Heating Broiler Houses with a Wood Pellet Furnace

Dr. Doug Overhults
Biosystems & Agricultural Engineering
University of Kentucky

presented at
Annual International Meeting
American Society of Agricultural and Biological Engineers
New Orleans, LA, July 26-29, 2015

Tunnel Ventilated Broiler Houses

- Totally enclosed
- 12 x 152 meters
- Built 1998
- South-central KY
- Natural gas fuel
- Radiant brooders
- Half-house brooding

Objectives

- Compare gas & wood pellet heating systems for 1 year to determine:
  - ✓ Concurrent annual fuel consumption
  - ✓ Gas replacement fraction for wood pellets
  - ✓ Changes in minimum ventilation rate

Heating Systems & Monitoring

Pellet Furnaces & Nat Gas (metered)

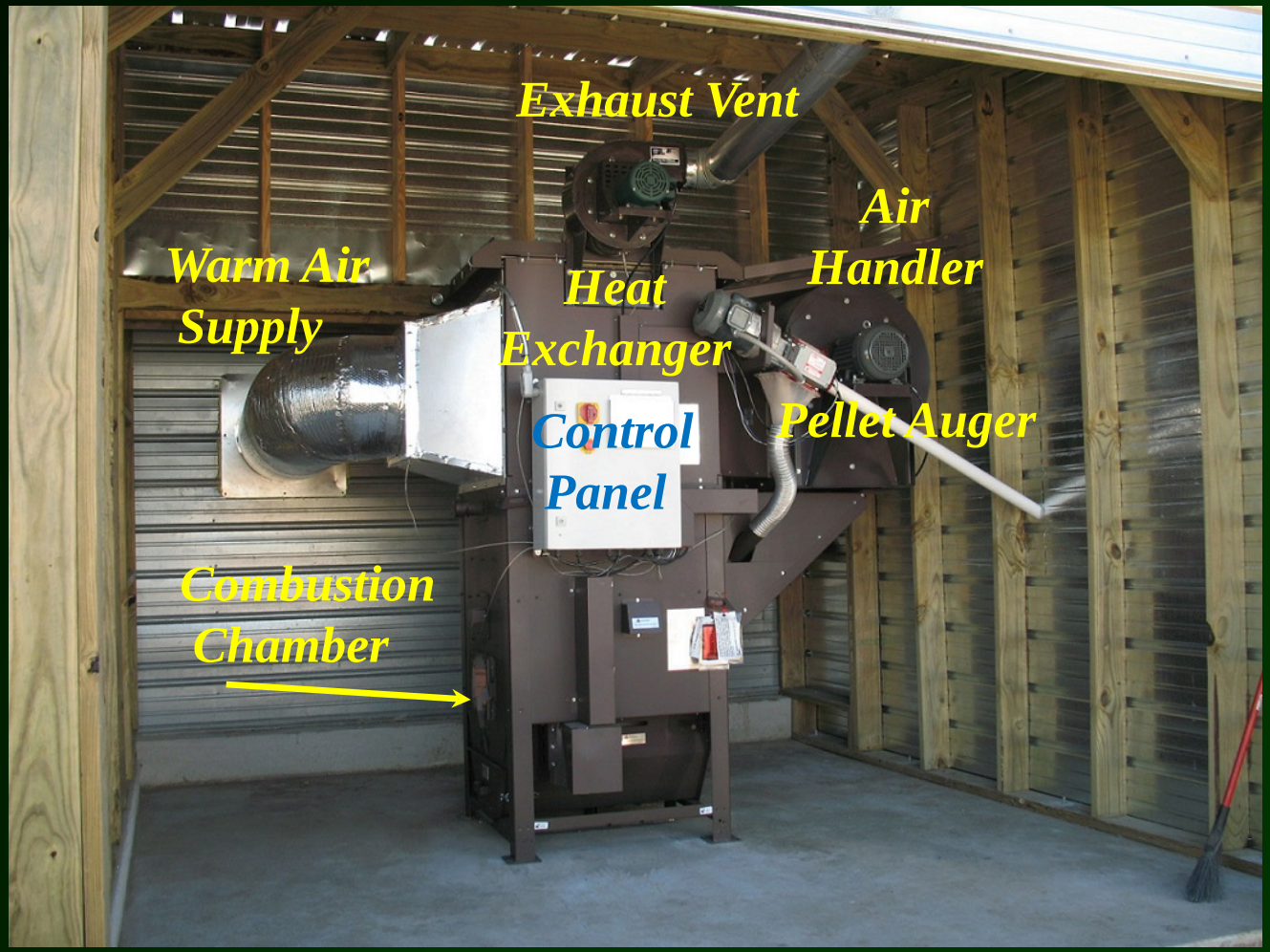
Nat Gas (metered)

