Minimum Ventilation Can Change Broiler Growers

Good ventilation is critical to broiler flock performance year-round. This is especially true during the winter season when growers must battle cold outside temperatures and manage ammonia (NH_3), carbon dioxide (CO_2), humidity, and litter condition, while keeping fuel use at an affordable level.

Providing the proper minimum ventilation during winter may sound easy, but it is actually quite difficult to maintain bird comfort while efficiently managing fuel use. Growers often think that minimizing fuel use during winter months should override everything else, including providing a warm, comfortable, uniform environment that optimizes bird health and production. However, this approach can have serious consequences on flock performance and profitability.

Minimum Ventilation

Growers may sometimes believe minimum ventilation is simply operating a fan or two on a timer and opening a few inlets every now and then to let some fresh air in. It is actually much more complicated than that. Minimum ventilation during cold weather can be challenging because every poultry house on the farm ventilates differently, and ventilation requirements change constantly based on the time of day, inside and outside humidity levels, inside and outside temperatures, wind speed, bird age, and stocking density. However, any grower willing to *watch*, *listen*, and *learn* what to do and what not to do can overcome the challenges.

Too much **moisture is the greatest cold-weather challenge** we face in poultry houses, often resulting in wet litter and increased ammonia that can be costly in terms of bird health, performance, and profitability. Even on new litter, moisture control is very important and, as there is little ammonia produced by that first flock on new litter, growers tend not to ventilate enough. Ventilation (air exchange) is the only solution for too much moisture in the house. Moist, humid inside air must be exhausted and replaced by cooler, drier outside air capable of picking up and removing additional moisture. Minimum ventilation can be thought of as the ***least amount*** of cool, fresh air needed to optimize good air and litter quality for the birds without compromising the desired house temperature. Unfortunately, due to constantly changing conditions, the ideal minimum ventilation rate at any given time is difficult to achieve and even more difficult to maintain throughout an entire flock.

In fact, it can't be achieved at all or maintained unless the house is extremely tight and well sealed. Air leakage around curtains, doors, fans, and tunnel inlets can lead to excessive heat loss from the house and cold drafts on the birds, and it will ultimately increase fuel bills and reduce performance. The tighter the house, the better control you have over when, where, and how much air enters.

As a result, you also have better control over the internal environment (temperature, NH_3, humidity, litter moisture) and bird comfort. A **tight house also allows for better negative pressure**, making it easier to move cooler incoming inlet air along the ceiling to the middle of the house before it starts to fall toward the floor. This allows incoming cooler air to mix evenly and be warmed by in-house air before ever reaching the birds, improving the chances for a successful minimum ventilation strategy.

Oxygen (O_2), NH_3, CO_2, carbon monoxide (CO), humidity, and dust are critical factors growers must adequately manage during the winter season to ensure bird health and comfort. Integrators typically provide growers with minimum ventilation guidelines that, when followed, will help maintain O_2, CO_2, CO, humidity, and dust at acceptable levels. The O_2 content of fresh air is approximately 20 percent and should be at or very near this level in the chicken house at all times. Less than this for long periods of time can make birds more susceptible to developing ascites (water belly). High CO_2 levels (>3,000 ppm) in the house for extended periods also can lead to ascites, as well as decreased weight gain, reduced feed and water intake, increased incidence of dehydration, and reduced bird activity levels.

Controlling NH_3 is more difficult than controlling other air quality parameters. Minimum ventilation rates

often will not control NH_3 at acceptable levels. Every house generates NH_3 differently, and if you have high NH_3 levels early in a flock, it is almost impossible (and certainly expensive) to ventilate your way out of the problem. Therefore, litter amendments that lower litter pH for the first few weeks of a flock should be considered as a cost-effective alternative to overventilation as a means to decrease house NH_3 levels, especially during the brooding period. **Minimum ventilation is not designed for NH_3 removal**! The primary role of minimum ventilation is moisture removal; and to a somewhat lesser extent, maintaining a safe O_2 supply through adequate air exchange.

