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Controlling Humidity in Turkey Houses – Metric Edition

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As a general rule, for every pound of feed a turkey eats it will drink a little over two pounds of water. As birds get older, feed consumption increases dramatically and so does the amount of water they drink. For example, 10,000 ten-week-old birds will eat over six tons of feed a day and drink over 13 metric tons of water a day. At the end of a 15-week flock, 10,000 toms will have consumed over 160 metric tons of feed and over 360 metric tons of water!

Where does the water go? Actually, a small percentage of this water is retained by the birds, approximately 45% is exhaled into the air in the form of water vapor and approximately 55% is deposited into the litter in the form of feces. When a grower operates fans or lowers the curtains, the moisture-laden air in the house is replaced with drier outside air, thereby removing water from the house. The drier air that the fans/curtains bring into the house will not only pick up water that the birds are placing into the air but also remove water from the litter, keeping it drier. Of course, if a producer does not bring in enough fresh air, water will build up in the air as well as in the litter, leading to house sweating and litter caking.

Relative Humidity

All air contains some amount of invisible moisture. We generally describe how much moisture is in the air in terms of relative humidity. But we must keep in mind that the moisture holding ability of air is not constant, it changes with temperature. Warmer air can hold more moisture than cooler air. In fact, for every 10°C increase in air temperature, the moisture holding ability of air approximately doubles. So, 20°C air can hold about twice the moisture as 10°C, which can hold about twice the moisture of 0°C, and so on.

The actual amount of moisture that is contained within a 100 cubic meters of air at various combinations of temperature and relative humidity can be found in Table 1. From Table 1 it can clearly be seen that maximum moisture holding ability of air (Rh=100%) changes quite dramatically with temperature.

For example, 35°C air can hold nearly ten times the moisture as 0°C air can. Since the moisture holding capacity of air changes with temperature, the amount of moisture that is in the air when the relative humidity is for instance, 50%, is not the always the same. So if outside it is 5°C with a relative humidity of 50% and inside it is 25°C with a relative humidity of 50%, even though the relative humidity is the same, the air inside the house actually contains nearly four times the amount of moisture per 100 cubic meters than the air outside the house.

°C	20%	30%	40%	50%	60%	70%	80%	90%	100%
-10°	0.040	0.060	0.080	0.090	0.110	0.130	0.150	0.170	0.190
-5°	0.060	0.090	0.120	0.150	0.180	0.210	0.240	0.270	0.290
0°	0.090	0.130	0.180	0.220	0.270	0.310	0.360	0.400	0.450
5°	0.130	0.190	0.260	0.320	0.380	0.450	0.510	0.580	0.640
10°	0.180	0.270	0.360	0.450	0.540	0.630	0.720	0.820	0.910
15°	0.250	0.370	0.500	0.630	0.750	0.880	1.010	1.140	1.270
20°	0.340	0.520	0.690	0.860	1.040	1.220	1.390	1.570	1.750
25°	0.460	0.700	0.940	1.170	1.410	1.660	1.900	2.140	2.390
30°	0.630	0.940	1.260	1.580	1.910	2.240	2.570	2.900	3.240
35°	0.830	1.250	1.680	2.110	2.550	2.990	3.440	3.890	4.350

Table 1. Liters of Moisture per 100 Cubic Meters of Air

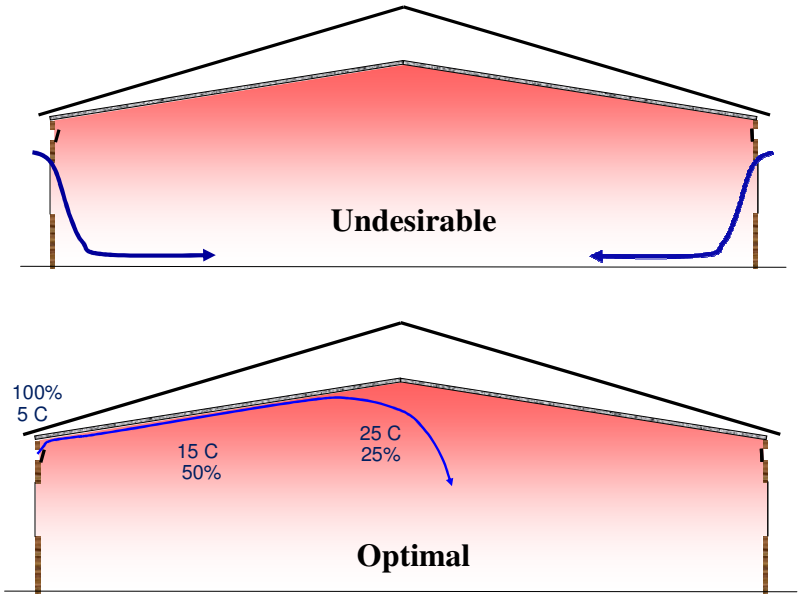
Cold and Wet Weather

Once you realize that the moisture holding ability of the air changes with temperature, and that humidity is a relative concept, you can begin to understand how you can remove moisture from a house even when it is cold and rainy outside. For instance, if it is 5°C and rainy (100% Rh) many producers believe that ventilation rates should be decreased because, after all, what is the point in bringing saturated air into a house where the relative humidity may only be 60%?

