Commercial Pile Experiments and Improved Methods of Storage at Great Western

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The Great Western Sugar Company has conducted extensive tests over the past 5 seasons to determine if storage pile rim protection is economical and what types of rim protection materials are most practical, economical and give consistent results.

The following is a typical experiment designed to study the effect of rim protection. Captive samples were buried in the outer 2 ft. of pile tops and sides and the following treatments were tested: no cover-sides, no cover-top, 6" straw-sides, 2" straw-top, 18" straw-side, 6" straw-top, woven polypropylene-sides, woven polypropylene-top, 6" straw covered with woven polypropylene-sides. The results of these tests are shown in Table 1.

While the treatments of 18" straw, plastic, and straw + plastic are the most beneficial on the rim itself, tests where entire piles were weighed and sampled show that 6" of straw on the sides and 2" of straw on top are most consistent in giving benefit. Our tests indicate a reduction in storage losses of 17 to 20% where recommended straw covering procedures are followed (Table 2 and 3).

Table 3. Summary of ten detailed test pile studies 1969-70, 1970-71, 1971-72

	Storage Days Avg.	Direct Sugar Loss Lb/T/Day	Recoverable Sugar Loss Lb/T/Day
Non-covered	104	0.334	0.445
Covered	106	0.262	0.352
Reduction in loss - %		21.1	20.9

In 1970 we first installed a 500 ton ventilated trench of beets in an ensilage trench in our Loveland factory district (Figure 1).

The beets came out of this experiment in excellent condition in mid-January 1971. A couple of isolated frozen spots never did thaw out and losses of just slightly over 1/4 lb/ton/day were experienced (Table 4).

This encouraged us to build a commercial size trench to store 10,000 tons of beets in the Lovell, Wyoming district in 1971 (Figure 2 and 3).

Beets in this ventilated trench were cooled down satisfactorily and were stabilized very near 40 F until January 1972. During a period of extremely cold weather with temperatures as low as -30 F natural convection currents in the pile froze massive areas of the pile from top to bottom. Even the soil under the frozen areas was frozen.

Table 1. Results of Rim Storage Studies - Kluver and Ward.

Storage Period (Avg.)	Treatment	Location on Pile	Loss Lb/T/Day		
			Weight	Gross Sugar	Recoverable Sugar
25	No cover	Sides	17.39 a**	1.823 a	1.823 a
	Woven polypropylene	Sides	7.57 b,c	.352 c	.414 c
	6" Straw	Sides	12.03 b	.581 b,c	.777 b,c
	18" Straw	Sides	10.85 b,c	1.050 b	1.111 b
	No cover	Top	15.12 a	1.697 a	1.893 a
	Woven polypropylene	Top	9.25 b	.534 a	.631 b
	2" Straw	Top	8.24 b	.506 a	.548 b
	Interior*		2.72	0.292	.405
49	No cover	Sides	16.49 a	1.226 a	1.142 a
	Woven polypropylene	Sides	6.87 c	.551 b	.564 b
	6" Straw	Sides	8.75 b	.596 b	.614 b
	18" Straw	Sides	8.34 b	.666 b	.677 b
	No cover	Top	10.94 a	.753 a	.740 a
	Woven polypropylene	Top	6.53 b	.498 b	.594 a,b
	2" Straw	Top	5.68 b	.448 b	.466 b
	Interior*		2.31	.230	.318
71	No cover	Sides	11.28 a	1.210 a	1.225 a
	Woven polypropylene	Sides	4.44 c	.282 b	.433 b
	6" Straw	Sides	5.42 b	.396 b	.541 b
	18" Straw	Sides	5.21 b	.431 b	.561 b
	6" Straw + woven polypropylene	Sides	3.29 d	.261 b	.411 b
	No cover	Top	7.82 a	.611 a	.707 a
	Woven polypropylene	Top	3.09 c	.208 b	.312 b
	2" straw	Top	5.71 b	.637 a	.661 a
	Interior*		1.90	.215	.300

*Determined from beets maintained under simulated storage conditions at Research Center.

