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NEWSLETTER
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Controlling Sidewall Energy Losses

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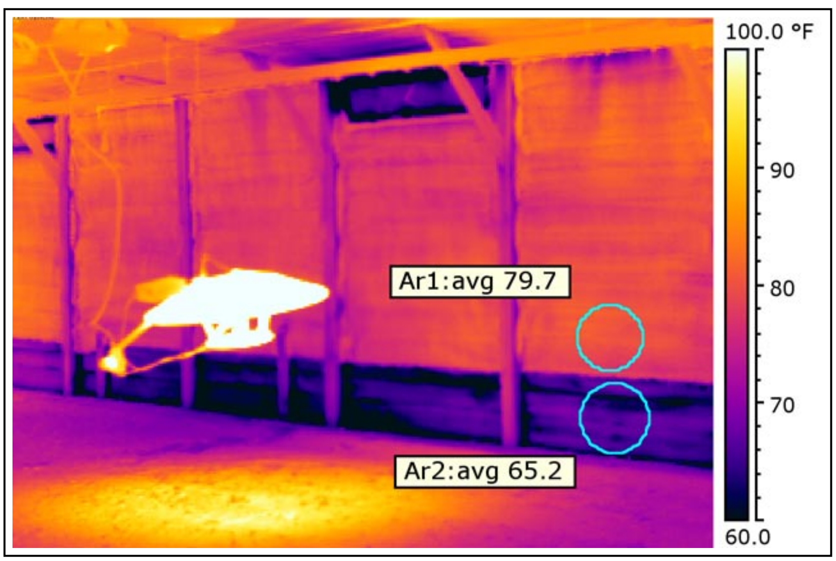
We have experienced some very cold weather in several parts of the broiler belt in 2007. One thing is for sure, when the weather gets cold we get a lot of calls on keeping heating costs down. This newsletter will focus on results of work we have done for the past three years looking at low cost options for reducing energy transfer through the sidewalls of existing poultry houses.

Although this newsletter will focus on retrofit options for sidewalls, we must point out that the largest heat or energy loss potential in a poultry structure is the ceiling. Ceilings can be re-blown or insulation added. If you have high ceiling houses, they can be repaired but it is not as easy as adding R-value to a dropped ceiling house. Ceiling insulation should be checked yearly. If you have ceiling insulation problems then by all means they should be corrected first.

The second place to look for energy savings is side and end walls. There can be 6,000 to 8,000 sq ft of side and end wall area in a typical commercial poultry house. Each square foot of uninsulated wall has the potential to transfer a large amount of heat energy to the cold outside.

How fast heat is lost through a wall depends on the insulation R-value of the wall and on how big a temperature difference there is between inside and outside. The bigger the temperature difference (we call it "delta-T") and the lower the R-value of the wall, the faster heat is lost. That delta-T is what pushes the heat through the wall and makes the brooders run. If the delta-T is zero – same temperature outside that we want it to be in the house – there is no heat loss. But try keeping it 88°F inside when it is 28°F outside – a 60-degree delta-T – and you will need a high R-value to slow down the heat loss. Curtains are poor insulators, with an R-value of R-1. Foam board insulation can be R-5 to R-6. 3½-inch batts (fiberglass or cotton) can be R-11. So getting a wall with an R-value of several points will help.



This thermal photograph, registering infrared rather than the colors our eyes normally see, shows a good example of how adding R-value to a sidewall keeps heat in the building and makes the interior wall temperatures warmer. Lighter colored objects are warmer and darker colored objects are cooler. The two temperature readouts in this photo indicate the temperatures inside the circles, showing a 14.5-degree F difference between the spray-foamed upper part of the wall (at 79.7°F) and the uninsulated lumber lower part of the wall (at 65.2°F).

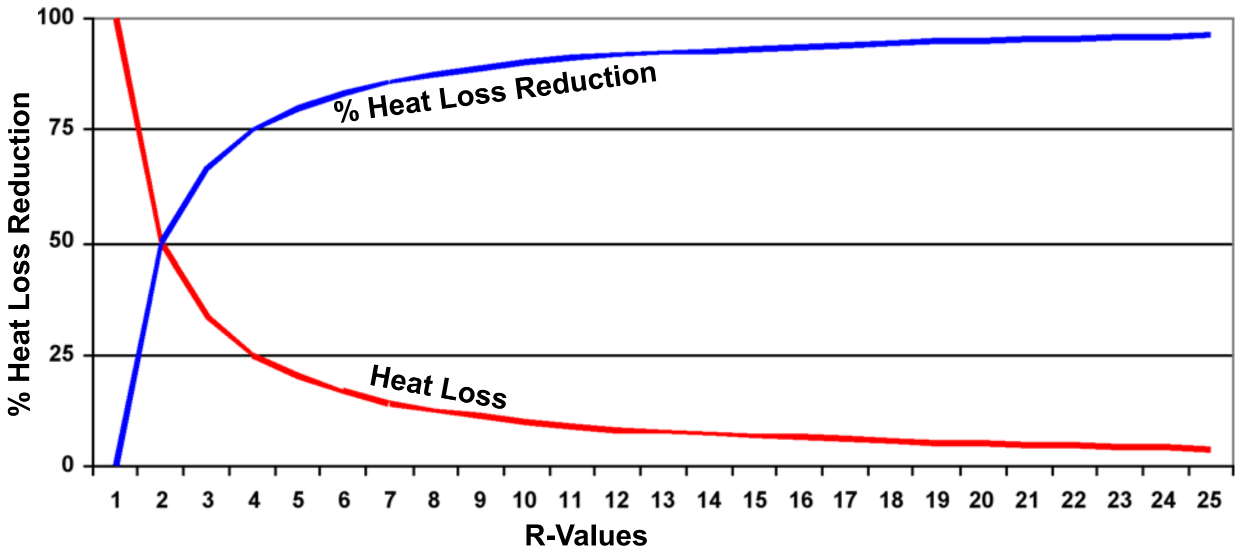
The total heat loss from a poultry house in Btu's per hour is what can empty the propane tank fast if the weather is very cold and the house lacks good insulation. Heat loss from side and end walls can be calculated by a simple formula:

