Airflow Rate is Key to the Natural Air Drying of Grain

Natural air drying uses the drying potential of unheated natural air to dry the damp/moist grain to safe storage moisture levels. Natural air drying minimizes energy consumption and improves grain quality. The success of natural air drying depends on several factors such as seasonal local weather conditions, initial grain moisture, grain type, and in-bin aeration system design. However, airflow rate is the key to effective and timely drying of grain for long term safe storage.

Natural Air Drying

Natural air drying in an in-bin drying process removes moisture from the grain by utilizing unheated natural air as grain moisture carrier. The in-bin drying system equipped with an aeration fan(s) and full floor perforation (recommended) pushes the air through the grain which carries away the moisture from grain. In an upward flow aeration system, drying starts from the bottom layer of the grain establishing a drying front (drying zone) and drying is finished when this drying front reaches the top and the top layer of grain is dried to the target moisture. Natural air drying is a slow drying process and it may take up to 4-8 weeks to complete drying. Therefore, it is essential to have enough airflow rate for timely drying to prevent grain spoilage (hot spots, molds, and mycotoxin development).

Airflow Rate

An aeration system should have properly sized fan or fans to uniformly deliver at least 0.10 cfm/bu airflow rate, sufficient exhaust vents, and perforated flooring. Fully perforated floors are preferred for uniform distribution of airflow. Often a bin iAirflow rate is generally described in cfm/bu (cubic feet of air per minute per bushel). For a known grain volume in a bin (bu), if airflow (cfm) of the fan is also known (for specific grain type and depth) then we can calculate airflow rate by dividing fan airflow (cfm) by grain volume (bu). For example, in a 30,000 bu bin, if a fan can deliver 15,000 cfm, then airflow rate will be 0.50 cfm/bu (15,000/30,000). Air flow rate can also be directly measured in a bin at the grain surface by an anemometer using a cone shaped funnel (that amplifies the low air velocity at the surface).

The airflow for specific fans is provided by fan manufacturers for varying static pressures (related to grain depth and grain type) in the forms of tables or fan curves. The amount of air pushed by a fan or combination of fans is highly dependent on grain depth and grain type. As the grain depth increases, resistance to airflow (static pressure) pushed by the fan also increases, resulting in reduced airflow. Therefore, a fan should be carefully selected so that it can deliver the desired airflow rate in a specific bin, grain type, and grain depth.

Advancing Grain Storage Management

How Much Airflow Rate is Enough?

The recommended airflow rate for in-bin drying is 1-2 cfm/bu, depending upon the initial moisture content. For about 5% moisture removal, the minimum airflow rate required is 1.0 cfm/bu. Higher airflow rate ensures faster and timely drying of grain. For example, if airflow rate is doubled, the drying time will be reduced to approximately half. However, often the airflow rate in the bins is over estimated, and bins have much lower airflow rate than anticipated, which may lead to slow, unsuccessful drying, and grain spoilage. Insufficient airflow rate also results in increased energy consumption due to excessive fan run time and shrink loss due to over drying of the bottom layers of grain.

Best Management Practice

Grain loading and distribution of fines, broken, immature grain, and foreign material in silos greatly influences the airflow rate and its distribution. Generally, fines, broken, immature grain, and foreign material accumulate into the central core while loading and block airflow through the core. Peaked grain also increases the grain depth in the core, thus, air takes the path of the least resistance through sides (which have a relatively lower grain depth). Air flow may be partially or completely blocked through the core. With such non-uniform distribution and low airflow rate, drying may take up to 3 times longer in the peaked core compared to drying near side walls resulting in excessive fan hour consumption and delayed drying with potential spoilage risk.

Grain bins must be cored by unloading peaked grain and then levelling the top surface (if possible) to ensure uniform airflow rate; if the required airflow rate cannot be achieved at the full bin capacity (eave height), an attempt should be made to fill the grain to a shallower depth. This will reduce the airflow resistance, thus static pressure, resulting in increased airflow rate. Alternatively, consider larger size fan or combination of fans.