Nat Gas – (not metered)

Gas Use

- Separate meters on 4 houses
  - ✓2 houses with pellet furnaces
  - ✓2 houses without pellet furnaces
- Main meter for whole complex

Forced Air Pellet Furnaces



Pellet Fuel

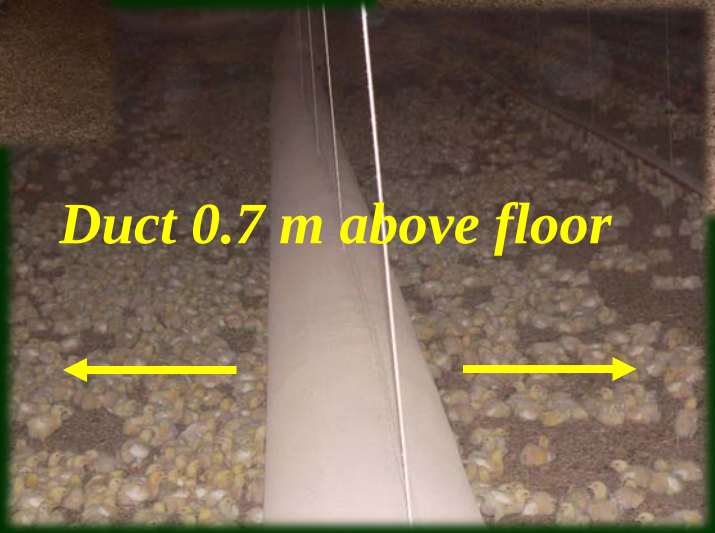
6 mm dia, random length to 4 cm

- Calibrated fuel feed auger
- Input fuel heat content into controller
- Controller regulates combustion heat input

Furnace Features

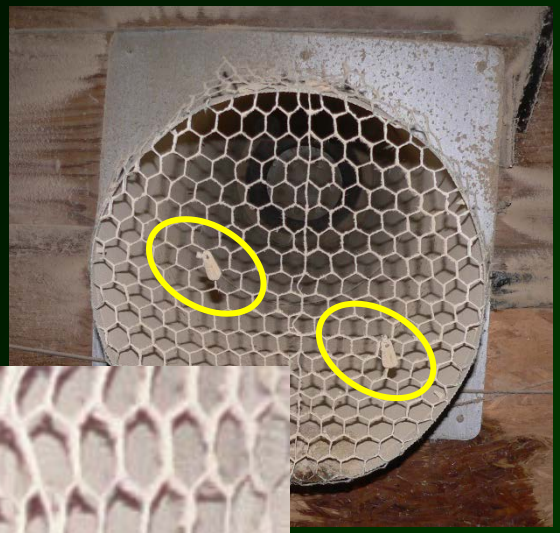
- Heat input - 527 MJ/hr (500,000 Btu/hr)
- Variable firing rate (manual selection)
  - ✓ 100%, 75%, 50% with wait & sleep modes
- Var speed air supply & exhaust
- Recirculates air from building

