The 8 most often asked Questions on Ventilation in the Field

Author/s : Winfridus Bakker (Cobb-Vantress)

Issues that will be discussed in this article:

1. Why is ventilation for the chick embryo as of 12 days of age in the setter and hatchery machines so important?
2. Ventilation & temperature control during transport from hatchery to farm (truck).
3. What is minimum ventilation in broiler houses?
4. How to calculate the number of fans needed?
5. What causes wet litter behind the evaporative pads?
6. How to do maintenance on evaporative pads to keep efficiency up?
7. What causes air distribution problems through the house and bird migration?
8. Causes of too much temperature differential between both ends of the house?

Issue #1. The importance of ventilation in the hatchery for the present day high-yielding broiler chicks.

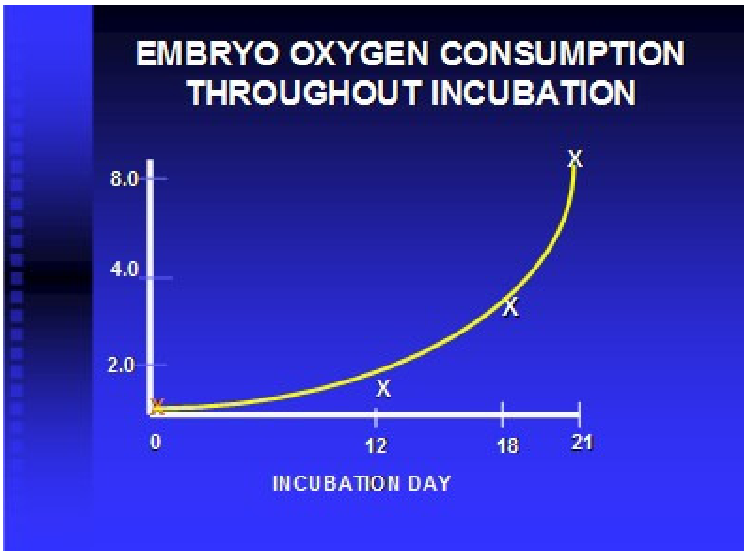
There are basically 3 ways to supply fresh air or oxygen to the setter and hatcher machines: The 1st way is by natural ventilation in open sided hatcheries. This concept is still used in some tropical countries but even there it is phased out due to the inability to constantly control the environment within the machines. Due to the fact that all modern models of setter machines are direct induction (plenum), they need to have an atmospheric controlled setter or hatcher room with positive pressure.

Photo 1: Evaporative cooling Unit on the roof of a hatchery

Ventilation in the hatchery is based on fresh air for the embryos and chicks, for temperature and relative humidity (RH) control and to maintain the right room pressures. Evaporative Cooling Units will only give fresh air and some temperature control under hot conditions. These units will need to be controlled in 3 stages: At slow speed, at high speed and then with the pumps running when temperature of incoming air will surpass 28ºC. The low speed should always be in operation to supply enough oxygen to the setter and hatcher rooms.


Photo 2: HVAC unit on top of the roof and how they look inside the setter room **(photo 3)**

HVAC units do all the important aspects of environment control in the hatchery: H stands for Heating, V for Ventilation and AC for Air Conditioning. They also control the air pressure within the room that is set by a PEC (pressure equalizing control) unit.



Graph 1: After 12 days of age the embryos start developing fast and oxygen need will rise constantly. It is in this period that ventilation should be optimal in order not to pre-dispose the chicks to respiratory and possible ascites problems later on in life.

By controlling the temperature and relative humidity in the setter and hatcher rooms, the dampers of the machines will for most of the time be open and the positive pressure in the room will assure that fresh air will flow into the machines through all the egg mass.

