Elimination of Trash Between Flumes and Slicers

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Our subject title states in itself that we do have a trash problem.

It is our thought that we should cover the whole problem to properly show the origin and cause of the trash. To do this, we must necessarily go back to the preparation of the seedbed and planting of the beet seed.

Since the early 1940's, farming practices have continued to change rapidly. We call to your attention some of the following: Crop rotation; soil conditioning; planting practices; fertilization; mechanical blocking and thinning; irrigation, and mechanical harvesting.

Now we are ready to take the beets over our receiving equipment. A large percentage of our receiving stations, as we all know, are obsolete insofar as modern cleaning devices are concerned. It is true that various improvements have been made and many modern receiving stations have been built, but the greater percentage are about as they were twenty years ago.

Nearly every section of the beet growing areas has its own particular trash forming or handling problem. This may be rocks, clods, mud balls, weeds, grasses, excess beet foliage or various other foreign material, any of which present a difficult cleaning problem, and later on, if not removed, a very serious factory operational problem.

Some figures have been prepared to show typical beet receiving operations. One hundred forty-nine stations received 1,666,000 tons of beets in about a 60-day period. This figures out about 200 tons per station per day. However, averages do not always indicate a true picture. Some receiving stations handled less than 400 tons total, whereas the maximum handled over one station in a 60-day period was 140,000 tons. Several stations handled from 50,000 to 100,000 tons.

All of us know that a good cleaning job cannot be accomplished unless a thin layer of beets is permitted to pass over the cleaning equipment, and this is impossible when a receiving station is taxed to capacity operation.

The history of factory machinery obviously intended to mitigate factory problems goes back so far into the beginning of the industry that it becomes manifest that trash has always been with us to a lesser or greater degree.

Fluming

Most modern flumes are built with "run-arounds" or bypasses on their top edges, so that, when the flow of beets is stopped, the water will flow around the plugged portion.

The older type flumes without the bypass feature are frequently supplied with covers which are easily removed, one at a time, to allow the beets to slide into the flume.

When beets are transported by fluming, they receive considerable cleaning as encrusted dirt is washed off or softened so that it can be more easily removed in the beet washer.

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Many plants have found it necessary to install high pressure water jets, at relatively short distances apart, to periodically flush out large accumulations of sand, mud and small rocks. Others have found it necessary to use power-driven equipment to periodically remove mud balls and medium to large size rocks from the flumes.

Recirculation of flume water is a general practice. The recirculated water is passed through some type of screening system to remove beet tails and trash.

Beet Feeders

Beet feeders have been designed to even out the flow of beets in the header flume before they pass through the various pieces of trash removal equipment, as all operate more efficiently when fed at a constant rate. The rate of beet flow is controlled by regulating the speed of the beet feeder.

Trash Catchers

Trash catchers serve the purpose of removing loose beet leaves, weeds, grass and small untopped beets.

Mechanical trash catchers have steel bars having barbed hooks or sharp side projections suspended from an endless chain which travels in a counter-direction to the Humed beets and gathers the trash. As the hooks travel up and back over the flume, they are struck or bounced on fixed bars to disengage the trash, which is deflected by a baffle to one side of the flume.

Many plants have installed multiple trash catchers, some have added wheel drums to the trash catcher sprocket wheels and trash and drag hooks of various design have been tried for greater efficiency in eliminating trash.

Rock Catchers

Rock catchers of various design are used at most factories. Prior to mechanical harvesting it was not necessary to use rock catchers in the California territory. In the last six years it has been necessary to install rock catchers at some of the California plants.

Beet Washers

Two types of beet washers are common:

1. A large tank with satnd and gravel traps located under the perforated or slotted bottom. A large shaft with paddles turns within the tank to agitate the water and beets and in turn move the beets from the inlet to the outlet end.
2. A long narrow tank through which perforated flights are dragged by an endless chain system. This system moves the beets counter-current to the water flow. Purpose of both types of washer is to remove dirt from the beets.

Trash Rolls

A series of horizontal or longitudinal rolls set on a declined angle serves the purpose of separating the beets from the water and also further eliminates dirt, sand and small rocks. These rolls, if not overtaxed, will also eliminate loose trash, and are of some help in stripping leafy material attached to the beet.