Warm Air Distribution



Furnace Air Temperatures

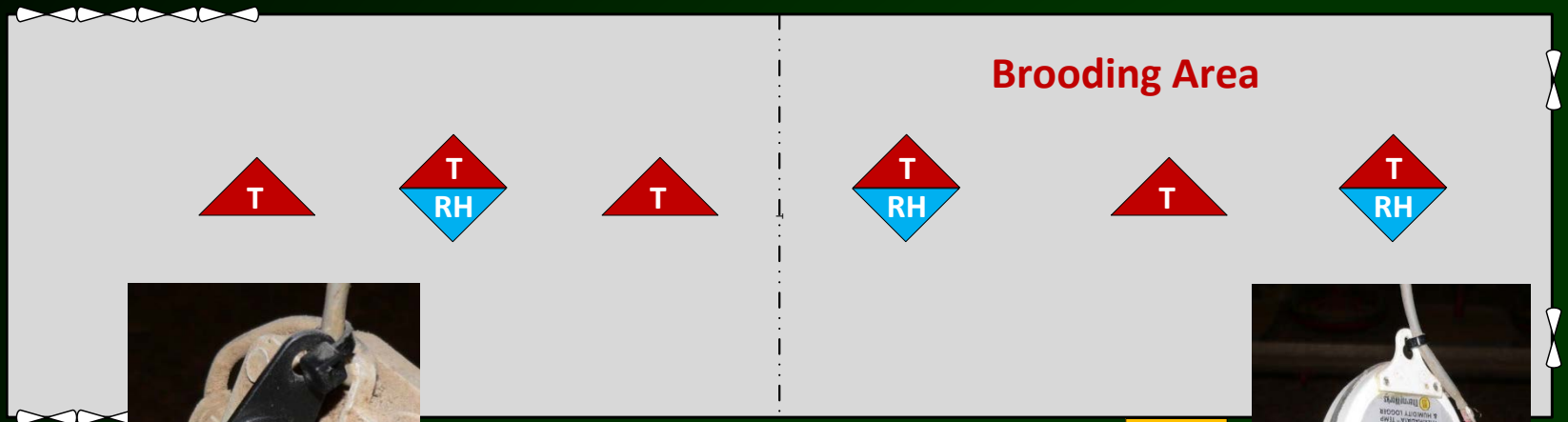
Return



I-Buttons
2 per duct

Supply

Temperature & RH in the House



I-Button

Thermoworks

Record @ 12 min intervals

Minimum Ventilation Rate

- Monitoring run time of 3 fans per barn
  - ✓ 1, 36-inch fan in brood end
  - ✓ 2, 48-inch tunnel fans
- Current switches (CR Magnetics) & Pace Scientific data loggers
- Airflow measurement with FANS

Pellet Fuel Measurement

- Calibrated Pellet Feed Auger
  - ✓ Controller has 15-min calibration cycle
  - ✓ Collect pellets & weigh
  - ✓ Enter weight into controller
  - ✓ Recalibrated with each new load of pellets
- Controller logs auger run time and records fuel use

Results

- 2 Winter flocks completed
- Currently on 4th flock

Heating Fuel Use
(per house average for 2 flocks)

Primary Heating Fuel	Gas, m^3	Pellets, kg	Total Heat Input, MJ
Natural Gas	6,200	0	231,260
Wood Pellets	1,800	10,963	265,040

