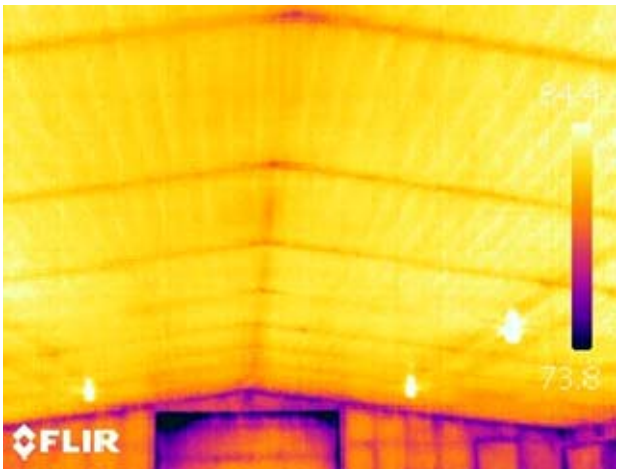
UK COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY — COLLEGE OF AGRICULTURE

POULTRY HOUSES: WHAT'S IN YOUR ATTIC?

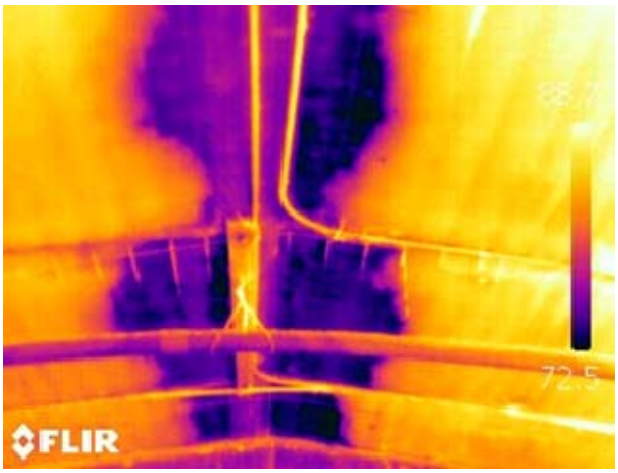
By Doug Overults, Rich Gates, Jacquie Jacob and Tony Pescatore

Having quality ceiling insulation is of significant benefit to poultry producers year round. During cold weather, hot air produced by the brooders, furnaces and the chickens quickly rises towards the ceiling. If the ceiling is not properly insulated this valuable heat will pass through it, resulting in lower house temperatures and higher heating costs. Conversely, during summertime ceiling insulation keeps the amount of heat entering the house through the ceiling to a minimum. On a hot summer day, attic temperatures in dropped-ceiling houses can easily exceed 130°F. If a ceiling is not properly insulated, heat from the attic space will enter the house, leading to higher house temperatures and lower bird performance. Attic insulation should be checked yearly to verify a sufficient level and proper distribution of insulating material.

The most common form of insulation used in dropped ceilings is blown-in cellulose, which settles and shifts over time. A poultry house built in the 1980s probably had 5-6 inches of insulation when new but by 2008 this same house often has less than two inches of insulation due to settlement and compaction (see Figures below). Exhaust fans turning on and off tend to pulse the ceiling a little which over time can tend to shake the insulation down toward the side wall. In addition, strong winds can also shift cellulose insulation, especially if the eaves are not closed sufficiently.



Thermal image of a well insulated ceiling



Thermal image of a ceiling showing lack of insulation at the peak

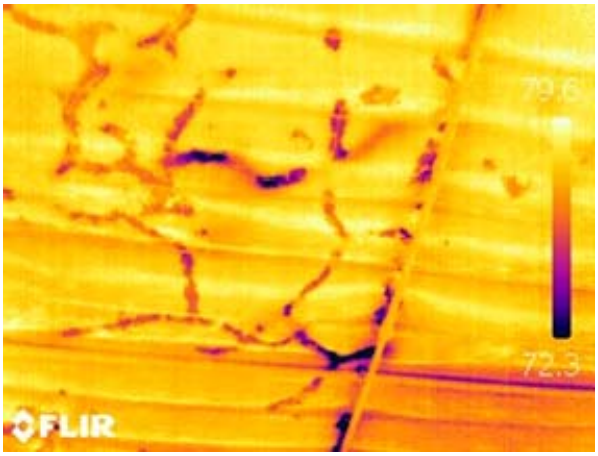
Thermal imaging cameras record different colors for different temperatures. All objects that are warmer than absolute zero emit infrared light/heat that is invisible to the human eye. Infrared cameras measure the amount of "invisible" energy emitted and converts it to a temperature. Software within the camera then converts the temperatures to a color so you end up with a picture where each color represents a specific temperature. **In the images, blue areas are cool surfaces and yellow areas are warm surfaces.**

