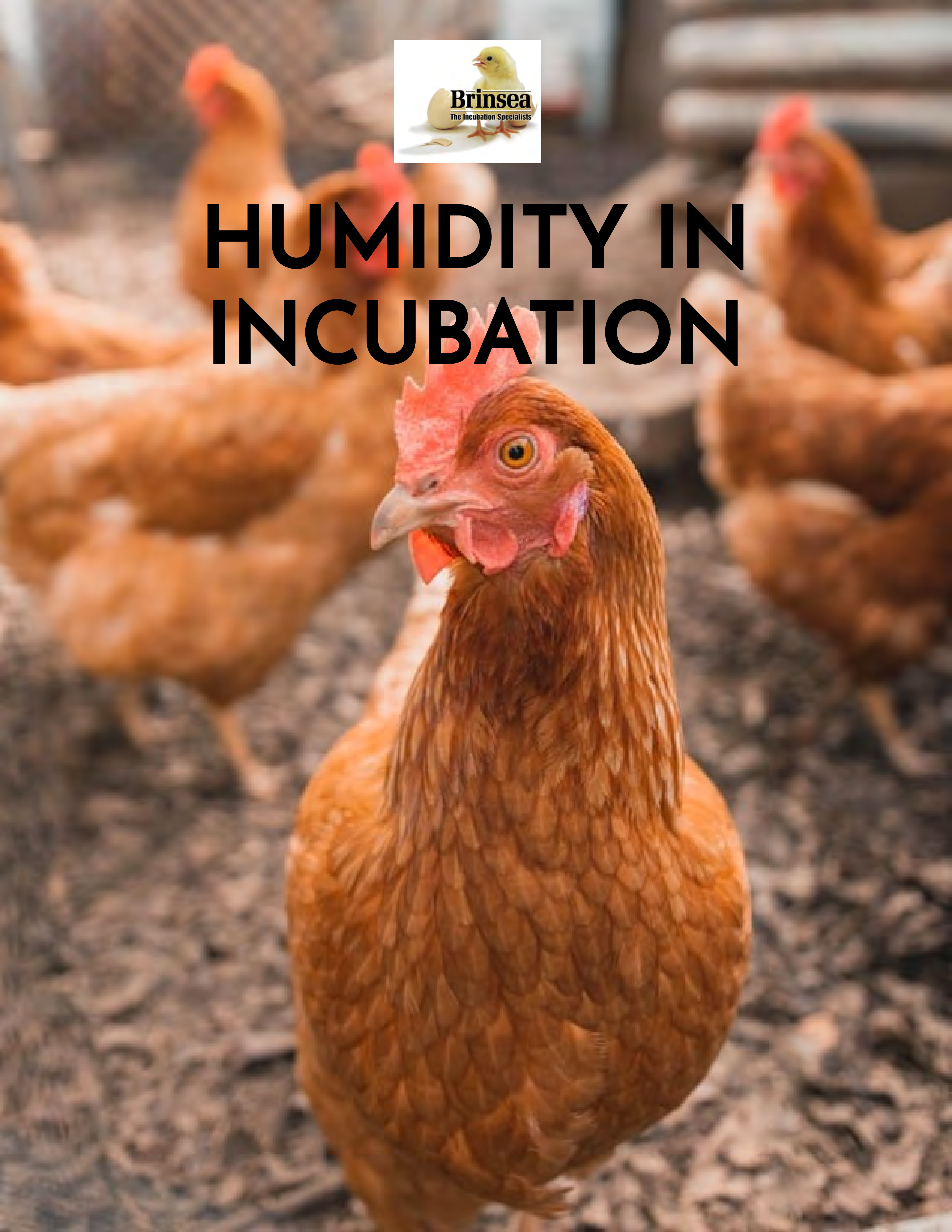
Brinsea
The Incubation Specialists

HUMIDITY IN INCUBATION



Humidity is one of four primary variables which must be controlled during egg incubation - the others being temperature, ventilation and movement (or turning). Humidity is the most difficult of the four to measure accurately and control and therefore is commonly misunderstood. The operator instructions that accompany all incubators give guidelines to achieve correct humidity levels for most species under normal conditions and in most cases this gives excellent results so please check that you have followed these guide lines. However there are times when incorrect humidity levels do cause problems and further steps are needed to check that humidity levels are correct. This information sheet explains the effect of different humidity levels, measurement of humidity and the best techniques for achieving correct humidity levels.

