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# Moisture Migration in Stored Grains [1]

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A grain farmer may have the returns from much of the year's work stored on the farm for future feeding or sale. To minimize the risk of post-harvest losses, the grain must be placed in storage at the proper moisture content and temperature. It must be aerated, and a regular and accurate method of inspection and sampling followed to maintain the stored grain quality. For additional information concerning sampling procedures refer to the extension publication entitled *Grain Sampling* . Potential problems exist when: 1) damaged and/or high moisture grain is stored; 2) the aeration system is inadequate or improperly used; or 3) the grain bin is incorrectly filled or unloaded. For additional information concerning principles of grain storage, refer to the extension publication entitled *Grain Drying and Storage on Florida Farrns.*

Grain is a good insulator; heat loss from grain is relatively slow in comparison to other materials. For this reason, when grain is placed in a bin in the fall, the grain near the center tends to maintain the temperature at which it came from the dryer or field. The grain near the bin wall tends to cool near the average outside temperature. As the outside temperature decreases, the difference in temperature between the grain at the center of the bin and that near the bin wall produces air currents inside the grain mass. The cool air near the bin wall falls since it is more dense, forcing the warmer air up through the center of the

). As the cold air passes through the center of the grain mass, it warms and picks up more moisture. As this air nears the top center surface of grain, it cools to a point where it can no longer hold the moisture it has picked up. This moisture condenses on the surface of the grain, increasing the surface grain's moisture content and creating a local environment that enhances mold or insect growth. This surface moisture change can occur even though the average grain moisture content is at or below recommended levels. The reverse situation occurs during the

). In this case, the moisture condenses near the bottom center of the grain mass. Generally, the problem of natural air currents developing within a bin may be minimized by covering fan outlets when not in use and by keeping the grain temperature in the center of the bin within 10°F of the average grain temperature near the bin wall. Temperatures can be

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maintained in most farm structures by using aeration fans that pull air down through the grain at airflow rates of at least 0.25 cubic feet per minute (cfm) for each bushel of grain in the bin until the temperature of the grain mass is within 10°F of the average monthly temperature. A slightly lower airflow rate may be used in very large farm or commercial structures. However, it is not necessary to lower he temperature of the grain mass below 40°F because fungi that attack stored grain cannot develop below this temperature. Also, the aeration system should not be used to raise the temperature above 60°F because mold and insect growth occur at a much faster rate above this temperature. (For additional information concerning insects refer to the extension publication entitled *Pest Management Strategies for Storing Grain in Florida* .) It takes approximately 120 hours (five days) for the entire grain mass to cool or warm when air is supplied at the rate of 0.1 cfm per bushel. This time is reduced to 12 hours when the airflow rate is increased to 1 cfm per bushel, which would be typical of the performance of a drying fan used for aeration.

The types of aeration systems and methods of bin filling determine the probable storage problem locations within the bin.

## Aeration Systems

Most modern grain storage bins are equipped with either subfloor aeration ducts or perforated floors. Subfloor duct systems may be of several types usually resembling an "X" "Y," or "I" type system ( Figure 3 , Figure 4 , and Figure 5 ).

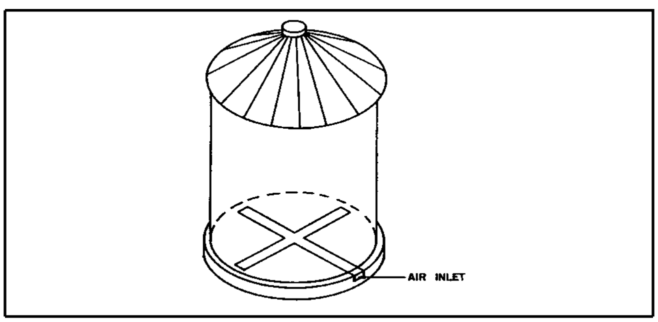


**Figure 3 .**

Air flows along the path of least resistance; hence, there may be "dead space" areas through which very little air passes when using a duct type aeration system ( Figure 6  and Figure 7 ). Likewise,

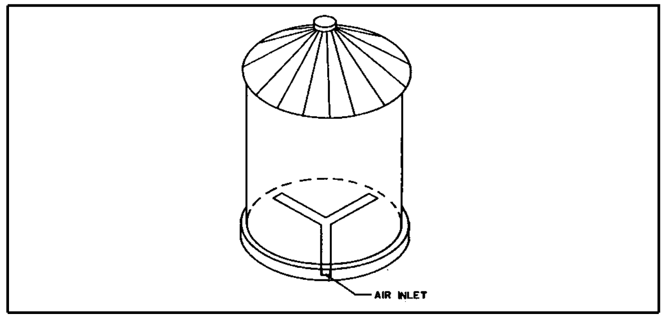


**Figure 4 .**

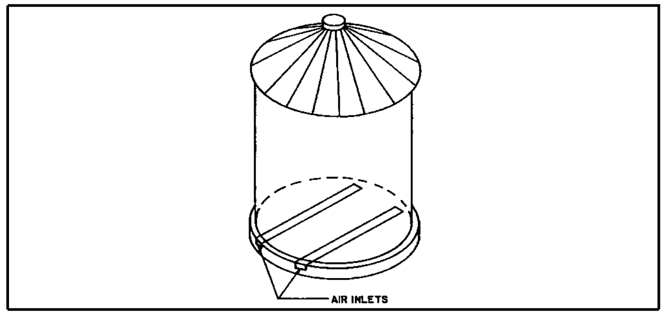


**Figure 5 .**

overfilling of a bin may create "dead space" zones ( Figure 8 ). When inspecting a bin for possible trouble spots, be sure to probe into these "dead space" zones if possible.