**Statistical significance at the 5% level of treatments within a comparison (example: sugar loss - sides - 25 days) is indicated by the small letter following the mean. If two means are followed by the same letter, they are not significantly different. If they are followed by different letters, they are significantly different.

Table 2. Detailed Test Pile Results.

Factory District	Treatment	Days Storage	Loss expressed as lb/T/D			Percent Reduction in Loss Compared to Check		
			Rec. Sugar	Gross Sugar	Weight	Rec. Sugar	Gross Sugar	Weight
Gering	No cover	103	0.380	0.319	1.87	--	--	--
	Straw - 6"	98	0.286	0.290	1.52	24.7	9.1	18.7
Billings	No cover	123	0.458	0.299	0.77	--	--	--
	Straw - 16"	128	0.389	0.261	0.67	15.1	12.7	13.0
Ft. Morgan	No cover	96.5	0.420	0.328	1.67	--	--	--
	Woven poly	100	0.350	0.237	1.52	16.7	27.7	9.0
Greeley	No cover	77	0.367	0.278	1.88	--	--	--
	Straw - 6" + woven poly + ventilation	84	0.324	0.218	1.43	11.7	21.6	23.9
Goodland	No cover	108.5	--	0.310	1.67	--	--	--
	Straw - 6" + woven poly	113	--	0.247	1.34	--	20.3	19.8

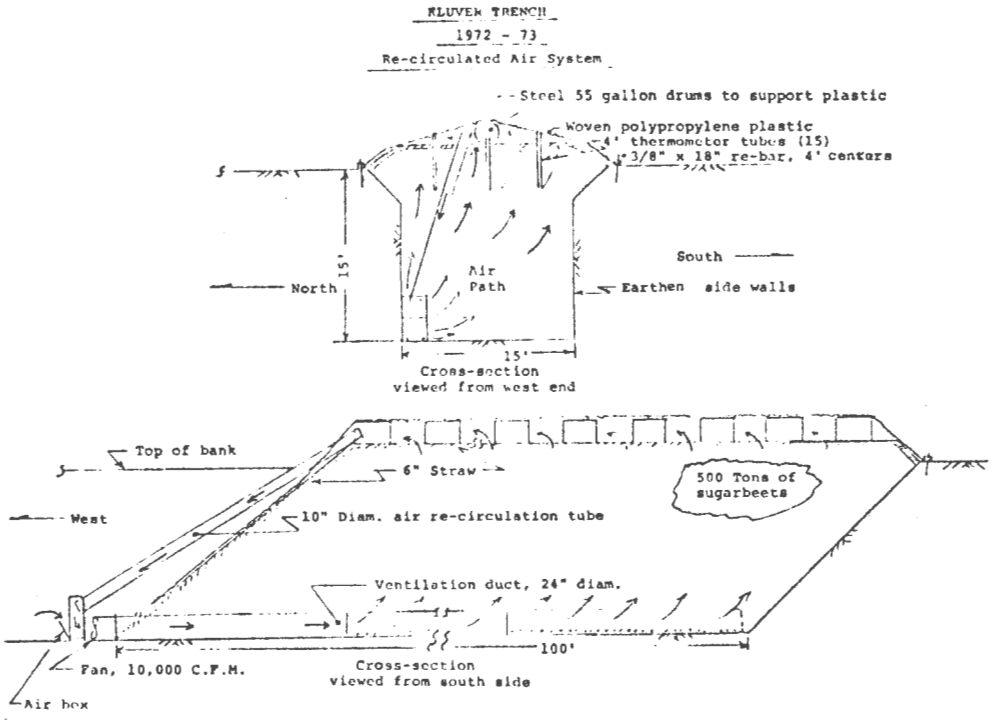

Figure 1.

