Quality Losses in Commercial Piles: An Approximate Cost Analysis

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The Holly Sugar Corporation purchases 1,350,000 tons of beets on an annual basis for processing at four northern area plants located in Colorado, Montana and Wyoming. Beets received at the receiving stations are screened using conventional grab rolls to separate dirt and trash from the load. Dirt and trash weight are deducted from the received weight to give a screened weight of beets. A representative tare sample is obtained from the load after screening for tare lab determination of dirt tare plus top tare and sugar content on washed crowned beets. Dirt and top tare weight are deducted from the screened weight of beets received. The grower then is paid on the basis of screened weight received minus top plus dirt tare as determined in the tare lab and on sugar content as determined on washed crowned beets. Under this system of beet payment the processor absorbs essentially all of the extractable sugar lost due to respiration and rot occurring from the time of receiving and purchase to the time of introduction into the factory for processing.

At this point definition of some in-house terminology associated with storage losses both with respect to sugar loss and weight loss may be helpful.

1. Sugar shrink Weight of sugar lost per ton of beets purchased from the time of purchase to the time of slice. Sugar shrink is expressed in terms of plus or minus percentage based on purchased weight of sugar determined at time of beet purchase.

2. Weight shrink Beet weight lost per ton of beets purchased from the time of purchase to the time of slice. Weight shrink is expressed in terms of plus or minus percentage on a base weight value determined at time of beet purchase.

3. Extraction Weight of granulated sugar produced per unit time expressed as a percentage of sugar weight introduced into the factory in beets sliced per unit time.

4. Recovery Total campaign weight of granulated sugar produced expressed as a percentage of total sugar weight in beets purchased for the campaign. Recovery ordinarily cannot be determined until campaign is completed.

During a typical campaign in the northern area, if there is such a thing as a typical campaign, the following effects related to beet quality decline during storage are noted with respect to time.

Figure 1 indicates a typical percent slice variation from an arbitrarily established standard slice rate norm. During the first part of the campaign, the factory operation goes through an induction or lining out phase and slice rates increase, usually peaking out some time in December.

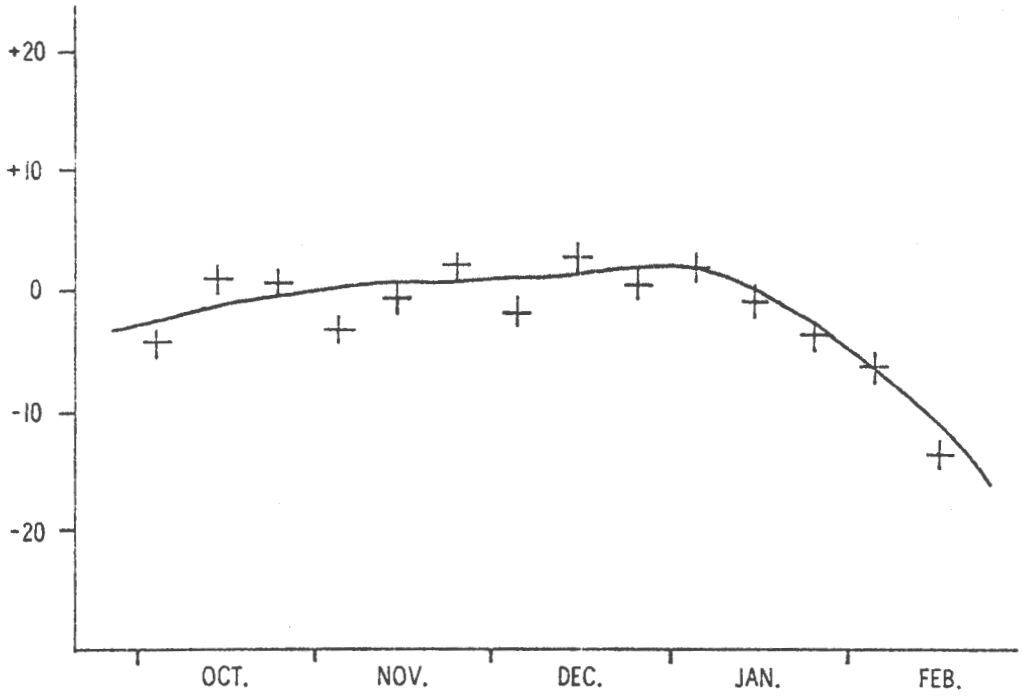

Figure 1. Percent of standard slice vs time (Northern plants)

