National Food and Energy Council

AT-102

END USES:
Long Term Storage
High Quality Product
Oil Seed Drying

APPLICABILITY:
Farms With Ample Storage
Cereal Grains, Wheat, Soybeans
Grain Belt Climates

OBJECTIVES:
Peak Clipping
Strategic Load Growth
Strategic Conservation

STATUS:
Equipment Readily Available
Widespread Use, Many Areas
R & D Continuing

Ag Technical Brief

This work done under contract with the Electric Power Research Institute.

Grain Drying—Unheated Air

DESCRIPTION

Unheated air grain drying, often referred to as natural air drying, makes use of the air's natural capacity for absorbing moisture and the fact that air with a relative humidity of from 60 to 70 percent will dry grain to a moisture level that is safe for long-term storage. Vaneaxial fans (short bladed fans in cylindrical housings) capable of developing up to 4 inches of water column static pressure, and centrifugal fans (rotors with very short blades mounted in scroll housings) capable of developing up to 8 inches of water column, force air through several feet of damp or wet grain.

Once the drying process is begun, air is generally moved through the grain regardless of local weather conditions. Completely saturated air (100% relative humidity) exists only under intense fog or rain conditions. Even then a 1 to 3°F temperature rise is imparted to the air by the heat of compression. As this air passes through the fan, the relative humidity is reduced to less than 100% before entering the grain. Although very high humidity air removes only small amounts of grain moisture and will not dry the grain to safe storage moisture levels, any heat buildup in the grain is controlled by continuous air movement.

Unheated air drying is a slow process requiring from several days to a few weeks to effect complete drying of the grain. Actual drying time depends upon airflow and weather conditions. However, the risk of inadequate drying is minimal when equipment is properly sized, installed and operated.

Specifications

Unheated air drying normally takes place in grain storage bins equipped with fully perforated floors as the required long periods of drying do not fit batch or continuous flow systems. Airflow rates from 1 to 3 cfm/bu delivered to grain having moisture contents from 20 to 26 percent, wet basis, are achieved by installing 1 to 3 horsepower (0.75 to 2.25 KW) of fan power for each 1,000 bushels of grain to be dried. Grain depth must be considered to keep static pressures, against which the fans must operate, within reasonable limits. For example, maximum shelled corn depth for an air flow of 1 cfm/bu is about 22 ft. Maximum depth decreases to 12 ft., or less, at 3 cfm/bu. Higher air flows (cfm/bu) can be obtained by partial filling of bins. Bin capacities can range from 3,000 bu (18 ft. diameter) to 30,000 bu (48 ft. diameter).

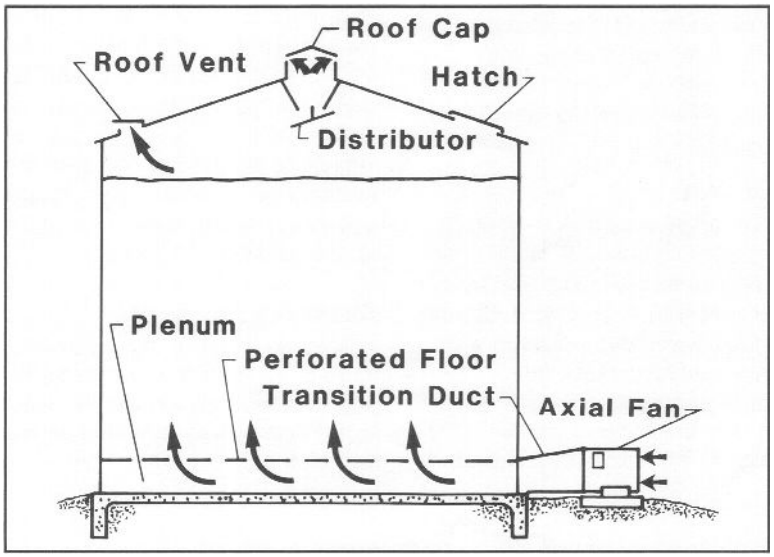
Applicability

Properly managed, unheated air drying can be successfully used to remove excess moisture from grain under most climatic conditions. It has been particularly successful in the corn belt when applied to the drying of cereal grains harvested between late September and late November, when average daily air temperature drops to below 50°F. In most years, the relative humidity during this period allows corn to dry to 14 or 16%, wet basis.

Soybeans, wheat and grain sorghum, generally harvested at moisture contents considerably lower than corn, can be dried with essentially the same equipment as used for corn. Other grains, in regions with different climatic conditions, may require special attention.

