AgriFutures Australia Chicken Meat Program Extension Webinar #4 – Litter management (Summer focussed)

This webinar was presented on 10 October 2024 (1:00 pm AEST) by Mark Dunlop (mark.dunlop@daf.qld.gov.au) and hosted by Sarika Pandya, Manager, Levied Industries (CME), AgriFutures Australia.

Acknowledgements

AgriFutures Chicken Meat Consortium – Nutrition, Gut Health and Environment project (PRJ-016111) is a multi-institutional and multi-national collaboration, part of the AgriFutures Chicken Meat Program.

The Consortium team acknowledges funding and support from all stakeholders. It includes AgriFutures Australia with its associated levy payers, The University of Queensland, The University of Sydney, Central Queensland University, Department of Agriculture and Fisheries Queensland, Massey University, Aviagen, dsm-firmenich, Lucta, Eurolysine (formally Metex Noovistago), Lallemand, Poultry Research Foundation, World Poultry Science Association New Zealand Branch, and another nine international universities.

Thank you to the growers and integrators who have contributed to this information by providing access to their farm, giving their time or sharing their thoughts and data.

AgriFutures Australia Chicken Meat Program

Department of Agriculture and Fisheries, Qld Government, for supporting this research

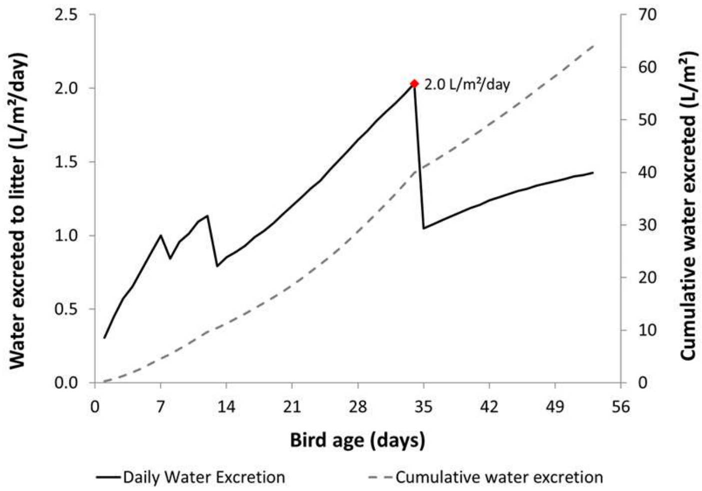
Heading into Summer is a great time to check some of the important parts of the shed and ventilation system. Ensuring these are right will help with litter management and help you to provide a comfortable environment for the chickens when the weather heats up.

As growers well know, keeping litter dry and friable requires managing ALL aspects of chicken production…all the time.

- Setting up the shed correctly, including pre-heating and drying litter
- Appropriate ventilation and heating
- Managing litter conditions
- Adjusting drinker height and pressure
- Feed quality & nutrition
- Husbandry practices, including even density and monitoring chicken health and behaviours

Reduce excess water going to the litter

Chickens add most of the water



AgriFutures® Chicken Meat

The chickens are the main source of water onto the litter. At the peak of the grow-out, the chickens add about 2 litres of water per square meter of the floor every day.

At the end of brooding, the chickens are applying about 1-1.2 L/m²/day. This is a lot of water for the litter to absorb when ventilation is often still quite low and can result in a short-term increase in litter moisture in the second and third weeks of the grow-out.

No litter material, or litter depth, can absorb the amount of water that the chickens are applying. It is only a short-term measure. The water applied to the litter one day MUST be removed that day otherwise the litter will become wet & caked.

Reduce excess water going to the litter

Check drinker flow rates are not too high

Bird age (days)	Water flow rate (ml/min)	
	Ross® 308	Cobb® broilers
0–7	20	40
8–14	60-70	50
15–21	60-70	60
22–28	70–100	70
29+	70-100	90

…BUT chicken growth rates and **litter conditions** are the best measures

AgriFutures® Chicken Meat

Wet litter often starts under the drinkers. If the flow rate in the drinkers is higher than it needs to be, or if the drinkers are at the wrong height (usually set too low) then excess water will spill onto the litter as the chickens drink.

Growers should use a water flow meter and measure the flow rate and see how it compares to the breeding company recommendations. A method to do this is available in the broiler management manuals for your breed of chicken. The method can also be found at on the Litterpedia website

https://chicken-meat-extension-agrifutures.com.au/resources/litterpedia-2/#drinker-management

The measured flow rate is only a guide. Some drinkers respond differently with the flow meter than they do when chickens are drinking. So also look at the litter conditions. If the litter beneath drinkers is mostly dry or only slightly damp then do not reduce the flow. However, if the litter under the drinkers is often the start of wet litter in the shed, then it might be a sign that the drinker pressures (which affects the flow rate) are too high, or that the drinkers are worn, or that the drinker system needs a thorough clean.

