

*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 Association

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Stopping Sweating, Condensation & Wet Houses

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At this time of year we get lots of calls from growers and industry representatives about wet conditions in houses. When the weather is cold, sweating or condensation will be prevalent in many houses across the poultry belt, contributing to wet litter, ammonia, damage to equipment and the structure, and also poor bird health. In this newsletter, we look at the causes and cures for sweating, condensation and wetness. We have also included a handy 10-point guide summarizing good cold-weather management strategies.

Why Condensation Happens

When warm moist bird air comes in contact with cold surfaces, such as curtains, vent doors, or water lines, condensation and sweating can and does occur. This happens because the building's inside surface temperatures have dipped below the indoor air dewpoint temperature. The more moisture there is in the house air (the higher its relative humidity), the smaller the temperature drop it takes to cause sweating.

Condensation is a problem in wintertime because interior building surfaces are at their coldest then. Let's remember that for each pound of live weight that we have in a poultry house, we will get about 5 BTU's per hour of heat released into the house, and we will get about 0.01 pounds of moisture per hour as well. So, birds in a house put off heat and moisture. It is typical to have air temperatures of 80-85 degrees in the house during the first couple of weeks of bird life. If ventilation and heating systems are not managed properly, we can have relative humidities in the neighborhood of 75-80%. This sets the stage for lots of condensation throughout the house.

If 85-degree air at 80% relative humidity comes in contact with a surface that is at 78 degrees (or lower), condensation will occur (see table on page 3). The air coming into contact with the cooler surface is slightly chilled and can no longer hold the amount of water that it did at 85 degrees, so water pops out of the air onto the cool surface. As we said above, the more moisture there is in the air (the higher the relative humidity), the closer the sweat temperature is to the actual temperature. This means that in cold wintertime, sweating is much more likely to occur, especially on poorly insulated inside surfaces.

How to Prevent Condensation

The key to minimizing condensation or sweating is to operate the house at lower relative humidities. An 80% relative humidity is extremely high moisture, at which condensation will occur on almost all building surfaces. At 80% relative humidity, air only has to be chilled by about 7 degrees for sweating to take place. If we can reduce the relative humidity of the air in the poultry house to 65%, the air would have to be chilled about 13 degrees for sweating to take place.

Your ventilation system is the tool for reducing the relative humidity of indoor air. When you bring in fresh air through the inlets and mix this fresh air with the warm, dryer air in

The wet wall shown in this photo is caused by very high relative humidity and warm, moist bird air coming into contact with cool building walls and foundations. The problem can be minimized by lowering relative humidity in the house through more fan run time and by improving air mixing with properly adjusted vents or by using stir fans.



the top of the house, overall relative humidity of house air will be lowered, and in turn, sweating will be reduced. You should realize that even at proper relative humidities some condensation will occur on extremely cold surfaces such as curtains, water lines and concrete foundations. But the key to controlling condensation on most building surfaces is to move more air through the house while placing a special emphasis on good air mixing and stirring. This will remove moisture from the litter and reduce relative humidity.

Good Insulation Is Essential

Even if the house is running properly, with relative humidity in the mid-60% range, condensation will occur on any uninsulated or under-insulated wall or ceiling surface in the house. If the attic insulation is thin, the tri-ply ceiling will sweat. If wind or varmints have shifted insulation in the attic so there are bare spots, then the cold air in the attic will contact the tri-ply on the attic side and the warm poultry air below the tri-ply will cause the ceiling in that area to sweat. Of course, the way to head off this problem is to inspect the attic at least once a year and to be sure that you have good coverage of insulation in the attic.