$$\text{Heat Loss (Btu's/hr)} = \frac{\text{Area of walls X delta-T (inside temp – outside temp)}}{\text{R-value of walls}}$$

Without getting complicated we can see that if the R-value of a wall increases from R-1 to R-2 the heat loss will be cut in half. Going from R-1 to R-3 cuts the heat loss by one-third, to R-4 cuts it to one-fourth of what it was, and so on. The important point to realize is that in adding insulation you get the biggest bang for the buck for the first few units of R-value that are added. That is why if you have a good solid wall house with say R-8 insulation value, you will not get much payback by increasing to R-13. But if you have a lot of curtain area and you create a solid wall and change your R-value from R-1 to R-5, you will get an 80% reduction in heat lost through the wall.

The illustration below shows graphically the relationship between increasing R-value and the resulting percentage of heat loss reduction (that is, energy savings). Again, the point to learn from this graphic is that the first units of insulation are the most cost effective. If you already have an R-11 wall, upping the R-value from R-11 to R-12 yields very little reduction in heat loss. But going from an R-1 to say, an R-11 will yield very dramatic reductions in heat loss and can be easily cost justified.

% Heat Loss Reduction as R-Values Increase

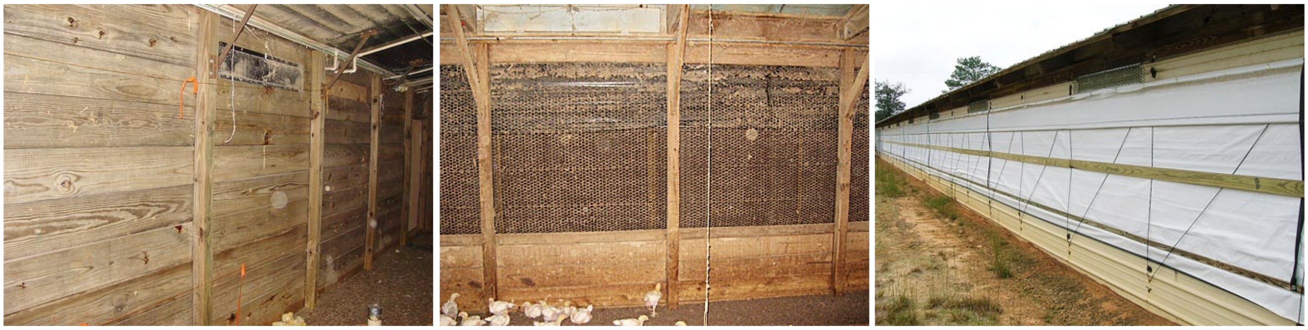


We have looked at two main scenarios to reduce sidewall energy losses in existing buildings:

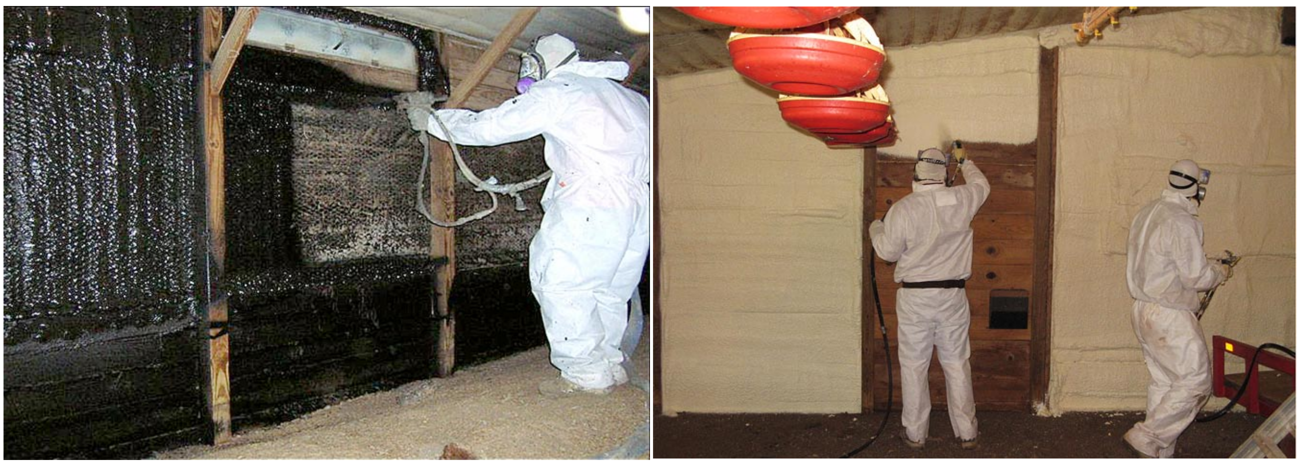
- Spraying closed cell polyurethane foam on lumber and curtain walls
- Filling post house walls with batting and then covering the batts with plywood or tri-ply on the inside and tin on the outside.