Implementation Considerations

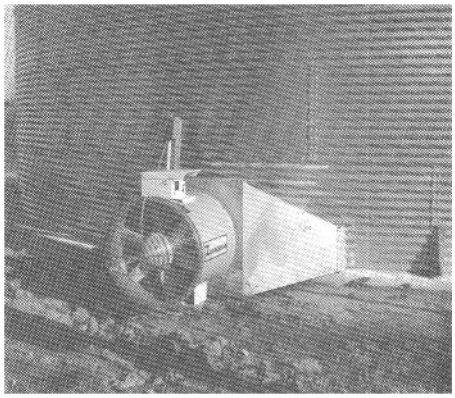
Unheated air drying of grain is often not as readily accepted by grain producers as heated air drying because of a lack of knowledge of the potential for unheated air to remove moisture from



Typical unheated air crop drying system

a wet-grain product. It may be necessary to explain the concept, i.e., "sell the idea", based on the success of drying corn in the corn belt. Climatic conditions that are significantly different from "corn belt" weather during and following the harvest of a crop, should be carefully reviewed with respect to its effect upon unheated-air crop drying practices.

An advantage of unheated air drying is that it can be used in combination with an existing heated air grain drying facility, as well as being installed as a "stand alone" drying system.



Properly sized electric motor driven fans installed on bins dry grain with unheated air.

EVALUATION

Availability

Most manufacturers and suppliers of grain drying equipment have matched grain bin and fan units that are available for unheated air drying on almost any size operation. Some fan manufacturers promote unheated air drying as a part of their crop drying equipment advertising. Properly selected fans, capable of developing those static pressures required to move air through grain, can be installed on any suitable grain drying bin or building.

Cost Per Unit

Fans will range in cost from $100 to $200 per hp (0.75 kW) with centrifugal fans costing more than vaneaxial fans. Fans powered with three-phase motors will cost less than those powered with single-phase motors. However, three-phase electrical service is not available to many farms.

Electrical wiring and concrete pads on which to place fan-motor units are part of installation costs, as well as are costs associated with any modification of existing bins, i.e., the placing of fully perforated floors in bins used for drying.

Reliability

Fans powered with electric motors are very reliable. Normal maintenance of fan and/or motor bearings should be performed if and as required. While many unheated air drying systems operate without complicated controls, any associated controls require normal maintenance to insure proper functioning, reliable performance and long life.

Utility System Benefits

Unheated air grain drying has a good load factor during and following the harvest season for a particular grain. Corn drying equipment provides a steady electrical load for approximately 8 weeks, primarily during October and November. Therefore, it is normally a valley-filling load that does not add to summer or winter peaks. In addition, it is a load that can be turned OFF during daily peaks, if necessary, as short interruptions of the drying process is not detrimental to the quality of the end product.

Customer Benefits

Farmers using unheated air drying systems consistently produce very high quality grain that has a uniform moisture content. In some grain marketing situations, this helps meet grain quality specifications demanded by a "food grade" grain buyer.

Energy requirements for drying are low, ranging from 0.1 to 0.2 kWh/bu per percentage point of moisture removed from corn. Unheated air drying systems can relieve or eliminate harvest delays that are often created by capacity limitations of rapid drying systems. The capacity of unheated drying systems is essentially equal to the total volume of space available for storage.

Customer Acceptance

In some areas of the corn belt 25% or more of all corn dried on farms is dried with unheated air; or with air heated very little. Farmers like unheated air drying because it places little, if any, restriction

Inspection of a farmer's unheated air dried corn indicates this method of drying results in very high quality grain.

on harvesting rates, has low labor requirements, and has great potential for saving energy. The method is also readily adapted to existing grain drying and/or storage facilities which can be modified at low cost. A few successful systems in a community encourages others to adopt unheated air drying of grain.

Utility Programs

Many midwest electric power suppliers promoted low or no-heat grain drying in the late 1960s to mid-1970s in order to build electric energy loads, particularly during the off-peak season of late September through November. Load curve valleys were filled with little or no special rate incentive. During those years, many studies on the progress of drying, energy requirements, and quality of the grain were conducted by both power supplier and university researchers.

Comments

A collaborative educational effort among electrical power supplier, equipment sales persons, and cooperative extension educators has been a good approach to promoting unheated air grain drying.

Numerous publications, now readily available from county extension offices, universities, equipment manufacturers and power suppliers, were prepared as a result of early investigations. Utilization of this information can encourage unheated air drying in regions where the method is not now practiced.

See the Technical Brief on **Grain Drying—Low Temp Electric** for additional information on low heat grain drying.