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Poultry Housing Tips

Alternative Heating Systems...Heating System Efficiency

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Though with rising propane prices traditional propane heating systems are becoming increasingly expensive to operate, we sometimes forget that there are a number of good reasons why brooders, furnaces, and tube heaters have been used for decades to keep our poultry houses warm during cold weather. Propane heating systems are relatively inexpensive to purchase, easy to maintain, and most importantly, very energy efficient. Yes, very energy efficient nearly 100%. This fact becomes very apparent when you start comparing the heating efficiency of a brooder/furnace to that of an alternative heating system.

First, all of the heat produced by a brooder/furnace when burning propane goes into the house. This is not the case with an alternative heating system where some type of heat exchanger is used. Basically, air or water taken from the house is heated by moving it around the combustion chamber and/or a series of tubes carrying the hot exhaust air to the chimney. So even though most of the heat produced by burning the fuel is transferred to the air or water which is then used to heat the house, a portion of the heat is lost through the furnace's chimney. How much heat is lost through the chimney will vary based on the design of the heating system but it is generally in the range of 5 to 20%.

A second factor that tends to reduce the overall heating efficiency of an alternative heating system is the fact that they don't instantaneously stop producing heat when an environmental controller/thermostat stops calling for heat. With traditional propane heating systems when heat is no longer needed, a valve on the brooder/furnace quickly closes and the burning of propane stops. With an alternative heating system, it is not that simple. For instance, a hot air system may continue to add heat to a house because the burning unit may need to cool off before it shuts down. Furthermore, even though the flow of fuel has been stopped to the burning unit, there may be a significant amount of fuel in the combustion chamber that will continue to burn. Even though this heat may be delivered to the house, it is not needed, and therefore is essentially wasted fuel.

The last factor that tends to reduce the efficiency of an alternative heating system are problems with distribution. With a propane heating system, heat is basically only added to the area of the house where the house's controllers/thermostats are calling for heat. With a hot air alternative heating system, even though only one area of a house may require heat, hot air will tend to be delivered to the entire house. This often results in one area of a house becoming a few degrees warmer than it really needs to be to get the cooler area(s) of a house to the proper temperature. Though this will not necessarily harm the birds, it will result in a reduction of heat system efficiency. With hot water systems (hydronic), heat distribution problems are reduced by the fact that it is possible to utilize "zone heating." If fan/radiator heat exchangers are used, valves on the units are only opened in the areas of the house where the heating is required. If fin or heat pipes are used, water flow through the pipes can sometimes be cut to portions of the house where heat is not required. But in both instances, the level of zone heating is rather limited. Whereas a house with a propane system may have six or more heating zones to fine tune the delivery of heat to very specific locations, with hot water systems a house may have four heat zones at best and possibly only two, thus increasing the likelihood of overheating some areas. Furthermore, it is important to realize there can be significant heat losses delivering the hot water from a central boiler on the farm to houses possibly hundreds of feet away.
The net result of all these potential losses of efficiency is that though a propane heating system may have a heating system efficiency of nearly 100%, an alternative heating system may only have an overall heating efficiency of between 50% and 75%. For example, let's say we have side-by-side houses, one with a traditional propane heating system and the other with

an alternative heating system. The tunnel curtain area of the houses is too cool. In the house with the propane heating system three brooders come on for a few minutes to bring the house up to the proper temperature. All the heat produced by the brooders (let's say 5,000 Btu's) is delivered to this specific area of the house and as soon as the house temperature is sufficient, they shut off. In the case of an alternative heating system, to deliver 5,000 Btu's of heat to the brooding curtain area we may end up adding another 3,000 btu's of heat to the center of the house where it is not needed and another 1,000 Btu's of heat maybe lost up the chimney of the burning unit. So even though we may only need 5,000 Btu's of heat, we will need to burn enough fuel to produce 9,000 Btu's of heat, making the overall heating system efficiency only 55%.