Cellulose insulation was introduced into the poultry house market in the mid-1970s. When installed properly, it does a relatively good job. In the late 1990s, most of the poultry companies started requiring tunnel ventilation which meant the houses had to be much tighter. The result was much more vibration on the ceilings. This can result in the cellulose shifting out of the peak and sliding down the truss. It can also cause the cellulose to settle much more than it had in previous years. In the winter, air cools as it moves toward the outside, and moisture condenses in the walls and attic. This makes the insulation wet, causing it to get heavy and compress, which in turn reduces the effectiveness of the insulation. This moisture will also eventually cause structural problems. It is important that a vapor barrier be present.

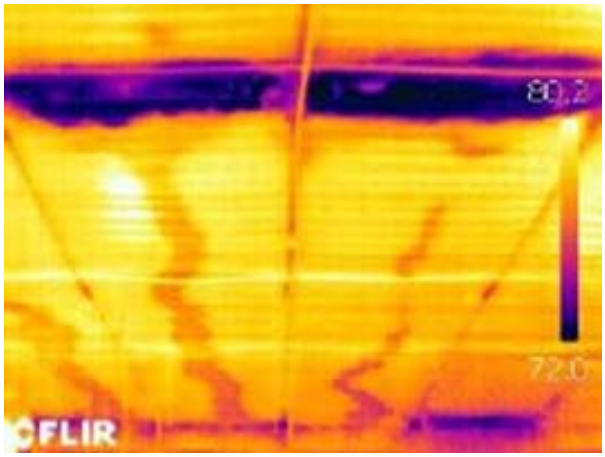
Blown-in cellulose type insulation has an average R-value of 3.2 per inch. To obtain the suggested R-19, a minimum of 6 inches is required. Many of the older broiler houses have only 2-4 inches of insulation, which is often insufficient for controlling temperature loss in the winter and temperature increase in summer. **Adding insulation CAN save 300 to 600 gal LP/house/year**. The payback for this investment needs to be calculated to determine whether or not the addition is economical.

Other ceiling insulation can be batt or blanket insulation, which is installed in different thicknesses. A 3½- to 4-inch batt of fiberglass has an R-value of approximately 11 and a 6-inch batt of fiberglass has an R-value of approximately 19.

Attic insulation should also be inspected for areas damaged by rodents and pest-control measures put in place and the insulation replaced as necessary. It may also be necessary to repair any leaks in the roof. Insulation should be replaced as needed. There are steps that can be taken when installing blown-in cellulose insulation that will help to minimize the shifting of insulation from the peak of the house. Before blowing the insulation, install a four-foot swath of unfaced 3½ inch fiberglass batt (R-13) at the peak of the ceiling. Cellulose insulation is then blown on top of the fiberglass batt, minimizing the possibility that the peak of the ceiling will be left uninsulated. An additional



Thermal image of a ceiling showing rodent damage to the insulation



Thermal image of a ceiling showing where water has leaked in and run on top of the ceiling toward the eaves.

intervention can be the installation of 1 inch x 4 inch insulation stops between the lower cords of the trusses before blowing in the cellulose. The insulation stops act as dams keeping the insulation from sliding toward the side walls and away from the peak.

Simple Payback

If the cost of housing modifications is free, then all the money saved is money earned. However, most modifications will have materials and labor costs. How do you decide whether the cost will be a good investment? A simple approach often used is to determine the simple payback, in years, of how long before the savings you realize have paid off the initial investment. “Simple” payback is so-called because we neglect depreciation and time-value of money. It is a gross estimate to let you decide if you are on the right track.

