


Poultry House Litter Moisture Control... The Basics



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1

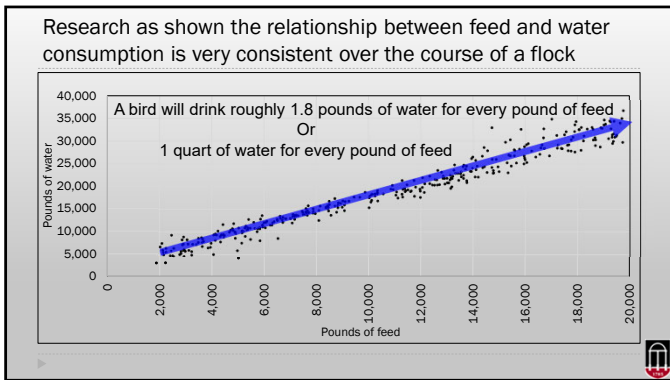
A 21-day-old broiler

- ▶ Will consume approximately ¼ of a pound of feed each day
- ▶ and will drink ½ of a pound of water or 8 oz of water

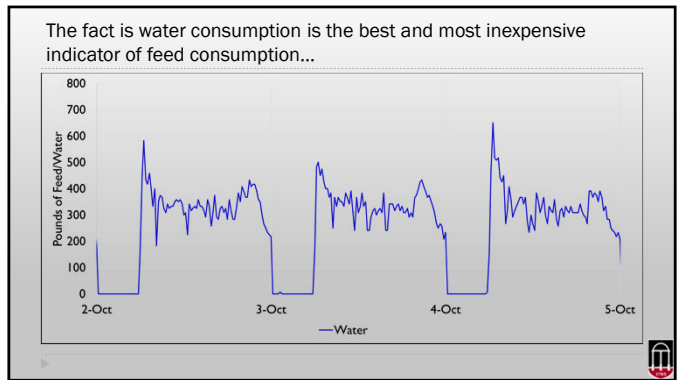





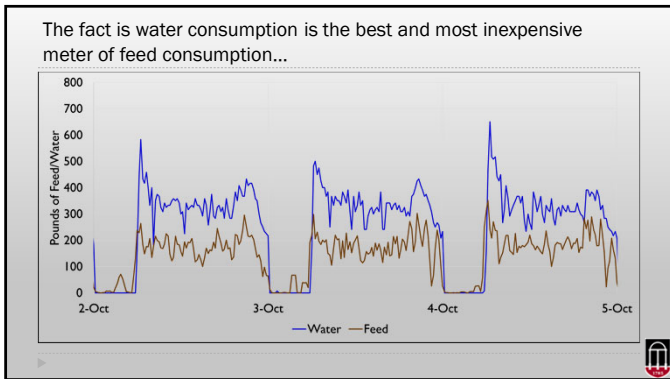
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A 21-day-old broiler

- ▶ Will consume approximately ¼ of a pound of feed each day
- ▶ and will drink 8 oz of water
- ▶ A bird will retain 20% of the water consumed (1.6 oz)
 - ▶ tissues, organs, blood, etc....
- ▶ Therefore, each 21-day-old bird will add 6.4 oz of water to the house over the course of the day (8 oz - 1.6 oz = 6.4 oz)
- ▶ But...

6

Interesting fact...




- ▶ The digestion of feed actually creates water...
- ▶ Digesting ¼ pound of feed will produce 1.6 oz of water

7

So, a 21-day-old broiler...

- ▶ Will drink 8 oz of water
- ▶ Will retain 1.6 oz of water
- ▶ tissues, organs, blood, etc....
- ▶ Will create 1.6 oz of water by digesting a ¼ pound of feed
- ▶ Therefore, each bird will add 8 oz of water to the house over the course of the day.
- ▶ The fact is for any bird age, the best measure of the amount of water the birds are adding to a house each day is a water meter.



8

Now to control house litter moisture it comes down to the simple fact...

- ▶ That we need to ventilate a house based on the amount of water the birds are adding to the house each day




- ▶ In short, whatever the birds are drinking each day...
- ▶ We need to remove from the house each day...

9


If we don't remove the water the birds add to a house each day, over time we will end up with wet litter.

- ▶ Which in turn will lead to:
 - ▶ Excessive ammonia
 - ▶ Respiratory issues,
 - ▶ Damage paws,
 - ▶ Reduced performance
 - ▶ Etc.