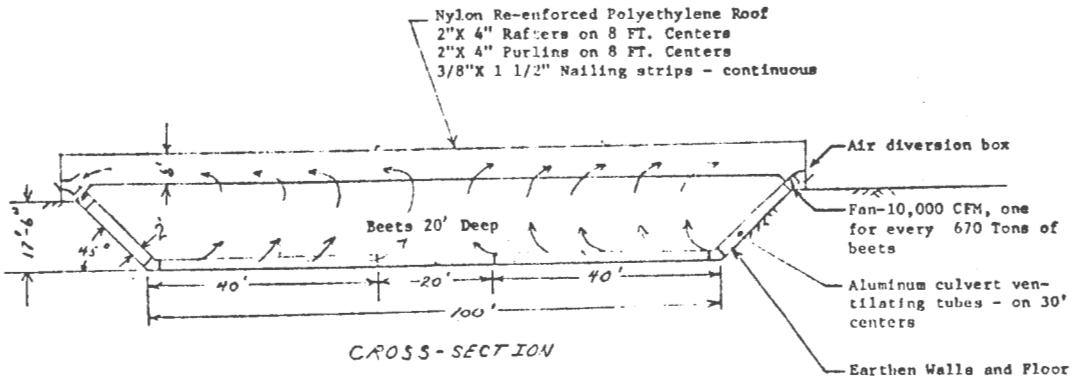

Figure 2.

Table 4. Summary of 500-ton trench storage tests.

Test	Days Storage	Recoverable Sugar Loss Lb/T/D
Goodland (71-72)	95	0.192
Loveland (70-71)	99	0.274
(71-72)	160	0.223
Avg. Straw Cover (70-72)	105	0.353

Table 5. Summary of 10,000 ton trench storage test.

Treatment	Days Storage	Recoverable Sugar Loss Lb/T/D	Reduction in Loss %
Covered above ground pile	124	0.433	--
Trench (1971)	119	0.372	14

The beets were removed before appreciable thawing occurred but isolated spots did thaw and rapid deterioration had started when the pile was removed in February 1972.

Though storage in the big trench was appreciably better than the check pile, it did not approach the 1/4 lb/ton/day that we were striving for (Table 5).

In 1972 we again filled the trench. A 2" X 4" rafter structure was placed on top of the pile and it was covered with plastic. Ducts and air diversion boxes were installed to re-circulate air after initial cooling had taken place (Similar to Utah and Idaho's 1971 system in Idaho Falls).

All season the interior was dripping wet. During -32 F weather over an inch of white frost accumulated all over the inside of the plastic. The beet temperature was stabilized very near 40 F and stayed there during the coldest weather. No freezing occurred except in a couple of isolated spots on surface beets adjacent to the N.W. walls where small air leaks occurred.

One section was left uncovered and heated air was forced in during cold weather. Freezing was prevented but dehydrated beets were evident for 3' around the air ducts at removal time of February 15, 1973. The beets were in excellent physical condition. No frozen or significant warm areas were found anywhere in the pile where re-circulation or heating was done. The beets processed in the factory like early December stored