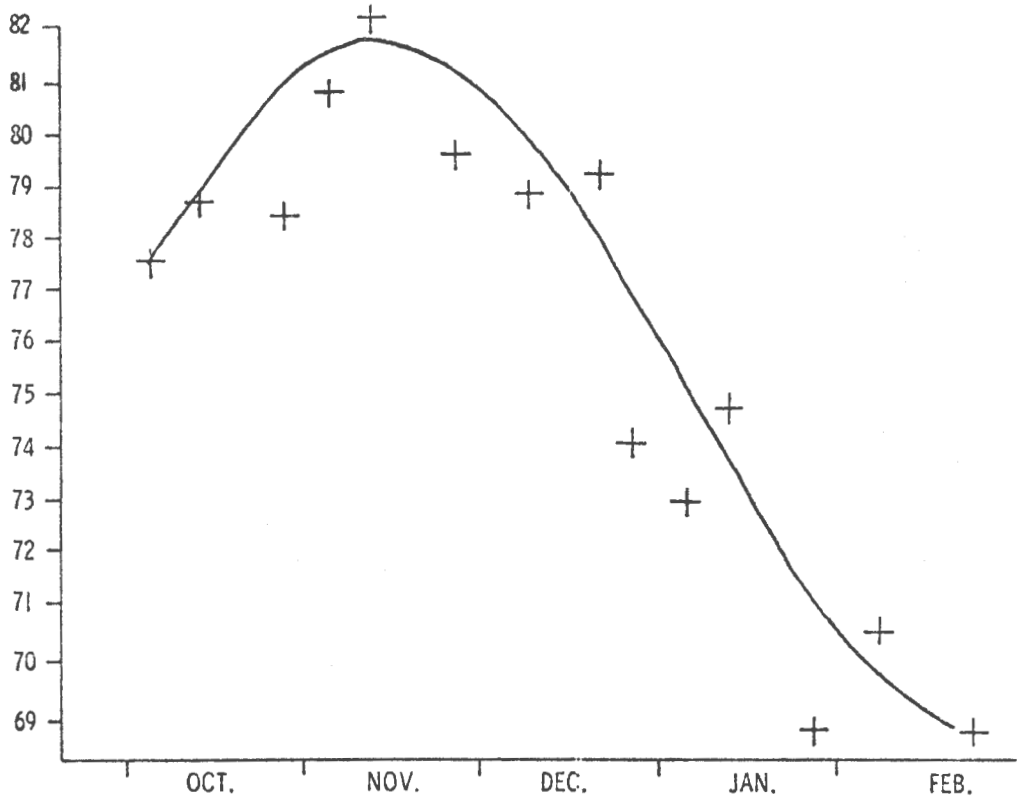

Figure 2. Percent extraction vs time (Northern plants)

From the latter part of December on through February, slice rates decline to approximately 20% below the standard norm. This decline in slice is directly associated with loss of sugar in storage with subsequent decrease in beet purity and increase in tons non-sugars introduced to the sugar end per unit weight of beets sliced.

Figure 2 indicates a typical plot of straight house extraction vs. campaign time. Again we note a significant decline in extraction beginning in mid December and continuing at an accelerated rate through January and February. The decline in extraction is directly related to deterioration of beets with subsequent sugar loss during the latter part of campaign. The campaign average extraction was 77%.

Figure 3 indicates a typical plot of cwt sugar production per unit time as compared to an arbitrarily established standard production rate. Again a decrease is noted during the latter part of December due to decreased beet slice and decreased extraction of granulated sugar from beets sliced.

