The *Poultry Engineering, Economics & Management*
NEWSLETTER

Critical Information for Improved Bird Performance Through Better House and Ventilation System Design, Operation and Management

Auburn University, in cooperation with the U.S. Poultry & Egg and Alabama Poultry & Egg Associations
Issue No 43, September 2006

Poultry House Energy Retrofits for Fuel & Cost Savings

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Poultry producers in the United States continue to face rapidly rising propane costs, and the cost of fuel to heat poultry houses is causing severe grower cash flow problems. We have been bombarded with questions and inquiries on what to do and how to solve this problem. The purpose of this newsletter is to outline the steps that should be taken to evaluate your poultry houses and then to solve the problem in a cost effective manner. There are some new technologies that are entering the market that have been shown to be cost effective and should possibly be considered. This newsletter mainly concerns retrofitting older houses and not new construction, because the need for retrofitting information is so great. In fact, we are seeing such escalation in energy prices that we have houses that are structurally capable of growing birds but are rapidly becoming "energy obsolete" because of their high fuel operating costs.

House Must Be Structurally Sound and Up to Date Enough to Justify Retrofitting

There are several energy engineering or structural considerations that must be considered before funds should be allocated for an energy retrofit. The first consideration is the structural integrity of the house. The question growers must ask themselves is, "Are my houses structurally sound enough to be kept in production another five years"? If trusses, walls or other major components are nearing failure and structural modifications would be extensive, a retrofit should probably not be done. There is a time to take a poultry house out of production. We cannot afford to spend energy retrofit dollars on houses that have serious structural problems. Also, don't consider spending energy retrofit dollars on a house that does not have a good operational winter inlet system. Vent doors that operate off of static pressure controllers that can throw air at high velocity into the center of the house are necessary for a good energy management program.

A related issue with respect to engineering is the tightness of the house. In all ventilation courses we teach, before we discuss insulating houses we always recommend

With today's propane prices, converting curtain sidewalls to insulated solid sidewalls is imperative to bring fuel costs down. Curtain sidewall shown here was treated with one inch of sprayed-on polyurethane foam, which has been shown to be an effective and relatively low-cost energy retrofit.

that tightness be addressed. We first addressed the need for tightening up houses in Newsletter #9 back in January of 2001 (available at www.poultryhouse.com). It's even more important now, and even if a house is not in good enough shape to justify extensive retrofitting, stopping air leakage is probably well worth doing if the house is to be kept in production.

Houses to be retrofitted don't have to be tight but they have to be capable of being made tight in the retrofit process. We see many houses that test in the .08 static pressure range before retrofitting and we have been able to get them as high as a .20 or higher after retrofitting.

#1 Energy Retrofit Option: Ceiling Insulation

The first consideration on any type of retrofit must be ceiling insulation. Basically, the higher the R value the less heat loss will take place and the less fuel it will take to maintain desired temperatures. Modern houses should have a minimum of R-19 in the ceiling. This is much easier to achieve in dropped-ceiling houses than it is in high ceiling, open truss houses. In the high ceiling, open truss houses the most important thing to consider is being sure the ceiling is tight. Foaming the ridge and the eaves and repairing missing or damaged board insulation are probably the only things that can be afforded in a high ceiling house. Dropping the ceiling or adding more insulation to an existing high ceiling house is generally cost prohibitive.

In dropped ceiling houses it is imperative to get a complete blanket of insulation in the ceiling; either complete batts or blown-in cellulose is recommended. See our Newsletter #34 at www.poultryhouse.com for more information. Newsletters #9 and #11 also contain important relevant information.

#2 Energy Retrofit Option: Sidewall Insulation

With today's energy prices the days of open sided housing are gone. Poultry houses now must be run year round in a totally enclosed mode to achieve desired flock performance without incurring excessive fuel costs. For houses without solid sidewalls, it is imperative that we take the lowest R value area in the house, which is the curtain, and replace it with some type of structure that will have an R value of at least R-8. This will cut the heat loss through the walls by approximately 80%. This step also greatly improves the tightness of the house. It goes without saying that a reliable automatic-transfer standby generator is required.

Certainly, replacing uninsulated curtains with solid insulated sidewalls is no simple or inexpensive undertaking. It is especially difficult in steel truss houses because the truss supports are usually on 10 foot centers with almost no structural material in between. Correcting this problem by building a lumber wall can be expensive. In dropped ceiling houses that use posts on four or five foot centers, it is possible to create a cavity in the wall which can then be insulated with fiberglass batts or filled with slightly moistened blown-in cellulose that is blown into the cavity. It is most desirable to have lumber on the inside of the house which could be plywood, followed by a 4 mil plastic vapor barrier, then the insulation, and finally a tin covering on the outside. A lower-cost alternative is to use the existing curtain (if it is in good shape) as exterior sheathing, fill the wall cavities with fiberglass batts, and then cover the interior walls with tri-ply. The curtain should be pulled very tight and nailed off with 1 X 4 treated lumber strips across the middle. Cost of installing batt type insulation varies from $0.65 to $1.00 per square foot, depending on wall conditions and materials.