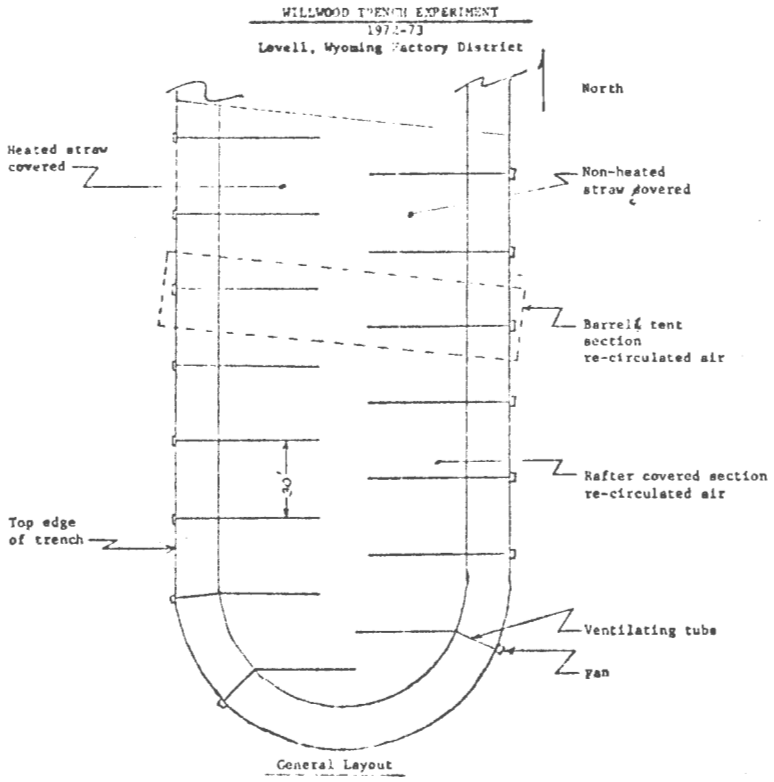

Figure 3.

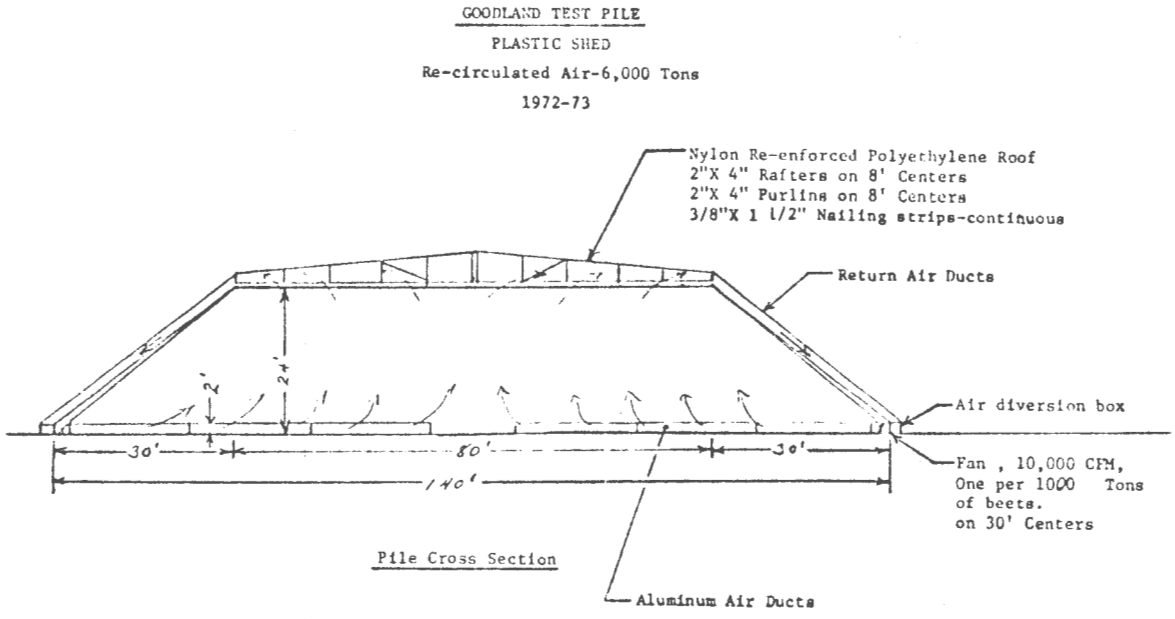

Figure 4.

beets and though final corrected figures are not in, the gross sugar loss was .21 lb/ton/day.

In 1972 a covered pile with a re-circulating air system was set up at Goodland Kansas (Figure 4).

I won't go into details on this pile since it is patterned after Utah-Idaho's system that they are reporting on. The beets were in excellent processing condition on February 2, 1972 and had a gross sugar loss of under 1/4 lb/T/day. Freezing did not occur, even on the side rim beets.

Beets under woven polypropylene on pile sides had less surface mold than beets under solid black plastic.

It appears to me that beets can be safely stored for processing into March in G.W.'s western districts if they are sheltered, above or below ground, and their pile air is continuously re-cycled through the pile.

In 1971 an aerial remote temperature survey was made of several beet piles on the Kansas and Nebraska area.

Consistent hot patterns on pile rims show the need for changes in piling methods and machines. Some work had been initiated in piler improvements.