Batch Dryers

Natural or Ambient Air Dryers

Natural air/ambient air drying is the simplest and most energy efficient type of grain drying. It requires a storage bin with a full perforated floor, a maximum grain depth of about 20 feet for corn and a blower to move air through the grain (Figures 12, 13). If the corn from the field is less than 20 to 22 percent moisture, the grain can be dried with just ambient air. The grain should be screened before filling the bin to remove fines and broken kernels that would clog the perforated floor and reduce airflow. Leveling the grain is necessary to achieve uniform drying. The fan must run longer to dry the peak if the grain is not leveled, which increases drying time and cost. Drying shallow depths increases airflow and reduces drying time. If multiple bins are available, each bin can be filled with a layer of grain before adding more to the first bin. Airflow rates need to be 1 to 1.5 cubic feet per minute or higher depending on location. Contact your local University Extension agent for airflow recommendations.

During a fall harvest season with low humidity, ambient drying will have the highest energy efficiency. During a fall with cool or damp weather, the grain may not be dried to the recommended storage moisture before winter and drying must be finished in the spring. If the weather is warm (average above about 60 degrees), or the grain is high in moisture (20 percent or more), spoilage can occur before the grain gets dry at the top of the bin. After sundown or during misty cloudy conditions when average relative humidity exceeds 80 percent, adding enough heat to warm outdoor air by 5 to 10°F increases drying speed but increases the amount of energy used. A disadvantage of this dryer type is that grain on the bottom can be over-dried if outside air relative humidity is low or if too much supplemental heat is added. A stirring device can reduce over-drying of the grain, improve airflow, and decrease drying costs by about 20 percent.

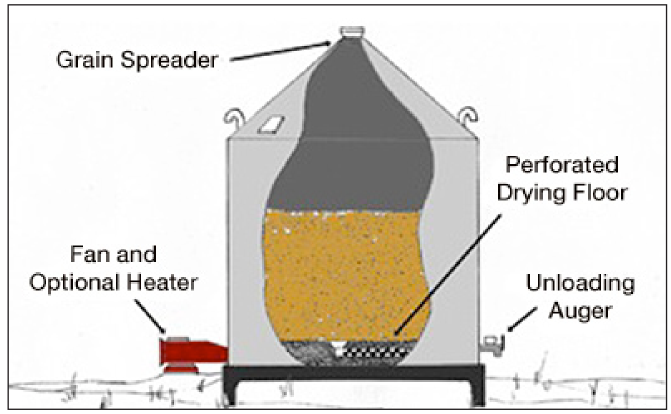

Figure 12: Low-temperature bin dryer components. Source: Scott Sanford

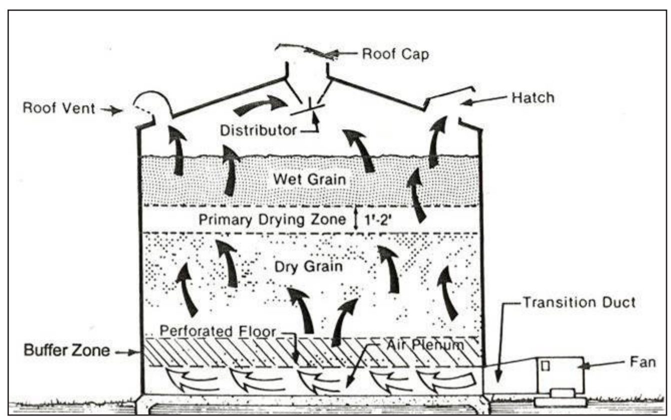

Figure 13: Bin Dryer. Source: K. Hellevang

Ambient or natural air dryers have efficiencies of about 1,500 to 1,650 Btu per pound of water removed if fans are sized properly and grain depth is not excessive. Energy consumption increases when supplemental heat is added, but is an economic trade-off to preserve grain quality and value.

