MISSISSIPPI STATE UNIVERSITY EXTENSION

Broiler House Ventilation During Cold Weather

The cold weather ventilation program in a broiler house is designed primarily for **moisture removal**. With the arrival of cooler weather, growers and integrators must once again address wintertime ventilation management.

Ventilation during cold weather is always challenging because growers do not want to burn any more fuel than necessary, but they do want to maintain a high level of flock performance. For most growers, fuel is their greatest single expense during the year. Therefore, growers tend to reduce ventilation rates during the winter to conserve fuel and lower production costs.

However, failure to maintain an adequate house environment can lead to poor air and litter quality. This can result in reduced flock performance that is detrimental to net returns. The goal is to have the lowest possible fuel cost that will still allow you to provide an environment that is best for the birds. This is accomplished by using a **minimum ventilation rate**: the quantity of fresh, outside air that must be moved through the broiler house to absorb and remove moisture.

Perhaps the key principle of winter ventilation is that warm air holds more water than cold air. Therefore, a controlled minimum ventilation rate uses limited quantities of cold, dry outside air like a sponge (as this air is heated once inside the broiler house) to absorb moisture within the house. Integrators generally provide their growers with guidelines on how to manage and control minimum ventilation rates.

However, **it is impossible to control ventilation if the house isn't tight**. A house that cannot achieve a minimum of 0.13 to 0.15 inches (curtain-sided) or 0.20 to 0.22 inches (solid sidewall) of water column when static pressure-tested will use excessive amounts of fuel to maintain the target temperature. And in this situation, you still cannot maintain an optimum environment because of air entering in places you don't want, such as loose-fitting curtains or cracks around footings, doors, and so forth. Sealing the house and maintaining a tight building envelope should be the first priority to proper ventilation during cold weather.

Checking House Tightness with Static Pressure

First, be sure to close the house up tight. Make sure all doors, vents, fan louvers, and tunnel openings are sealing tight. It is easy to overlook some of these if you do not physically walk the house and check. Tunnel inlets can cycle over time causing cords and cables to stretch and loosen, creating cracks running the length of the opening. A single small opening or crack may not hurt the static pressure by itself, but multiple cracks added together can make a significant impact on static pressure. Next, turn on a ventilation fan and record the static pressure reading from the controller or a handheld magnehelic gauge or manometer.

A good rule of thumb when checking house tightness is to use 1 cubic foot per minute (cfm) of fan capacity for each square foot of floor space. For reference, a 40-by-500-foot house is 20,000 square feet and will require 20,000 cfm of ventilation to be turned on to appropriately check house tightness. Most 48-inch fans will be near the 20,000 cfm rating. A 52-by-500-foot house will require 27,000 cfm, which is close to one 54-inch fan. Of course, fans will vary by manufacturer so these are close estimations.

Also, check and make sure fans are in proper working order with good belts that are snug and pulleys that are in good shape. To check individual fan performance, repeat the steps above for each fan individually and note the static pressure reading for each one. A fan that isn't running efficiently will produce a lower static pressure reading than the other fans. If you are constantly cycling the same few fans for minimum vent, they will most likely wear quicker than, for example, the last fan you turned on during tunnel ventilation.

Some level of air exchange is necessary because the birds need fresh air to breathe and propane needs oxygen to burn. For example, for every gallon of propane burned, 850 cubic feet per hour of fresh air is consumed. In addition, 92,000 Btu of heat, 108 cubic feet of carbon dioxide, and 6.8 pounds (0.8 gallons) of water is produced for every gallon of propane burned. It's this water that causes many of the problems faced by producers.

With small chicks and cold weather, moisture production can be significant. If you burn 300 gallons of propane the first few days with small chicks, that is like adding 240 gallons of water to the brooding area of the broiler house (300 gallons × 0.8 gallons water per gallon propane = 240 gallons water). This moisture must be removed through ventilation. Otherwise, you set yourself up for wet litter, ammonia, respiratory issues, foot pad problems, increased pathogen challenge, and so forth.

Tightening Up the Broiler House

If you determine the house needs to be tightened up but you can't see any obvious leaks, cracks, or holes, you may want to consider smoking the house to check for leaks. To do this, you will repeat the same procedure used to check for tightness but have a helper introduce smoke to the exterior of the structure. The smoke will make its way inside the house through any cracks and holes, making them visible inside the house. There are commercially made smoke generators that when lit will produce a thick smoke of multiple colors. An alternative to these smoke generators is a simple propane insecticide fogger filled with baby oil. These foggers can be purchased at local hardware stores and will produce a thick white smoke for an extended period.

Another way to tighten up the house and gain better control of the amount and location of ventilation air that enters the house is to have **solid sidewalls**. Converting from curtain-sided to solid sidewall housing can dramatically reduce heat loss through conduction. For example, curtain material has an R-value of 1. However, by switching to solid sidewall construction and installing 3.5-inch fiberglass batt insulation in the wall, the R-value in the wall becomes R-11. A good rule of thumb is that when you increase the R-value of a material from R-1 to R-2, you essentially cut the heat loss through the material by half. Going from R-1 to R-8 cuts the heat loss by 85 percent.

Broiler House Fans

Stir fans are a great way to help promote the drying of litter and reduce fuel costs as much as 25 percent in older houses. Even newer houses can see fuel savings of nearly 10 percent. Stir fans break up the temperature gradient that forms in poultry houses. Warm air rises, so the hottest air in the house is at ceiling level. Stir fans mix hot air with the rest of the air. This keeps hot air gently moving back down across the litter to promote drying, and reduces brooder run time.