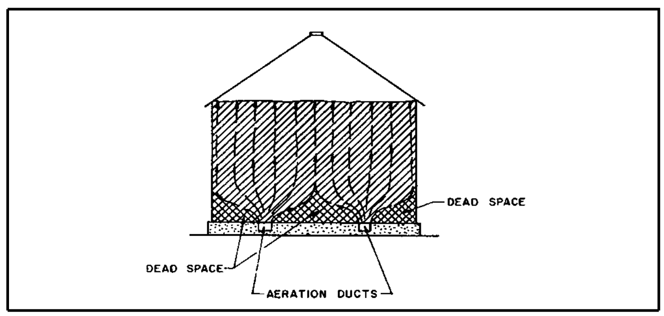


**Figure 6 .**

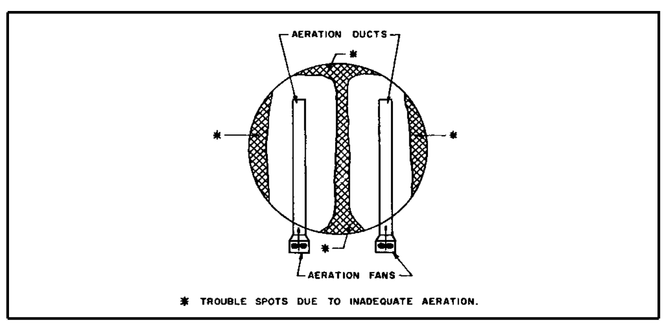


**Figure 7 .**

The best method for distributing air evenly through the grain mass is to use a perforated floor ( Figure 9 ). However, if improper filling procedures are used, possible trouble areas could still occur if

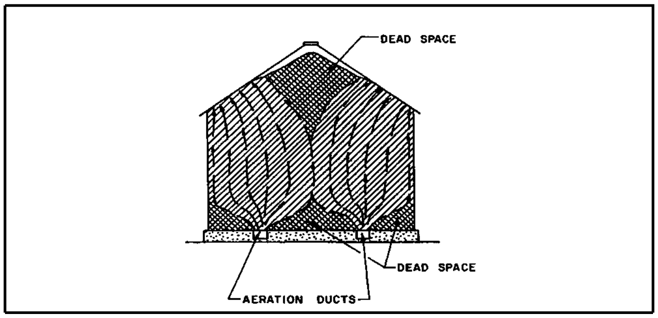


**Figure 8 .**

there is an accumulation of fine material and foreign matter in the top and bottom centers of the bin ( Figure 10 ). Likewise, overfilling may present the same problem for bins equipped with perforated floors as for those with duct systems ( Figure 8 ).

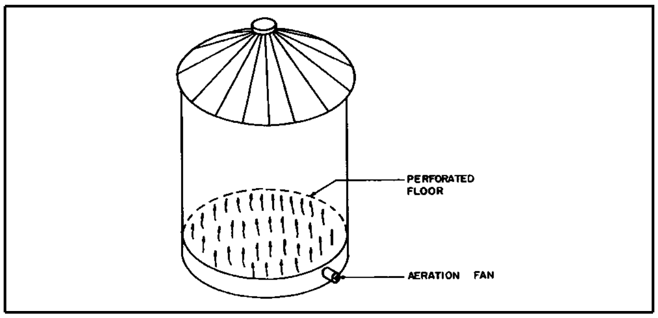


**Figure 9 .**

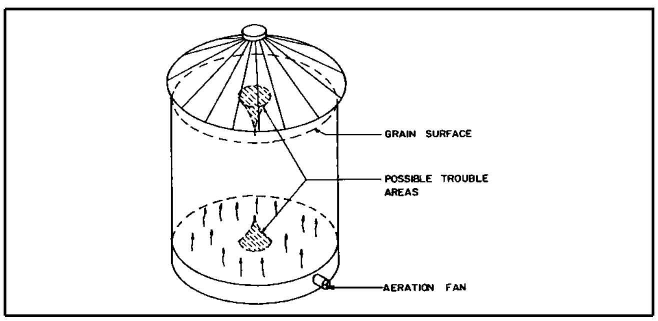


**Figure 10 .**

## Summary

This publication has discussed moisture migration in grain storage structures, problems caused by moisture migration, and management steps to prevent these problems. Successful storage of grain begins with preharvest management practices to insure proper grain bin sanitation and insect control followed by proper drying of the grain. The grain must be monitored during storage to head off storage problems. Aeration should be employed to help maintain grain quality in storage, to insure uniform temperature throughout the grain mass, and to prevent moisture migration.