Before spending time and effort checking incubation humidity levels it essential to ensure that temperature and egg turning are correct - refer to the unit's operating instructions. Also check that the eggs are fertile and the parent stock healthy, properly fed and free from in-breeding.

The effect of humidity upon the incubating egg

Egg shells are porous - they allow water to pass through, and so all eggs, whether being incubated or not, dry out slowly. The amount of water that an egg loses during incubation is important and this is determined by the humidity levels within an incubator; if the humidity level is higher then the egg will 'dry out' more slowly than if the humidity is lower.

All eggs have an air space at the round end and as water is lost through the shell it is replaced by air drawn through the shell into the air space which gradually increases in size – the greater the water loss through the shell, the larger the airspace. This air space plays a crucial part in incubation. Within it is the first air that the fully developed chick breathes and the space allows the developed chick some movement inside the shell to allow it to maneuver into hatching position.

If the incubation humidity has been too high the egg will have lost too little moisture and the chick will be rather large. In this case the air space will be too small, the chick's respiration will be affected and the young bird will have difficulty breaking out of the shell because of the lack of space. Commonly with excessive incubation humidity the chicks will die having broken through the shell in one place ('pipped') either through weakness because of the lack of air to breathe in the shell or because of lack of space to turn and cut around the shell with their bill. Often, because of pressure within the egg, the bill protrudes too far out of the initial hole preventing the normal anti-clockwise progress of the bill chipping the shell from inside. The bill becomes gummed up with drying mucus.

Low incubation humidity levels lead to small chicks with large air spaces by the time the hatch is due. These chicks will tend to be weak and may also die just before, during or just after hatching. It should be noted that in general that a slightly lower humidity level than optimum is likely to be less disastrous than a slightly higher than ideal level.

Measurement of humidity

Many materials are capable of absorbing water or water vapor and air is one of them. Water vapor is a gas like any other gas, and air is a mixture of gases, one of which is usually water vapor. The difference is that the amount of water vapor varies widely whereas the other gases which make up our atmosphere remain fairly constant. The range of vapor may be from none to a certain maximum which the air can absorb (called saturation). This maximum increases with temperature.

There are two commonly used ways to measure humidity and the differences need to be clearly understood. These are:

Relative Humidity (RH) expressed as a percentage.

This is a measure of the amount of vapor in air compared with the maximum that could be absorbed at that particular temperature. This is why relative humidity (RH) is quoted as a percentage. For example an incubation RH level of 50% might be quoted. This means that at incubation temperature the air in the incubator contains half of its maximum possible water vapor capacity. Because maximum possible water content increases at higher temperature, if the temperature was increased but no additional water added then the % RH level would drop.

A good way of imagining this effect is to think of a bath sponge. When the sponge is squeezed to half it's normal size clearly it can hold less water. Imagine a half squeezed sponge soaked in water until no more can be absorbed (saturated) this is analogous to cold air at 100% RH - no more water can be absorbed. If the sponge is allowed to expand completely then, although the amount of water has not changed, the sponge is relatively dryer than before because it has greater capacity to absorb water.
This is analogous to warmer air containing the same amount of water vapor which will now have a much lower RH level. Conversely when air cools the capacity of the air to hold water vapor reduces and % RH levels will rise. If the air temperature drops below the saturation point (100%RH) the water vapor condenses. An example of this is dew forming on a cold night after a warmer day.

