Cold-Air Aeration for Temporary Storage of High-Moisture Shelled Corn

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Cold-Air Aeration for Temporary Storage of High-Moisture Shelled Corn

COOPERATIVE EXTENSION SERVICE
SOUTH DAKOTA STATE UNIVERSITY
UNITED STATES DEPARTMENT OF AGRICULTURE
Cold-Air Aeration for Temporary Storage of High-Moisture Shelled Corn

The Harvest "Bottleneck"

Cold-air aeration can be used for temporary storage of high-moisture shelled corn when drying facilities will not keep up with harvesting. It can also be used for storage of shelled corn for winter feeding.

Shelled Corn Storage Time

The length of time that shelled corn will keep in "cold storage" depends on the moisture content and temperature in the grain mass. Figure 1 shows the "TMT Curves" (time, moisture, temperature) developed by the USDA Agricultural Research Service at Ames, Iowa.

From these curves, it can be seen that when 22% moisture shelled corn is immediately cooled and stored at 40 degrees F, it will store safely for 60 days (note circle, Figure 1). The times shown on the chart are for a dry-matter loss of ½%.

Kernel Damage and Fine Material

Iowa research shows that field shelled corn that is 30% damaged mechanically will deteriorate three to four times faster than whole sound kernels.

Field shelling for cold-air aeration storage should be done with a minimum of mechanical damage and with a minimum of resultant material which interferes with air movement. Harvest is advised at 22%
When Will It Be Cool Enough?

Figure 2 shows the percent of night-time average temperatures (weekly averages) that will reach 40° or below for different locations.

<table>
<thead>
<tr>
<th>Dates</th>
<th>Huron Weather Station</th>
<th>Sioux Falls Weather Station</th>
<th>Yankton Weather Station</th>
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<tr>
<td>Oct. 4-10</td>
<td>15%</td>
<td>13%</td>
<td>10%</td>
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<tr>
<td>Oct. 11-17</td>
<td>26%</td>
<td>18%</td>
<td>15%</td>
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<td>Oct. 18-24</td>
<td>50%</td>
<td>70%</td>
<td>34%</td>
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<td>Oct. 25-31</td>
<td>74%</td>
<td>64%</td>
<td>60%</td>
</tr>
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<td>91%</td>
<td>87%</td>
<td>79%</td>
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<td>100%</td>
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</tr>
<tr>
<td>Nov. 29-Dec 5</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Figure 2. Probability (based on 70 to 80 years of records) of weekly average night-time temperatures being at or below 40 degrees. “Night time” refers to the 12 coldest hours of the 24-hour day.

Note from Figure 2 that if you live near Huron, you can expect the weekly night-time temperature to average 40° or less on 91% of time periods between November 1 and 7, or approximately 9 out of 10 years. November 1 is probably about the earliest that harvesting for cold-air aeration should be started in South Dakota.

The actual time you plan to hold shelled corn should be based on measurement of actual shelled corn temperatures in the pile (see Figure 1). For instance, if you store 22% moisture shelled corn and are not able to get the temperatures below 50° for 10 days, then you will have used 10 of the 30 allowable days, or one-third of the available storage time. If you then cool it to 40°, the time you have left would be about two-thirds of the time allowable at 40° (two-thirds of 60 days is 40 days). Your total storage time is then 50 days instead of the 60 days you would have had, if cooled immediately to 40°.

Aeration System

An aeration system that supplies ½ c.f.m. (cubic foot per minute) per bushel of storage is recommended. This can be a conventional bin with an aeration system of this capacity. Aeration fans should deliver the required amount of air at one or more inches static (water) pressure.

This type of aeration should not be confused with conventional aeration, which is concerned with cooling of dry grain. Aeration systems for dry grain use as little as one-twentieth c.f.m. per bushel.

A typical ¾ hp., 12-inch diameter aeration fan will move about 2,000 c.f.m. against 1-inch static pressure. This fan would be suitable for cooling about 4,000 bushels of high-moisture shelled corn (see Figure 3). The cold-air aeration system in Figure 3 uses two 40x50-foot sheets of plastic. The pile is about 34x44 feet on the ground, and capacity is about 4,000 bushels. A sheet 100 feet long would store about 10,000 bushels and require an 18-inch, 1½ - to 2-hp. fan delivering 5,000 c.f.m. and 18-inch diameter duct.

Operation

Shelled corn placed on the system should not be left over night, but should be cooled as soon as possible. Paper or plastic over the uncovered part of the perforated duct will direct air flow through the grain.

A sheet of plastic placed over the pile will be held down securely by the fan if edges are sealed. The edge of the bottom sheet can be rolled up and the top sheet tucked under it. Boards can be laid on top to keep sheets from coming apart when the fan is off. It probably will be necessary to operate the fan to hold the top sheet when it is windy, unless old tires or other weights are used to hold it down.

The fan should be operated, and air moved through the corn, whenever the outside air is colder than the corn. To check temperature of the corn, probes can be used, or a thermometer held at the fan discharge as it runs. Generally, air would be moved through the corn at night.

To allow air to move through the corn, lift the top sheet at the corners and slide a board inside on top of the corn, adjusting the four corners so air is moving, but with enough pressure remaining on top of the plastic sheet to hold it down. The sheet could be removed if there is no threat of rain.

This pile of shelled corn was kept cool by aeration until the drying system was able to “catch up” with harvest. The pile held about 3,000 bushels. A 12-inch diameter aeration fan and 12-inch diameter ducts were used.
Figure 3. 4,000-bushel aeration system using two 40x50-foot plastic sheets.

An easy method of checking for spoilage or heating is to smell the exhaust air. Corn “going out of condition” has a distinctive spoiled odor.

Once corn is cooled to 40° or less, operate the fan at least twice a week to check temperature and re-cool if necessary. Corn will not necessarily stay cool, once cooled, because of the self-heating that takes place.

While loading shelled corn on the pile, check the “over” measurement to be sure that the upper plastic sheet will cover the corn. Make allowance for the fact that during aeration corn on the surface will dry, and the pile will spread. The above measurements are based on dry shelled corn, so if height is not over 9 feet, width should be 34 feet or less.

Any heating will shorten allowable storage time considerably.

Corn may dry one to two percentage points in the cooling process. As it dries, the top corn will roll...
down the slope, and the pile will cover more ground area than before. Allow extra plastic at ends and sides for this movement.

Actually, the limiting measurement of the pile that a 40-foot wide plastic sheet will cover is the "over" measurement. Check this as you fill and allow some extra for spreading of the pile.

**Drying Method After Cold Storage**

Usually, a hot-air drying method will also be necessary after storage of corn, since temperatures late in the season will be too cold for economical in-storage drying with supplemental heat ("controlled humidity").

Cold-stored corn can be batch-dried in a drying bin, in a conventional batch dryer, or in a continuous-flow dryer. Corn temperatures during the drying should not exceed 140° F. for corn to be marketed, because of the detrimental effects of excess heat on corn-refining processes.