Factsheet

Understanding Humidity in Incubators

Summary

- Two Types of Reading instruments: Wet Bulb and Electronic
- Two main different measurement standards: Wet Bulb Readings and Relative humidity readings. The figures are not interchangeable
- Relative humidity is the most user friendly as it relates to the effect of the humidity
- The effect of the humidity is to control the loss of moisture from the egg
- The average humidity is what is important, not a spot reading.

Discussion

There are 2 common responses to auto humidity control. One is to say I will set it on auto and just forget about it, the machine will do the rest. The other is to suddenly become fanatical about precision, now we can read the humidity often, if it varies a couple of points something must be wrong. Both extremes may work for a while, but both will let us down in the long run. It is better we understand what the humidity does and then see to understand how to make it work for us.

Why have humidity in the incubator?

Humidity is important in the incubator as the correct humidity allows the correct respiration of the egg. It is important to allow the chick and the air cell to be the right size when the chick starts to hatch. If the humidity is too high or too low then the chick will grow all the way up to hatch and then die or get stuck in the shell. As far as small operators are concerned, the average humidity is all that is really important, so high humidity for a day is not significant, and or low humidity for a day is not significant if the end average is correct.

Measurement Standards

But there are now a number of ways to read humidity and understanding each method is important. It is also important to understand that there are three different measurement standards.

1/ *Absolute Humidity* is the physical amount of water per cubic metre of air, usually expressed as grams per cubic metre of air. For our purposes this is good to know but not useful for our application.

2/ *Relative Humidity* is derived from a comparison of how much moisture a cubic metre of air at a certain temperature could hold if it was saturated, that is held all the moisture possible, and the actual amount of moisture in the air at the time. So let us assume that a cubic metre of air at a certain temperature could hold 20 grams of moisture before it became saturated. Then this would be called 100% humidity at that temperature. If the same cubic metre of air at the

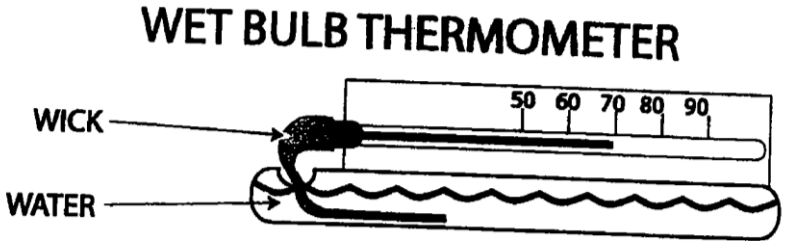
same temperature had only 10 grams of moisture then the relative humidity would be 10/20 x 100=50% Relative humidity. Now this is really important. Relative humidity gives us a measure of the effect of the moisture in the air.

To understand what this feels like. Take a room that is 20 degrees of thermometer temperature, and 50% relative humidity. I will usually feel comfortable if this was my house.. If it was 90% at 20 degrees we will feel quite hot, and uncomfortable. Alternatively 20 degrees and 10% humidity I would will make you feel quite cold. The different levels of moisture effect how we feel. It is a measure of the effect of the moisture in the air.

So we want to get a good idea what the relative humidity is, because that is what has the effect on our eggs.

Reading Methods: Wet Bulb Thermometer.

Historically, the most common method of reading humidity has been using a wet bulb thermometer. This is essentially a standard thermometer, which has a "wick" or cotton sock over the bulb at its bottom. The thermometer without the wick would read the same as the standard dry bulb thermometer. However, when the wet wick is placed over the bulb, the thermometer now reads differently. The water evaporating from the wick cools down the thermometer bulb so it now reads lower than the standard thermometer. The amount of cooling is dependent on the amount of water in the air of the incubator. If the air is very dry, a lot of water evaporates, so the thermometer reads a lot lower than the standard thermometer. If there is a lot of water in the air, not much evaporates off the wick, so there is not much cooling, so the thermometer reads almost the same as the standard thermometer. This is called the WET BULB DEPRESSION. The difference between the standard thermometer and the wet thermometer directly relates to the humidity in a special chart called a psychometric chart. So we can use this to calculate the relative humidity which is what the digital controls read. In fact this is a common way of calibrating the digital control for humidity. The only real factors which effect the efficiency of the wet bulb system is the purity of the water, distilled is best, the cleanliness of the wick, and the structure of the glass, which for our purpose is considered not to change. The Wet bulb thermometer should be placed in the incubator at a place where there is good air flow, is not too close to the walls of the incubator, and can be read from the outside. The incubator should be closed for about an hour to allow the humidity and temperature in the machine to stabilize.

