# Sugarbeet Storage Effects on Processing

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Before examining the effects of storage in the processing of sugarbeets, some mention should be made of the fact that there are many and varied types of storage procedures practiced throughout the beet growing areas of the world and even within the U.S. borders. It is not our purpose to compare methods nor their effects on processing, but to describe the effects of what we consider a typical storage season on our ability to process sugarbeets and extract salable sugar.

Our factories begin operations in early October and the harvest is controlled for the first two or three weeks in order to minimize the quantities exposed to the normally high daytime temperatures while awaiting processing. When harvest controls are lifted, the establishment of the "permanent" piles begins. Some of the beets will remain in storage for periods in excess of 100 days.

Under our normal storage conditions, beet spoilage is not a serious factor. Yet even in the absence of spoilage, the general effects of storage take their toll on the factory performance and the ability to recover sugar. It is this situation which will be described in this paper.

Considering a straight house, when sugar enters the process in the beet, it has three possible routes: A. recovered for sale; B. to molasses and C. lost directly or indirectly.

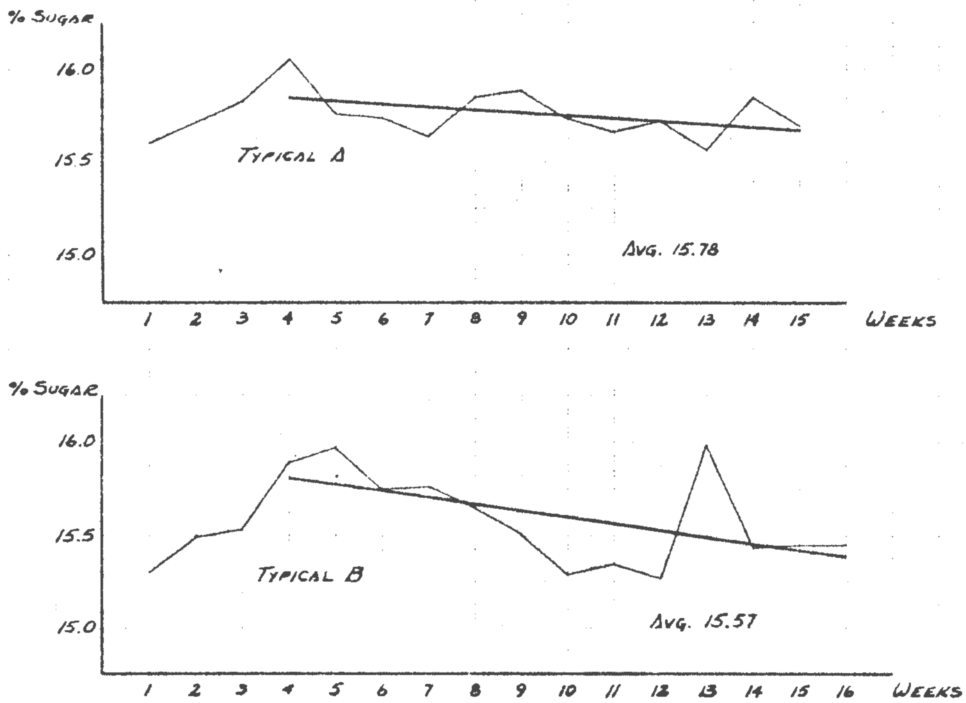
A measure of the factory efficiency is the relationship of the sugar recovered for sale to that which entered in beets for the same period. This is known as extraction, and it can be influenced by sugar taking any of the routes listed above or the ability to sample and measure sucrose entering with suitable accuracy.

The effects of sugarbeet storage on sucrose determination have only received deserved attention in recent years. Figure 1 shows the sugar content in cossettes by weeks during two typical (and consecutive) storage periods in one of our areas. The sugar content was determined by the standard hot digestion method. Examination of Figure 1 discloses a slight downward trend during the storage period as would be expected from continued respiration. Yet a more accurate determination of sucrose might well indicate otherwise. For example, other studies have shown that both invert and kestose increase during normal storage, but that the negative polarizing effect of invert cannot be relied upon to cancel the positive effect of kestose. Other polarizing non-sucrose constituents also contribute to the sucrose error of polarizing methods.

