Beet Receiving and Storage

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This past harvesting season, one of the wettest encountered in years in our area, presented us with a new and difficult set of problems which had to be solved as quickly as possible. The rapid transition from 80 percent of the beets hand topped in 1947 to only 23 percent in 1951, with the balance, or 77 percent, harvested mechanically for our Company as a whole, is one of the most important factors to be considered. We had felt that we were about keeping pace with this transition in the method of harvesting, except at one or two factory districts where mechanical harvesting had progressed more rapidly. However, the delay caused by repeated storms during the harvesting season, coupled with the inability of growers to hire workers to sort beets from dirt on the harvester picking tables, resulted in the largest delivery cf mud, rocks and trash ever before experienced. At most of our factories slicing was reduced below former standards because of inability to unload, flume and wash a sufficient quantity of clean beets to allow normal slicing.

The magnitude of this problem of dirt and rock removal can be appreciated when I tell you that at times at our Billings, Montana, factory this past campaign the total tonnage of rocks and chunks of mud taken by the rock wheel from 3,500 tons of beets exceeded 570 tons every twenty-four hours, this despite the fact that all but one of the thirty-four receiving stations at this factory is equipped with Rienks screens. The same problem is with us in years of extremely dry harvest when the hard clods are as troublesome to remove as the chunks of gumbo mud were this past season.

To get cleaner beets to our factory slicers we must constantly strive to improve methods and equipment at all three of the following places: first, in the field through grower cooperation; second, at the receiving stations by improving the screening devices; and third, at the factory with better trash catchers and rock wheel installations. The topic assigned to me will cover only the first two of these, except to say that the factory rock and trash catchers must be remodelled to handle many times the volume of dirt, trash and rocks than that for which they were designed.

Grower Cooperation

An analysis of the tonnage harvested in the Great Western territory by all harvesters in 1951 discloses that 80 percent was harvested with harvesters equipped with picking tables, and 14 percent by harvesters which deposited the beets in windrows after topping, while 6 percent were topped after being pulled from the ground and elevated directly to the truck or trailer cart. Even though most of the machine-topped beets are delivered shortly after being pulled and never have an opportunity to dry sufficiently for the soil to separate easily from them as they pass over the screening devices at the dumps and pilers, much can be done to decrease the amount of dirt delivered if more care is exercised by the grower.

The dissatisfaction caused by high tares and the consequent ill effect it has upon company-grower relations makes it imperative that both Company and grower organizations put on an effective campaign to encourage

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growers to eliminate as much dirt and trash as possible before delivering the beets to the receiving stations. The cost of hauling all of the dirt returned to the truck through the screen, besides that deducted for abnormally high tares, is a tremendous expense.

As an example, I cite the experience of one of our Montana growers who hauled 1,041 tons of beets and dirt to the station in order to deliver 592 tons of clean beets. He had brought in 43 percent, or 449 tons of dirt with his beets. A large part of this had to be hauled back to his farm for unloading at a double hauling cost. 1 know this is not unusual in other areas, for I saw some loads of beets being delivered to northern California factories late in November which were equal to the above example.

As a grower becomes more experienced in operating his harvester, he learns ways to improve its performance. There are countless examples of fine grower response to an appeal from company representatives to clean up unusually dirty beets. More encouragement and assistance should be given to those inventive individuals who develop ideas to eliminate clods and dirt. Beet growers are constantly improving the performance of their harvesters or offering valuable suggestions to the manufacturers for improvements they have worked out successfully for their conditions. The future market for harvesters will go to the manufacturer who improves his machine to best cope with the industry's problems.

Improvement of Screening Devices

Much can be done to improve the performance of our present receiving-station equipment to take out more dirt and trash. So far the rubber Rienks screen seems to provide the best type of screen for our conditions. It is not entirely satisfactory, however, when the mud is of such consistency that it will stick to the rubber kickers. Up to this year we were of the opinion that rubber Rienks screen could not be plugged with mud. However, we have found it will operate for longer periods without plugging than the steel Rienks screens. Replacing steel Rienks screens with rubber will assist in improving the screening facilities.