Figure 4 indicates the percentage increase of cost in labor and materials required to produce a cwt of sugar. Labor plus material costs are essentially fixed as daily production of sugar decreases cost per cwt increases. In this case it is noted that cost per cwt produced can increase as much as 30% during the latter part of February.

Figure 5 shows the corresponding S-shaped sugar shrink curve corresponding to a typical northern climate high-low temperature profile vs time, indicated in figure 6.

Table 1 exemplifies the difference between beets piled, beets purchased and beets sliced at an average time of 65 days with respect to percent weight shrink, percent sugar shrink, percent extraction and percent recovery.

Table 1. Weight and sugar shrink statement on the basis of one ton of beets purchased.

	Beets Piled 5% Top Tare	Beets Purch. 0% Top Tare	Beets Sliced Campaign Avg. 130 Days
Wt. Beets - lb.	2105 lbs	2000 lbs	1920 lbs
% Sug. Cont.	15.7%	16.0%	15.5%
Wt. Sug. - lb	330.5 lbs	320.0 lbs	297.6 lbs
% Wt. Shrink	+ 5.3%	0	- 4.0%
% Sug. Shrink	+ 3.3%	0	- 7.0%
% Extraction	81.0 %	-	77.0 %
Sug. Prod. Cwt	2.68 cwt	-	2.29 cwt
% Recovery	83.7 %	-	71.6%

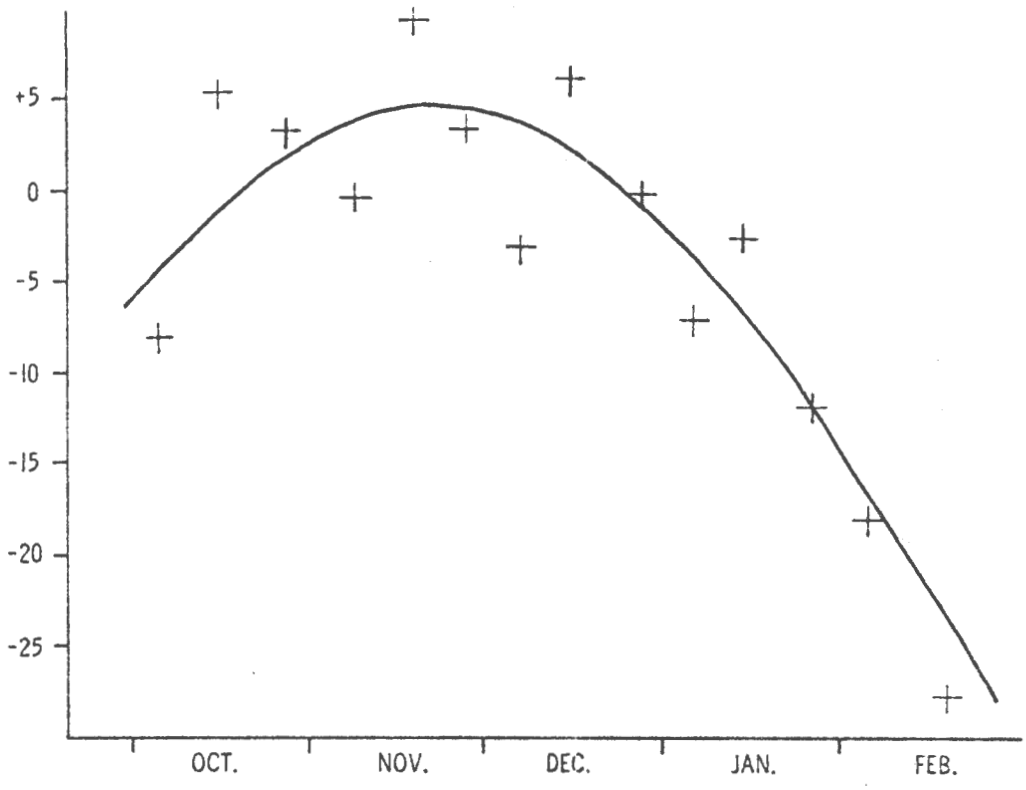

Figure 3. Percent of standard CWT of sugar production vs time (Northern plants)