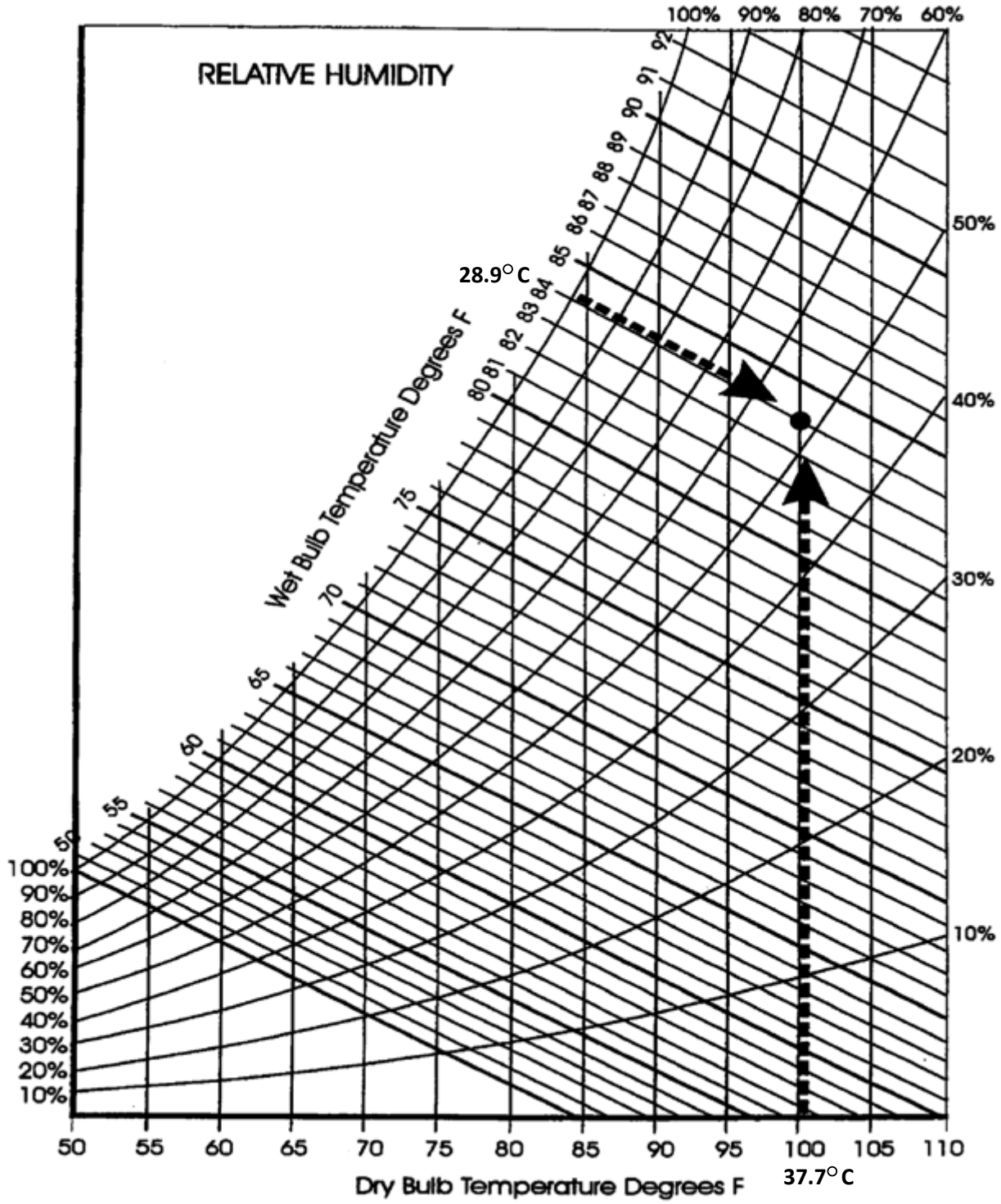


Two types of reading are available from a wet bulb:

One is the actual wet bulb reading, which must be compared to the dry temperature reading

For instance, if the incubator is running at 100 degree F, a very common temp for chickens, and the wet thermometer reads 84 that represents one humidity, but if the temperature is 102 degree F say for quail, then 84 degree F is a different humidity level.

The other way is to generate a relative humidity reading. This involves taking the dry temperature of the incubator and the wet bulb reading, and putting them into a RH chart, like this one.


RELATIVE HUMIDITY
100% 90% 80% 70% 60%
50%
40%
30%
20%
10%
28.9° C
37.7° C
Wet Bulb Temperature Degrees F
50 55 60 65 70 75 80 81 82 83 84 85 86 87 88 89 90 91 92
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
50 55 60 65 70 75 80 85 90 95 100 105 110
Dry Bulb Temperature Degrees F

First find the dry temperature on the bottom of the chart, then find the wet bulb reading on the right hand curved line, follow the grid lines until the two intersect, and read off the humidity from the curved lines.

The first think you will see from using this chart, is that there is some judgement involved in reading the chart. Secondly a small change in one of the input reading makes a considerable change in the RH from the chart. So at best the reading accuracy of this system is about 1-2%.. Changing the input reading from either thermometer 1 degree makes about 3% difference in the RH. So we need to understand the limitation of the instrument.