Under dry to moist soil conditions, blowers located above the reverse rolls of the screen have proven quite effective in aiding in trash removal. When the beets are muddy and trashy the blower causes the screen to plug more quickly and it must be disconnected until the soil is drier. The past three seasons we have tried a blower located under the boom of the piler operated by a separate motor, which discharges a stream of high velocity air from below and through the beets as they are dropped from the end of the boom to the pile. This blows a surprising amount of leaves and weeds to the top of the beet pile, preventing them from going into the pile to cause heating and spoilage. The trash can be removed from the top of the pile prior to reloading for shipment to the factory.

Slowing down the speed of the Rienks screens to 110 or 115 r.p.m. has improved trash and dirt removal. This reduced screen speed is essential for rubber screens, since at speeds of 135 to 140 r.p.m. they tend to bounce the beets over the reverse rolls, carrying much of the leaves and trash with them.

Widening and lengthening the screen to allow beets to spread out in a thin layer in passing over the screen will provide better screening. The longer and wider Rienks screens which have a set of two reverse rolls in the middle of the screen, with a drop to another set of forward rolls and a second set of reverse rolls, provides better screening. These alterations, while possible, will require time and expensive changes if applied to the present receiving and piler equipment.

A rubber belting drape placed on top of the steel Rienks screens, extending to the end of the last forward roll, has aided in dirt and trash removal by keeping the beets down on the screen and in rolling them over as they pass over the screen. One of our factory organizations reports better results if the drape extends down over the reverse rollers. Unless care is used this will force more small beets through the Rienks screen and is one of the reasons why this longer drape arrangement cannot be used successfully with the rubber Rienks screen.

At smaller stations where the deliveries are easily handled without undue delay, the flow of beets from the beet hopper to the screen can be reduced sufficiently to prevent them from piling up on the screen so deeply that poor screening results. The reduction in the percent tare will compensate for an additional minute required to elevate a load of beets. During periods following a storm, when deliveries are slower and trouble is experienced in keeping the screen clean, the flow of beets up the piler elevator to the screen should be reduced by slower dumping of the truck or, preferably, by cutting down the size of the opening from the beet hopper to the elevator by an adjustable gate.

In 1948 a flail-type beater was installed above a piler Rienks screen in an attempt to knock off adhering leaves and dirt from the beets. It was not successful, even though varying speeds and sizes of flails were used, rotating with or against the flow of beets across the screen. When the rotation of the flails was rotating to knock the beets in the direction of the flow of the screen, it assisted them off the screen too rapidly for good screening. When rotated against the screen's rotation, it tended to cause the beets to pile up and prevented effective screening.

Automatic and Mechanical Dirt Reclaimers

Practically all of our beet dumps and all of the Silver pilers have dirt-catching devices installed under the elevator belts to automatically return to the grower's truck most of the dirt dropped from the belts while his load of beets is being elevated. On most of our pilers the present dirt reclaimers do not extend low enough to prevent serious losses of dirt. Engineers from both the manufacturer and our company are working on designs to improve piler dirt reclaimers on the new models as well as for those now in the field whose reclaimers proved inadequate in a harvest such as the past one.

Central Taring

The most controversial issue during the harvesting and receiving of a beet crop in recent years is the question of determining an accurate tare. Fifteen years ago, in an attempt to improve upon the method of taking tares at the individual stations, the company decided to try out the idea of bringing all tare samples at the end of each day to a central tare house located at the sugar factory.

The first tare houses used men equipped with hand brushes to clean the beets. A few factories tried power-driven rotary brushes. In 1946 the shortage of men to operate the tare houses induced the introduction of beet washers to replace the hand cleaning, and automatic top taring machines to replace the beet knife for trimming the crowns of poorly topped beets; also, the installation of hot air dryers to remove the excess water from the washed beets. These improvements, with the two electric self-registering scales to weigh the dirty and clean samples, eliminated most of the hand work formerly required and received the approval of all concerned in the determination of a proper tare.

The rotary metal beet washer is a perforated steel drum enclosed in a housing open at both ends. It is 2 feet in diameter and 2 feet, 6 inches long and revolves at $4^{1/2}$ r.p.m. with water spray jets inside discharging water against the beets at 125 pounds pressure supplied by a 2-inch pump. The uncleaned sample is put in one end of the washer and, when clean, discharged from the opposite end into a perforated metal basket. Under normal conditions each washer has a capacity of from 45 to 50 samples per hour.