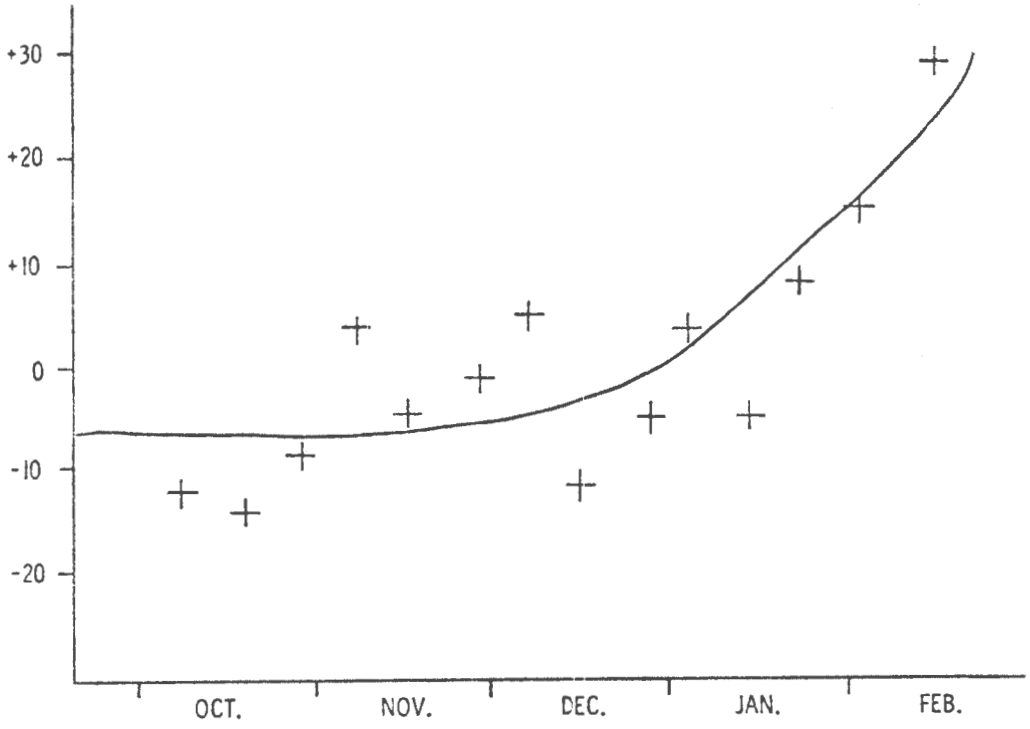

Figure 4. Percent of standard cost per CWT sugar produced vs time (Northern plants)