Wet Bulb temperature

This is the temperature (in degrees C or F) of a thermometer with a moist cotton wick around its bulb. Evaporation of water from the wick cools the bulb by an amount related to the relative humidity. This cooling effect is the same as the chill we feel when we step out of a shower. It is the difference between Wet Bulb temperature and air temperature that is important, so air or Dry Bulb temperature must also be known to define the RH. In incubators the Dry Bulb temperature is constant (we hope!) so WB is often quoted on its own.

Direct measurement of RH is not easy. Cheap hygrometers are available but you get what you pay for; we have seen cheap instruments reading 30% different from out of the same new pack! More expensive direct reading digital instruments are better but need re-calibrating regularly. When looking into digital hygrometers check both the accuracy quoted and the hysteresis percentage. Both figures should be better than +/- 5% - if either is not quoted, don’t buy it! For example: Brinsea’s Advance Humidity Pump uses a top quality sensor with accuracy of +/-3% and 0% hysteresis – see below for more details.

The most reliable, cheap method of measuring RH, is to measure wet and dry bulb temperatures and convert the information to %RH by using a simple chart.

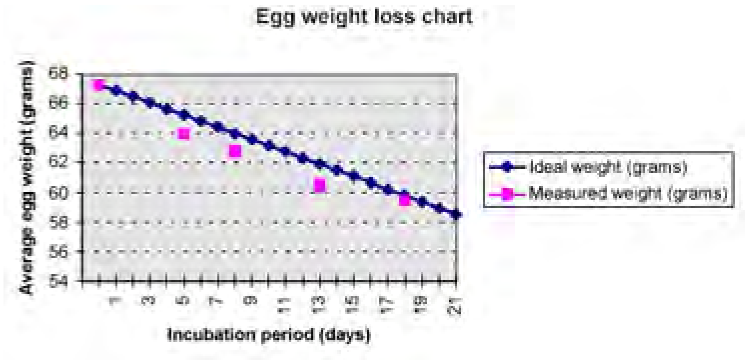
A couple of points worth noting. The Wet and Dry bulb thermometers may be conventional (mercury) thermometers or they may be electronic sensors. There are two special cases where Wet and Dry bulb readings are identical; when the air is saturated (100%RH), and when the wet wick has dried out!

A further complication is that it is difficult to measure humidity in ‘still air’ incubators. Wet bulb thermometers do not work well in near static air conditions. The other problem is that the temperature will vary by several degrees from the top of a still air incubator to the bottom and so RH readings will vary with height too. Fortunately the humidity level in still air incubators is probably less critical than fan assisted (or forced draught) machines (see information sheet So why fit a fan?).

Achieving correct humidity levels

There is a fairly easy and reliable way of measuring RH indirectly and directly measuring the effect that RH level has on the egg. This is by weighing the eggs to monitor their water loss over the incubation period. Most species of bird (with the exception of the ostrich family) need to lose between 13 and 15% of their weight from the time of setting the eggs in an incubator to hatching. By measuring the weights of the eggs at intervals during incubation, taking the average weights and comparing these to the expected weights needed to achieve the ideal weight loss by hatching, it is possible to see when the rate of water loss is too great due to humidity being too low and vice versa.

In practice this means drawing a graph (see below) with incubation time in days along the x-axis and weight up the y-axis. The average weight of eggs when set (day 0) can be entered and the ideal hatching weight (average day 0 weight less 14%) can be plotted on the day the hatch is due. These two points are then joined to give the ideal weight loss line. Average weights can then be taken every three or four days and plotted on the graph. If the actual average weights are lower than the ideal then humidity levels need to be increased and vice versa. Thus any deviation from the ideal weight loss line can be corrected as incubation progresses. The important point is to reach the ideal weight loss by hatching day; some deviation form the ideal weight loss line earlier in incubation will have little adverse effect.



The graph above shows the average actual weights of incubating eggs against the ideal weight loss line - Note that the greater than ideal weight loss in the earlier stages of incubation has been corrected by hatching day.

The combination of monitoring egg weight loss and precise control of humidity with the Automatic Humidity Management Module (see below) is the ultimate solution of ensuring correct incubation humidity.