HATCHERY VENTILATION REQUIREMENTS

LOCATION	TEMP.	RH	AIR VOLUME	PRESSURE
Egg Receiving	65-68	60-65%	1 minute AE	.000
Egg Holding	65-68	60-65%	2 cfms –1000	+ .005
Setter Rooms	75	55%	8-12 cfms-1000	+ .010- .020
Hatcher Rooms	75	55%	17-25 cfms-1000	+ .005- .015
Chick Pull	75	65%	0.5 minute AE	- .010- .020
Chick Holding	75	65-70%	40-60 cfms-1000	- .005- .000
Wash & Cleaning	70	70%	1 minute AE	- .015- .025
Clean Holding	75	50%	1 minute AE	+ .015- .020
Hallways	75	60%	5 minutes AE	.000

ALL EXHAUST PLENUMS SHOULD BE MAINTAINED AT .000 TO ATMOSPHERE

Table 1: This important table basically mentions how to manage the environment in each room of the hatchery in order to have optimum quality chicks. Investing in environment often results in better hatchability but this is not always the case. Investment in environmental control will be seen mainly at chick level (quality) and better field performance of the broilers. Pay back can be very fast based on the local conditions (altitude for example) and is one of the overlooked areas in many companies.

Issue #2: Ventilation, Temperature & RH control during chick transport.

Chicks that suffer from heat stress for more than 15 minutes will dehydrate, are more susceptible (reduced immune response) and have alterations in the intestinal tract reducing GPD in first week and affecting uniformity of the flock.

Photo 4: Excessive temperatures in the holding area of the hatchery due to insufficient air flow or circulation and in the chick truck are probably the 2 main reasons of reduced chick quality arriving at the farm. Chicks in these cases do not only dehydrate but are often deprived of adequate oxygen levels affecting the respiratory tract, which includes the lungs. In traditional natural ventilated trucks body temperature of the chicks vary from 95ºF=35ºC in the lower part and up to 104ºF=40ºC in the upper part of the truck body.

Truck Ventilation systems, Maximum Temperatures & required Air Exchange per 1000 Chicks

Ventilation type	Max Temp.	% RH	Air Exchange	Obs.:With natural ventilation more
Natural	90°F=32.3°C	65%	30-40 cfms/1000	air is drawn over the chicks and higher
Evaporative	85°F=29.5°C	65%	20-30 cfms/1000	temp. can be permitted. The lower the
Air conditioned	78°F=25.5°C	65%	20 cfms/1000	air flow the lower the temp. needs to be.

Some basic thoughts need to be taken into account with the chick truck.

1. Since heat always rises upwards it is much easier to move this heat upwards through the chick boxes instead of the other way around, trying to push fresh incoming air down. This means that air intake into the truck body is at the bottom and the exhaust at the top.

2. There should be a positive air pressure (+0.15) if a positive air distribution intake plenum is used.
3. The holes in the intake plenum (positive pressure) should be equal to the holes in the exhaust plenum (negative pressure) to assure even distribution of the air through the whole chick cargo. This is extremely important to have even temperatures and fresh air.
4. The floor of the truck (especially rear axle) should be very well insulated to avoid heat buildup from the road over long hauls during hot weather.
5. There should be a RH control, set at 65%, to avoid dehydration of chicks during transport.

New designs of chick transport stress the importance of having for 100% of the chicks the right climate conditions (temperature and RH) so that chicks arrive in optimal conditions at the farm and maintain FCR in the 1st week below 1:1 and in the 2nd week below 1:1.1

Some other reflections:

1. If the body temperature of the chicks is too high the chicks lose body energy (panting) and are more susceptible with less start up growth in the first few days in the broiler house.
2. If the body temperature is too low, the body energy is also diverted and used to maintain body temperature and the immune system and initial body weights are affected (7 days of age).
3. If chicks are stored too hot in the chick room of the hatchery or in the chick truck (when standing still due

to traffic problems), naturally ventilated chick trucks will not be capable to remove excess heat production build up.

4. If the body temperature of the chicks is correct you will hardly hear the chicks and they will sleep most of the time. Hearing noisy chicks is a sign of stress (temperature or oxygen deprivation).

Issue # 3: Minimum ventilation in broiler houses.

