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Poultry Housing Tips

Oxygen

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Though oxygen is crucial to a bird's survival, a young chick actually requires very little to thrive. For instance, the oxygen requirements for a day-old bird is approximately 0.00016 ft^3/min. Since air is only 20% oxygen a chick needs to breath in 0.00083 ft^3/min of fresh air to get its 0.00016 ft^3/min of oxygen. This of course is a very small number and may be difficult to relate to. But, when we look at a typical house it becomes easier to understand how very little fresh air this really is. For instance, let's say we had a 40' X 500' house with 25,000 birds. We simply multiply 0.00083 ft^3/min per bird X 25,000 birds and we discover that we only need to supply 21 cubic feet of fresh air each minute. Twenty-one ft^3/min of fresh air per minute is not a lot of air. A couple of 36" fans would only have to **operate 0.3 seconds out of five minutes** to supply 21 ft^3/min of fresh air!

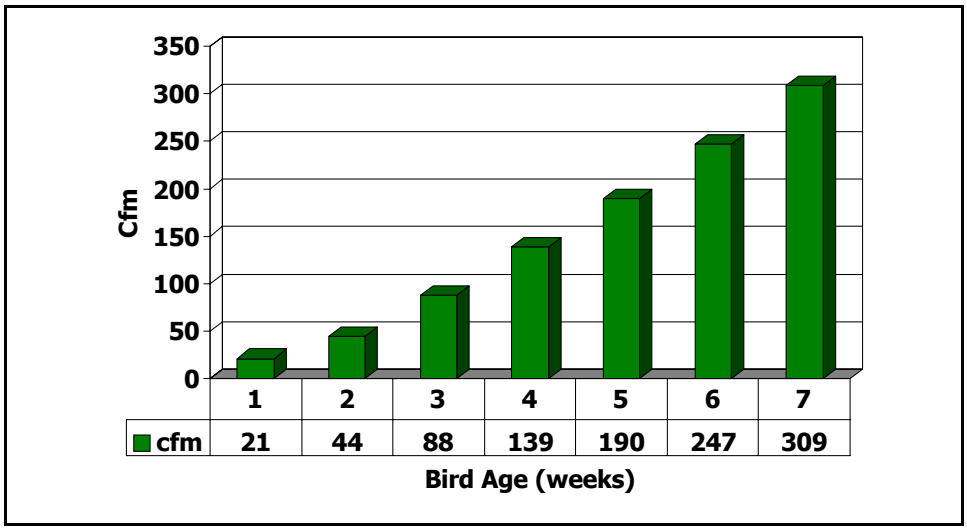

Figure 1. Fresh air required to supply oxygen to 25,000 broilers

Now it is important to realize that the chicks are not the only things in the house consuming oxygen. In fact, in many instances the primary users of oxygen in a house are the brooders/furnaces. Burning one gallon of propane requires the oxygen contained in 850 cubic feet of fresh air. So lets say we had a house of 26 pancake brooders and it is a cold night and one half of the brooders are operating. The 13 brooders would burn approximately 4.3 gallons of propane

per hour requiring 60 cubic feet of fresh air per minute. This is roughly three times the amount of fresh air required by the birds. But again, it is important to realize that we are still not talking about a lot of fresh air. Two 36" fans would still only have to operate **1.2 seconds out of five minutes** to supply the oxygen requirements of both the birds and brooders. The typical house probably has well over ten times this amount in leakage alone.

What about older birds? Though older birds do require more oxygen than younger birds, the fact remains that, relatively speaking, older birds do not require as much oxygen as many believe. For instance, the oxygen requirement for a seven-week-old bird is approximately 0.0012 ft^3/min. Again taking into account that air is 20% oxygen and a 40' x 500' house may have 25,000 birds, the fresh air requirement would be 146 ft^3/min. To obtain 146 ft^3/min, two 36" fans would only need to operate on average **2.2 seconds out of five minutes**.

This is not to say that insufficient oxygen is never a problem for birds. But, it is not house oxygen levels that tend to be problematic, but rather blood oxygen levels. For instance, the precise oxygen requirement for a day-old chick depends somewhat on "feed" consumption. Now for a day-old chick, when we talk about feed it can either be the feed you supply or that in its yolk sac. Oxygen is required in the "combustion" of feed to produce heat and energy for growth. As the air temperature drops the bird must consume more feed and therefore more oxygen to stay warm. For instance, a day-old chick in an 82°F house requires 20% more energy and 5% more oxygen than one in a 92°F house. If air temperature at floor level drops just another three degrees to 79°F, the chick requires approximately 50% more energy to stay warm. And if the air temperature happens to drop an additional four degrees to 75°F, a chick requires **twice** the energy to stay warm than one kept at proper brooding temperatures! The lower the temperature drops, the more energy the chick requires to stay warm and the more oxygen it must to consume to survive (Teeter, 2004).

