“Understanding Hatchery Ventilation”

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The importance of good ventilation is taken for granted on the farm but it doesn’t always attract the same attention in the hatchery. Yet it is here where the foundations for the good broiler performance are laid.

Getting the basics right for hatchery ventilation will help achieve a timely hatch, prevent bacterial contamination, ensure high chick quality, help to avoid ascites and contribute to healthy overall returns.

It is important to understand why the correct ventilation is so vital. An oxygen level of 19.6% by volume is integral to successful embryonic development, so providing an adequate air supply to the eggs while they are inside the machines is a top priority. While oxygen enters the egg through its porous shell, carbon dioxide escapes in the same manner.

A lack of oxygen adversely affects the hatch. As the developing embryo creates heat, it needs additional oxygen and must exhaust carbon dioxide. If the embryo is unable to dissipate this heat satisfactorily, it will develop too quickly, resulting not only in early hatch but also in dehydration and a high likelihood of mortality on the farm. Scattered hatching times reduce hatchery production.

With incorrect ventilation, the embryo experiences stress from the cold and there is impaired growth. There is slow development of the circulatory system and heart as well as reduced efficiency of the yolk
When there is a lack of oxygen, ascites can occur in today’s high-yielding birds at an early age due to decreased capillary flow. Clinical signs of ascites include an enlarged heart and muscle congestion. Fluid builds up in the bird’s abdomen, and the heart grows in size from overwork. Regulating air volumes in the hatchery is the first step towards implementing a good ascites prevention program.

Pressure controls are excellent tools for attaining a positive pressure on the fresh air intake side of the machines and a neutral pressure on the exhaust sides, thereby preventing the development of micro-environments within the machines and the fresh air supply itself. This careful balance can deter bacterial contamination and ensure better overall chicken performance following hatch.

Every hatchery needs to pay careful attention to field performance. After hatching, it is crucial to move the chicks as quickly as possible into the brooding area and to give them water. Each and every chick needs to be robust and healthy on arrival at the farm. It is the earlier access to an adequate oxygen supply in the hatchery that is paramount for both the development of strong embryos and an on-time hatching process, giving the chicks the best opportunity to thrive.

How to achieve effective ventilation

The good news is that hatchery ventilation is not complicated as long as the system in place is properly designed, installed, monitored and controlled. For best effectiveness, the system must address the following:

- Air volumes to meet oxygen demand, even in high altitudes
- Pressure control throughout the hatchery
- Humidity control for good air quality
- Temperature requirements

The first steps in establishing a successful ventilation program is an understanding, measuring and monitoring pressure inside the fresh air area, also referred to as a room or plenum. The best fresh air supply systems react to the needs of the hatchery environment from one moment to the next. Pressure controls regulate air movement and manage air volume supply.

Positive pressure in the room is an indicator that the available air supply surpasses that which the room demands. A neutral fresh air area means that the air supply and air demand are equal, with no air to spare should demand increases. On the other hand, a negative air supply signifies that the area's air needs exceed the available supply.

Pressure measurement to any area besides atmosphere requires a different approach when setting the controls. When the pressure is measured from the room/plenum to atmosphere, you only have to set the controls to what you want. If the pressure for the exhaust plenum is measured to the room and the room is set at +.02, then the plenum control must be set to -.02 to have a neutral pressure in the plenum. When the pressure is all measured to atmosphere and the room is set at +.02 and you want the exhaust plenum to be 000, then you can set it at 000. Consider two separate examples in which the objectives are identical but the references for measurement differ slightly:

Measuring exhaust plenum pressure *to the fresh air supply pressure*

Objectives: Neutral exhaust plenum pressure = .000 | Fresh air supply pressure= +.015

Required Settings: Exhaust plenum pressure = -.015 | Fresh air supply pressure= +.015

Measuring exhaust plenum pressure *AND* fresh air supply *to atmosphere*

Objectives: Neutral exhaust plenum pressure = .000 | Fresh air supply pressure= +.015

Required Settings: Exhaust plenum pressure = .000 | Fresh air supply pressure= +.015

As these examples demonstrate, regulating exhaust pressure is a major concern in any ventilation system. A variable speed fan and a pressure equalization device are required for controlling exhaust from designated areas. If through correct administration of pressure controls both the exhausts and fresh air supply react to machine demand, then hatchery management can easily set and monitor effective profile settings rather than make continual manual adjustments to the machines.

As mentioned earlier, an oxygen level of 19.6% by volume is the target, and air volume is the only acceptable source of oxygen for a hatchery. Therefore, a hatchery must not only provide adequate air volume to the eggs inside the machines but also stay up-to-date on the air volume needs within different areas, including the incubators, hatchers and chick handling and holding areas.