Minimum ventilation will guarantee fresh air (oxygen) availability to the chicks as of day old to obtain maximum growth rate and organ development in the first few weeks, critical for good end performance of the flock.

It is very evident that minimum ventilation in broilers is a misunderstood management concept in many companies and especially in most tropical and sub-tropical countries. Because average temperatures are high, it is assumed that only tunnel ventilation after 4 weeks of age is needed to control the temperature and get fresh air to the birds.

The problem arises when one, or several tunnel fans are used to control the temperature and get fresh air at bird level in the first 14 days.

With this concept excess air speed over the chicks will result, causing a chill effect. Feed kcal will in this case be used for heat production and not for maximum growth rate.

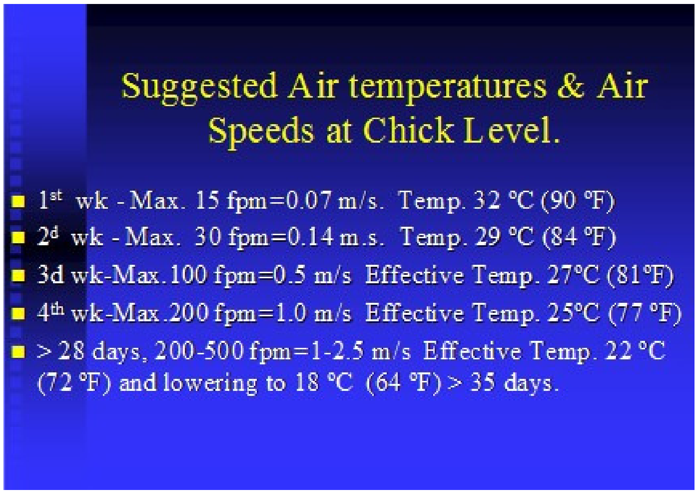


Table 2: Baby chicks in the first 2 weeks of the rearing should receive almost zero air speeds from the ventilation system. If only 1 fan ran from the tunnel ventilation system, the airspeeds would surpass easily 50 fpm, and that is 4 times as much as the chicks should feel. The consequences are inconsistent broiler results that most of the time do not get even close to the body weight (BW) and feed conversion (FC) standards of the breed.

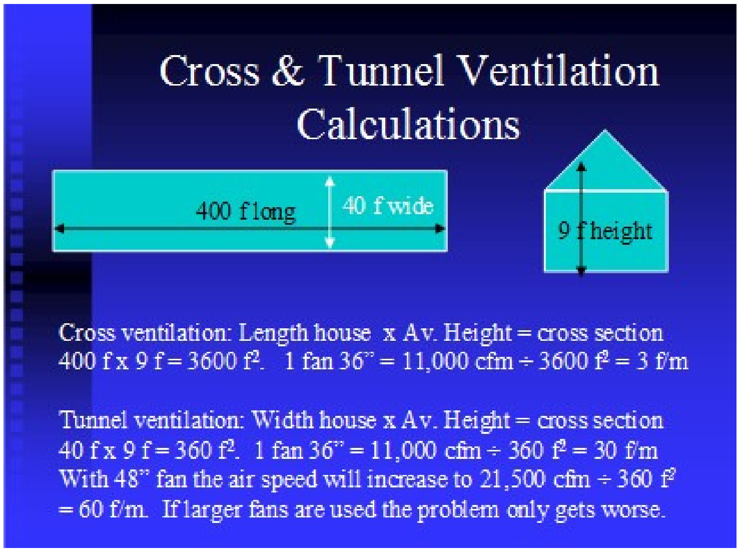
Minimum ventilation can be done in several ways. It is, however, important to realize that minimum, transition and tunnel ventilation depends on good airtight houses with minimum leaks or false air entering the house. Be assured that this will need enough attention when upgrading existing older house facilities.

The following 2 situations are seen very often in the field, affecting considerably broiler performance.