A new option for retrofitting older houses is to keep the existing curtain as the exterior wall as described above, and apply spray-on closed-cell polyurethane foam insulation. This procedure avoids the expense of having to add structural wood framing, sheathing, and a vapor barrier to the walls. On the inside, the bird wire is exposed and sprayed from the eave to the floor with a layer of 1 to 1½ inches of polyurethane foam. This treatment from the inside both seals the wall tightly and yields an insulation value in the R-7 to R-10 range with relatively low labor and materials costs. (Note: Spray-on polyurethane foam is also an excellent sealant for ridges and eaves in high ceiling houses, and for the ceiling in evaporative cooling pad dog houses.)

Spray-on Polyurethane Sidewall Treatment: Costs and Returns

Auburn University has been monitoring several Alabama tests houses that have had curtain sidewalls treated with a 1-inch sprayed polyurethane foam in an energy retrofit similar to that mentioned above. The treatment of these 40 ft x 500 ft houses cost approximately $6,000 per house. The R value of the sidewalls went from approximately R-1 where the curtains were to R-8, and above and below the curtains the R value went from R-2 to R-9. Analysis of the data on these treated houses for one year showed a savings of 35% in fuel costs has been realized in comparison to identical untreated houses. Static pressure (tightness) of the houses increased from 0.12 before treatment to 0.26 after treatment. Annual fuel savings were 1,850 gallons

Photo shows spray-on polyurethane foam above the tunnel inlet, often a difficult area of the house to get air-tight.

Spray-on Polyurethane Foam Retrofit Treatment for Curtain Sidewalls: Annual Per House Fuel, Performance, and Profitability, 2005/2006 AU Study.

Fuel & Production	Untreated	Treated	Improvement
Livability (%)	92.35	93.34	0.99
Liveweight Pounds	715,738	736,355	20,617
Avg. Daily Gain	0.0933	0.0961	0.0028
Feed Conversion	1.8653	1.8313	0.0340
Propane (Gallons)	5,300	3,450	1,850
Cost & Returns			
Treatment Cost	$0	$6,000	-$6,000
Production Value (@$.05)	$0	$1,031	$1,031
Fuel Savings (@$1.30)	$0	$2,405	$2,405
Total Improvement	$0	$3,431	$3,431
Years to Payback			1.74

Older 40 X 500 curtain-sided dropped-ceiling houses, retrofitted with tunnel ventilation, evaporative cooling system, vent doors, and controller in the mid-1990s.

Applying spray foam to the interior sidewall with one inch of foam seals the house and changes the R value of the curtain to about R-8 and the R value of a wood wall to about R-9. Heat loss through the wall is reduced by 75-80%.

In low-cost energy retrofitting of a curtain sided house, the exterior curtains can be pulled good and tight and fastened with 1 x 4's, letting the existing curtain be the weather barrier. Exterior tin can be added later if desired.

If sprayed-on polyurethane foam is to be used, protecting the cured insulation from bird pecking and beetle damage like that shown here is essential.

In wood-framed houses with posts on 4 or 5 foot centers, a low-cost insulation option is to fill the wall cavities with fiberglass batts and cover the interior with tri-ply with bands on 1-foot centers.

per house after treatment. High to low temperature differences in the treated houses are only 3-4 degrees, but are 7-8 degrees in the untreated houses. Further advantages of this type of insulation and sealing were seen in slight improvements in bird performance data over a 7 flock, one year period. The table on page 3 summarizes the energy savings, flock production improvements, and investment recapture for these houses under typical North Alabama farm conditions. At prevailing propane prices ($1.30 per gallon) and grower pay rate ($0.05 per pound), investment cost of the retrofit should be fully recaptured within about 10-12 flocks.

Precautions Needed for Spray-on Polyurethane Sidewall Treatment

If spray-on polyurethane is used, the exposed (cured) polyurethane foam must be protected from continuous pecking by the birds and from darkling beetles, which will burrow into the cured foam, causing product weakening and ultimately sloughing off.

Protection against bird pecking can be achieved with a physical barrier, such as nailing ripped plywood sheets continuously down the house along the bottom 15-18 inches of the wall, or rolled roofing material tacked to the posts and run completely down the length of the house. Another option is to use a higher density closed-cell foam or sprayable plastic product on the footer area. An effective beetle control method is to treat the area beneath the feed lines and against the perimeter walls with a 24-48 inch band of boric acid at a rate of 100 pounds per house before each flock. Another method is to apply a labeled insecticide or growth inhibitor at labeled rates; several products are available. If you are considering spray polyurethane foam insulation where the foam will be exposed on the interior of the house, it is absolutely imperative that you have an aggressive beetle control program.

Bottom Line

The bottom line with any type of energy retrofit is whether or not the cost of modifying the structure and installing the materials can be recouped in a timely manner. In energy retrofits that Auburn University has been studying, we see that in almost all cases payback of the initial energy retrofit cost is within three years, depending on the investment and the amount of modification of the structure required. There are many different technologies that are discussed as being important for improving poultry production and profitability, but there are very few items that can repay the investment cost as rapidly as an energy retrofit.

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