Managing High-Temperature Grain Dryers for Energy Efficiency

High-temperature grain dryers, whether continuous flow or batch flow, are capable of high-speed grain drying to accommodate increasing grain yields and farm sizes statewide. Dryer design and dryer management are both key to achieving maximum grain drying energy efficiency.

Wet holding

Wet grain holding capacity allows drying to continue through temporary stops in harvesting (overnight, rainy days, and breakdowns). At minimum, the wet holding capacity should equal the difference between the daily harvest amount and the amount that can be dried during daily harvest hours (approximately 4-8 hours of harvest capacity). Some producers plan for a full day of harvest capacity in wet holding. Greater capacity may cause problems with the allowable storage time for the wet grain.

Wet holding bins should have aeration rates of 0.5 to 1.0 cubic feet per minute per bushel (cfm/bu) of capacity to keep grain cool.

If wet holding bins are not emptied every day, they should be equipped with hopper bottoms or power sweep augers that remove grain from the bottom of the bin so that no wet grain is trapped for extended periods. Additional calculations for wet holding capacity and other topics can be found in the *Grain Drying, Handling and Storage Handbook* (MWPS-13) available from Midwest Plan Service.

Drying temperature

Drying rate and drying fuel efficiency both increase with increasing drying temperature. High temperature dryers for corn typically use temperatures of 120 to 180 degrees Fahrenheit.

Risks of grain discoloration and quality loss increase above 200 degrees. Seed grains, specialty grains, and in-bin dryers may have lower temperature limits.

Column dryers equipped with multiple heating zones can utilize higher drying air temperatures in the upper zones where moisture is being removed faster and lower temperatures in the final drying zone. This variable temperature approach can maximize energy efficiency while protecting grain quality.

Adequate airflow

Airflow rate is the primary key to drying rate. Factors that reduce airflow rate with the same electrical input rob your system of efficiency.

Accumulation of fines on drying floors and screens reduces airflow. Use proper combine settings, grain cleaners, gentle handling, and frequent checking and cleaning to minimize fines accumulation.

Grain resistance to airflow is directly proportional to the depth (thickness) of grain. But fan performance drops faster as airflow resistance increases. Excess grain depth or improper matching of fans to the drying system can hinder drying rate and efficiency.

Graphic courtesy of GSI

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Cooling

High temperature drying systems often cool the grain quickly before leaving the dryer. Rapid cooling of hot grain can lead to increased seed coat cracking and increased damage with further handling. Delayed cooling can reduce the harmful effects of rapid cooling and can increase dryer throughput and efficiency.

Transferring hot, dried grain to a separate cooling bin allows a batch dryer to be refilled sooner, increasing drying rate by as much as 33%. From either continuous flow or batch dryers, if dried grain is transferred while it's hot, the drying process can be stopped at 1-1.5 points above the target moisture content. This extra moisture is removed in the cooling process. Using this method, energy savings of 10-15% can be achieved. Be aware that significant condensation can occur in the cooling bin. Transfer the cooled grain to a separate storage bin or equip the cooling bin to manage the extra condensation.

Delayed cooling can be improved further by allowing the hot grain to "steep" for several hours in a process called dryeration. This process allows removal of 2-3 points of moisture in the delayed cooling process and energy savings of up to 25%.

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Heat recovery

Even when delayed cooling is not possible, energy savings are possible by recapturing heat energy from the cooling process. Recirculating the cooling air and even the drying air from the final portion of the drying phase into the drying airstream can create energy savings of 10-20%. Some continuous flow dryers are equipped to capture cooling air by reversing the airflow through the cooling section. Other dryers can be equipped with shrouds and ductwork to achieve this same effect. Bin roof dryers achieve this cooling heat capture by cooling grain on the floor and adding the cooling air to the drying air plenum.

Mixing the drying grain

Exposing the wettest grain to the highest air temperatures maximizes drying efficiency. In bin systems, this effect is achieved by stirring the grain. In column dryers, flow diverters or inverters can channel the wetter outside grain back to the inside of the drying column. Mixed flow column dryers may use both grain mixing and an extended configuration air plenum to achieve higher efficiency.

Controls and sensing

As additional efficiencies are sought, close attention to controls and moisture and temperature sensing becomes increasingly important. Check and calibrate your moisture meters and temperature sensors frequently. Consider additional sensing equipment and automated controls to avoid over-drying and finished grain moisture variability.

Energy management

If you are thinking about installing a high-temperature grain drying system or upgrading existing equipment, contact your local energy providers to discuss the potential changes in your energy demand and consumption. Also, inquire if there are any energy audit services or rebate incentives available for your project.

Managing for energy efficiency

- Maintain airflow by cleaning screens and floors, watching combine settings and grain damage, and matching fans and grain depth for optimum performance
- Use higher drying temperature within the recommended range for your dryer to increase fuel efficiency
- Calibrate your moisture meter and temperature sensors often to increase reliability and avoid over-drying