Some charts use the dry temperature and the wet Bulb Depression. If we subtract the wet reading from the dry reading then we get Wet Bulb Depression So 100 degrees Dry-84degrees wet gives 16 degrees Wet Bulb Depression.

However this reading can be a problem. It's the method used in most of the books on incubation, and tends to be regarded as an absolute. As you can see the humidity can have the same wet reading but be very different, if it is not compared with the dry temperature.

The other reading methods is using an electronic humidity gauge. This is becoming more regular today as the quality and accuracy of humidity probes improves. 10 years ago a reading from costing $100.00 was worthless, but 10 such instruments and get a range of readings plus or minus 15 %. Today a $50.00 instrument at new may be +/-5% accurate quite accurate enough for incubation work. However the sensing elements are very susceptible to drift, dirt and chemicals. So it is necessary to check calibration to be sure of accuracy. Most popular humidity probes do not have an ability to match the reading to a reference instrument. Industry accuracy probes still cost in the region of $ 1000.00

To test the calibration of an electronic gauge use a wet bulb thermometer, dry bulb thermometer, and RH electronic gauge, all in the same part of the incubator, as close as practical to each other without touching. Allow the machine to be closed for at least on hour before taking readings. Read all three instruments at the same time and write down the readings. Using the RH chart, calculate the RH reading from the dry bulb and wet bulb readings. Compare the two. The wet bulb reading is the more accurate reading as it has fewer factors which can change.

So what incubator humidity is right? " I read this in a book," or "I saw it on the internet ", or "So and So told me this is what is correct". The trouble is , unless the information source is using the same incubator, with the same eggs, and the same calibration, the "recommended" humidity figure may be at best irrelevant, or just plain wrong.

So let me explain why.

There is only one thing that matters with humidity. Only the egg can tell you. So learning how to read the egg is the single most important thing you can learn about humidity.

The egg needs to lose enough water by evaporation and respiration so that by 3 days before the egg is due to hatch the egg will be about 14% lighter in weight. This can be seen another way by candling the egg. If the humidity on average has been correct, the air cell in the big end of the egg will be between 25% and 35% of the egg. That's a lot of empty egg. But the chick needs this space to breath and to get out of the shell.. So you can tell this by candling the egg with a torch, called a candler, or by using scales.

So what effects how much water evaporates out of the egg? (we cannot effectively control the respiration, the chick is doing that)

Two things; The structure of the shell, and the humidity of the incubator. Because each species has a different shell structure, generally the humidity needed is related to the specific species being incubated. This is also a compromise when we want to do several species at the same time in the same incubator.

So now we are back to the actual humidity. But the actual humidity will depend on what sources of information I have.

But are the existing books and information sources correct? I usually say no, and this is why.

1/ It can be is a bit difficult to read the fancy charts so sometimes you can read them wrongly.

So the advice may be arrived at by wrong use of the charts.

2/ The advice is given by someone incubating eggs which may be very different to the shell structure of your eggs, due to genetics, diet, or age.

3/ The advice may well be from a different era. Lots of the methods from 30 years ago are now recognised as being based on a wrong understanding of the eggs.

4/ The advice may be based on incubators with different humidity systems. Most existing incubators use what I call STATIC humidity systems. That is you put water into a container, and then cover or uncover the container until you get a humidity reading which gives the correct weight loss or air cell size. This is ok, but we need to be reminded that the average humidity is all that matters. With a static system, the humidity in the incubator is the combination of the ambient humidity in the room, which may go up and down, plus the water evaporated from the eggs, plus the humidity added to the incubator from the evaporation of the water container. Now if I read the humidity in the afternoon, I will read a higher humidity than if I do it at 4am. So which reading is right? Calculating the average is somewhat difficult. If the operator is consistent, then he will adjust the humidity to achieve the right weight loss.

Also, if the machine is manual turn or semi-automatic turn, then every time the incubator is opened, the humidity will escape. It will take an average machine 2-4 hours to get the humidity back to balance. If I do this 3 times a day then for a lot of the day the humidity will effectively be low, even though the temperature in the machine recovers quickly.

In the Automatic humidity machines, the control instrument is set for a particular humidity level. The control then actively adds water by evaporation to the incubator, or allows the humidity to fall as the fresh air comes into the incubator. If the outside humidity goes up, then the control doesn't add any more moisture, but allows it to fall to the "Set Humidity". If the outside humidity goes down the machine adds moisture, to bring it up to the set humidity. If I open the lid the machine actively adds extra moisture to quickly recover to the set figure. The result is the average humidity is the same as the reading. We can then change the setting if our eggs do not respond with the correct weight loss.

We have seen a lot of humidity figures quoted which are way above the real average figure, and these have caused a lot of confusion. A rule of thumb we have found is that the fully automatic incubators like the R-Com run 5-10% lower than the book recommendations based on the old technology incubators. So if your book says 60% start at 50%.

REMEMBER, it is easier to slow down the humidity loss by simply running high humidity, however it is very difficult if you get 2/3 of the way through and need to lose more weight. It's much harder to correct.