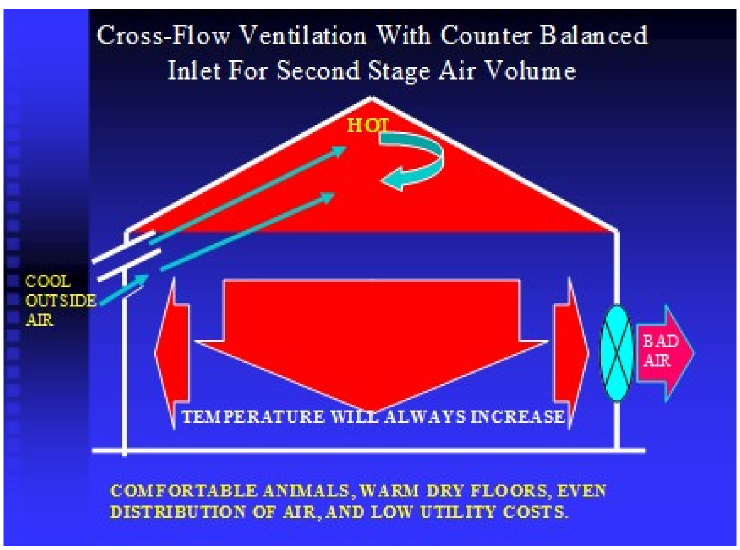
Photo 5: All fans running in the first week to control the temperatures, but now excess airspeed over the chicks and chilling results.

Photo 6: Older broilers that receive too much airspeed (chilling) stay down on the floor and this effect feed and water intake.

In order to control the temperatures within the permissible range and have at the same time a low airspeed over the chicks ventilation is done over the cross section and not over the length of the house.



Design 1: Explaining the difference in air speed based on tunnel and cross ventilation.



Design 2: Cross flow ventilation to obtain air exchange & temperature control at the same time

There are several ways to apply cross ventilation and there are even some hybrid concepts with transition ventilation. If more info is required please contact the author by email.

Issue # 4: How to calculate the number of fans needed.

- Calculate the cross section of the house: Average height x width. Ex: 40 f x 9 f =360 f^2
- Multiply the cross section by the maximum air speed required: 360 f^2 x 500 fpm = 180,000 cfm's total fan capacity needed.

In existing houses you can calculate backwards and see how much the air speed is in the house (theoretically, then real air speed can be different based on many factors).

- Take total fan capacity and divide by cross section to get the speed in the house.
- Examples: 9 fans x 20,000 cfm at 0.10 negative pressure = 180,000 cfm's ÷ 360 f^2=500 fpm. (OK).
- Example: 8 fans x 20,000 cfm at 0.10 neg pressure =160,000 ÷ 360 f^2= 444 fpm (not enough). To get to 500 fpm baffles could be installed. The height of the baffles is calculated and not just ad random: Take 160,000 cfm's and divide by 500 fpm (needed maximum air speed) = 320 f^2 divided by the width of the house 40 f = 8 f the height at which the baffles should start.

Observations on air speed:

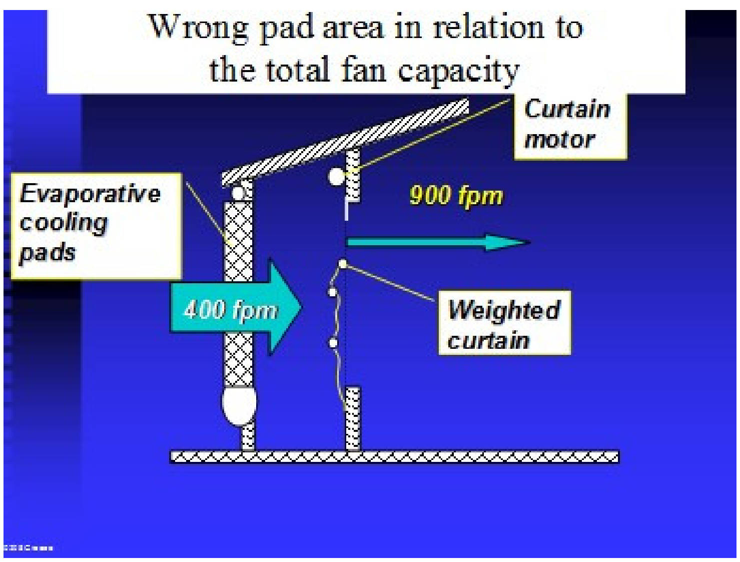
- Anytime the air speed is over 500 feet per minute (2.5 m/s) the pressure drop increases 0.02 for every 100 feet (32 m) you move the air.
- For 500 f long house this would increase the pressure to (5x0.02 =) 0.10, so pressure would move above 0.20 in total. All fans will reduce their efficiency and fan capacity.
- Any baffles added at any height will slow the air down even more and create an even higher pressure drop and could double the cost of running the fans.