10

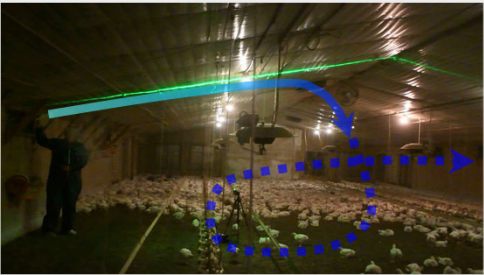
How do we determine how much we need to ventilate each day to remove the water the birds are adding to a house?



- ▶ Under "typical" wintertime conditions,
- ▶ a rough rule of thumb is...
- ▶ we need to exchange approximately 14,000 cubic feet of air to remove each gallon of water added to the house.

11



We bring in 14,000 cubic feet of air...



12

So, if a water meter indicates that 500 gallons flowed into a house on a given day...



- ▶ We would need to remove 500 gallons of water
- ▶ To do so we would need to exchange...
 - ▶ 500 gallons X 14,000 ft³/gals
 - ▶ 7,000,000 ft³ per day
- ▶ Or in terms of cubic feet of air per minute...
 - ▶ 7,000,000 ft³/day / 24 hours / 60 minutes = 4,860 cfm

18"

13

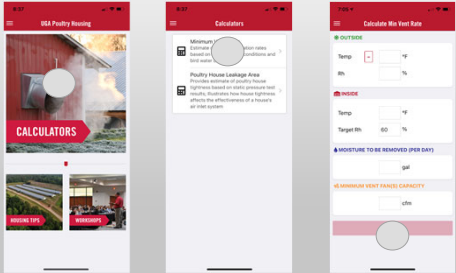
What if conditions are not "typical"

- ▶ How do minimum ventilation rates vary as inside/outside conditions vary?

14


To help answer this question we developed a minimum ventilation calculator (Poultry411 App - IOS/Android)



15

Example:

- ▶ Broiler house with fourteen-day-old birds



16

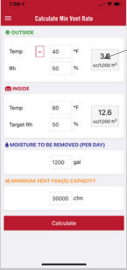
Inside conditions = 80°F, RH = 50%



- ▶ Outside it is 40°F, Rh = 50%
- ▶ Daily water consumption = 1,200 gallons
- ▶ Three 36" exhaust fans (10,000 cfm) will be used for minimum ventilation

17

Outside (40°F, 50%)

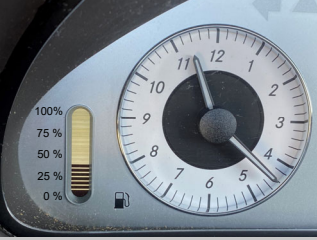


Absolute humidity

18

Relative humidity vs. Absolute humidity


- Relative humidity: How **full** of moisture the air is...



19

Relative humidity vs. Absolute humidity

- Absolute humidity: How **much** moisture there is in the air



20

When dealing with poultry houses, absolute humidity is often expressed in terms of ounces of water per 1,000 cubic feet of air

- Typical pop-up canopy = 1,000 cubic feet



21

For example, let's say that it is 40°F and raining...


- The relative humidity is 100%
- The absolute humidity would be 6 oz of water per 1,000 ft³



22


If it is 40°F and the Rh= 50%...

- The absolute humidity would be 3 oz per 1000 ft³



23

Outside (40°F, 50%)



24

Outside (40°F, 50%) Inside (80°F, 50%)

Absolute humidity?

25

A very important fact is that the moisture holding capacity of air changes with temperature...

► It's like having a gas tank who's size changes with temperature.

26

In fact for every 20°F increase in temperature the moisture holding ability of air doubles.

- At 40°F, 1,000 cubic feet of air can hold up to 6 oz of water (Rh=100%)
- At 60°F, 1,000 cubic feet of air can hold up to 12 oz of water (Rh=100%)
- At 80°F, 1,000 cubic feet of air can hold up to 24 oz of water (Rh=100%)

27

Inside 80°F, 50%

28

Outside (40°F, 50%) Inside (80°F, 50%)

29

House moisture removal process

For every 1,000 cubic feet of air exchanged we remove 9.6 oz of moisture

30

Outside (40°F, 50%) Inside (80°F, 50%)
1,200 gallons to be removed with three 10,000 ft³/min fans

31

Minimum ventilation rate = 11,112 ft³/min

- ▶ Rule of thumb vent. rate = 1,200 gals X 14,000 ft³/gal = 16,800,000 ft³/day
- ▶ = 11,670 ft³/min

32

Though the app can be used to provide a minimum ventilation rate estimate on any given day of a flock...