The following factors affect air volume requirements:

- Total number of eggs in the incubator or hatcher rooms
- Room volume
- Desired room pressure
- Type of ventilation system in use

While careful pressure control in a hatchery maintains advantageous bio-security of air movement by pushing air from clean toward dirty areas, it also ensures that air volume is indeed available when machine demand increases. To create good air distribution within the machines, the table below shows both recommended pressure scales and air volume requirements for standard divisions within a hatchery.

Recommended Pressure Scales and Air Volume Requirements by Hatchery Area

Room/Plenum	Air Exchange	Pressures
Egg Holding	2.00 CFMS per 1000 eggs	.000 - .005 +
Incubator	8-12 CFMS per 1000 eggs	.015 - .020 +
Hatcher	17-25 CFMS per 1000 eggs	.005 - .01 +
Hallways	5 per minute air exchange	.000
Dirty Pull	40-60 CFMS per 1000 chicks	.010 - .020 –
Clean Holding	1 per minute per room volume	.020 - .025 +
Chick Holding	40-60 CFMS per 1000 chicks	.000 - .005 –
All wash areas	1 minute air exchange	.020 - .025 –
Exhaust	Equal to machine demand	.000 Even

Pressure conversion (0.01 inches H20 = 2.5 Pascal's, 0.01 mbar, 0.1016 mmH20)
Air Exchange (1cfm = 1.69chm)

Satisfying the minimum oxygen level requirement for a hatchery can be more difficult when special circumstances, such as high altitude, apply. The answer is to increase the positive pressure in the fresh air supply area to funnel more air volume through the machines. Each type of machine has a maximum pressure level that also allows for an appropriate damper opening to accept an adequate air volume.

The chart below compares altitude and partial pressure of available oxygen in the air. Note that it is virtually impossible to obtain the 19.6% usable oxygen in the air at locations above 762 metres (2,500 feet).

Relationship between Altitude and Partial Pressure of Available Oxygen in Air

Altitude		**Reduction**	**Available**
Sea Level		0%	20.5 - 21.0%
1,500 feet	457 meters	3.5%	19.8 - 20.3%
2,000 feet	610 meters	5.1%	19.5 - 19.9%
2,500 feet	762 meters	8.1%	18.9 - 19.3%
4,000 feet	1,219 meters	11.2%	18.2 - 18.6%
6,000 feet	1,829 meters	16.6%	17.1 - 17.5%

No ventilation program is complete without providing eggs with a defence against moisture loss. During incubation, an egg loses water vapour through pores in the shell. Humidity and temperature are key factors in every egg's battle to stay hydrated.

When a hatchery applies water while the humidifiers are running, the temperature drops for as long as the humidifiers are in operation. In addition, running heaters will fight to maintain the pre-set temperature. Consequently, the humidifiers and heaters race against one another and ultimately increase the facility's energy expenses unnecessarily.

The best method for controlling relative humidity is through steam humidification, which uses the hatchery's air supply. By introducing steam in the room or fresh air supply duct, humidification occurs without a costly drop in temperature. Fresh air, when tempered by humidity and temperature, increases machine efficiency, fosters an ideal environment for embryonic development and meets air volume demand.

A delicate equilibrium among temperature, humidity and fresh air supply is necessary for protecting incubating eggs. The table below is a guide for temperature and humidity requirements for the various hatchery areas.

Temperature and Humidity Requirements by Hatchery Area

Room/Plenum	**Temperature Range**	**Relative Humidity**
Egg Holding Cooler	65 - 68° F (18 - 20° C)	65%
Incubator Room	75 - 80° F (24 - 27° C)	55%
Hatcher Room	75 - 80° F (24 - 27° C)	55%
Chick Holding	75 - 78° F (24 - 26° C)	70%

Guidelines for Smooth Ventilation System Operation

1. *All of the internal as well as external doors must remain closed unless someone is passing through them.*
2. *The fresh air supply, air volume demand and exhaust must be balanced at all times.*
3. *A variable volume air supply (HVAC) and exhaust/recirculation volume must be available to assist with maintaining a dependable, consistent hatchery environment.*

4. *When natural chimney exhausts are used, the effects of the chimneys will vary drastically as the outdoor temperature changes. Mechanically controlled exhausts are a better alternative, so seasonal or temperature-related swings do not affect production.*
5. *Any variable speed fan that controls pressure in a room or plenum must have a good back draft shutter.*

In summary, good chick quality is the prerequisite for good broiler performance and attractive profit margins. Chick quality is directly related to good hatchery management. This depends on hatchery-wide pressure control, adequate air volumes for oxygen delivery and well-maintained humidity and temperature levels.
In a modern-day twist to the old conundrum "What came first?" the answer is neither the chicken nor the egg ……. quite simply it's the correct ventilation.'

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