The Practice & Purpose of Minimum Ventilation

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Ventilating poultry barns during cold winter months is a delicate balancing act of preserving warmth and expelling moisture. It's imperative that heat is retained in the barn so that fuel costs stay low during the cold-weather season; however, heaters and livestock both add abundant moisture and toxic fumes to the environment. There are devastating and costly repercussions to not eliminating those environmental stressors.

Minimum ventilation is used to master this balancing act. Minimum ventilation is the lowest level of ventilation needed to maintain the best atmosphere in the barn at the lowest economical cost. Its goal is to maintain humidity and temperature levels while controlling ammonia and dust so that the environment meets the air quality standards required for animal health.

There are many factors that work in concert during minimum ventilation. Litter quality and air quality are both influenced by house moisture, water usage and consumption, heat balance, and air movement.

MOISTURE

The moisture level in the house heavily influences the health and well-being of the flock. If too much moisture is present, wet litter, ammonia, respiratory disease, foot pad dermatitis, and other pathogens can quickly become severe and devastating problems.

Ammonia is a colorless irritant gas produced when the uric acid in bird excrement comes into contact with water and air and is converted into ammonia. Even in low concentrations, ammonia causes respiratory problems that will weaken the immune system defenses. Suggested maximum levels are 25ppm.

WATER

The watering system is the biggest factor in moisture addition to the house. Water usage and consumption increase tremendously over the life of a flock. Roughly 20% of the water consumed by the broiler is retained. The remaining 80% winds up back in the environment and must be removed from the house.

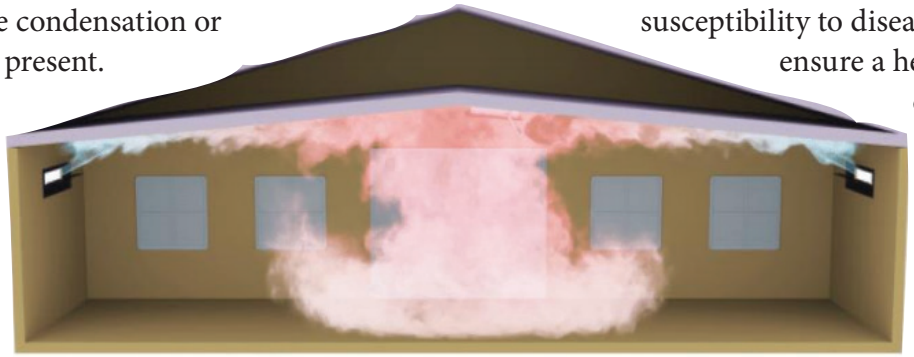
Watering systems can have a significant impact on the litter and air quality in the house. Too much wastage leads to increased ventilation rates and fuel usage or excessively wet litter.

To put this in perspective, a house of 24,000 broiler chicks at seven days old will release 266 gallons of water back into the environment every day. If there are 1,600 drinkers that each drip 0.1 ml per minute, there is a spillage of 230,400 ml per day. The ventilation system would have to remove those additional 60 gallons of water per day. It is easy to imagine the detrimental impact of waterlines that are set to the wrong height, or set to a pressure higher than bird requirements, or that aren't cleaned and flushed regularly.

Litter moisture levels are a good indication of moisture levels in the house. It indicates how well the barn has been ventilated. We strive for litter moisture between

20% - 30%. Tools exist to measure this, but a good immediate indicator is that litter is friable; you can squeeze the litter in your hand, it will slightly hold its shape, and then crumble when you push your thumb into it.

Litter starts to cake around 40% moisture. It's first noticeable under the water lines, where the most moisture is concentrated, but can quickly spread to other areas where condensation or clustering might be present.



Wet litter leads to chilled birds, and chilled birds are not productive. This is where it becomes imperative that we understand the relationship between heat and air movement.

HEAT

Two kinds of heat are present in a barn. Sensible heat is the dry heat put off by lights or motors, solar heat gain, and bird body heat. Latent heat is the moist heat added by bird respiration, moisture evaporation, and heater byproduct.

Among the byproducts of fuel consuption is water. Burning one gallon of propane will yield 0.81 gallons of water, adding to the moisture load of the house. Luckily, sensible heat also helps to remove moisture. As the litter is warmed by radiant heat, moisture is evaporated out of it and into the air. As air is warmed in the house, its holding capacity increases. Finally, the moisture-laden air is ventilated out of the barn.

Barns and floors should be heated enough to prevent cold stress. Low brooding temperatures (mid-80's or lower) cause hormonal changes, create immunosuppression, and result in increased susceptibility to disease challenges. To ensure a healthy environment during brood (when chicks need the most help regulating their body temperatures in their environment) floors should be warmed to 90°F, ideally with some warmer areas closer to 110°F.

AIR MOVEMENT

The goal of the minimum ventilation system is threefold: *1. To provide sufficient fresh air to maintain air quality; 2. To provide sufficient fresh air to control house temperature; 3. Accomplish this using minimal energy.* Incoming air must be guided through the right location, in the right direction, at the right velocity.

All openings or cracks serve as an air inlet in a negative pressure house, so a loose house is far from ideal. Air should come in only through designed inlets

because inlets determine how much air enters a certain spot and which direction it goes. Inlets should be placed as close to the ceiling as possible. Ideally, the top of the inlet is right at the ceiling where the warmest air collects.

Incoming air is cold, so it needs to be heated up before contacting the birds. To do this, air needs to move along the length of the ceiling to be heated properly. Because hot air rises, the cold incoming air has a natural tendancy to fall to the floor if it doesn't have enough velocity. This leads to chilled birds, wet litter, and uneven temperatures.

The velocity of the air must carry it to the center of the house. This means the static pressure in the house must be high enough to pull that air through the inlet, and throw it towards the center of the house.

Static pressure is the pressure acting on the air to pull it into the barn through the inlet. With enough static pressure, you create an "attached" air jet. Air will travel along the ceiling, meet with the incoming air from the oppostite wall, and then start to fall towards the floor where it gathers moisture and gases to be ventilated out of the barn. By traveling the full distance to the center of the house, the fresh air is warmed before it contacts the birds, preventing chilled birds.

To improve ventilation and heating efficiency, use stir fans to their full potential. The goal should be to move the house air so that it's mixed floor to ceiling, end to end, sidewall to sidewall. A moving capacity (percent of volume of the house air to be mixed each minute) of 10% creates good destratification and temperature uniformity, but litter drying is minimal. However, 20% air movement creates excellent destratification, great temperature uniformity, and good litter drying.

Proper spacing and orientation of basket fans or centrifugal fans can accomplish the necessary mixing. Keep a look out for our next white paper that analyzes the efficacy of basket fans and centrifugal fans in hot and cold weather.

Want to learn more?

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