High ammonia levels may require that minimum ventilation rates be significantly increased to achieve NH_3 levels at 20 parts per million or less, instead of ventilating for moisture removal only. Unfortunately, it is often difficult for growers who have grown birds for several years to determine the NH_3 level in the house simply by using their noses. Many growers become desensitized to NH_3 over time and may no longer be able to detect levels at less than 50 parts per million.

However, it has been known for almost 50 years that prolonged exposure to NH_3 concentrations as low as 20 parts per million can be detrimental to bird health and performance, when birds remain in such an environment throughout the growout period (Anderson et al., 1964). In addition, eye damage may occur with as little as 12 hours of exposure to 45 to 100 parts per million NH_3 (Black, 2012). Therefore, many service technicians and even some growers now carry ammonia meters to help manage air quality in today's broiler houses.

While growers may not always have mechanical sensors to measure various air quality factors, they do have several thousand living sensors taking measurements for them. **Birds in the house are sensors,** and their behavior can tell you a lot about how good a job you are doing. However, as mentioned earlier, you must be able to take hints from what the birds are telling you and respond accordingly. When you first walk into the chicken house, the sound and activity level of the birds, house temperature, and feel of the air (dry, humid, stuffy, and so forth) will tell you a lot about bird comfort level. Keep in mind that **bird comfort is more important than your comfort**, especially when chicks are small. As a result, for the first couple of weeks of a flock the chicken house should be too hot for your liking (but just right for the birds).

If you aren't uncomfortable from the heat during the early brooding period, you are probably growing the birds too cool. This will likely have a serious negative impact on flock health, performance, and the settlement check later on. Birds should be uniformly scattered about the house and "talking" quietly but not "fussing" or "complaining" in either huddled bunches because they are too cold or piled against the walls because they are too hot. These are characteristics of comfortable chicks:

- Spread evenly throughout the house
- Quiet, uniform noise level (no loud fussing or chirping)
- Approximately one-third of the birds eating
- Approximately one-third of the birds drinking
- Approximately one-third of the birds resting

New growers not familiar with raising chickens must quickly learn all the little things (basics) their birds can "tell" them. This is where the service technician can be a great asset in helping new growers to understand what to look for and how to respond. Raising chickens may not get any easier once you know the basics, but you will have a better understanding of the things you should do and why you should do them. Growers who have raised birds for any length of time should already be aware of the basics, but to be successful you must **practice the basics, not simply be aware of them**.

Moisture and Humidity

In-house humidity and moisture levels are constant challenges to growers during the winter season. Where does this moisture and humidity come from? Several sources are at work creating moisture and high humidity in the chicken house, including outside weather conditions, the birds, the drinkers, and the heating system. During winter, outside temperatures are much lower than during summer, and humidity levels are often quite high, making it more difficult to dry out the house.

In addition, **each bird retains only about 20 percent of the water it consumes** (Black, 2012). The rest leaves the bird through respiration, excretion, or by heat production. For example, a house of 20,000 broilers weighing approximately 6 pounds and consuming 2,200 gallons of water per day will retain 20 percent, or 440 gallons. However, 1,760 gallons will end up somewhere in the house through respiration, excretion, or heat production. If the proper house environment is to be maintained, this water must be removed through adequate ventilation. Otherwise, the litter will soon become wet and caked, and the air moist and humid and approaching saturation.

A similar situation can also exist with younger birds. Water consumption will not be as great as with older birds, but additional moisture is added to the litter by spilled water from the drinkers and from fuel combustion. For example, for every gallon of propane fuel that is burned, 6.8 pounds (0.8 gallon) of water are produced.

In addition, a broiler chick excretes about 0.06 ounce of water per hour in the first week and 0.11 ounce per hour the second week (Swysgood, 2012). Therefore, back when our 20,000 6-pound birds in the previous example were 2 weeks old, they were excreting 413 gallons of water per day (20,000 birds × 0.11 ounce/hour = 2,200 ounces/hour ÷ 128 ounces/gallon = 17.2 gallons/hour × 24 hours/day = 413 gallons/day). This water increases the likelihood the litter will become caked unless adequate ventilation is provided. Guidelines for minimum ventilation rates increase weekly to account for the increased moisture output by the birds as they age.

