DRYING AND STORING SHELLED CORN

No. 8 October 1974 Extension Bulletin E-799

Grains can be stored for several months or even years with little or no detectable loss of quality if stored under the proper conditions. However, if improperly stored, grain can begin to spoil in a matter of a few hours. Spoilage is the result of the growth of microorganisms. Factors influencing this growth are:

1. Moisture content of the grain.
2. Temperature.
3. Condition or soundness of the grain.

The relation between air temperature and grain storage time of different moistures is shown in Table 1. If grain is held longer than the time shown in the table, loss in grain quality caused by mold will lower the grade. Note the short time grain can be held at the average harvest moisture of 25% to 30% with temperatures above 60°.

Harvesting Shelled Corn

Field studies show as much as 25% to 35% visible kernel damage for field shelled corn at 28% kernel moisture. Both visible and invisible kernel damage increases as the kernel moisture increases at harvest. This kernel damage is no particular problem for corn stored as "high moisture grain" except to increase the treatment problem for corn preserved by acid treatment. However, for corn that is dried the damaged kernels increase the opportunity for mold growth, result in more broken kernels and fines during drying and handling and can increase the cost of drying.

Reduce kernel damage by:

1. Adjust combine frequently as recommended by manufacturer.
2. Keep ground speed of combine at manufacturer's recommendation
3. Avoid overloading the combine by slowing down.
4. Harvesting as much grain as possible between 26% and 28%.

Table 1. Maximum time for storing shelled corn at various corn moisture and air temperatures.

Storage air temperature (fahrenheit)	Corn Moisture Content			
	15%	20%	25%	30%
	Days			
75°	116	12.1	4.3	2.6
70°	155	16.1	5.8	3.5
65°	207	21.5	7.8	4.6
60°	259	27	9.6	5.8
55°	337	35	12.5	7.5
50°	466	48	17	10
45°	725	75	27	16
40°	906	94	34	20
35°	1,140	118	42	25

Drying Shelled Corn

Moisture evaporates from grain at basic, predictable rates. There is no magic about grain drying and no short cuts. It requires 1,800 to 2,000 BTU to evaporate a pound of water from shelled corn through a mechanical drying system. Kernel temperature is the critical temperature, but since it is difficult to measure, air temperature is the indicator of what is happening. Control devices sense air temperature rather than kernel

temperature. Recommended air temperatures for drying grain are:

100 to 110° for seed; 140 to 150° for food grains; 160 to 180° for feed grains.

Actual grain temperatures, however, vary with the rate of air flow in relation to the air temperature, and the time of exposure to the heated air--so follow manufacturers recommendations.

Overheating causes the greatest damage to farm-dried grain. Since the air flow is fixed by the manufacturer, the only adjustment available is temperature. Many operators increase the drying temperature to speed drying particularly for high-moisture grain. This causes burning, uneven drying, and increased kernel breakage reducing corn quality. When drying conditions are poor, lowering the drying temperature slows the drying but improves grain quality.

Grain depth is important to in-bin drying. Air flows fall off as grain depth increases. Variation in the final grain moisture between the top and bottom layers results from the combination of air temperature, air flow and grain depth. Stirring devices reduce this moisture variation for in-bid dryers and increase drying capacity but cannot compensate entirely for this variation. Drying temperatures below 100° will yield better quality grain than temperatures over 100°. An in-bin dryer is a low-volume drying unit. Increasing the drying temperatures does not overcome this characteristic.

Grain depth and drying temperatures are important to quality drying for batch-in-bin dryers, and modified bin dryeration units that transfer hot grain to another bin for cooling. Follow manufacturer's recommendations carefully. Reduce grain depths and drying temperatures if drying results are not satisfactory.

Uneven drying can occur in any type of dryer from uneven air distribution in the plenum chamber, plugged perforations in the floor or wall of the dryer, or from outside wind pressures. New dryers should be checked carefully for hot or cold spots by grain sampling or feeling the grain or dryer surfaces.

Farm dried grain can be equal in quality to commercially dried grain if the farm operator will familarize himself with the drying process and the dryer.

Aeration of Grain

Grain dried properly to 15% moisture content and cooled to 40° by an aeration system will remain in good condition into the following summer.