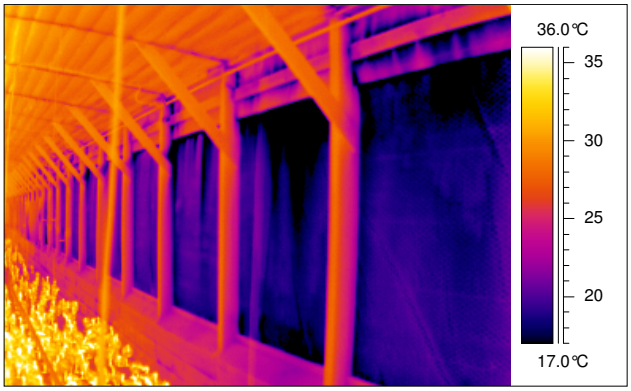
One must keep in mind that the moisture holding ability of air changes with temperature and that in fact even though the relative humidity of the outside air may be higher than that inside, the outside air can actually be drier if it is significantly cooler outside than inside. For instance, if it is 25°C inside and the relative humidity is 60% there are 1.41 liters of water in every 100 cubic meters of air. This means that there are actually over twice the amount of water in every 100 cubic meters of air inside the house than outside when it is 5°C and the relative humidity is 100% (0.64 liters/100 m3 of air). So for every 100 cubic meters of "dry" inside air you exchange with "wet" outside air, you are actually removing 0.77 liters of water from the house.

It is important to realize that drying will only take place if the cold incoming air is warmed before moving down to bird level. If sidewall curtains are cracked, the cool air will quickly fall to the floor before mixing with the warmer, drier air next to the ceiling. This is why it is best to use exhaust fans and air inlets so that air entering the house can be directed toward the ceiling to increase warming before moving to the floor level, see Figure 1. If you do not have exhaust fans, circulation fans should be used to move the warmer air from the ceiling over to the side walls. Circulation fans during cold weather should be directed upward or raised toward the ceiling to insure that air movement at bird level is not excessive.

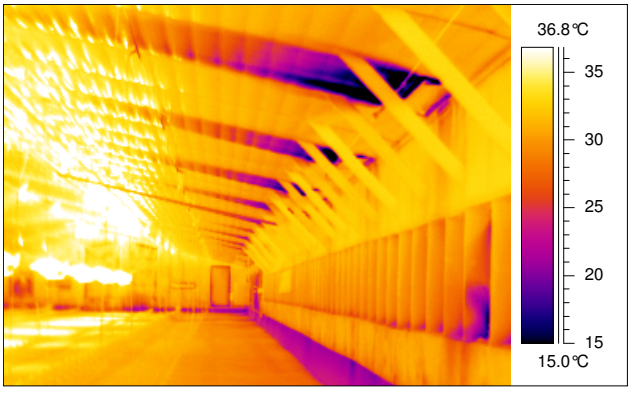
Figure 1. House Air Flow Patterns



This optimal air flow pattern keeps the air away from the birds as long as possible. It maximizes heating and the moisture holding ability of the air and it minimizes drafts.



Poor air flow – sidewall curtain leakage.



Good air flow – ceiling inlet air flow.

Maintaining Dry Litter

Monitoring relative humidity is a good way to make sure that the air in your house can remove moisture from the litter. Ideally, the relative humidity should be between 50% and 70%. If relative humidity is below 50% you can dry out the litter too much leading to dusty conditions. If relative humidity is above 70% for a prolonged period, litter caking and house sweating can occur.

It is important to keep in mind that warmer air holds more moisture than colder air when you are trying to keep your litter dry. For instance, let's say you had mid-aged birds and your house temperature was 21°C and the relative humidity was 65%. You noticed that litter was starting to get a little damp and wanted to dry it out before it slicked over. You turned down your minimum ventilation fan thermostats to 19°C to bring in more air. Since the temperature of the air is lower, the moisture-holding ability of the air would also decrease, resulting in the relative humidity increasing to approximately 78%. This will make it more difficult to remove water from the litter. Yes, you would bring in more air which would help to some extent, but the downside is the higher relative humidity would make it more difficult to pull the water out of the litter.

On the other hand, let's say we increased the house temperature just 2°C and left the minimum ventilation fan settings the same. The relative humidity would decrease to approximately 58%, making it significantly easier to draw water out of the litter. Another option would be to leave the house temperature the same and to turn up the minimum ventilation fan settings. This also would work provided that we do not let the house temperature fall. In some instances this will mean adding heat to the house in order to maintain the desired house temperature.

Summary

The key to keeping a house dry is the quality of air, not the quantity of air. Bringing in a lot of cold air and letting our house temperature fall does not usually work as well as bringing in a moderate amount of air and warming it.

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