- Having higher airspeeds than 500 fpm is of course possible but this comes normally at higher electricity and investment costs.

Issue # 5 What are the causes of Wet Litter behind the Pads.

- Wrong pad area in relation to the total fan capacity.
- No use of inlet curtains that assures proper ventilation behind the pad area of the house.
- Pads wrongly installed (up side down in case of 45/15 pad) or the wrong type.
- Wrong timer program for wetting and drying.
- Wrong setting of temperature and RH shut off.
- Water too cold and pad area covered against the sun.
- Calcified pads or dirty without enough maintenance.

Wrong pad area in relation to the total fan capacity.



Design 3: The inlet pad area is determined by the total fan capacity installed. Only at total fan capacity running should the pump operate in order to make full use of maximum evaporation. The pads are calculated to work at maximum efficiency with an airspeed going through

them at 400 fpm (2 m/s). Within the pads a friction is induced to elevate the temperature of the incoming air to enhance evaporation of the water and thus cooling of the air leaving the pad towards the inside of the house.

Dividing the total fan capacity by 400 will give the total area for 6" wide (15 cm) pads in square feet. Divide again by 2 to know the area to be installed on each side of the house. Pads come normally in segments that are 5 or 6' in height.

If the pad area is too small the airspeed will be too fast going through the pads and this will reduce evaporation and more water droplets will enter the house elevating RH and wetting the litter.

If the airspeed is too low through the pads there is just not enough temperature rise (friction) reducing evaporation rate and again also helping to wet the litter on the inside.

reducing evaporation rate and again also helping to wet the litter on the inside.

- **No use of inlet curtains that assures that there is proper ventilation behind the pad area of the house.**

Photo 7: The inlet curtains will permit that air enters restricted (compressed) into the house. When the air expands (RH will go down) it has the ability to take up more humidity of the house.

The airspeed of the air will also guarantee that the whole area behind the curtains will receive enough ventilation to keep the birds happy and have a uniform bird distribution. Observe that the curtain inlet is more than 1 m of the floor so that incoming air will not hit the birds. That could cause bird migration towards the inlets on hot days and make litter very humid.

- **Pads wrongly installed or the wrong type.**

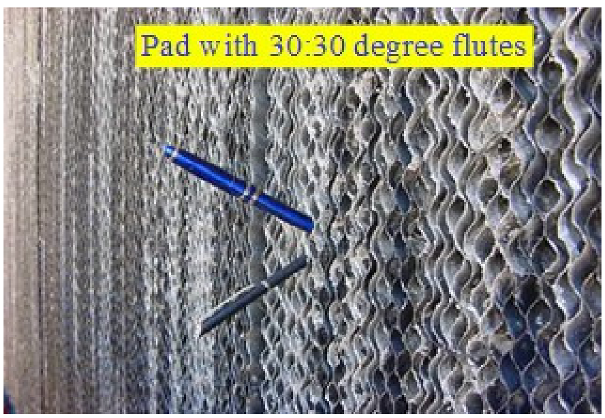


Photo 8: Under normal temperature and RH conditions pads of a 30-30 degrees angle should be used. Under very dry conditions (<30% RH) and high temperatures (>35ºC) a 45-15 angle pad is used with the 45 degree angle always positioned towards the outside. If pads are upside down with the 45 degree pad and directed towards the inside of the house more humidity will be brought into the house. With the 30-30 configuration it does not matter how installation is done.