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Picking Tables

Many of the plants are equipped with additional trash rolls between the discharge of the elevator and the picking table.

The beets are fairly well spread out and evenly distributed on the picking table belt, but are traveling at a fairly high rate of speed. The picking table man or men therefore only have time to hand pick such items as tin cans, pieces of wood, and large bunches of trash.

Magnetic Rolls

Magnetic rolls are usually placed at the discharge end of the picking table. They catch small pieces of magnetic material such as nails and wire.

Dead Knife Pocket in Slicer Drums

The dead knife pocket serves the purpose of a catchall for rocks and magnetic material which have escaped the previous trash moving equipment.

High Pressure Water Jets

High pressure water jets are used at the beet washer and trash rolls. The high pressure water removes adhering dirt and some attached leafy material from the beet.

Diffusers

While the continuous diffuser cannot be classified as a trash removing piece of equipment, it should be mentioned that excess trash does not seriously affect the mechanical operation of a continuous diffuser. Operation of a conventional battery may be seriously retarded when excess trash is encountered.

There have been many new efforts in recent years reattacking the problem of trash elimination at the factories, because agricultural progress, in its growing pains of modernization, has presented new problems exceeding the efficiency of the previously adequate trash removal equipment.

It is a generally accepted fact that while extreme trash and dirt conditions can slow up a plant to 10 percent or more of capacity during such periods, the beets finally going to the slicers are usually mostly free of everything not attached to them. The solution to the untopped crown, with up to six inches of leaves and quite often a bolter stalk in the middle, has so far defied factory machinery and inventiveness.

With today's high cost factors, each plant must maintain a maximum rate of slice or else it will find its operations winding up in the loss column. The inclusion of trash or soluble material from trash, tops and crowns reaching the slicers materially affects our operations as regards extraction and production costs. In addition to this, most plants are using 2-4 more men per day to handle the trash now being removed by our present equipment.

As previously stated, our subject is the "Elimination of Trash Between Flumes and Slicers." For the purpose of opening the discussion, we have used the experiences of one factory, showing what it has done toward improving the cleaning of beets of rocks, mud, sand and trash.

At the "A" factory, during the period of war years, or between 1940-1945 with the increased mechanization of the beet harvest, it became apparent that something should be done to remove clods of dirt and rocks,

which were shipped in great quantities with the beets. The beets received by car and truck were so filled with material of all kinds that it was impossible to float into the factory more than 25 percent of the needed quantity to supply the factory capacity. A crew of twelve men working with shovels, poke poles and also using an electric-driven wench to drag a walking plow through the flume, made little or no impression on the settled clods, rocks and leaves in the bottom of the flume.

In the intercampaign season of 1945-1946 a gravity separator was installed. The separator consisted of a pocket below the bottom of the flume and was located immediately after the beet feeder wheel at the wet hopper. The pocket was made full flume width, about three feet long and three feet deep. The underflow water for the separation was furnished from a line connected to the wet hopper drenching pump. Enough underflow water was used to float beets but rocks, clods and other heavy material were allowed to settle to the bottom of the pocket. This pocket bottom was made up of $^{5/8}$-inch steel bars, spaced about $^{5/8}$-inch apart, hinged to form a dump gate. The gate or pocket bottom swung open at regular intervals allowing the material to drop into a drag, which in turn loaded the mud and rocks on a gondola car. The interval of dumping of the gate was controlled by a Reeves variable speed drive, and was speeded up if the quantity of material being removed was extremely heavy.

The first season that the separator was used the amount of mud and rocks removed averaged about twenty-five tons daily. The past season, mud and rocks taken from the beets at this point averaged about seven tons daily. Some of this reduction might be accounted for by the fact that in 1946 few cars were emptied at the wet hopper by means of the drenching pump, while the past season all cars were unloaded in this manner. It can be assumed that the drenching pump dissolves many clods; however, credit for the decrease in dirt is partly due to the improvements in harvesting and beet receiving station equipment.

