Wes Peterson

Improving Grain Dryer Efficiency

Methodology

Maintenance

Operations
Types of Dryers
Names reflect air flow pattern

- Cross-Flow Column Dryer  
  - (batch and continuous)
- Batch bin dryers (high temperature)
  - Bin Dryers
  - Roof Dryers
- Mixed-flow dryers  (Counter and concurrent flow)
- In-Bin Continuous flow dryers  (Counter-flow)
- Ambient Air / Low temperature bin dryer  
  (10°F increase in air temperature)
- Combination drying
Conventional Crossflow Column Dryer
In-Dryer Cooling
Duct Work for Heat Recovery

Retro-fitting Dryer with Heat Recovery

- Drying Air Plenum
- Cooling Air Plenum
- Duct to Dryer Air Intake
- Heat Recovery Cooling section
- Access needed for cleaning screens
- Heat Recovery Lower Heating Section
  - And
  - Cooling Section
Reverse Flow Cooling

Courtesy of Zimmerman Dryers
Mixed Flow Dryer - Air Flow Patterns

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Mixed-Flow Dryer
Dryeration

- Transfer hot grain (120 to 140°F) to cooling bin
- Moisture: 2-3% above storage moisture content
- Grain allowed to "Temper" for 4 to 12 hours
- Cool grain
  - Remainder of drying occurs as grain cools
  - Moisture reduction: ~0.4% per 10°F of temperature decrease
- Transfer grain to storage bin

- Energy savings: 15% - 25%
- Dryer capacity: increases up to 70%
- Improved grain quality
  - Fewer stress cracked kernels and breakage

<table>
<thead>
<tr>
<th></th>
<th>Cracks</th>
<th>Breakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid cooling</td>
<td>43.6%</td>
<td>11.3%</td>
</tr>
<tr>
<td>Dryeration</td>
<td>7.6%</td>
<td>6.7%</td>
</tr>
</tbody>
</table>
Dryer Energy Efficiency

- No dryer performance standards
- Limited independent dryer test data
- Limited research data

- Buyer beware!

- Rule of thumb fuel usage
  - High Temp. dryer w/o heat recovery
    - 0.02 gallon propane/bushel / % moisture removed
    - 0.018 Therms NG/bushel / % moisture removed
    - 0.01 kWh Electricity
• BTU = CFM X Temperature Rise X 1.1
Cross-Flow Column Dryer

CROSSFLOW DRYER DRYING CORN FROM
25 to 15% wb

TOTAL ENERGY, BTU/LB OF H2O EVAP

0 100 150 200 250 300
DRIYING TEMPERATURE, °F

10 30 50 75

100 CFM/BU

AIRFLOW RATE
Maintenance Procedures
Reduced Air Flow

- Frosted/Plugged Air Inlet
- Plugged Exhaust Screen
Plugged Exhaust Screens
Plugged Exhaust
Reduced Air Flow
Structural Failure
Grain Column Now Wider

Air Flow Has Changed
Gap At Fan Outlet
Reduced Airflow To Grain
Fines Build-up

Fines Can Add To Combustion

- Grain In Air Space
Wet Grain At Dryer Top Never Gets Dry
Plugged Grain Turner
Reduced Grain Flow
Air Flow & Burner Problems

Loose Duct Sheet

• Moisture Covering Burner
Burner Ports Plugged

- It Was Left Uncovered
Not All Burner Parts Are In Place

- Evidence Of Tall Flame On Side
Cracked Burner Causes Uneven Flame
Burners Needing Repair
Cleaned

Plugged

Venturi Air Inlet
Burners With Debris

Vertical Fired

Up-Fired
Up-Fired Low Pressure Burners
Burner Not Covered

Water by Expensive Controls
Water Running Out Of Fuel Manifold
If You Smell Gas, It Is Leaking!
NFPA 86
Standard For Ovens & Furnaces

8.7.2.3
Means for testing all fuel gas safety shutoff valves for valve seat leakage shall be installed.
• While keeping mechanical and electrical equipment in safe and working order can be a learned behavior....some learn better than others
Routine operational guidelines include understanding the manual...

• Sometimes just knowing where it is ...is a start
Highlight or reproduce periodic maintenance schedules outlined in manuals

Most manuals will have them scheduled
Tech Training

Discipline yourself and/or staff to follow it correctly

Value of experienced operators “not a rookie thing”

PRODUCE YOUR OWN CHECKLIST CONSISTENT WITH YOUR FACILITY
  • Have this done by your experienced operators. Value the experienced operators

High temp dryer is not for inexperienced operators

Provide advanced technical training...manufacturer or dealer support can help you with this
Maintenance is more than just houskeeping
MAINTENANCE OR SUBSISTANCE

Value of true maintenance versus fixing to get by

Inspections based on four values

- Cleanliness – is the equipment or component clean?
- Functionality – is the equipment or component functional?
- Integrity – is the equipment or component in good working order?
- Safety – is the equipment or component safe?
  - Can equipment be safe but not clean?
  - Can equipment lack integrity but be functional?
  - Can equipment be functional, yet not safe?
  - Etc.

An inspection with these values in mind will always identify a fault and determine the priority of the repair
- Make fuel train a completely separate inspection and report
Maxon NP3 Low Pressure High Efficiency Burner
Moisture Sensors / Testers

- Inaccurate readings
  - Spoilage / Overdrying
- Replace battery before season
- Testers not accurate
  - Above 22%
  - Underestimate hot grain (above 90F) by at least 1 to 2 %.
- Checking Calibration:
  - Compare to certified unit (coop or feed mill)

Refer to Purdue U Fact Sheet #14
## Cost of Overdrying

<table>
<thead>
<tr>
<th>Bushels Dried</th>
<th>Percent Overdry</th>
<th>Wasted Gas $2.00/Therm</th>
<th>Shrink Loss (bu)</th>
<th>Total Loss at $5.00/bu</th>
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<tbody>
<tr>
<td>100,000</td>
<td>0.5%</td>
<td>$910</td>
<td>$585</td>
<td>$3,834</td>
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<td></td>
<td>1%</td>
<td>$1,820</td>
<td>$1,163</td>
<td>$7,634</td>
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<td></td>
<td>1.5%</td>
<td>$2,730</td>
<td>$1,734</td>
<td>$11,401</td>
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<td>2%</td>
<td>$3,640</td>
<td>$2,299</td>
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BE SAFE!!!!!!

Thank you