Grain Dryer Efficiency

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Electric, Gas, & Dryer Design

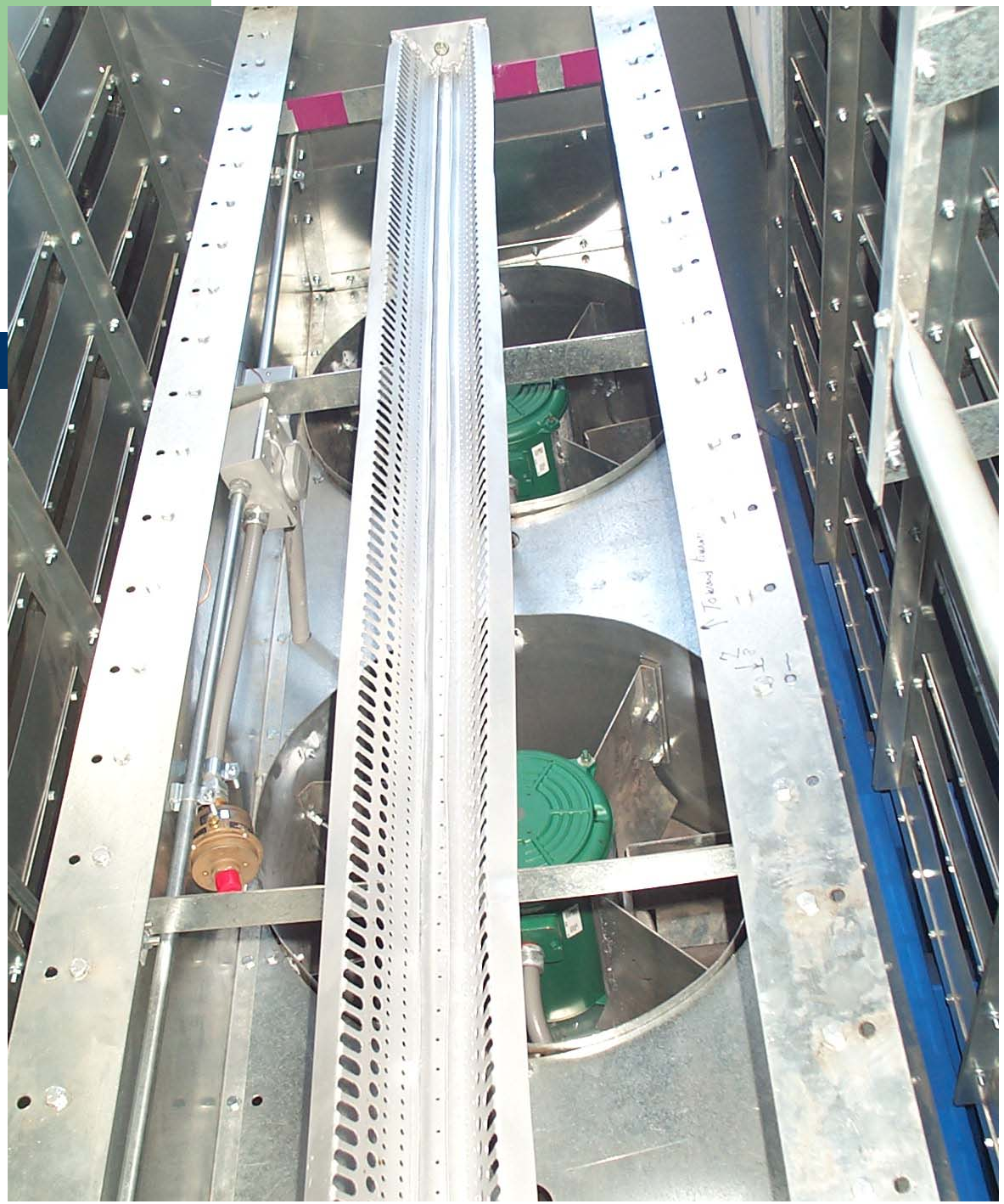
- Fan design and motor selection for highest CFM/Watt
- Burner design and profiling for the highest moisture removal at the lowest BTU/#Water
- Dryer designs vary
  - Small dryers used on farms seldom use high efficiency burners and heat recycling.
  - They have product discharge variations and heat striations.

Electrical Efficiency Basics

- Ultra high efficiency motors
- Fan selection to yield the highest CFM/Watt
- Many smaller direct drive fans yield higher CFM/Watt than one large belt driven fan.
- Fans must be selected for the real static pressure that the dryer operates; including inlet guards, fan inlet curvature, fan internal pressure, exhaust conditions, burner static pressure and positive and negative screen pressure.