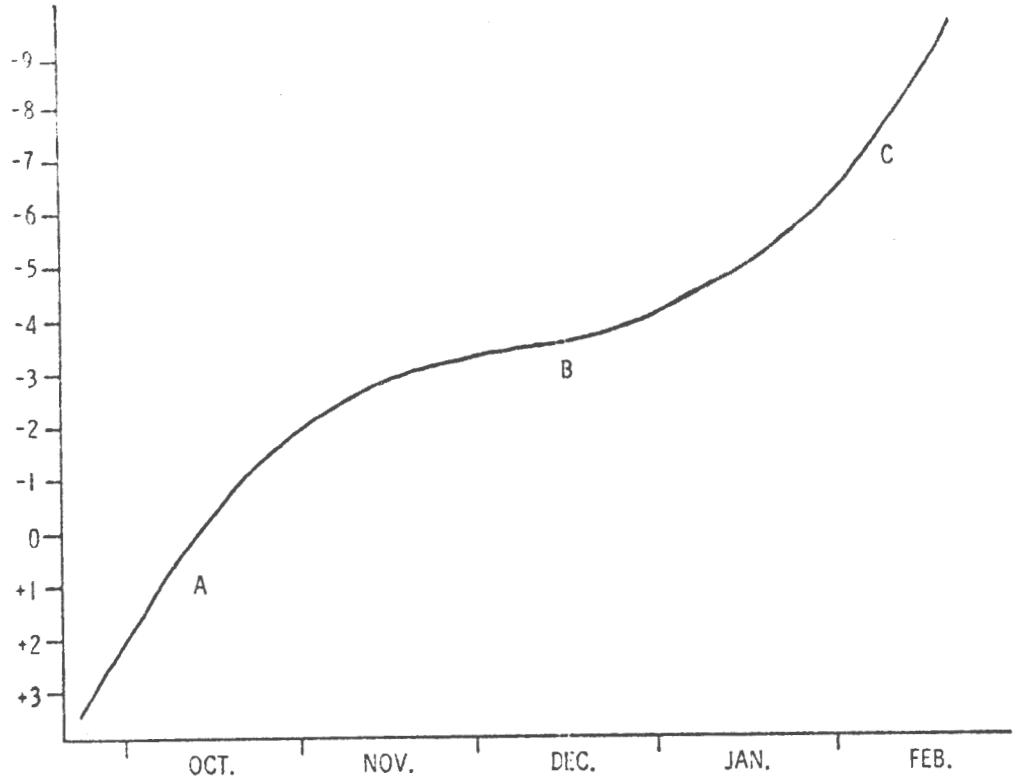

Figure 5. Percent sugar shrink vs time (Northern plants)

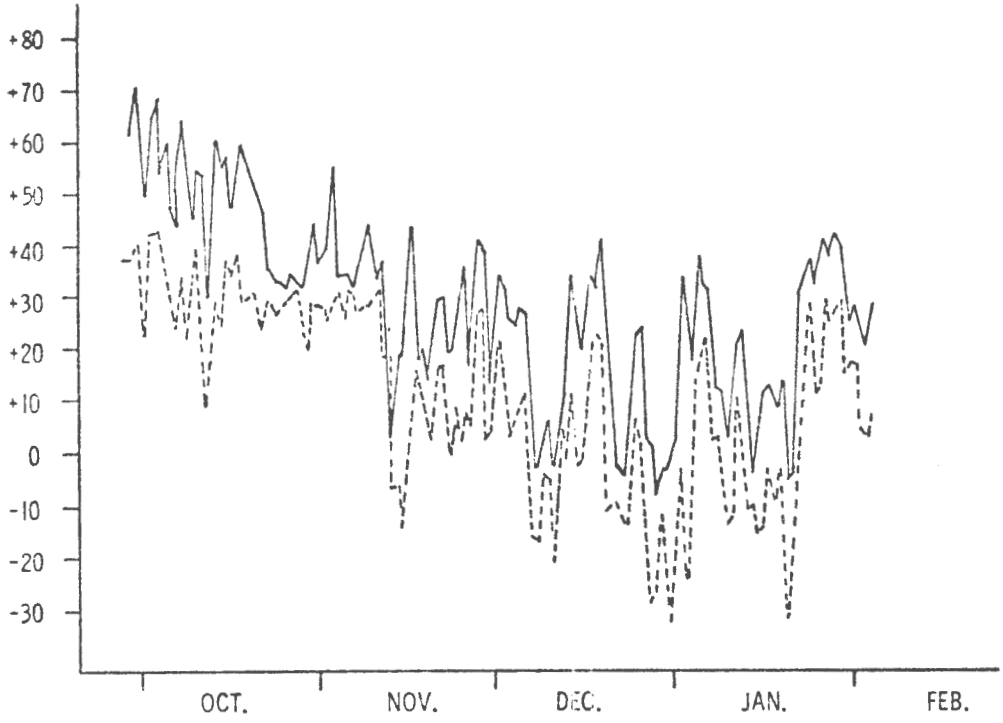

Figure 6. Ambient high-low temperature vs time (Northern plants)

Table 2 converts table 1 data into projected sugar and molasses production using a 4,000 ton factory slicing 130 days. To establish a zero shrink point of reference it is assumed that fresh beets are sliced immediately upon being received. The difference in sugar production represents the sugar loss attributed to storage loss due to respiration and rot. It is assumed that the larger total weight of fresh beets to slice and sugar to produce can be accomplished within a fixed time of 130 days.