- **Wrong timer program for wetting and drying.**

Photo 9: Normally with the RH of the air of 50% the pads operate with a cycle of 3 out of 10 minutes, meaning the pumps will run for 3 and will be off for 7 minutes. The higher the RH the slower the evaporation rate and the less the pumps will need to run to wet the pads.

If pumps run all the time there is less evaporation of the water and the excess wetting of the pads will increase the RH levels in the house.

The largest evaporation rates of water are obtained when the pads are almost dry.

- **Wrong setting of temperature and RH shut off.**

Photo 10: Factors that increase the RH in the house:

1. Managing the pumps by hand or having no humidity shut off.

1. Letting pumps run when RH is over 70%.
2. Letting pumps run when temperature is below 82ºF or 28ºC.
3. Humidistat in the wrong area of the house (should be placed 6 f (2 m) behind where the pad area ends.

- **Water too cold and pad area covered against the sun.**

Photo 11: Water on the pads preferably should be above 82ºF or 28ºC for evaporation.

Water in underground deposits will have temperature of 70ºF or 21ºC or less.

Pads will be too cold and thus less evaporation but adding RH to the house and killing birds under extreme conditions. A temperature of >25 ºC of the pads is good. Pads should be in full sunlight. The hotter the pads and the water wetting it the more evaporation will take place and the cooler the air. Use products to reduce algae growth on the pads (maintenance).

- **Pads, that are calcified or dirty without enough maintenance**

Photo 12: Pads in full sun. There will be a tremendous reduction in the evaporative cooling effect of pads when they become calcified. Opening once a week the purge line is essential to take out the mineral concentration and it can be done even twice a week based on the hardness of the water.

The purge line should be opened when the pump is running in order to drain the minerals in the vertical PVC purge line. If pads become too hard they function more as a humidifier bringing water into de house and wetting litter. There are situations where the pumps should be running most of the time to keep the pads wet and reduce mineral deposition.

Issue # 6: How to do maintenance on pads to keep efficiencyup:

Photo 13: Surfactants are used to clean the pads on regular basis to maintain maximum evaporation capabilities. Procedures for cleaning.

- 1. Normally clean pads annually with surfactant (wetting agent) which clears the pores of the pads and enhances evaporation capacity.
- 2. Add half cup of surfactant to the tank and let the pump run for 2 hours.
- 3. Use a low pressure water hose to clean the flutes (up and downwards). Best way to do this is from the inside out.ç
- 4. Clean the water tank completely (water is black or dark).
- 5. Add clean water again and you are good to go.

Observations: Adding too much surfactant to the water could cause the pads to collapse due to excess water absorption by the pads and becoming extremely heavy, so be careful.

Surfactants can be purchased very cheap at any store that sells insecticides and pesticides. The product is usually added to enhance the penetrating effect of pesticides on the leaves.

Issue # 7: Causes of air distribution problems through the house and bird migration.

- No inlet curtains that regulate the uniformity of the air distribution in the house (design 4)
- Excess airspeed in the center of the house (at any age) (design 4).
- Too high a temperature differential between both ends of the house.
- The inlet curtain is too low, drawing the birds towards the pad area.

Design 4: Low inlet air speed.