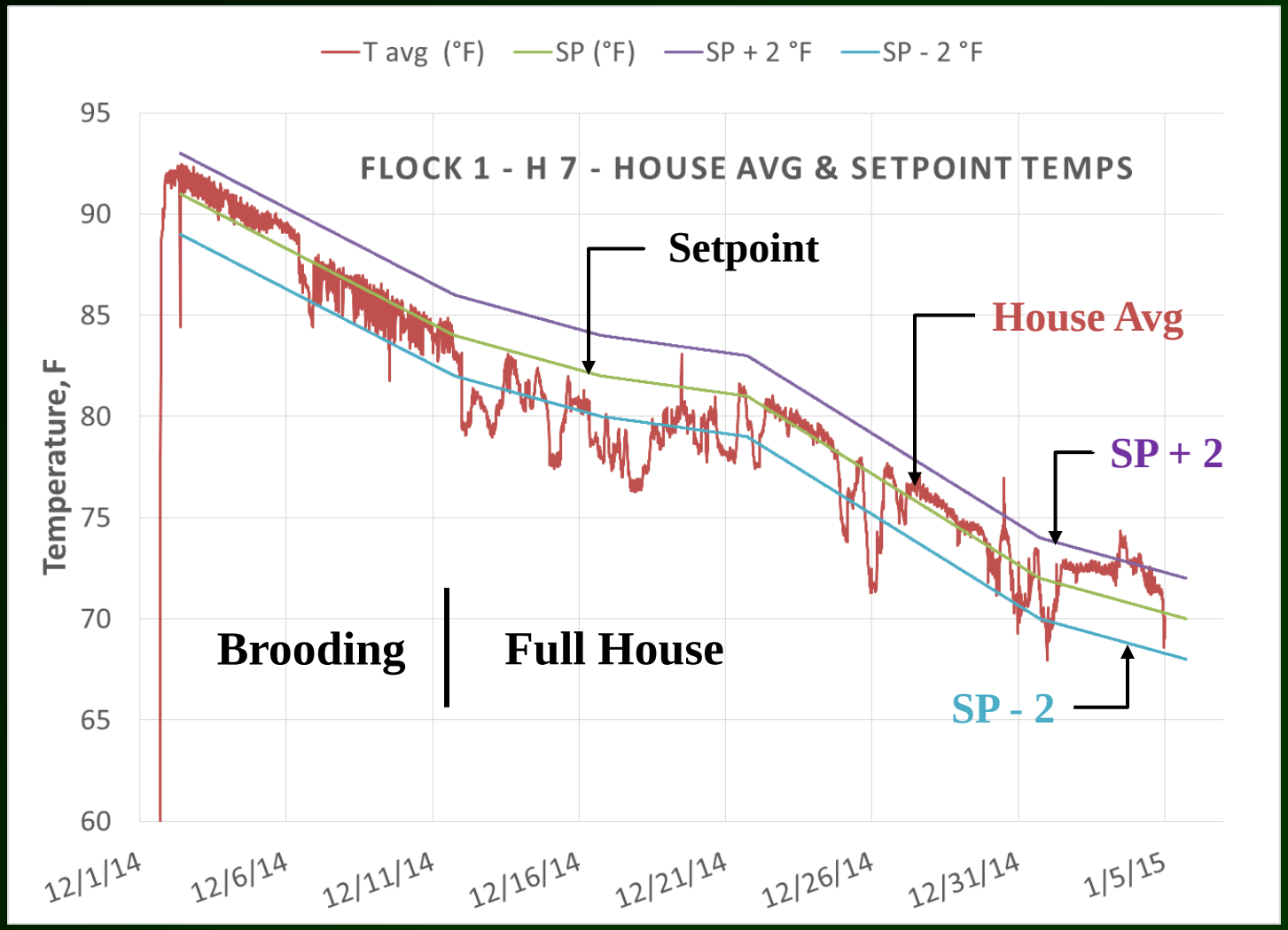
Pellet heat content - 18.2 MJ/kg (7825 Btu/lb)

Fuel Cost

Primary Heating Fuel	Fuel Cost	Gas Replaced
Natural Gas	$ 3,507	0 %
Wood Pellets	$ 2751	71 %

Pellet cost = $159.5 / 1000 kg *($145 / ton)*
Gas cost = $0.56 / m^3 *($16 / mcf)*

House Temperature Control

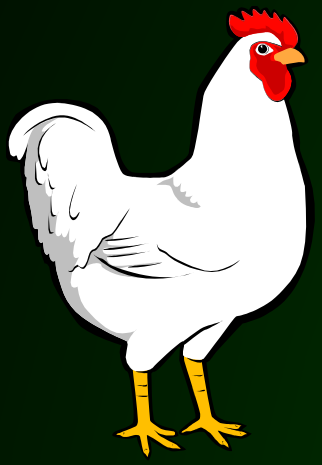


Observations

- Similar building heat requirements
- Fuel cost is reduced
  - ✓ Unique to this grower
- Temperature control
  - ✓ Good in brooding
  - ✓ Needs improvement in full house

Project Continuation

- Continue monitoring through 6 flocks
  - ✓ 2 more winter flocks to be monitored
- Fan calibrations with FANS
- Furnace efficiency measurements
  - ✓ Combustion analyzer
  - ✓ Temp differential and airflow measurement in supply & return ducts



QUESTIONS ? ?