Altering incubation humidity levels

All incubators should have the facility to evaporate water inside the egg chamber and thereby influence humidity levels. Always refer to the manufacturers instructions. The important point is that two controllable factors influence humidity levels: water surface area and the amount of fresh air the incubator draws in.

All Brinsea® incubators have two water vessels to give some flexibility over evaporation rates. Remember that it is the total surface area of water that matters not the depth. So to increase humidity levels fill the second vessel (or if both are dry, fill one) and reduce ventilation by either adjusting the control or blocking up to half of the ventilation holes. Some ventilation must be maintained to allow the chicks to breath. Refer to the operator instructions for your model. In exceptional circumstances it may be necessary to further increase the surface area of evaporation by using evaporating pads or blotting paper to soak water from the vessels in the incubator. Do not spray the eggs with water - the increase in humidity is very short lived and bacteria may be spread.

A third factor does affect incubation humidity levels and this is the ambient (or environmental) humidity level. Clearly if the air being drawn into the incubator contains very little water then incubation humidity levels will be lower (all else being equal) than if outside air is very humid. As explained above cold air cannot contain much water vapor so when cold winter air is warmed, the RH level will be very low (remember the sponge!).

This happens in heated houses in winter and in incubators. The result is that, in general, humidity levels will tend to be lower in your incubator in winter than in summer and so water evaporation and ventilation levels should be adjusted with this in mind. Because eggs are particularly sensitive to excess incubation humidity the most common mistake associated with incubation is to use the same regime of water and ventilation in the summer that was successful in the winter. In warm summers it may be possible to add no additional water to the incubator until hatching time because the combination of warm, damp ambient air plus the water given off by the eggs themselves gives sufficient RH levels.

There is no evidence of any change in ambient humidity levels associated with global temperature change as a result of the Greenhouse Effect. Small climatic temperature changes are insignificant when compared to seasonal variations and so although it may be fashionable, there is no justification in blaming a poor hatch on global warming.

Humidity and Hatching

The humidity levels required as the chick emerges are different from those earlier in incubation. For the last day or so of incubation humidity levels need to be much higher than earlier on. By this stage the weight loss of the egg should be 13-15% and water loss for the last 24-48 hours will not significantly affect this. The high humidity levels are required to prevent the membranes of egg drying too fast as the chick hatches and becoming tough and difficult to tear. In natural incubation the membranes cannot dry quickly because the parent bird is sitting on the egg but in an incubator drying membranes can be a problem. The actual level of humidity is not too critical for hatching but needs to be at least 60% RH. Humidity levels drop rapidly when the incubator is opened and take much longer than temperature levels to re-establish. Try to avoid the temptation of opening the incubator too often when chicks are emerging to maintain high RH levels.

Automatic Humidity Management

To meet the needs of bird breeders concerned about controlling incubation humidity Brinsea® have incorporated an Automatic Humidity Pump in all EX models of their incubators. This device serves to provide a highly accurate and constant readout of humidity (expressed in %RH) and a precisely controlled pump which regulates RH within the incubator to the setting the user selects. Thus, in a similar way to the principle of Brinsea's temperature controls, the user selects the humidity level the eggs require, the unit responds by altering the amount of water pumped to the incubator and the change in humidity level can be monitored on the digital display. Because the system is constantly monitoring the incubation humidity level, external effects, such as seasonal ambient humidity variations, are compensated for and the incubation humidity level remains constant. For hatching, the user simply has to increase the setting on the incubator and the new setting will automatically be maintained. The Automatic Humidity Pump overcomes problems of wicks drying and becoming contaminated sometimes associated with wet bulb thermometers and provides the ultimate in refinement of humidity control. Contact your stockist or Brinsea® Products direct for more details.

Humidity can be tricky to get right, and there are a lot of varying opinions out there, which is why we've created this guide on what you need to know about humidity in incubation. Let us know if you ever have any questions!

Brinsea Products USA
Website: brinsea.com
Email: sales@brinsea.com
Phone: 888.667.7009