Table 1 lists the typical minimum ventilation rates recommended for broilers at various ages. Using this information, you can determine the run time needed on your minimum ventilation fans in three simple steps:

Step 1. Determine total ventilation rate needed (let's assume 20,000 birds 4 weeks old).

20,000 birds 4 weeks of age need 0.50 cfm/bird
(this figure is from the table)

0.50 cfm/bird × 20,000 = 10,000 total cfm needed

Step 2. *Determine fan on/off duty cycle needed.*

Fan duty cycle = cfm needed ÷ cfm/fan
(let's assume 20,000 cfm/fan)

10,000 cfm needed ÷ 20,000 cfm/fan = 0.50 on/off cycle

Step 3. *Determine timer ON setting needed.*

ON setting = fan duty cycle × timer minutes
Let's assume we have a 5-minute timer and we know our duty cycle is 0.50, so:

0.50 duty cycle × 5-minute timer = 2.5 minutes
(150 seconds) ON time

ON run time should be 150 out of 300 seconds (5 minutes) or half the time

Step 2 requires that you know the cubic feet per minute (cfm) rating on your minimum ventilation fans. For example, a 36-inch fan is usually rated around 10,000 cfm; a 48-inch fan is rated around 20,000 cfm, etc. The larger the fan, the greater the cfm rating will be. If you don't know your fan's cfm rating, ask your service technician or contact the fan manufacturer. If you contact the manufacturer, you will need to provide a model number for the fan so they will know which fan you have.

Table 1. Typical minimum ventilation rates.

Bird age (days)	Week	cfm/hr/bird
1–7	1	0.10
8–14	2	0.25
15–21	3	0.35
22–28	4	0.50
29–35	5	0.65
36–42	6	0.70
43–49	7	0.80
50–56	8	0.90

Based on the above scenario, one 20,000 cfm minimum ventilation fan in a house of 20,000 4-week-old broilers would be running half the time to adequately remove the moisture being produced. During periods of very cold weather, some growers have been known to reduce the run time or even shut the minimum ventilation fans off for a period of time in an effort to conserve fuel and keep the house warm.

However, you should carefully consider the very negative impact that a poor environment resulting from less than adequate ventilation will have on bird health, performance, and possibly survival. No grower wants to burn more fuel than necessary, but the recommended minimum ventilation rate should ALWAYS be maintained for moisture control, air exchange, and bird health. ***Managing* your fuel use** to optimize bird health, productivity, and profitability **should mean more than *minimizing* fuel use**.

Even though outside temperatures are lower during the winter, making it more difficult to dry out the house, there will still be a few "warm" sunny days with low humidity. Take advantage of these days and "overventilate" on warm afternoons to increase air exchange and help dry the litter. Warming this additional air by 20 degrees decreases its moisture level by 50 percent, allowing it to pick up and hold more moisture as it is moved down and out of the house. In other words, increasing air temperature by 20 degrees doubles the moisture-holding capacity of the air (Tabler et al., 2012). Therefore, when you have a reasonably warm, sunny day during the winter, use nature to your advantage to help dry out the chicken house.

Summary

Minimum ventilation can sometimes challenge even the best poultry growers. However, it is necessary to maintain both air quality and litter conditions. The house must be tight for a minimum ventilation program to work successfully. Otherwise, too many uncontrolled air leaks can have detrimental effects on bird health and performance and result in excessive fuel use. **Moisture and NH_3 are likely the two biggest issues** most growers will face in the broiler house during the winter season.

An adequate minimum ventilation program will likely handle the moisture issue if growers follow recommended guidelines and do not cut corners on fan run time in an attempt to minimize fuel use. However, minimum ventilation likely cannot handle a serious NH_3 challenge, and fan run time may have to be increased above that needed strictly for moisture removal to maintain adequate health and welfare conditions for both you and the birds.

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