In the same year that the gravity separator was installed, the Franklin Jig was remodeled. The Franklin Jig was located just ahead of the beet wheel and this location was maintained for the reason that it could better serve at this point when fluming beets from the beet bins. The revamping of the Franklin Jig was done by putting in slanting bars in the pockets, eliminating baskets formerly used. The rocks and other heavy material were settled into the pockets by pulsations of the plungers as before, such settled material being removed from the pocket by side flush gates. The rocks and debris were elevated to ground by means of a scroll and drag. Sand, rocks and clods removed at this point averaged about five tons in a twenty-four hour period. The advantage gained by remodeling the Jig was in the cleaning of the rock pockets. Formerly it was necessary to haul out the baskets for dumping. The employee would not haul up the heavy baskets more often than he could help doing so. Now the man had to only turn a valve wheel opening the flush gate. The pockets were kept empty and as a consequence no rocks went by.

Sand traps were located in the flume just ahead of the Franklin Jig. These traps were of the conventional type, five in number and with manually operated dump levers. The sand thus removed was shoveled from the

pit to ground level. Each twenty-four hour period approximately six tons of sand and rocks were hauled away.

From the gravity separator to a distance of about seventy-five feet down stream the main ditch was also used as a header flume for the beet bins. This section was particularly troublesome, filling up with mud and rocks and leaves until it was almost impossible to float beets. It was in this part of the ditch that the water jets were first installed. A four-inch pipe line was laid in the bottom of the flume, removing concrete, and repouring, so that the top of the pipe was flush with the ditch bottom. Nozzles having a *y*$_s$*-inch* opening were placed about six feet apart pointing down flume. The back side of each nozzle was protected by a piece of plate to prevent trash hanging on and reducing the effectiveness of the spray. In like manner, nozzles were placed in the wet hopper and under the beet control wheel, about five feet apart. Approximately eleven or twelve nozzles were used on each section. The water was turned on only one section at a time using a 550-gallon, two-stage pump, which gave a nozzle pressure of about 100 pounds.

The flume was cleaned by using the sprays at pre-arranged intervals when the beets are cut off at the control wheel. Usually, about five minutes were necessary to clear the ditch. When beets were being drawn from the *wet* hopper, the sprays on the flume bottom were turned on. This procedure assisted in moving the dirt and rocks into the separator pocket.

An additional change made at the wet hopper which improved the movement of beets and dirt was the covering of the bars in the run-around flume by steel plate, allowing a four-inch opening at the lower part of the bars for the water to pass. The plate not only prevented the runaround from filling with trash, leaves and small beets, but actually gave the water more pressure to move the beets.

Sprays were put *in* each of the seven flumes under the storage bins from the header flume at a distance of about 120 feet, spaced 10 feet apart, pointing down stream. Before the sprays were put in it was impossible to operate at more than 50 percent capacity. Enough beets could be moved afterward to keep the factory at full capacity.

It cannot be presumed that any system of removing rocks, sand and mud is perfect; however, it is evident that since 1945 progress has been made. Improvements to the predescribed process such as added pump capacity and doubling the amount of flume sprays have been deemed desirable. Mechanical means of dumping sand traps and sand removal would better the work at the sand traps. Perhaps future ideas yet to be worked out will give a more complete removal of rocks, sand and mud from the flumes.

Mud, sand and gravel which remain attached to the beet must be removed in the beef washer and on the roller picking table. An ample supply of water has been used flowing in an opposite direction to the movement of the beets. As in most plants now in operation, space had not been allowed to provide for a beet washer long enough to remove all of the mud which adheres to the beet at all times. Mud and sand were dumped at regular intervals bv the use of flush valves located below the washer screen.

Additional sprays at the roller picker with increased water pressure assisted in removing some mud and small gravel which were held by the beet roots.

The men at the upper belt picking table were placed under direct supervision of the knife station foreman. Many tin cans, a few rocks, wood

and trash were eliminated at this point, preventing knife changes and loss of knives. A magnetic pulley at this place is always very helpful.

Many years ago the only means of removing trash from the flumes was by hanging rakes (somewhat similar to the present Dalton rake) , in the flume. One or more men attended the rakes, pulling them out and dumping them on the ground. This method, while crude, was quite effective at the time, and was continued in use until the Dalton weed catcher was installed. The Dalton weed catcher had rakes hanging on two chains, spaced as close as possible and not interfering with one another. The chains were driven by means of sprocket wheels, and moved counter-current to the flow of the water in the flume, at the rate of about 28 feet per minute. The overall length of this weed catcher was twenty feet and it was housed in a heated building which kept it free from ice in cold weather. It was found to be very important that the rakes not hang too deep in the water. The proper depth, or rather the depth at which the rakes caught and held the most trash, was such that they did not bear too much weight on the floating beets. The rakes discharged their load upon an apron by means of dragging their upper back side over angle irons set in a slanting position across the top of the Dalton frame. It was found necessary to have a man attend to the trash for the reason that many untopped beets were caught. They had to be topped by the attendant and returned tothe flume. Rough estimates were that seven tons of trash" and leaves were hauled away from the Dalton weed catcher each twenty-four hours.