The use of beet knives in the hands of individuals to take the top tare was subject to human judgment, sometimes questioned by one party or the other, so automatic rotary topping machines were made and installed. All beets now are topped usually before washing by rotary beet crowners made of a bronze casting, the center portion of which is cone-shaped, carrying high carbon steel knives to trim the large-sized beets to the exact angle. The outer rim of the rotor is a flat surface bearing knives protruding slightly which remove the crowns of smaller beets from which the tops are to be cut off squarely. Each crowner revolves at a speed of 700 r.p.m. and is powered with a one-horsepower electric motor.

The perforated metal tare baskets are 18 inches in diameter and 12 inches high, all balanced to weigh exactly the same. They carry the wet washed sample through a sloping 12 to 15-foot drying tunnel requiring from 5 to 6 minutes to reach the clean weight scale. Steam or gas heat is used to preheat the air drawn from the outside, after which a buffalo heater fan rated at 6610 C.F.M. is used to circulate the hot air through the tunnel, removing only the free moisture adhering to the outside of the beets.

The average tare house which expects to work 900 tare samples per day will require 6 men, 2 scales, 2 washers and 2 crowners for efficient operation.

At those factories where individual sugar analyses are to be determined, the clean tare sample is immediately transferred to the beet laboratory.

Storage of Beets

In 1947, an unsatisfactory experiment in which we tried ventilating factory storage piles located over flumes is our only experience with ventilation to control storage losses. Because of our relatively short storage period, we have felt that the returns on the investment did not justify the expense involved. During the past five years the average number of days beets were stored varied from fourteen in 1948 to twenty-six days in 1950. This past year beets were stored an average of approximately twenty days.

Storage losses may be reduced and controlled to a great degree by following a few simple precautions. During the building of a storage pile, the piler should not be moved more than three to four feet for each complete swing of the boom. This will keep the top of the pile smoother. It will reduce the amount of dirt and trash deposited in one spot as compared to that when longer moves are made. The dirt and trash spots will also be nearer the top of the pile. At the first signs of hot spots developing, it is easier to dig down to them from the top of the pile for exposure and aeration, and if this is done in time it will stop further spoilage.

If the boom is swung to the outside rim of the pile whenever unusually dirty or trashy loads are received, it will decrease the danger of spoilage.

Spoilage losses in piles should decrease proportionately in the future with the increase of mechanical harvesting and its improvement in trash and dirt elimination. Two of the most serious causes of pile spoilage have been the hot, wilted beets and the frosted or frozen beets loaded from field windrows. With the further elimination of hand toppers and the replacement of harvesters which place beets in windrows, these sources will no longer be a factor in a few years.

The height and shape of the storage pile are undoubtedly important factors in decreasing storage losses. One of the serious losses which occurs in any pile, whether ventilated or unventilated, is in the beets exposed to the elements on the sides and top of the pile. More tonnage in relation to the surface exposed can be stored in a high narrow pile than in one with the same cross sectional area built wider and lower. For example, a pile 90 feet wide at the base and 22 feet high has 17 percent less surface exposed on the sides and top for the same tonnage stored than one with a base of 120 feet and 14 feet high. In normal years the worst beets to process are those from the outside of the piles. All other conditions being equal, to cut down on this loss is a saving.

There are those who believe that the natural exchange of air between the outside and inside is facilitated by the high narrow pile, as compared to the low, wide one. More information is needed to show the rate of exchange of air under differences in temperatures between the inside and outside of storage piles.

Daily examinations of the top of the piles will detect the first signs of spoilage. Trenching down to the spot, which usually starts four to six feet below the surface, will generally retard any further heating. If this does not stop the heating, that part of the pile should be reloaded at once. Heavy shrinkage losses of sugar and weight have been prevented by first reloading the early piled ends of the storage piles if they were put in during a period of unseasonably hot weather. The same procedure should be followed on the last end piled, if frost has damaged some of the beets which went into storage. The cost of transferring reloading equipment is minor as compared to spoilage losses sustained by waiting.

If I have disappointed you in not offering some startling new methods to improve those we are now following, let me remind you that most of the strikingly successful innovations have come from doing the old things better than they have ever been done before.