Table 2. Cost of sugar shrink - 4000 ton slice, 130 days, -7% weight shrink, - 4% sugar shrink.

BEETS PURCHASED - TONS SUGAR
520,000 x .160 = 83,200 tons sugar

BEETS PILED AND SLICED ON DELIVERY
547,370 X .157 = 85,937 tons sugar
85,937 X .81 X 20 = 1,392,180 Cwt sugar
Estimated tons 79.5 Brix Molasses Produced = 27,314

BEETS PILED (AVERAGE 65 DAYS)
499,200 X .155 = 77,376 tons sugar
77,376 X .77 X 20 = 1,191,600 Cwt sugar
Estimated tons 79.5 Brix Molasses Produced = 30,950

Table 3 summarizes the difference between a hypothetical immediate slice of all beets received for piling during harvest and beets sliced after an average of 65 days storage.

Table 3. Cost of sugar shrink - 4000 ton slice, 130 days, -4% weight shrink, -7% sugar shrink

	Fresh Beets	65-Day Beets	Difference
Weight shrink	+ 5.3	-4.0	
Sugar shrink	+ 3.3	-7.0	
Sugar Prod. cwt	1,392,180	1,919,600	+200,580
Molasses Prod. tons	27,314	30,950	-3,636
Extraction %	81	77	
Recovery %	83.7	71.6	

Table 4 summarizes the credits and debits inherent in reducing shrink to a zero value.

Table 4.

COST OF SUGAR SHRINK

$9.75 net sugar
$35.00/ton molasses

FRESH BEETS - CREDITS AND DEBITS

	AMOUNT	CREDITS - DEBITS
CREDIT SUGAR	200,580 Cwt	+ $1,955,655
$9.75 Cwt		
DEBIT MOLASSES	-3,636 Tons	-$127,260
$35.00/ton		
TOTAL CREDIT		+$1,828,395
AFTER TAX CREDIT		+ $950,765
48% Tax		

Table 5 computes the cash amount that could be expended per ton of beets purchased under the Holly contract stipulations to reduce shrink 25% and 50% respectively. The table is further summarized with a projection reflecting total capital which could be expended to reduce shrink 50% assuming 20% after tax R.O.I. is acceptable.

Table 5.

COST OF SUGAR SHRINK

TOTAL AFTER TAX COST - $950,765

COST PER TON BEETS PURCHASED
$950,765 ÷ 520,000 tons = $1,83/ton

25% REDUCTION OF SHRINK = .46¢/ton

50% REDUCTION OF SHRINK = .92¢/ton

IF A SUGAR SHRINK REDUCTION OF 50% COULD BE ACCOMPLISHED, A FACTORY PURCHASING 520,000 TONS BEETS PER YEAR COULD EXPEND 520,000 tons x .92¢/ton ÷ .20 = $2,392,000 ON PHYSICAL FACTILITIES PROVIDING A 20% AFTER TAX R.O.I. WAS ACCEPTABLE

SUMMARY

In summary an approximate shrink cost has been determined by calculating a hypothetical 0-shrink extraction and cwt production vs actual circumstances using a typical northern area -4% campaign average weight shrink and a -7% sugar shrink corresponding to a campaign average straight house extraction of 77 vs 81 for fresh beets as received. It is assumed that the additional slice and sugar production required per day could be accomplished in the same time period of 130 days due to the higher beet quality. Therefore, factory operating expenses per campaign would remain the same. Since operating expenses are the same during the fixed 130 day campaign in both cases and the cost of beets is the same, the difference between a hypothetical 0-shrink situation as compared with actuality is the credit-debit difference between additional sugar produced value at net and decreased molasses production at average market price per ton.

Having established the idealized hypothetical zero shrink comparative economic analysis with the actual, it is then possible to approach reality with respect to potential economic gains which could possibly be obtained by reducing sugar shrink by 25% and 50%.