Energy Conservation and Heat Uniformity in Broiler Houses

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(Family Vacation ....)
WINTER 2006

Highest Fuel Costs Ever!

- What did we learn from 2005?
- What can we do to conserve energy in 2006?
- What can we do to provide a more uniform growth environment to enhance production?
Assessing and Improving Temperature Uniformity

- Infrared thermal cameras provide an excellent means of assessing temperature uniformity and heat flow.

- Small diameter, low horsepower “greenhouse” recirculation fans are a cost effective means of reducing temperature stratification and should reduce fuel use.
Infrared Thermal Camera

- The camera captures thermal images that provide a full field of concurrent temperatures over an area. It’s great for evaluating temperature uniformity!
- Thermal Sensitivity ~ 0.15 F
- Cost ~ $25,000
Infrared Thermal Camera

The camera receives thermal radiation sent off by objects and produces image colors that are brighter with increasing temperature.
Infrared Thermography

Wire connections in a switch box.

Notice the bright yellow color at the wire connection on the left; it's HOT!
Ceiling Temperatures
With and Without Paddle Fans

With Paddle Fans

Without Paddle Fans
Floor Temperatures
Furnace vs. Tube Heat

Sidewall: Furnace

Sidewall: Tube
18” 1/15 h.p. Recirc Fans

Hang near ceiling, 60 – 70 ft centers;
1 row of fans for house ≤ 50 ft wide
Cost ~ $150 to $200 each.
Using 18” Diameter Recirc Fans

10 ft. High Ceiling – 5 Day Birds

Ceiling-Floor Temperature Differences

Temp Diff (F)

Hour of Day

W/O FANS  FANS
Small Recirc Fans

- “Gently” push warm air from ceiling to floor. Warmer floor temperatures reduce heater run time and improve the bird environment.
- Work especially well with furnace systems to distribute heated air and make this system competitive with other heating systems.
What Can Be Done to Conserve Energy?

- Tighten our older houses.
- Increase the thermal resistance of our houses.
- Improve our heating systems.
- Use smart minimum ventilation.
Tightening an Old Steel Truss House

Folding and inserting sill-seal tape under bottom of metal sidewall.
Tightening an Old Steel Truss House

Spraying polyurethane foam behind the sill-seal.

Covers can be used on almost all tunnel fans.
Tightening an Old Steel Truss House

Notice the cold temperature of the foundation/sill.
Tightening an Old Steel Truss House

Without a Fan Cover

With a Fan Cover
Tightening an Old Steel Truss House

Gaps around end doors need to be sealed.

Sill-seal can be folded and stapled to the door frame.
Tighten Houses

- **Tightness Test:** Close the house and operate 2 sidewall fans .... Read the static pressure.

- **Before:** 0.05” s.p.  **After:** 0.11” s.p.

- 0.11” s.p. ~ barely tolerable

- **Cost of Supplies:** $200

- We all know the “tricks” that can be used to tighten a house. This year energy prices may be high enough that we are motivated to make some investments.
Increase Thermal Resistance

- There is significant movement to solid sidewall housing.
- Older houses could benefit by adding attic insulation.
- In areas of the U.S. that use end brooding, growers are installing tunnel doors.
Increasing Thermal Resistance

Insulated Tunnel Doors Provide Thermal Resistance Over Pad Opening.
Wall Temperatures
Solid vs. Curtain Sidewall

Solid Sidewall    Curtain Sidewall
Solid Sidewall Housing
Results With a Pair of Older Houses

- We studied an older pair of houses, both curtain sided, heated with furnaces, and updated to tunnel ventilation.

- Gas use history before and after one house converted to solid sidewall was compared to the gas use in the curtain sided house.

- Gas savings with a conversion to solid sidewall is not guaranteed. House management mistakes and other factors associated with older housing can negate fuel savings.
Solid Sidewall Housing
Results With a Pair of Older Houses

Gas Use Per 1000: Solid vs. Curtain

Pre-Conversion

S Converted to Solid SW

LP: gal/1000

Flock
Improving Heating Systems

- Small recirc fans or paddle fans improve furnace systems and radiant tube systems through heat redistribution.

- Radiant tube systems are rapidly gaining popularity.
Radiant Tube Heating

- Tube heating primarily transfers heat by radiation; sending out thermal “waves” from a warmer object (heater tube) to cooler surfaces (birds, floor, walls, etc.).

- Air around the tube is not heated by radiation, but by convection: moving cooler air picks up heat from heater surfaces.
Radiant Tube Heating

- Initial observations ...
  - At first, growers run their set temps too high. Your settings should be 2 or 3 °F below “furnace settings”.
  - We are learning to properly size tube systems. At first, tube systems were oversized causing excessive cycling, gas use and temperature fluctuations.
Radiant Tube Heating

- Initial observations ....
  - Tubes can work with center ceiling installation and with sidewall installation. Strong opinions exist on which is better.
  - While there appears to be fuel savings associated with using radiant tubes, maybe more important production benefits have been seen.
Radiant Tube Heating

- **Comparison Study: Nov/Apr 04-05**

- **Used 2, 50 ft x 500 ft solid wall houses**
  - One house: 85,000 Btu/hr tubes in center
  - One house: Standard furnace heat.
  - Used paired genetics for flocks
Radiant Tube Heating

- Results ....
  - 2 flocks showed ~20% less gas was used in tube house vs. furnace house.
  - 3rd flock: added recirc fans in furnace house and tube house still used 10.9% less gas.
Radiant Tube Heating

- Results for a January flock....
  - 25 pts heavier weight in tube house,
  - 2 pts better on feed in tube house,
  - 20% less fuel used in tube house,
  - Tube house made $900 more compared to furnace house.
At another farm we compared fuel use before and after tubes were installed and compared to an adjacent house of similar construction that used furnace heat.

These houses were 42 ft wide and curtain sided. One house had a single center row of 85,000 Btuh tubes. The other used typical furnace heaters.
Radiant Tube vs. Furnace Heating

Results With a Pair of Older Houses

Gas Use per 1000: Tube vs. Furnace

Flock 2003-2005

Prior to Tube

After Tube

LP (gals/1000)
Radiant Tube Heating

- Radiant temperature distribution on the floor of 2, 60 ft wide solid sidewall houses were monitored during January and February 2005.

- Despite high initial floor temps under the tube on the center feed line, there was enough heat at two outer feed lines to produce excellent results.
AVG. FLOOR TEMPS: DAY 1
Easy Radiant Tube Heater: 100,000 Btu/hr
Daily Outdoor Temperature Range: 54.9 - 38.9 F

Brood Chamber: Avg. Floor Temps on new litter, at Off-Center Distances from Mid-Tube Position for Tubes Near South Curtain and Near Middle of the 60 ft. Wide House.
AVG. FLOOR TEMPS: DAY 3
Easy Radiant Tube Heater: 100,000 Btu/hr
Daily Outdoor Temperature Range: 39.1 - 30.1 F

Brood Chamber: Avg. Floor Temps on used litter, at Off-Center Distances from Mid-Tube Position for Tubes Near North Curtain and Near Middle of the 60 ft. Wide House.

*Sensors at 23.5 ft oc are on opposite side of house from other sensors.