High Temperature Bin Dryer

A high-temperature bin dryer (Figure 14) uses the same equipment as the natural air dryer with the addition of a propane- or natural gas-fired high capacity heating unit. The plenum temperatures are usually set at approximately 140°F. The disadvantage of this dryer type is that in order to get the grain on top dry, some of the grain on the bottom gets over-dried. This reduces grain weight to sell and increases energy use. Stirring equipment can reduce the moisture variation, decrease drying times and reduce energy costs by up to 30 percent. Using stirring equipment is encouraged with high temperature bin dryers because it reduces over-drying grain at the bottom of the bin. The energy efficiency for these dryers is about 2,500 Btu per pound of water removed. It should be noted that the cost for electrical energy used to operate stirring equipment is recovered by the savings in over-drying grain and in LP or natural gas needed to heat drying air.

Stirring

In-bin stirring devices consist of a vertical auger-like mechanism that rotates in a circular path slowly around the bin (Figures 15, 16). The stirring device moves grain vertically, lifting dry grain from near the floor and allowing moist grain to fall and replace it. A stirring device should be run continuously when drying with a high temperature bin dryer. In an ambient or low-temperature dryer it is recommend to run the stirring device once after filling, if harvest moisture was greater than 20 percent then a second time when the grain is dried to about 18-20 percent moisture and a final time when the grain has reached the desired storage moisture. The disadvantages of stirring mechanisms are maintenance requirements and mechanical breakdowns. Grain stirring after filling can increase airflow by a third, thus reducing drying times, but excessive stirring will cause fines to accumulate on the perforated floor and block airflow, thus disrupting the drying front and increasing drying times.