Air Leaks Will Cause Sweating and Wet Litter

Anywhere in the house where cold outside air is allowed to leak into the house, condensation is likely to occur. A very common sight, is a wet foundation wall caused by air leaking past an unsealed sill plate or air coming through an unsealed curtain. The incoming cold air flows out across the warm litter, causing condensation on the litter itself. Air leaks also defeat the function of the ventilation system, and must be sealed. (*continued on back page*)

TEN WAYS TO REDUCE SWEATING AND WET HOUSES

1. Run heating and ventilation to keep house air relative humidity at 70% or lower in cold weather. Get a relative humidity (RH) meter and use it. Humans cannot judge relative humidity very well.
2. Check your air inlet openings and static pressure. A modern house relies on the proper inlet opening and the proper static pressure to throw air to the center of the house. In winter, pressures of about 0.10 and with inlets opened to about 1 to 1-1/2 inches are what is needed. Failure to do this results in poor air mixing.
3. Check your house for cracks and air leaks. Cold air coming in through a crack or around a curtain will drop straight to the floor. Cold air falls and warm air rises. Stop up all cracks. This reduces sweating and litter caking and improves the bird environment.
4. Take a hard look at your tunnel inlet. Most are not sealed well enough. Consider a flap, an interior curtain, or other cold air barrier. Cold air leaking in at the tunnel inlet end causes sweating, condensation, and cake. Sealing this up is the solution to this problem.
5. Take a hard look at tunnel fans. Even the best shutters don't seal perfectly. In very cold weather installing bonnets or plastic over shutters that are not in use is a must, otherwise cold air hits the warm floors and we have condensation and caking.
6. Consider using stir or mixing fans. The more we can stir the air without causing drafts on the birds the better able the air is to pick up litter moisture. Stir fans mix air and aid in moisture pick up.
7. Take a hard look at your fan run times. Too many folks cheat on fan run times. Insufficient run times lead to higher humidities, sweating and higher litter moisture.
8. Look your ceiling over. If you have wet and dripping spots here and there on your ceiling, most likely you will find places with little or no insulation in the attic. Get into the attic and be sure your insulation has not shifted.
9. To stop sweating and fog in the back half of a tunnel house during brooding, quit pulling all the air to the back and exhaust some air from a side wall or front wall fan in the brood chamber. This reduces the amount of moist air going through the back of the house. Also turn on heat in the back of the house to 55-60°F.
10. Don't turn your heat off, even if you have big birds. In a cold winter, especially if your house is not very well insulated, you might well need some heat all the way to the end of the growout. Turning the heat off places too much demand on bird heat and causes us to load the house with moisture, resulting in heavy sweating and caked litter. Turning heat off also increases feed consumption.



An inspection of insulation in the attic of this chicken house reveals that wind has most likely shifted insulation. Note the bare ceiling. When cold air in the attic comes in contact with the ceiling tri-ply in the attic, we will have condensation in the bird chamber as warm in-house air contacts the chilled tri-ply.



Condensation areas on ceilings such as this during cold weather is a good sign that insulation has been moved or is not in place in the attic. If left unattended, the constant accumulation and dripping of moisture will induce mold growth and cause damage to the house structure and any equipment that is continually kept wet.

Surface Temperatures at which condensation occurs

| AIR TEMPERATURE | | | | | | |
|-----------------|------|------|------|------|------|------|
| RH | 65°F | 70°F | 75°F | 80°F | 85°F | 90°F |
| 40% | 40 | 45 | 49 | 54 | 58 | 63 |
| 45% | 43 | 48 | 52 | 57 | 61 | 66 |
| 50% | 46 | 51 | 55 | 60 | 64 | 69 |
| 55% | 49 | 53 | 58 | 62 | 67 | 72 |
| 60% | 51 | 56 | 60 | 65 | 70 | 74 |
| 65% | 53 | 58 | 63 | 67 | 72 | 77 |
| 70% | 55 | 60 | 65 | 69 | 74 | 79 |
| 75% | 57 | 62 | 67 | 71 | 76 | 81 |
| 80% | 59 | 64 | 69 | 73 | 78 | 83 |
| 85% | 61 | 65 | 70 | 75 | 80 | 85 |
| 90% | 62 | 67 | 72 | 77 | 82 | 87 |

Temperatures above are dew point temperatures for air at the conditions specified for sea level altitudes.

