Smart Ag Research

Evaluation of Top Grade Ag's In-Bin Drying Technology
2021: Year 2 of 3 *(multi-year project)*

Top Grade Ag (TGA) has developed a digital technology to monitor in-bin drying (IBD) of various grains, oilseeds and pulses in a cost-effective manner. Using sensors to estimate airflow, temperature and humidity at the air inlet and outlet, the IBD technology allows operators to track the progress of a drying event. This means farmers can optimize their drying operation while reducing energy consumption and total input drying costs.

Objectives

- Run regular drying events throughout the season to confirm the accuracy of IBD estimations.
- Calculate economic and performance metrics of grain drying using energy consumption information.
- Assess the relationship of British Thermal Units (BTU) per hour against the efficiency of drying the commodity.
- Determine if existing IBD sensor technology can predict when condensation will form on the bin ceiling during the drying process.

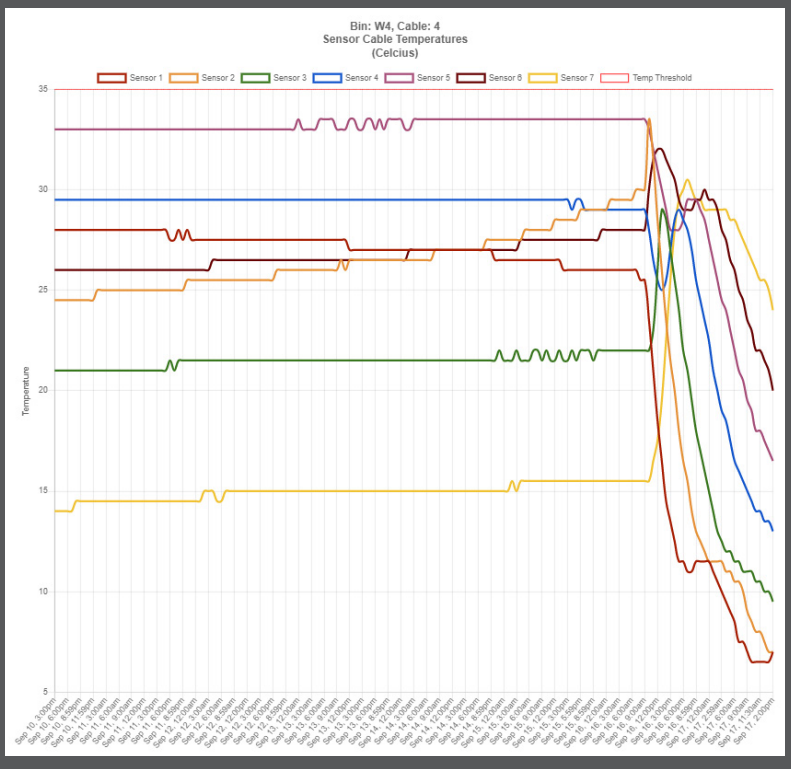
Study Details

- The Olds College Smart Farm has 4 bins equipped with aeration systems and TGA technology.
- OCCI performed 6 aeration events during the harvest/fall of 2021:
  - 1 drying event to dry down canola.
  - 5 cool-down events to reduce harvested grain temperatures to long-term safe storage levels.
- During the drying event, propane consumption of the indirect supplemental heater was recorded.
- OCCI used both in-bin and scaled benchtop trials to study condensation development and corresponding IBD sensor readings.

Results Energy consumption and drying metrics of the canola drying event on W5:

Drying Event Calculations/Estimations	
Bushels of Canola	4,410
Initial Average Moisture Content	11.6%
Final Average Moisture Content	8.3%
Moisture Removed (% MC)	3.30
Drying Time (hrs)	119
Water Removed (gallons)	617.2
Water Removed (lbs)	6,185.83
Propane Cost	$185.73
Electricity Cost	$92.09
Total Cost	$277.82
$/pt/bu (propane only)	$0.0128
$/pt/bu (total energy)	$0.0191
$/gallon removed (total energy)	$0.4501

BTU Breakdown (accounting for heater efficiency)	
BTU used for drying	3,615,246
BTU/MCPt/bu	248
BTU/gallon water removed	5,858
BTU/lb water removed	584
BTU/$1 of propane	19,466
BTU/hr	30,380



Grain temperature chart during W4 wheat cool-down event.

Smart Ag Research

Evaluation of Top Grade Ag's In-Bin Drying Technology
2021: Year 2 of 3 *(multi-year project)*

Results

For each of the aeration events performed, the estimated moisture of the TGA Control Center was ±0.16% of actual moisture as measured by the Smart Farm's Labtronics 919 Grain Moisture Meter. This level of accuracy is considered to be very acceptable for typical on-farm use, and would provide users with high levels of trust regarding the estimations.

Bin	Grain	Grain Quantity (bu)	Initial Moisture (%)	Moisture Removed (%)	TGA Predicted Moisture	Actual Moisture Sample Avg
W5	Canola	4,410	11.6	3.3	8.3	8.31
W2	Barley Feed	2,949	12.0	0.7	11.3	11.46
W3	Wheat	1,457	12.7	0.5	12.2	12.18
W4	Wheat	10,696	12.6	0.2	12.4	12.56
W3	Canola	1,091	7.9	0.6	7.3	7.2
W5	Canola	10,201	5.9	0.3	5.6	5.69

- Using current TGA technology to predict the formation of condensation development is possible — if specific parameters are taken into account.
- The addition of the bin temperature monitoring via the Grain Monitoring page of the TGA platform was highly accepted and appreciated by the Smart Farm and research teams.

Future Research

Identified research priorities for the third year of the project:

- Study of Wi-Fi signal strength interference caused by fans and/or large capacity electric motors.
- Further study regarding energy usage and drying efficiency.
    - Use of current and forecasted ambient conditions to make efficient drying decisions (supplemental heat or no heat added).
    - Use of IBD sensors and forecast modeling to increase moisture content of dry grain.
    - Study of changes in heater efficiency based on ambient temperature.
- Explore how changing the frequency of IBD sensor readings impacts the calculated moisture removal estimations.
- Evaluate temperature offsets of IBD sensors in a wide range of temperatures (e.g. From -20°C to 20°C measured at approximately every 5 degrees).
- Comparison of industry standard drying metrics and costs in comparison to the TGA system.