Figure 14: High-temperature bin dryer.
Source: Scott Sanford

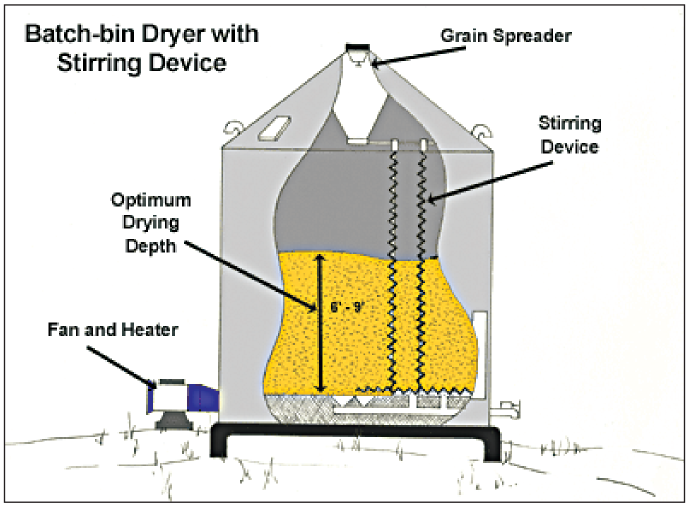

Figure 15: High-temperature bin dryer.
Source: Scott Sanford

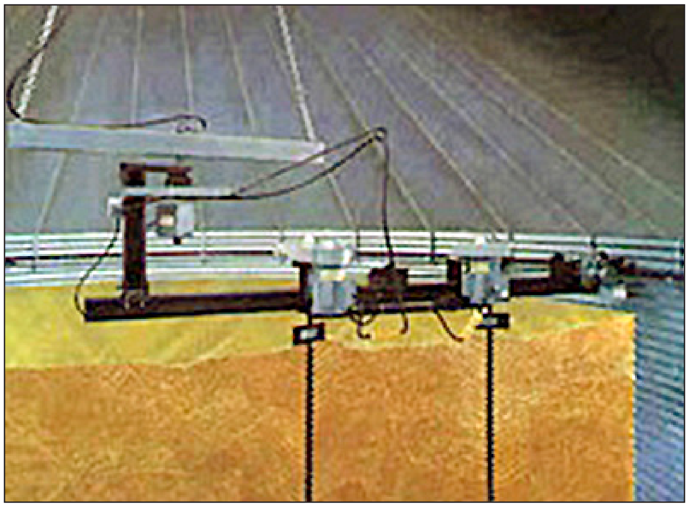

Figure 16: Cut-away view of a stirring device
Source: NECO

Roof Dryers

As the name implies, in this system the drying floor is in the roof area of the bin, Figure 17. The grain is piled on top of a suspended, perforated floor at a depth of about 16 inches. Once dried, the grain drops to the bin floor through hatches and chutes in the drying floor. The grain is then cooled. The air heated by the cooling process helps dry the grain in the drying chamber. Aside from managing the drying process to provide uniform airflow (cleaning) and prevent over-drying, there are no energy efficiency options to further reduce the energy use in this type of dryer. The efficiency of this type of dryer is about 2,300 Btu per pound of water removed.

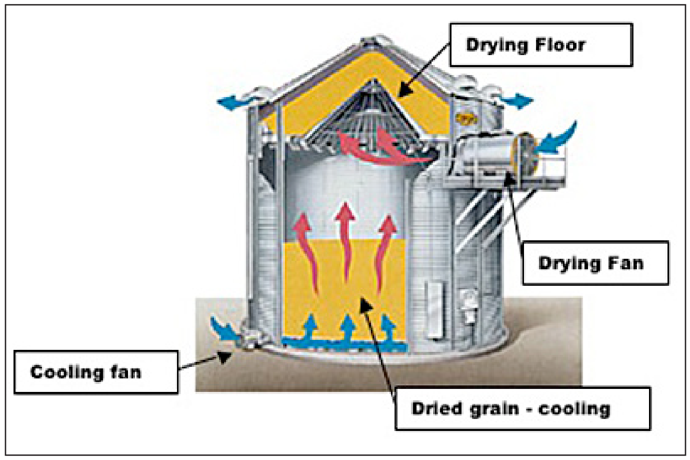

Figure 17: Roof dryer. Source: Grain Systems Inc.

Batch Column Dryers

These are typically small dryers that have a central plenum surrounded by column of grain (Figure 18). They may be stationary or portable (Figures 19, 20) and can be manually or automatically loaded and unloaded. Some are powered from a tractor PTO, which allows them to be used almost anywhere. Their major disadvantages are that they cannot be easily automated, so require more supervision and labor per bushel than other types of dryers and they have a large temperature and moisture variation across the grain column. The energy efficiency is about 2,500 to 3,000 Btu per pound of water removed. Using in-bin cooling or dryeration, and taking care to prevent over-drying, can improve energy efficiency.

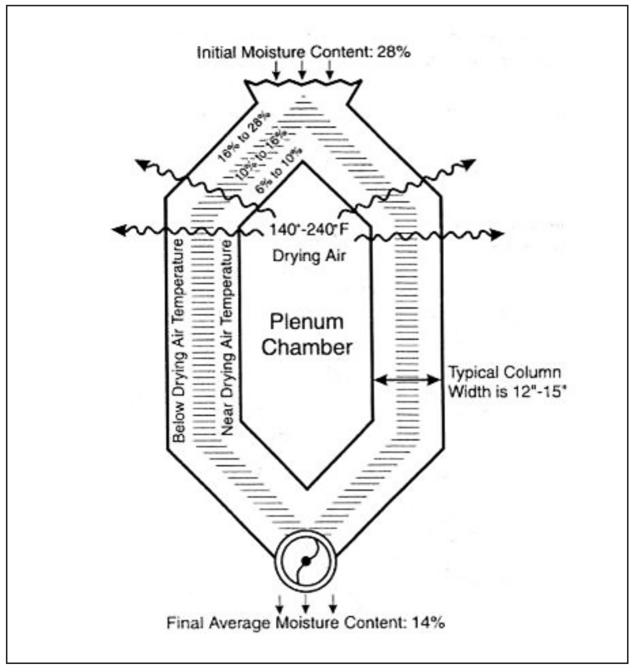

Figure 18: Column dryer. Source: Scott Sanford

Figure 19: Stationary cross-flow batch dryer. Source: K. Hellevang

Figure 20: Recirculating Batch Dryer. Source: Scott Sanford

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