An aeration system should exhaust air from the grain bin at a rate of 1/10 to 1/4 CFM (cubic feet per minute) per bushel of grain stored. Start aeration after the grain bin is filled when air temperatures drop 10° to 15° below the temperature of the grain in the bin. Operate the aeration whenever outside temperatures drop below grain temperatures until the grain is cooled to 40°. A thermometer hung in the aeration fan discharge will give a good indication of grain temperatures in the ben. Cooling grain usually requires 100 to 130 hours of fan operation.

Aeration prevents moisture migration within the stored corn and extends the storage life of the corn by cooling it. Moisture migration results from warm air in center of grain mass moving upward as the outside of the grain mass is cooled by colder fall temperatures. The warm air, is relatively high in moisture, which condenses onto the colder grain or bin surfaces resulting in crusting and mold growth.

Checking the Storage Bin

Grain bins should be inspected regularly during filling, during aeration, and during the storage period through winter, spring and summer.

Check for odor, condensation on grain bin walls and grain, and crusting or mold growth on the corn.

In-bin dryers are particularly susceptible to moisture condensation on side walls. Check carefully for moisture. Run fan until all condensation is evaporated and grain next to the side wall is dry.

If odor, condensation or crusting is detected, run aeration fan or drying fan without heat until condition is corrected.

If fines accumulate in the center of the bin during filling, draw off 20 to 30 bushels if there is a center or bottom unloading auger. This will remove most of the fines, remove the possibility of a hot spot developing and permit better air movement during aeration.

Do not enter a grain bin when unloading equipment is running when it might start automatically or be started by another person. It only takes a few seconds to be pulled into moving grain to the point where escape becomes impossible.

Many hundreds of dollars are lost in grain quality each year from failure to inspect grain storage, recognize danger signals, and take corrective action.

Check Grain Moisture

The only sure way to determine the moisture content of grain is with a moisture tester. Checking grain moisture into and out of a dryer frequently is the best guide to the performance of a dryer. Grain moisture can also provide guidance for adjusting dryer heat, the flow rate through automated batch and continuous flamedryers, and grain depths for in-bin drying units.

Moisture is evaporated from the surface of a corn kernel. As grain dries, the movement of moisture within the kernel slows. Thus, grain from a dryer where 10 to 15 points of moisture have been removed, will usually check low in moisture as it comes from the dryer. After grain stands 24 to 48 hours, the moisture in the kernel equalizes, and the true grain moisture can be determined, and it may be 1% to 2% higher than shown by the grain checked from the dryer.

Calibrate a moisture tester at least seasonally by checking it against an elevator moisture tester, by taking a sample of grain in a plastic bag or sealed jar to the elevator along with the farm moisture meter. Check the grain on both dryers. Overdrying 1% or 2% costs money. Underdrying can cause storage problems.

Grain Damage from Handling

The major causes of fines and broken kernels are high kernel moisture at harvest, incorrect combine adjustment, high heat in dryer, overdrying, long grain drops without cushion boxes to break the fall, and partially filled augers. Corrections can be made in most grain systems to reduce fines and broken kernels to an acceptable level of 2% to 3%. Careful inspection at various handling points in the grain system may pinpoint a specific problem. If augers are causing breakage, slow the auger speed so it runs three quarters or more full.

Recommended Storage Moistures

Dry Shelled Corn - 15% for short-time storage (October - May) with aeration.

Dry Shelled Corn - 14% for long-time storage with aeration.

High Moisture Shelled Corn - silo storage; ideal kernel moisture is 28% with a recommended range from 25% to 30%.

High Moisture Shelled Corn - acid treatment; 22% to 24% with a range of 20% to 30%. The amount of acid required and the cost increase with moisture content.

High Moisture Ear Corn - ideal ear moisture is 32% with recommended range from 30% to 35% ear moisture.

Ear Corn - Natural Ventilation - recommended kernel moisture of 20% with a limit of 24% in 6-foot wide cribs or round cribs with no more than 6 feet of corn between center air tunnel and outside of crib.

Ear Corn - Forced Air Ventilation with Unheated Air - recommended kernel moisture 22% to 24% with limit of 26%.

By Robert L. Maddex, Extension Specialist, Agricultural Engineering,
Michigan State University

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Gordon E. Guyer, Director, Cooperative Extension Service, Michigan State University, East Lansing, Michigan 1P-20M-10:74-UP