Now keep in mind that even if oxygen consumption were to double in a house with young chicks, which is impossible, this would mean that a producer would only have to operate a couple 36" fans for a few seconds out of five minutes to supply the necessary oxygen. The problem is that a chick's respiratory system is pretty much operating at near capacity when a chick is grown at normal brooding temperatures. A chick breathes in fresh air by expanding its body cavity, which causes a slight negative pressure. Air is pulled in to paired air sacs near the tail of the bird. Then the bird exhales by compressing its body cavity which forces the air from the air sacs near the tail through the lungs into two pairs of air sacs one set under the wings and another up toward the breast bone. As air moves into these front air sacs it displaces air from the previous respiration which the bird exhales. When the air moves through the lungs, oxygen is absorbed by the blood and carbon dioxide moves from the blood to the air.

If there is an increased demand for oxygen due to increased feed consumption, the heart has to push more blood through the lungs to increase the amount of oxygen available for feed combustion. Because the lung volume and cardiovascular volume within the lung tissue is fixed, the bird's blood pressure increases as the heart works harder and harder to push the blood through the lungs in an effort to get more oxygen into its bloodstream. The increased effort and blood pressure eventually leads to an enlarged the heart. Furthermore, increased blood pressure results in enlarged blood vessels and leakage of fluid from the vessels which builds up in the abdomen – a tell tale sign of ascites or "water belly." Oxygen demand does not need to increase much to initiate the onset of ascites. In fact, an increased oxygen demand in young chicks of as little as five percent has been shown to increase the incidence of ascites.

What is interesting is that increasing ventilation rates to solve an "oxygen" problem can actually make the blood oxygen levels worse in some instances. As ventilation rates increase the heating system has to operate more to heat the increased amount of cold air entering a house. Often the heating system cannot keep up with the increased heat demand causing house temperatures to fall. Furthermore, increased ventilation rates can lead to drafty conditions which can result in chilled birds. The combination of lower house air temperatures and drafty conditions results in chicks having to burn more feed to stay warm, significantly increasing their oxygen requirements.

Now it is true that lower oxygen at higher altitudes can be problematic for chicks. As altitude increases, the amount of oxygen in the air decreases. The environmental oxygen concentration for birds raised at high altitude may be 17% to 19% whereas at sea level oxygen levels are approximately 20.5%. This reduced level of oxygen, especially when coupled with low brooding temperatures, can lead to very low blood oxygen levels. The fact remains that at altitudes

where most broilers are grown, oxygen levels of 17% to 19% are extremely rare and could only result from a combination of severe under ventilation (no fans operating for a long period of time in an airtight house) with high use of supplemental heaters/brooders. A sign that oxygen is at these levels would be that a producer would find himself breathing faster and deeper, trying to get enough oxygen into their bloodstream. What would be considered low oxygen levels in most houses would be around 20.0% which at proper brooding temperatures has not been shown to be problematic.

Dust, respiratory infections, and ammonia damage may also play a part in limiting a bird's ability to extract oxygen from the air (Leeson, et al., 1995). Dust in poultry houses consists mostly of fecal and ureate particles (Zuidhof, et al., 1997). Bronchi in lung tissue exposed to small dust particles may restrict, reducing the efficiency of oxygen uptake by the lungs. Studies conducted in Canada using canola oil on the litter in a broiler house to reduce dust found that lower dust levels resulted in lower levels of acites (Zuidhof, et al., 1997). Studies using a litter treatment (PLT) to reduce ammonia levels have shown a significant reduction in ascites related mortality from 2.1% to 0.3% (Canadian Poultry Consultants, 2003).

As you can see, the primary challenge when it comes to oxygen is not getting it into a house but rather, making sure a bird can get sufficient oxygen into its bloodstream. Adequate oxygen uptake by chicks can be accomplished quite simply by maintaining proper brooding and keeping dust and ammonia levels to a minimum.

It is important to note that though a house full of day-old broilers may need only 20 ft^3/min of fresh air to supply the necessary amount of oxygen, this is not nearly enough fresh air to keep carbon dioxide, carbon monoxide, moisture and ammonia under control. To control these variables most experts agree that producers should ventilate a minimum of 75 cfm/1000 birds the first week (150 and 300 cfm/1,000 for second and third weeks respectively). These ventilation rates are nearly 10 times that required to maintain proper oxygen levels (i.e., 75 cfm/1,000 X 25 thousand birds = 1,875 cfm).

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