- ▶ One of the more useful ways of using the app is to explore how changing inside/outside conditions affect minimum ventilation rates

33

For instance,

- ▶ How would the minimum ventilation rate change on a rainy day?

34

Fourteen-day-old birds (80°F inside, Target RH = 50%)
(Outside = 40°F and 50% RH)

For every 1,000 ft³ of air we exchange...
9.6 oz of water removed

35

Fourteen-day-old birds (80°F inside, Target RH = 50%)
(Outside = 40°F and 100% RH)

For every 1,000 ft³ of air we exchange...
9.6 oz of water removed

For every 1,000 ft³ of air we exchange...
6.6 oz of water removed

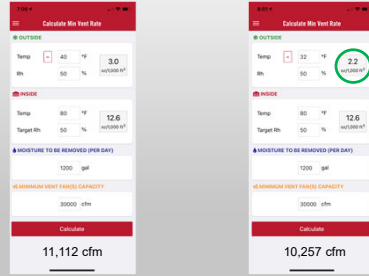
36

How would the minimum ventilation rate change if it was colder outside?



37

Fourteen-day-old birds (80°F inside, Target RH = 50%)
(Outside = 32°F and 50% RH)



For every 1,000 ft³ of air we exchange... For every 1,000 ft³ of air we exchange...

9.6 oz of water removed

10.4 oz of water removed



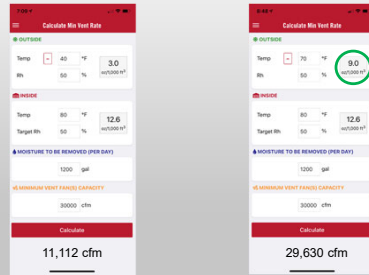
38

What if it is warmer?



39

Seven-day-old birds (80°F inside, Target RH = 50%)
(Outside = 70°F and 50% RH)



For every 1,000 ft³ of air we exchange... For every 1,000 ft³ of air we exchange...

9.6 oz of water removed

3.6 oz of water removed



40

Summary:



- ▶ During cold weather minimum ventilation rates can be decreased (10 to 15%) because the outside air contains less moisture.
- ▶ During moderate/warm weather minimum ventilation rates may need to be doubled to remove excess moisture from a house because the outside air tends to contain more moisture.



41

Cool, rainy days...



- ▶ On a cool, rainy day there is still more moisture in the air inside a house than outside, but minimum ventilation rates may need to be increased by 50% to take into account the additional moisture in the outside air.



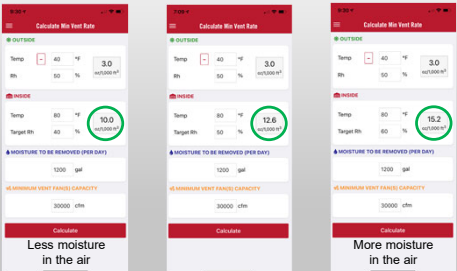
42

What if we want to change the target humidity?



43

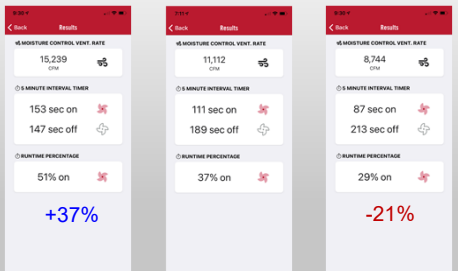
Fourteen-day-old birds (80°F inside, Target RH = 50%)



Less moisture in the air (40%) More moisture in the air (60%)

44


Fourteen-day-old birds (80°F inside, Target RH = 40%, 50%, 60%)



+37% (40%) -21% (60%)

45

Target RH and minimum ventilation rates



- Decreasing target RH from 50% to 40% may require minimum ventilation rates to be increased by approximately 40%.
- Increasing target RH from 50% to 60% may require minimum ventilation rates to be decreased by approximately 20%.

46


But important to realize that the Poultry411 app only provides a theoretical estimate...