Figure 2 shows a slight downward trend in thin juice apparent purity during the processing of beets from storage in these typical years. Since juice purification has been completed at this point any reduction in purity will indicate an increase in the non-sugar load going to the crystallization

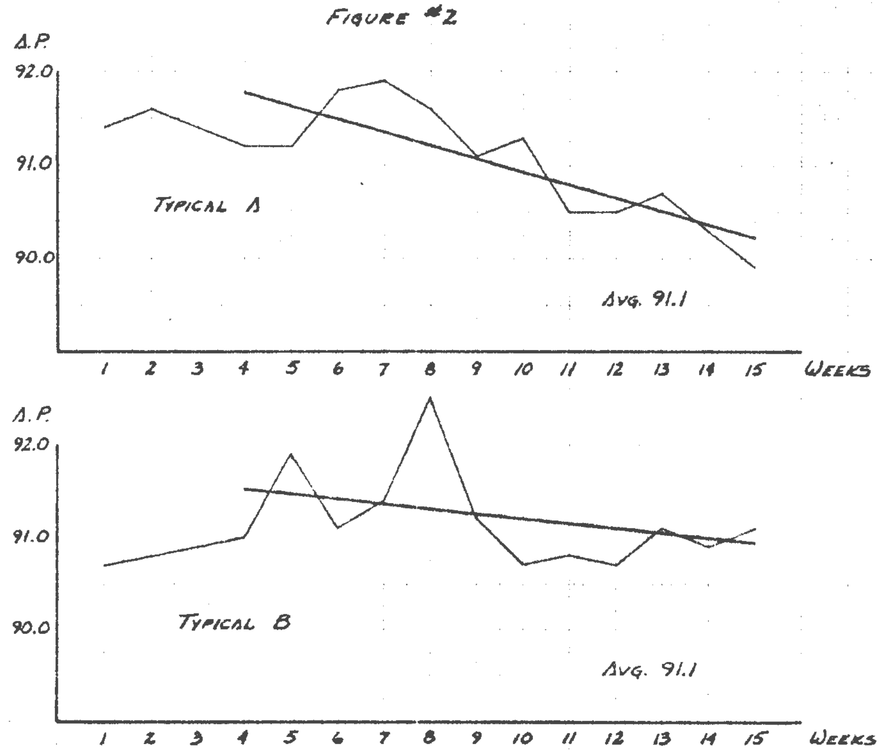
EFFECTS OF STORAGE ON SUGAR CONTENT

FIGURE #1




THIN JUICE ~ APPARENT PURITY

FIGURE #2



step and depending on the composition of the nonsugars, will divert more sugar to molasses. This is demonstrated in Figure 4 which shows a definite increase in the amounts of sugar in molasses as the storage period lengthens.

Known losses of sugar in the process are affected more by operating practices and types of equipment than by the beets where normal storage conditions have prevailed. Figure 3 shows opposite trends for these typical years. The known losses considered here are the amounts of sugar which accompany the pulp and the waste lime out of the factory.

It is undoubtedly true that even normal storage conditions cause changes in the beet tissue which could lead to problems in diffusing sugar from the cossettes. Within limits, the processing variables of draft, temperature, time and cossette preparation can be used effectively to control this sugar loss. It is likely that this can be accomplished only at additional processing costs, however.