Fan Design for MAX CFM/Watt

- 1979 Our dryer design used multiple 10 HP fans, using 28 to 31 Amps each.
- 1985 The above fan motor was improved, lowering the amps to 26-28.
- 1999 The above fan was redesigned, creating an ultra high efficiency motor, using 18-20 Amps
- 2000 We added an inlet cone and a computer designed wheel, which added 14% more air. Amps 20-22.



Burner design basics

- Some burners only have a 60% efficiency
- Burners made for boilers are designed for low air flow and high temperatures(400 plus).
- Grain dryers need high air flow and high mixing with drying air for low (180-200 F), overall temperatures.
- Burner profiling is needed for even temps.

Going beyond the normal

- The best BTU/pound of water possible at 60 degrees F. is 1180, according to a Psychometric Chart.
- Today's 'high efficiency' dryers under extended tests use 1700 to 2300.
- Using the dust in the dryer to supplement the fuel, QED injects the dust and air-borne particles into the burner to cut the outside BTU input to only 890 BTU/pound of water.

Dryer design continued

- Bin dryers have poor consistency of internal drying. Large heat wasting design. A lot of over and under drying and blending which causes poor product quality, forces the operator to over dry to protect from spoilage. This in turn requires more time. This uses more air and fuel. It also costs the user money because he sells on weight.

Dryer Design Continued

- Commercial Dryers have many designs.
- Many dryers still use 1960's designs. The advantage to the customer is they are cheap. As an example, they may cost half as much and use 3 to 4 times more fuel. When fuel is cheap then these dryers are popular. BTU per pound of water may be as high as 4000.

Dryer Design Continued

- Improvements to commercial dryers include:
  - Cooling heat recycling
  - Better burners
  - Full enclosures with both cooling and plenum heat recycling.
  - Grain exchanger coupled with heat recycling
  - Dryer discharge with even flows

Bio-energy full heat recycling

- Only QED uses all the energy saving items mentioned previously.
  - The amount of BTU's available from a pound of dust is around 11,000.
  - Since most corn is brought to the dryer at 2.5% FM (foreign material) and it discharges our dryer at about 1% FM, the difference is about 1.5% of product flow.
  - The exhaust losses are only a few pounds per hour.

Bio-Energy Savings

- At 120,000 pounds of product into the dryer per hour at 1.5% FM usage for fuel yields:
  - 120,000# X .015 X 11,000 BTU/# = 19,800,000 BTU.
- Actual efficiency of this is about 54%, so useable dust BTU is about 10,692,000.
- This is very close to half the energy used!
- Actual BTU available is dependent on how clean the incoming product is. The above is an example only.

Dryer costs increase when . . .

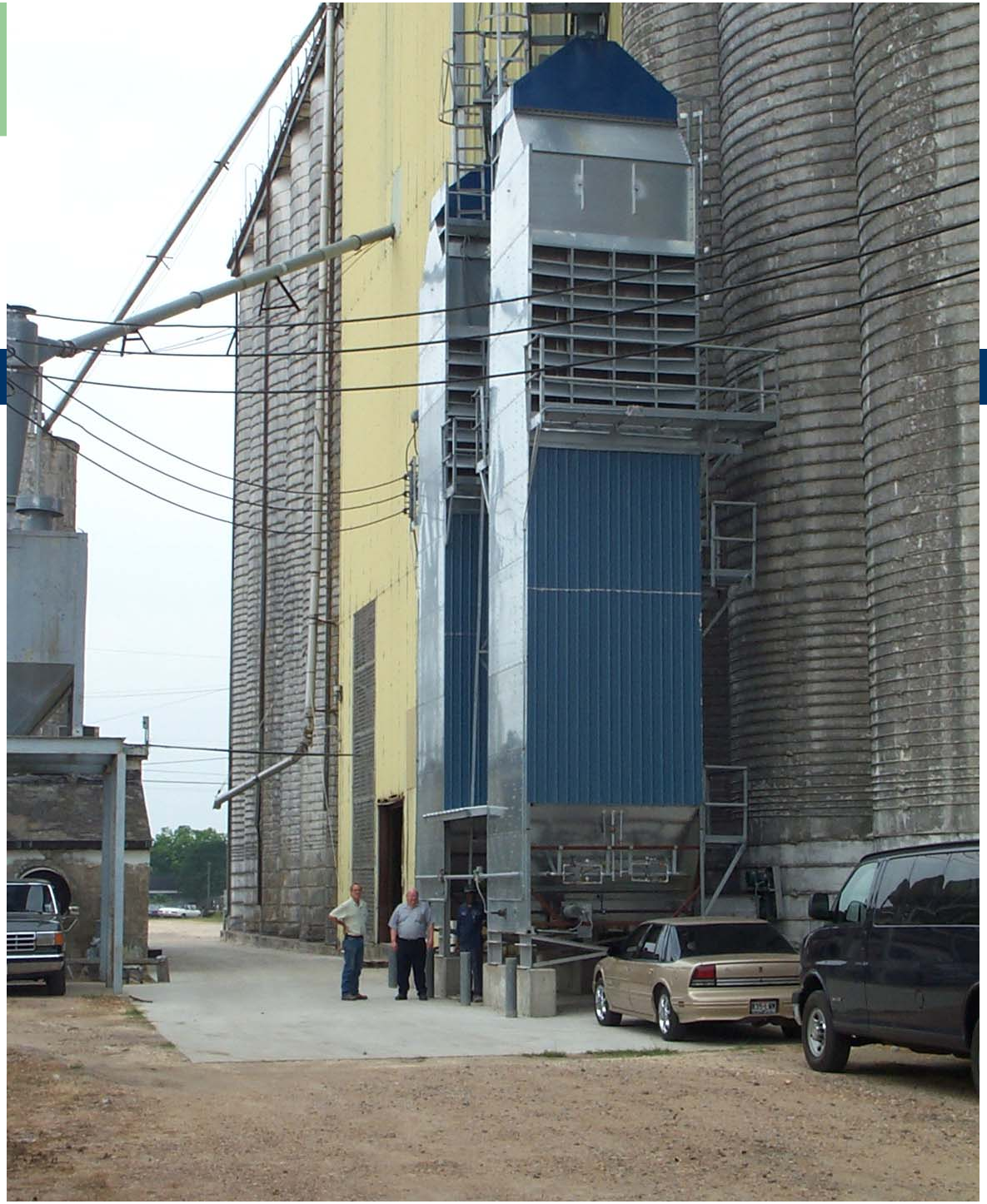
- dust in the plenum and on the plenum screens creates a back pressure, which reduces capacities, and lowers airflow.
- QED's solution is their own exclusive panel and rack system.
  - This is an expensive fix, but it actually improves overall air flow and product consistency while keeping the dryer clean.