Most operators are agreed that the use of an additional weed catcher located in the flume below or above the present installation would assist in removing more trash from the flume. Mechanical means could be used for piling of the trash from the Dalton were it not for the fact that many untopped beets are mixed with it.

The roller picker which is located at the beet washer discharge removed many leaves and much grass. The roller picker was made of a series of knobby rolls, eleven in number, $5^{1/2}$ inches diameter, 36 inches long, set 6 inches center to center. The rolls were placed horizontally, but sloping seven inches from front to back.

The knobs on the rolls grabbed the leaves and grass, discharging them below and allowing the beets to pass. Sprays at this point assisted in washing the trash into the rolls.

A wider and longer picker would be of advantage, provided that there was space available for a larger installation.

Probably much more can be said and many more things can be done to eliminate leaves, trash, grass, mud, rocks and sand from the beets on their short journey from bins to slicers. In the future a near perfect job can be done in the removal of undesirable material from the beets; however, we must call upon the personnel in charge of harvest to assist us in ' the prevention of contamination of all kinds, especially of the untopped beets.

Discussion[2]

This discussion centered about three topics. The first concerned the removal of trash by means of weed pickers, particularly as to the results

[2] E. Maudru, Session Chairman, Chemistry and Factory Operation, Eighth General Meeting A.S.S.B.T., conducted a general discussion at the meeting after presentation of this paper. This is a summary of that discussion.

experienced in relation to the number of rigs used *in* the picker. The thought was developed that four rigs in the flumes for any picker were about as many as the picker could carry. Experience indicated, also, that the use of more short pickers gave better results than the use of long ones. This information is based on the observation that the rigs were filled when they got half-way along the flume.

The thought was expressed that the time given to allow weeds to get up out of the beets has direct bearing on the matter. The trash which is down in the beets can be caught more easily by a second catcher if sufficient time is allowed for it to get to the surface.

The second topic of discussion was related to rock catchers. It was explained that the control of water admitted to the rock catcher installed at "A" factory is accomplished by taking water from the drenching pump of the wet hopper and diffusing it up through the slotted gate. A six-inch valve is used, operated about one-quarter open.

At Billings, where up to 350 tons of rock per day had to be removed, the wet hopper was placed close to the factory. Made of metal, it was constructed with six pockets, arranged sideways to the flume, each of which is an individual pocket with flume at the bottom and with a steep slope. High pressure jets were installed from there into the factory. Beets are taken into the factory by a wheel, slowing down the beets and making the rock wheel effective. Inasmuch as two ten-ton dump trucks operate twenty-four hours a day, the comment was made that someday all the rocks will have been removed from the Billings fields.

Another expression from comparative experience offered a different style rock catcher for comparison to the wheel and open flume or the drag under the opening in the flume types. In this style, beets are put in the water of a flume up above the ground by means of a beet wheel. Beets and water are then discharged into a flat steel trough about ten feet wide, spreading the beets very thin in the water. In the bottom of the trough, riffles are placed. Following two of the riffles is a very small drag, three or four inches high. The drag is protected by the riffle immediately ahead of it so the rock will drop out of the riffle into the drag. There are two such arrangements in series. While most of the rocks are caught in the first set, the second set usually gets the rest of the rocks with very few rocks going into the slicers. It was noted that this style installation is used in an area where the rock quantities are not as severe as they are at Billings, but it takes care of the smaller quantity very well.

A third point of discussion concerned the actual removal of stones and mud balls, after such have been caught, in a continuous operation. One expression from comparative experience gave preference to the use of a sturdy drag conveyor which can remove and load the rocks into truck or car in one operation. If a wheel is used, a smaller one might have advantages from the maintenance standpoint over a larger one. However, with any wheel, there still remains the necessity of conveyor loading or hand loading the rock into trucks for removal.