- Precisely how much fresh air we will actually need to control litter moisture will vary with:
 - Changes in temperature/Rh over the course of the day:
 - As outside temperature/rh changes the minimum ventilation rate changes
 - Side wall inlet system performance:

47

Side wall inlet performance:

- Is all the incoming air being sufficiently warmed/dried before moving down to floor level?
- Are the inlets breaking up temperature/humidity stratification?
 - Are we moving the hot/dry air off the ceiling down to floor level?
- Is the inlet producing some level of air movement floor level?



48

The best way to determine the correct minimum ventilation rate to control moisture...

- ▶ is to use the Poultry411 app to provide a starting point,
- ▶ then adjust the min. ventilation rate based on house relative humidity

49

Target RH is typically between 40% and 60%

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Above 60%...you are probably ventilating too little

51

Below 40%...are probably ventilating too much

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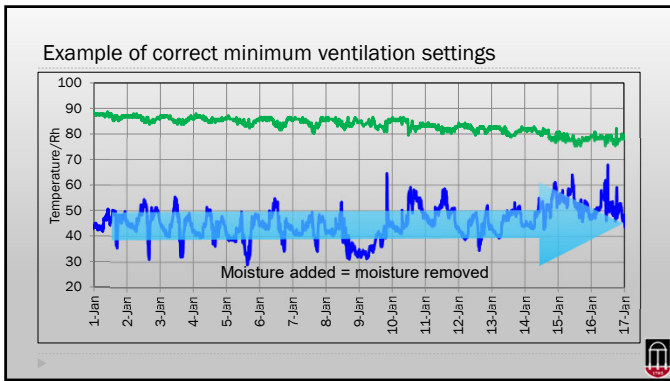
Example of incorrect minimum ventilation rate settings

53

Important fact:

- ▶ Once the litter cakes over...
- ▶ The rate at which moisture moves from the litter to the air is cut in half.

54



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But important to realize that any minimum ventilation calculator only provides a theoretical estimate...

- Precisely how much fresh air we will actually need to control litter moisture will vary primarily with:
 - Changes in temperature/Rh over the course of the day:
 - Side wall inlet system performance

56

Inlet system performance determines to a large extent a producer's ability to control litter moisture

57

How well an inlet system performs depends to a large extent on house tightness.

- We believe our houses are tight...but are they?
- How do you precisely know how tight a house is?
- and more importantly...
- How does house tightness correlate with the effectiveness of a house's inlet system

58

Which is why we created a poultry house leakage area calculator (Poultry411)

59

Example: 40' X 500' broiler house – everything closed tight

1 cfm per ft² of floor space

60

Results:

How would this affect the performance of our minimum ventilation system?

61

Inlet system performance

Let's say we are going to use a two 36" fans (20,000 cfm) fans for minimum ventilation

62

50 (10" X 42") will be used for minimum ventilation

63

Example: 40' X 500' house

64

House tightness

65

Tighter house?

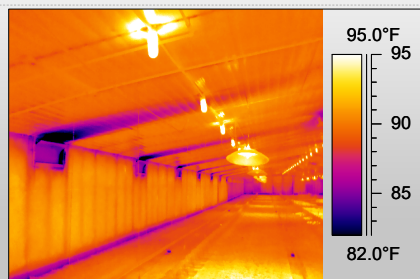
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In a tightness test using a 25,000 ft³/min fan we obtained a pressure of 0.24"



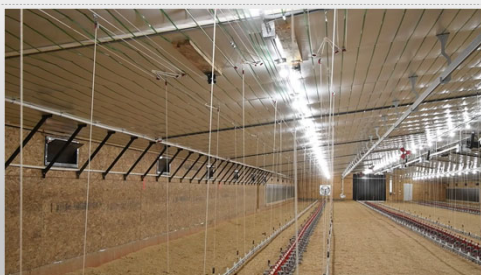
67

Tight house



68

The tighter the house, the more effective the inlet system will be, and the easier it is to control litter moisture



69

Summary:


- ▶ Use minimum ventilation app to come up with a min vent starting point
- ▶ Adjust based on house Rh
- ▶ Check house tightness:
 - ▶ The tighter the house, the better the side wall inlets will perform...
 - ▶ And the easier it will be to keep your litter dry while at the same time keeping energy usage to a minimum.



70



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71