The dryer costs more money

- To a basic dryer, you must add the following:
  - An extended top garner bin area to slowly start the heating process, which improves the quality of the product being dried.
  - Stainless Steel exhaust screens to prevent rusting and dryer-old-age syndrome.
  - Full heat recycling enclosure which reuses all the air for cooling and half the plenum air, which requires a frame, enclosure panels, heat exchanger and engineering.

The dryer costs more money p.2

- Interior rack and panel design increases air flow, allows for heat recycling, prevents interior screens from causing plugging which lowers capacity. Rack and panel design is about 4 times as expensive and requires more labor to assemble and build.
- The above design also makes the air flow consistent through all areas of the columns. This coupled with the even heats of the advanced burner system means that all of the product is exposed to the same amount of air at the same temperature. HOMOGENIOUS



The dryer costs more money p.3

- The cooling of the product is important so we gain all the BTU's available in cooling the product.
- The dryer discharge is important also to make sure that the flow down the columns is close to equal. Then, add extra measures to allow each column to be balanced by moisture. This costs money but increases product quality, storability, and test weight.

Energy Efficiency = Environmentally Friendly + Long Term Savings

- Initial dryer cost may be 50 to 65% higher, but the energy efficient dryer will save the following:
  1. Cut fuel cost by 1/3rd against the best competitors.
  2. In tests against other dryers, it shows the QED drying 5 bushels for the same amount of fuel they use for drying only one.
  3. QED delivers a product that can be stored at a higher moisture content. The reasoning for this is if every kernel is dried to within 1 point moisture spread, then you eliminate over-drying for the dryer that has a 3 to 6 point moisture spread.

Energy Efficiency = Savings

4. Cut the cost of electricity per bushel. Reuse all motor heat in the drying process and use high efficiency fans & motors.
5. Protect the crop, gentle drying, even drying yields higher test weights and less weight loss. Sell higher grade with less FM.
6. Enclosure protects the basic dryer investment. It changes the dryer from a 10 year replacement item to a 25 year replacement with normal maintenance. This is a huge importance that these items add to the longevity of the final product.

Payback in 60-75 drying days

- The combination of all the above savings give the consumer a fuel pay back of less than 2 years on a seasonal dryer and less than 3 months on a process dryer.
- Higher quality of product dried adds to payback.
- Lower electric costs add up to save money.
- Longer dryer life is a major cost savings.

We Need a Tested Standard

- It will take years to establish an efficiency standard, based on real tests.
- Every year there are different amounts of moisture removed at different ambients.
- Ratings need to be done for 40, 60 and 80 degrees F. for different areas of the country.
- Ratings need to be paid for and done by someone other than the dryer companies.