Information required for calculations

To determine how much additional attic insulation is appropriate, you need the following information:

- Dimensions of your building, separated into brooding and growing areas
- Type and quantity of insulation currently in your attic (and its R-value — see Table on the next page)
- Base the estimate on three winter flocks per year
- The temperature difference between the house and attic (For Kentucky conditions: a reasonable estimate is 35°F difference for 10 days during brooding and 27°F for 12 days during growout)
- What is the cost of the additional insulation you are considering?

Insulation in the attic of a broiler barn

Measuring insulation in attic

Table 1. R-values (hr ft^2 °F/Btu) for different insulation materials that can be used in poultry houses.

Insulation Type	R-value per inch (hr ft2 °F/Btu)	
	range	average
Fiber glass or batt	2.9 - 3.8	3.2
Hi perf fiberglass/batt	3.7 - 4.3	3.8
Loose-fill fiberglass	2.3 - 2.7	2.5
Loose-fill rock wool	2.7 - 3.0	2.8
Loose-fill cellulose	3.4 - 3.7	3.5
Perlite/vermiculite	2.4 - 3.7	2.7
Expanded polystrene board	3.6 - 4.0	3.8
Extruded polystrene board	4.5 - 5.0	4.8
Polyisocyanurate board, unfaced	5.6 - 6.3	5.8
Polyisocyanurate board, foil-faced		7
Spray polyurethane foam	5.6 - 6.3	5.9

Source: http://www.insulation-r-values.com/default.htm#3

Example calculation

- 40’ x 500’ broiler house with half house brooding
- Currently have 2 inches of loose-fill cellulose (R value of 3.5 per inch - see Table 1)
- Three winter flocks per year
- Brood for 10 days with supplemental heat for an additional 12 days of the growout period
- Cost of blown-in cellulose estimated to be 4.3¢/ft^2 for each inch of depth added

Square feet of brooding area = (40 x 500)/2		10,000
Temperature difference between house and attic during brooding	X	35
Brooding time (24 hr/day x 10 day x 3 flocks/year)	X	720
Current insulation value (hr ft^2 °F/Btu) = 3.5 x 2 inches	/	7
Convert Btu to gallons LPG	/	85,560
	SUBTOTAL = 421 gallons LPG / year	

Square feet of growout area = (40 x 500)		20,000
Temperature difference between house and attic during growout	X	27
Time with supplemental heat (24 hr/day x 12 day x 3 flocks/year)	X	864
Current insulation value (hr ft^2 °F/Btu) = 3.5 x 2 inches	X	7
Convert Btu to gallons LPG	/	85,560
	SUBTOTAL = 779 gallons LPG / year	

Total current propane use = 1,200 gallons LPG/year

Next, repeat the calculations above using the final height of insulation. For example, doubling insulation from 2 to 4 inches cuts fuel use in half.

* The fuel savings would be 1,200 - 600 = 600 gallons. At $2/gal, this would be savings of $1,200 per year.
* Cost of adding the additional 2 inches of blown-in cellulose = 2 inches x $0.043/ inch x 20,000 ft^2 = $1,714

Simple payback, in years = Cost of insulation / Annual fuel savings. In this example, $1,714 / $1,200 = 1.43 years (about 17 months).

By calculating the fuel costs for the different levels of insulation, you can use this method to help decide how much insulation is appropriate.

The table below shows some estimated simple payback values for adding insulation to an attic that initially has either 2" or 4" of blown-in cellulose insulation and is increased to 4" to 18". Of immediate interest is that, for these assumptions, if you already have 4" of insulation in the attic and you double it to 8" it will take over 5 years to payback the cost! However, if you have 2" and increase to 6" (R-21 if using cellulose), the payback is 2.14 years.

Initial depth of 2 inches		**Initial depth of 4 inches**	
Final depth (inches)	**Payback (years)**	**Final depth (inches)**	**Payback (years)**
4	1.43	4	0
6	2.14	6	4.29
8	2.86	8	5.72
10	3.57	10	7.14
12	4.29	12	8.57
14	5.00	14	10.00
16	5.72	16	11.43
18	6.43	18	12.86

Estimated simply payback values for addition of loose-fill cellulose attic insulation based on an installation cost of 4.3¢/ft^2 per inch of added insulation.