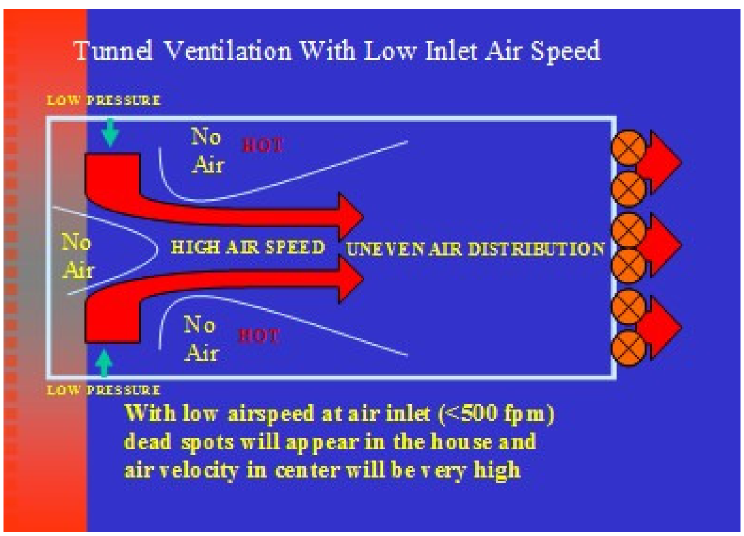


Photo 14: No birds in center of the house.

- Low airspeed due to insufficient closing of the shutters.

Photo 15: After 28 days with temperatures over 27 ºC a difference of 2 to 3 ºC from inlet to fan end is considered normal. Heat build up continues going towards the fans absorbing heat from the birds.

- Too many air leaks in the house permit hot air to come in (air speed will go up moving towards the fans).

- Airspeed going down towards the fans means over restriction of the inlet curtains.

No difference in temperature means in general excess air speed.

Issue # 8: How much temperature reduction is possible with pads and with fogger systems?

Table 3: The following table will give the temperature reduction that may be accomplished with evaporative cooling when dry-bulb temperatures and RH are known. With a good fogging system you can expect about 55% of the table values.

Dry Bulb F°	C°	Relative Humidity												
70	21.1	86	77	68	59	51	44	36	29	22	15	9	3	0
72	22.2	86	77	69	61	53	45	38	31	24	18	12	6	0
74	23.3	86	78	69	61	54	47	39	33	26	20	14	8	3
76	24.4	87	78	70	62	55	48	41	34	28	22	16	11	5
78	25.6	87	79	71	63	56	49	43	36	30	24	18	13	8
80	26.7	87	79	72	64	57	50	44	38	32	26	20	15	10
82	27.8	88	80	72	65	58	51	45	39	33	28	22	17	12
84	28.9	88	80	73	66	59	52	46	40	35	29	24	19	14
86	30.0	88	81	73	66	60	53	47	42	36	31	26	21	16
88	31.1	88	81	74	67	61	54	48	43	37	32	27	22	18
90	32.2	89	81	74	68	61	55	49	44	39	34	29	24	19
92	33.3	89	82	75	68	62	56	50	45	40	35	30	25	21
94	34.4	89	82	75	69	63	57	51	46	41	36	31	27	22
96	35.6	89	82	76	69	63	58	52	47	42	37	32	28	24
98	36.7	89	83	76	70	64	58	53	48	43	38	34	29	25
100	37.8	89	83	77	70	65	59	54	49	44	39	35	30	26
102	38.9	90	85	78	72	67	62	56	51	46	42	36	32	28
104	40.0	90	85	78	72	67	62	56	52	47	43	38	33	29
106	41.1	90	85	78	73	67	62	57	52	47	43	39	34	30
		Potential cooling for a given temperature and relative humidity												
Drop in ° F		3	5	7	9	11	13	15	17	19	21	23	25	27
Drop in ° C		1.7	2.8	3.9	5.0	6.1	7.2	8.3	9.4	10.6	11.7	12.8	13.9	15.0

Table 4: gives the sum of temperature and RH as an expression when birds will be affected by a combination of the 2. For every 2.5 ºC increase in temperature the RH will drop 20%. This feature is used effectively when the RH is too high. By letting the temperature increase, the RH will drop considerably, reducing the sum of temperature and RH and thus reducing the Effective Temperature Index, avoiding high mortality.

Effective Temperature

°F + RH % = Index

Index #	Consequences
150	Or lower, no problem for the birds.
155	Danger (example 86 °F + 69% RH).
160	Panting, loss of production, less feed consumption in broilers & less GPD.
165	Start of mortality.
170	High mortality (ex. 95°F + 75% RH).

Note: This article will NOT guarantee specific results and must be seen as a reference only.

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