You may think having baffles in your high-ceiling house means you can't use stir fans in winter, but that is not the case.

Paddle fans work well in houses with baffles and have the same benefits as the 18- to 24-inch axial fans more commonly used in low-ceiling houses. However, paddle fans should have forward and reverse speeds so that airflow can be directed upward in the winter to prevent a windchill effect on small chicks.

Direct the airflow of axial fans horizontally toward the end wall or perhaps slightly uphill toward the ceiling (not down). Growers often use stirring or mixing fans in different ways; some growers run them continuously, while others have them tied to the controller and alternate their operation with the vent doors. Stir fans should remain in use from the pre-heating period before chick arrival until the birds are at least 14–18 days old.

The American Society of Agricultural Engineers indicates a ventilation system for poultry or livestock shelters accomplishes one or more of the following:

- provides the desired amount of fresh air, without drafts, to all parts of the shelter
- maintains temperatures within the desired limits
- maintains relative humidity (RH) within the desired limits
- maintains ammonia levels below specified levels

How Ventilation Rates and Heat Affect Broiler Houses

Ventilation rates are designed to balance sensible heat (dry heat) gains and losses, as well as latent heat (moisture) gains and losses. Sources of sensible heat in broiler houses include bird sensible heat (body heat), mechanical heat from lights, feeder and fan motors, etc.; supplemental heat from brooders and furnaces; and solar heat gain. Sensible heat losses include heat removed by ventilation, building heat losses through curtains, doors, walls, etc.; and sensible heat used to evaporate water. Latent heat gain sources include water vapor from animals (manure and respiration); water vapor from evaporation (wet litter); and water vapor in incoming air. Ventilation removes latent heat from the broiler house.

The question often asked is, "How long do I minimum ventilate to control moisture in the house?" Integrator charts and guidelines are a good starting point. However, you should consider other factors, as well. Watch litter conditions for signs of slicking over in spots (especially near walls and under drinker lines), or litter sticking to your shoes or boots. Unfortunately, by the time you recognize there is a problem, it's almost too far out of hand to fix it. Therefore, maintaining the proper RH inside the broiler house may be a better option.

The RH should remain between 50 percent and 70 percent. If the RH approaches 65 percent, consider increasing the minimum ventilation rate. If the RH nears 50 percent, slightly decreasing the minimum ventilation rate may be to prevent the litter from becoming too dusty. An inexpensive RH meter can be purchased for around $10 to $20 and should be fairly accurate for up to 2 years. Also, take advantage of any occasional warm winter day. Increase the minimum ventilation rate on warm afternoons to take advantage of extra drying potential. However, remember to set the time back at night to its usual setting. So, the best answer to "How long do I minimum ventilate?" is: "As long as it takes to do the job correctly."

Ensure Good Ventilation with Proper Pressure

Good ventilation depends on having static pressure and vent door opening widths set correctly. The air should enter the vent door, follow the ceiling, and flow just past the center width of the house before falling. This means ceiling vents should open 1 to 2 inches, while sidewall vents should open 1.5 to 2.5 inches. Less than this will result in inadequate air volume to carry the air to the center of the house. This will result in cold air falling to the floor before it has had sufficient time to be warmed, creating damp litter and chilled chicks.

When the fans are running, the air pressure inside a broiler house is always less than the pressure outside. The fans move air out of the house, and air rushes in through the vent doors to replace the air being removed. This is referred to as a "negative pressure" system. Static pressure is actually the difference in pressure between inside and outside air. In most cases, the static pressure in a 40-foot-wide house should be between 0.08 and 0.12 when minimum ventilation fans are running. Houses wider than 40 feet may require a higher static pressure to achieve desired results (perhaps 0.15).

A good rule of thumb is that for each 0.01 increase in static pressure, 2 feet of "throw" is added to the jet of air (0.15 = approximately 30 feet of throw) on each side of the broiler house. This means that if you have a 40-foot-wide broiler house, you will need a static pressure of around 0.10 inches to 0.12 inches water column to get the air out into the peak of the ceiling from both sides. However, the higher the static pressure, the harder the fan must work to get air into the house. Fan flow rate decreases as static pressure increases. Therefore, there is a tradeoff: jet penetration length vs. fan airflow rate.

Litter Amendments Affect Broiler House Conditions

Litter amendments can affect ventilation rates in broiler houses, especially when chicks are small. Litter amendments allow growers to ventilate for moisture, not ammonia, greatly reducing ventilation rates. Often, ammonia concentrations of 50 ppm or higher are seen in houses with young chicks not treated with litter amendments, even though the integrator recommended guideline for ammonia may be 20–25 ppm. Ammonia concentrations of 50 ppm and higher are a serious welfare concern and can be damaging to the eyes and respiratory systems of young birds. Damage caused by ammonia cannot be corrected and will result in significant reductions in bird health and performance throughout the flock.

However, when used correctly in proper amounts, litter amendments inhibit ammonia production until the product is depleted, usually when the birds are approximately 10–14 days old. The value of the reduced ventilation rate alone typically ranges from $400 to $600 for the brooding period during cold weather. In addition, improved environmental conditions can result in better bird health and performance. Integrators often cover or cost-share the expense of litter amendments during cold weather to assist growers in providing the best environment possible for the birds.

Conclusion

The proper minimum ventilation program is critical to broiler production during cold weather. Even though the temptation is great to reduce ventilation to save fuel, consider how much money will be lost to poor performance, increased mortality, and reduced market weights. Providing proper minimum ventilation rates during winter months will result in an optimum environment that can maximize earning potential.

References

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