The concept of overall heat system efficiency is very important in determining how much an alternative heating system can potentially save you. For instance, often in sales literature there will be a chart comparing the cost of heating a house with a fuel such as wood pellets to propane. The argument may go something like this. Burning a pound of wood pellets will produce 8,000 Btu's of heat and therefore since a gallon of propane produces 92,500 Btu's of heat, it takes 11.5 pounds of wood pellets (92,500/8,000) to replace one gallon of propane. If wood pellets cost $150 per ton ($0.075 per pound) this would mean that a producer would need to burn $0.87 worth of wood pellets (11.5 X $0.075) to replace one gallon of propane. If propane is running $2 a gallon, a producer could potentially reduce their heating costs by approximately 65% by installing a wood pellet furnace. But, here is the problem. The above calculations assume the pellet furnace has heat system efficiency of 100% , which of course is not the case. If a more realistic heating efficiency of 60% is assumed, instead of burning 11.5 pounds of pellets to replace the heat produced by burning one gallon of propane, 19.2 pounds of pellets would be required, thus reducing the potential savings from 65% to 28%.

Alternative Fuel	**Btu's/lb**	**Cost ($ per pound)**	**Equivalent propane cost at various system efficiencies**			
			80%	**70%**	**60%**	**50%**
Wood pellets 6 % moisture ($150/ton)	8,000	$0.075	$1.09	$1.24	$1.45	$1.74
Corn ($3.50/bushel)	7,000	$0.063	$1.04	$1.19	$1.38	$1.66
Coal ($60/ton)	10,000	$0.030	$0.35	$0.40	$0.47	$0.56
Wood chips - dry 15% moisture ($50/ton)	7,000	$0.025	$0.41	$0.47	$0.55	$0.66
Wood chips - green 50% moisture ($25/ton)	4,000	$0.013	$0.36	$0.41	$0.48	$0.58

The above table illustrates how heating system efficiency affects the equivalent propane price for various alternative fuels. It is important to realize that not only can the cost of the fuel vary significantly from one location to another, but the heating value of each fuel type can also vary significantly. For instance, the heat content (btu's/lb) of most biofuels (wood, corn, hay, etc) will vary significantly with moisture content. The higher the moisture content, the lower the heating value, and the greater the quantity required.

From the table another important fact about alternative heating systems becomes clear: the more valuable the fuel, the more important overall heating system efficiency is to a producer's bottom line. For instance, if propane cost $2.00 a gallon and a producer installed a wood pellet heating system with an overall heating efficiency of 80%, he could cut the cost of heating

his houses roughly in half. But, if the heating system efficiency was only 50%, heating costs would only be reduced by approximately 13%. Conversely, if a producer were to install a system that burned a relatively inexpensive fuel (i.e, dry wood chips), whether the heating system efficiency was 80% or 50% wouldn't matter nearly as much. In either case, heating costs would be dramatically reduced when compared to propane.

Due to the inherent difficulties of heating a large poultry house from a single location, overall alternative heating system efficiencies are very likely to be below 70%. Because of this fact, it is crucial that any alternative heating system installed in poultry houses is capable of burning a low cost fuel, ideally a variety of low cost fuels. The downside is that often alternative heating systems that are capable of burning lower cost fuels tend to be more expensive due to the handling, feeding, and igniting difficulties. For instance, wood pellet heating systems tend to be relatively inexpensive due to the simple fact that wood pellets are a nearly ideal fuel. Wood pellets are easy to move with a conventional feed auger. Their low moisture content makes them easy to ignite, and they produce very little ash when burned. Large/rough green wood chips, on the other hand, are more difficult to auger and their moisture content can vary significantly, making ignition more problematic. As a result, systems that can burn green wood chips tend to cost more in order to overcome handling and combustion difficulties with a minimum of grower time and effort.

How quickly an alternative heating system will pay for itself depends in large part to the cost of fuel it burns and the overall efficiency of the system. The lower the cost of the fuel (per Btu produced), the quicker the return on the investment. But equally, if not more importantly, is overall heating system efficiency. Because even if an alternative fuel appears very inexpensive, if it is not utilized efficiently, an alternative heating system could prove to be a poor investment.

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