Various combinations have also been studied. Many factors must be considered in choosing the option that will work best on your farm. The foaming option might be easier from a modification standpoint and might be slightly cheaper, but there are possible problems with bird pecking and darkling beetles that must be addressed. The batt technique is most like a permanent, long-term solution.

Here is a brief description of what we have studied and some of the fuel usage reductions we have seen so far. In several dropped ceiling post houses, we spray foamed all side and end walls approximately 1 inch thick from the ceiling line down to the dirt pad. In all houses, the curtains were cinched up tight and a 1X4 strip was nailed down the center (see photo on facing page). Some houses were sprayed with a more dense, harder foam, and others with a lower density foam. ***In every spray foam treated house, static pressure readings more than doubled. Fuel consumption in these houses ranged from 30% to 35% less***. Bird pecking damage to the bottom of foam treated walls occurred, but more so in the lower density foam houses. If foam is to be used, a protective covering, either lumber or a bird-proof material, should be added along the bottom portion of the walls.



Above are pictures of typical curtain sided and lumber sided walls that are found across the broiler belt. These curtain and lumber materials comprise the envelope of the house. Even though these materials are not insulation per se, they do have some R-value. Walls of this type generally have a total insulating value of around R-2 to R-3, depending on how the wall was built. When these houses were constructed the price of propane was approximately 30 to 40 cents per gallon and energy efficiency was not much of a concern. Note that the house on the right has had a 1x4 lumber strip nailed across the curtain as part of the tightening up preparation for adding sprayed foam insulation to the inside of the curtain sidewall.



Above photos show spraying of closed cell polyurethane foam insulation in curtain sided lumber walled houses. The spray foam retrofit increases the R value to between R-5 and R-8, depending on the thickness of the foam. This energy retrofit can yield energy savings of up to 50% over the existing walls. Not only does it add insulation value to the walls, it increases the tightness of the house for ventilation purposes. Spray foam insulation can be susceptible to damage from rodents, darkling beetles, and prolonged exposure to sunlight and birds. Steps must be taken to avoid this damage.

These photos show retrofitting of a lumber walled house with batt insulation covered with tri-ply and bands. Depending on whether the wall is 4 or 6 inches thick this type of wall yields between an R-11 and R-19, and also dramatically increases house tightness. The 24 inch layer of OSB at the bottom of the wall was added to protect the insulation and tri-ply from equipment damage and bird pecking.

In several open ceiling houses, we used fiberglass or cotton batting to fill the cavities between posts and applied tri-ply material with bands over the batts. In all batted houses, spray foam was applied around the ceiling line, along the ridge cap, and in sidewall areas inside from the control room where conduit and equipment were mounted to obtain the best seal possible. Additionally, a 24-inch OSB band was installed around the wall bottoms to prevent damage from birds and equipment. ***Static pressure readings also more than doubled in these houses, and fuel consumption was reduced by at least 20%.*** Since high ceiling houses have a much larger volume of inside air, fuel savings will not be as great as in dropped ceiling houses after retrofitting.

With the higher static pressure readings, all retrofitted houses were able to maintain optimal brooding conditions with fewer fans running and slightly less run time. And because of the improved smoothness of the walls and tighter houses, improvements in tunnel wind speed were observed in hot weather flocks.

The Bottom Line

Delta-T is a moving target and both weather and the cost of propane vary. However, consider this scenario. We have a 40x500 house with 7,000 sq ft of side and end wall; propane is at $1.40/gal and contains 90,000 Btu/gal; and delta-T is 50 (say, outside temp is 25°F and we want inside temp to be 75°F). Here's how many gallons and dollars of propane will flow through that wall area every hour at different insulation values (check by the formula on page 2):

R-1 – 3.89 gallons, $5.45/hr
R-3 – 1.30 gallons, $1.82/hr
R-8 – 0.49 gallons, $0.69/hr
R-12 – 0.32 gallons, $0.45/hr

Obviously, insulation considerably slows that negative cash flow through the walls (and the first R-value increase saves the most).

The cost of our insulation retrofits ranged from about $6,500 to $10,000. In addition to energy savings, improvements in flock performance have also been observed in every retrofitted house we have tested. But even considering energy savings only, by conservative estimates the payback period to cover the investment cost in each case is expected to be only two to three years.

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