. Plastic was used to help hold frost out, however, by this time some frost had penetrated the cement sides and walls and the plastic sheets used for doors. The building cannot be insulated until the beets are removed.

The end results of our 1972 season will not be available until April, as our last plant is not scheduled to completed campaign until about the 1st of April. It is possible to give you a trend to date. At Idaho Falls, using February 1st through the 10th as a base for non-canopy covered beets and using the 11th through the 23rd as a canopy covered base, the canopy covered beets have improved extraction by 2.5%, sugar content by 1.3%, purity by 1.79% and slice by 3%.

At the Garland plant we have only been under canopy for five days. When we compare it with the preceding 5 days under side covered beets, the canopy covered beets have increased sugar content by 1.23%, purity by 2.08% and slice by 16%.

We have not, of course, cut any beets from our rigid storage. Were we to rate them by looks, in spite of all the problems in getting the building completed, you would have to say they look better than our best canopy covered beets.

I think perhaps the best testimonial I could give you would be to say that since the 1st of January we have been fighting the battle of frozen beets that have thawed out and each day it has been getting worse. Today we are under canopy beets at all of our factories and we are looking forward at five more weeks of good operation. And what about that proverbial factory superintendent? Well, he is still giving us a bad time -- we can't keep him out from under the canopy covered beets. During the last few weeks many of our canopy covered beets were used to blend with the badly damaged side covered beets in order to get them through the factory.