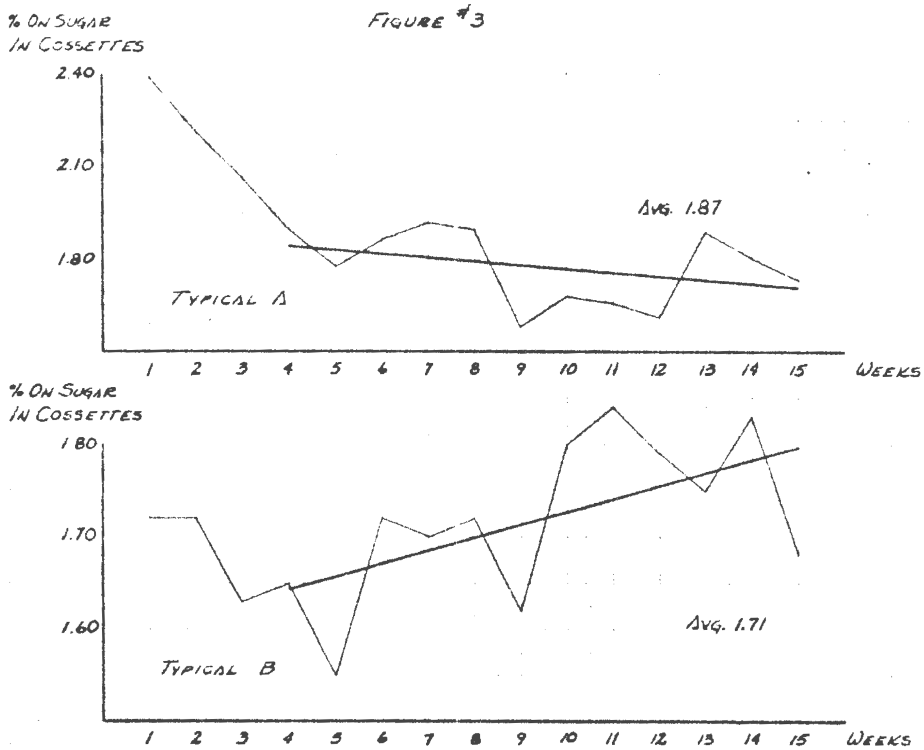
The same holds true in separating the juice from the waste lime originating in the carbonation system. Beets from normal storage conditions can create increasing difficulty in filtration as the storage period progresses. Such variables as temperature, pressure, amount of water and even carbonating conditions can be used to control this loss, usually at some additional expense.

This brings us to the major problem caused by beets which must undergo long storage periods: that of extraction. Figure 5 shows the resulting downward trend for extraction during the two typical process periods. This is primarily the result of the increasing amounts of sugar going to molasses during this period (Figure 4) which, in turn, is related to the increasing non-sugar load depicted by the downward thin juice purity trends of Figure 2.

Although the storage of beets contributes to a number of processing costs, including chemicals, limerock and fuel, it has its greatest influence in the loss in extraction. This fact provides tremendous incentive to find means of minimizing the effects of extended beet storage.