Ounces of water in 1,000 cubic feet of air

| AIR TEMPERATURE | | | | | | |
|-----------------|------|------|------|------|------|------|
| RH | 30°F | 40°F | 50°F | 60°F | 70°F | 80°F |
| 10% | 0.4 | 0.6 | 0.9 | 1.3 | 1.8 | 2.4 |
| 20% | 0.9 | 1.3 | 1.8 | 2.6 | 3.5 | 4.9 |
| 30% | 1.3 | 1.9 | 2.7 | 3.8 | 5.3 | 7.3 |
| 40% | 1.7 | 2.5 | 3.6 | 5.1 | 7.1 | 9.7 |
| 50% | 2.1 | 3.2 | 4.5 | 6.4 | 8.9 | 12.2 |
| 60% | 2.6 | 3.8 | 5.4 | 7.7 | 10.7 | 14.6 |
| 70% | 3.0 | 4.4 | 6.3 | 8.9 | 12.4 | 17.0 |
| 80% | 3.4 | 5.0 | 7.2 | 10.2 | 14.2 | 19.5 |
| 90% | 3.8 | 5.7 | 8.1 | 11.5 | 16.0 | 21.9 |
| 100% | 4.3 | 6.3 | 9.0 | 12.8 | 17.8 | 24.3 |

Ounces of water per 1,000 cubic feet of air based on temperatures and relative humidities listed at sea level altitude.

For any given air temperature, the higher the relative humidity (RH), the less a surface needs to be chilled to bring on condensation. The shaded areas show that if air temperature is 85 degrees and its relative humidity is 80%, condensation will happen if the air touches a surface only 7 degrees cooler, at 78°F. If we can keep the RH at 70%, however, the surface temperature has to drop all the way to 74°F to cause sweating, an 11-degree difference. The lower the RH in the house, the less sweating will occur.

Raising the temperature of air greatly increases the amount of water it can hold. This is why wintertime ventilation works to remove moisture from a house. Example: When it's 30°F and raining (100% RH), the air can hold only 4.3 ounces of water/1,000 cu ft. When we bring that air into a house, with good mixing, and its temperature rises to 80°F, it can hold a maximum of 24.3 ounces (at 100% RH). We don't let the RH go that high, but even at 70% RH it will hold 17 ounces, four times as much as at 30°F. This is how ventilation air is able to pick up moisture from the litter and exhaust it out of the house, even in cold, wet weather.

How to Keep the Tunnel End Dry During Brooding

When we brood chickens and exhaust all air through the tunnel end of the house, that end of the house will almost always get very wet. When the warm, moist bird air in the brood chamber is taken into a cold off end of the house, sweating will occur on almost all building surfaces. We have seen mold growing in houses and extremely undesirable conditions develop.

A cure for this common problem is to use one fan in the brood chamber and one fan in the back of the house. If a 48-inch fan is used in the back of the house and a 36-inch fan in the brood chamber for minimum ventilation, the moisture load in the back of the house will be reduced by about 33%. If 36-inch fans are used in both the front and back of the house, the moisture load in the back of the house will be reduced by half. Ventilating solely out of the back of the house in cold weather will cause big problems.,

Another step that will minimize condensation in the backs of houses during brooding is to put some heat in the off end. Growers are reluctant to do this, but they will get the benefit of this heat, for they are preheating the back of the house for turnout, as well as preventing damage to the house and equipment.

Sweating in the backs of houses rusts cables, disrupts electronic circuitry in furnaces and heaters, and causes ammonia, mold, and rotting and warping of wood. Do not allow the off end of your house to sweat profusely during brooding. Take steps to reduce or eliminate that condensation.

Run Proper Minimum Ventilation to Prevent Wet Litter

Be sure fan run times are sufficient to remove the moisture that is deposited in the litter by birds on a daily basis. If we manage houses for several days at very low fan run times, we will wake up one day to a slick house because we have not been keeping up with the moisture as it has been dropped into the house. For more help on good wintertime ventilation management, go to www.poultryhouse.com to find our newsletters #15, *Cardinal Rules for Wintertime Ventilation*, and issue #4, *What is The Most Important Part of Your Poultry House Ventilation System?*

Bottom Line

Excessive condensation and sweating is generally a sign of relative humidities that are too high in poultry houses. Excessive sweating will aggravate ammonia problems, damage equipment and the structure, and will lead to reduced flock performance. Growers and industry representatives need to know what causes this condensation and how to minimize the problem.



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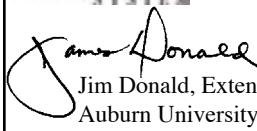
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