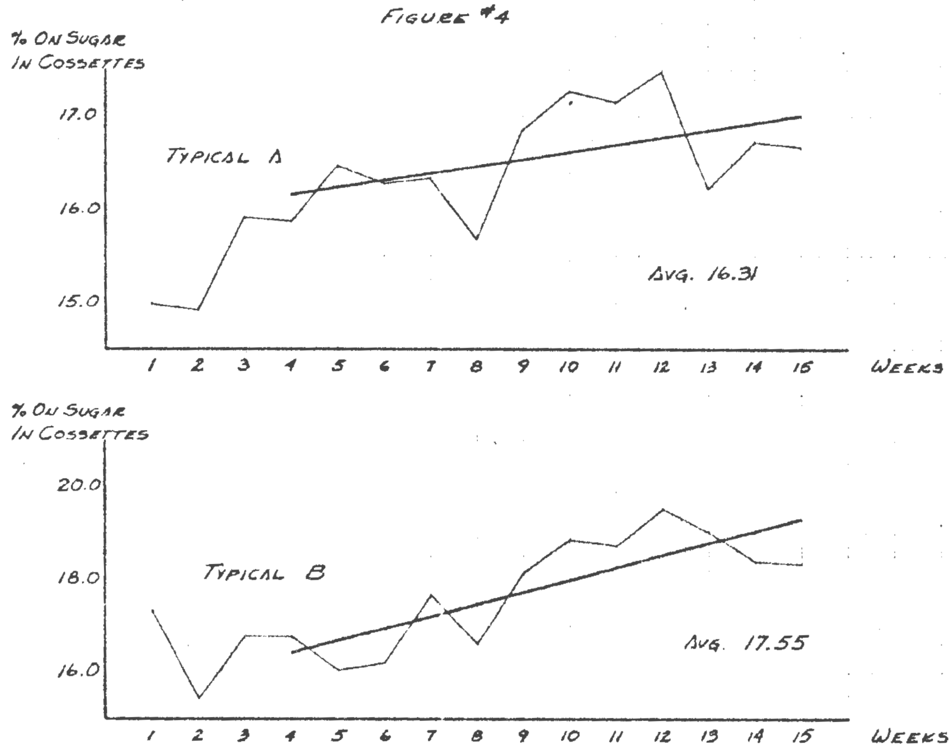
TOTAL KNOWN LOSSES

FIGURE #3



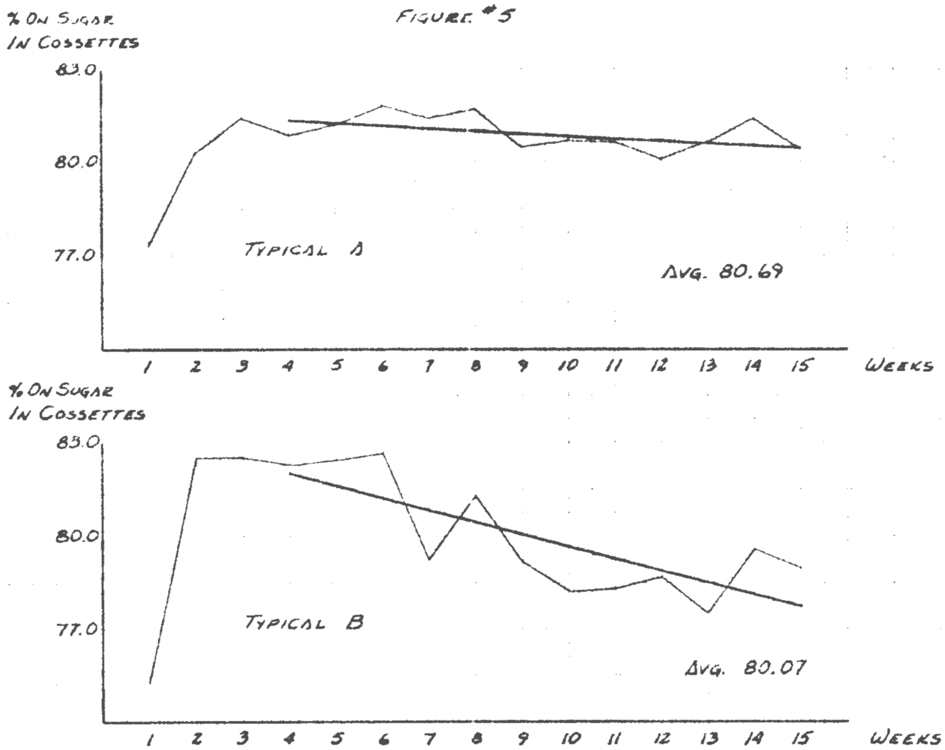

SUGAR IN MOLASSES

FIGURE #4



EXTRACTION

FIGURE #5



## DISCUSSION

Hobbis: I would like to hear a general discussion of the term respiration and exactly how much is involved there. Does respiration include the intermediate conversion of sugar? My understanding is that originally respiration applied only to $CO_2$ production. How do we separate these ideas as far as sugar in the beet is concerned and what terms do we use?

Wyse: Strictly speaking respiration would include only those reactions of carbon dioxide evolution and oxygen uptake. However, respiratory metabolism includes glycolysis (glucose conversion to pyruvate), the tricarboxylic acid cycle (pyruvate to $CO_2$) and electron transport ($H^+$ and $e^-$ to $H_2O$). Therefore, respiration in the beet root would include the conversion of sucrose to $CO_2$ but not sucrose conversion to raffinose and kestose.

Woods: Russ Johnson indicated that ventilation did not deter deterioration in rail cars, but Sherm Fox indicated that it did in trenches. Is this explained by oxygen supply, have you tried any carbon dioxide in those trenches or any deterrent?

Johnson: No, all we did was to hook two rail cars together and provide one with air scoops. This was in the summertime, temperatures were high and the only thing we did was to increase the temperature of the ventilated car. We have not tried increasing carbon dioxide or excluding oxygen.

Fox: We did store beets in trenches and we did ventilate with good results, but I think the difference is that we were working with temperatures below 40 F while Johnson is working with temperatures of 100 F.