Fans need to be running at their full speed to get the full amount of airflow through them. If a fan is running slower, the airflow will be less. This will contribute to lower ventilation rates (resulting in higher humidity and wetter litter) or lower tunnel ventilation air speeds, which will reduce the cooling effect.

Fans might run slower if the belts or pulleys are worn, if the bearings are worn/damaged or if the airflow is obstructed by dirty safety grills or shutters that don't fully open or close.

Direct drive, variable speed fans may also not work at their full speed if the speed control wire (sending a voltage signal to the fans) has any damaged, corroded or loose contacts.

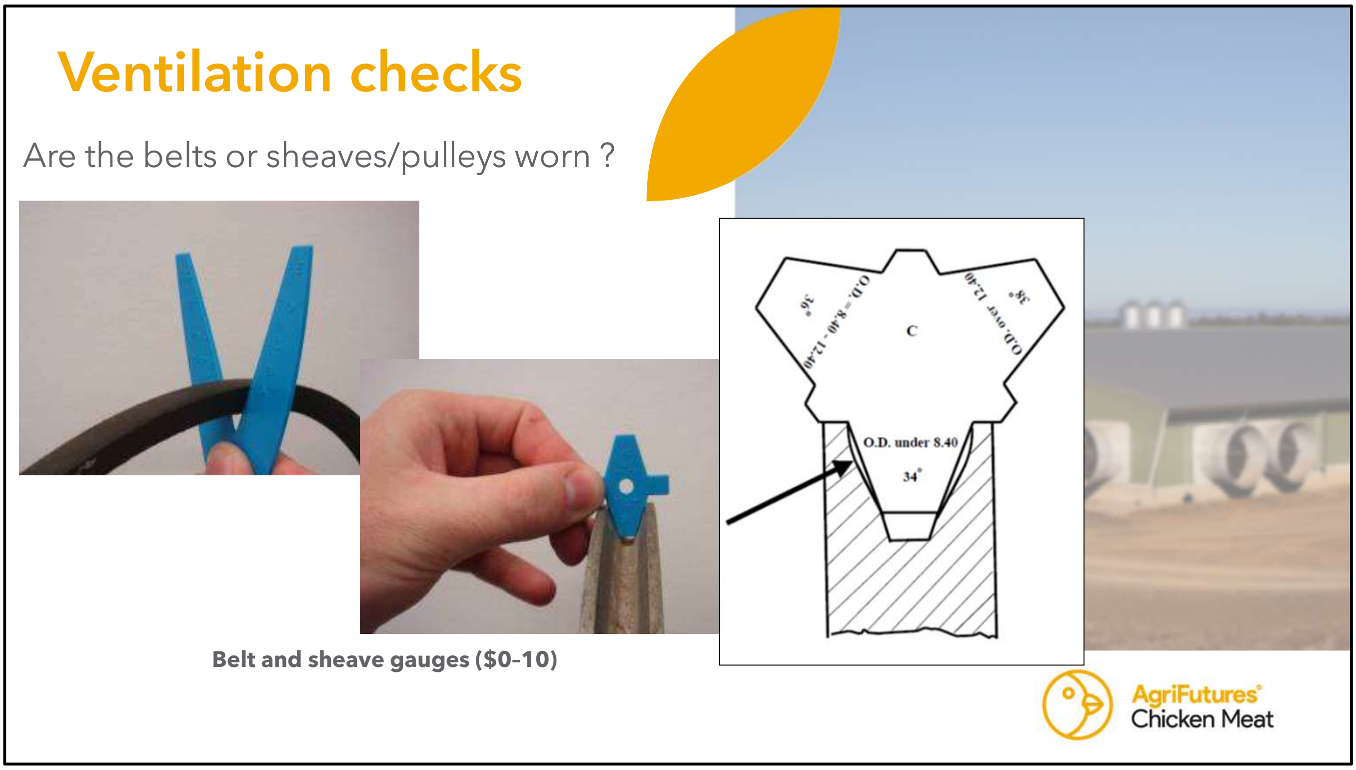
Measuring the rotational speed of the fans with a laser tachometer is one way to check all of these things, ensure fans are all working evenly, and that they are up to their original specifications. Your fan supplier should be able to provide you with the maximum RPM that your fan should be running at for comparison with the tachometer readings. (Note that the tachometer won't read RPM from the fans, but will read the number of 'blade counts per minute'.

To calculate RPM, divide the 'blade counts per minute by the number of blades.

RPM = blade counts per minute (tachometer reading) / number of blades.

So a fan giving a reading of 4000 blade counts per minute, and has 6 blades will have RPM:

RPM = 4000/6 = 666 RPM.

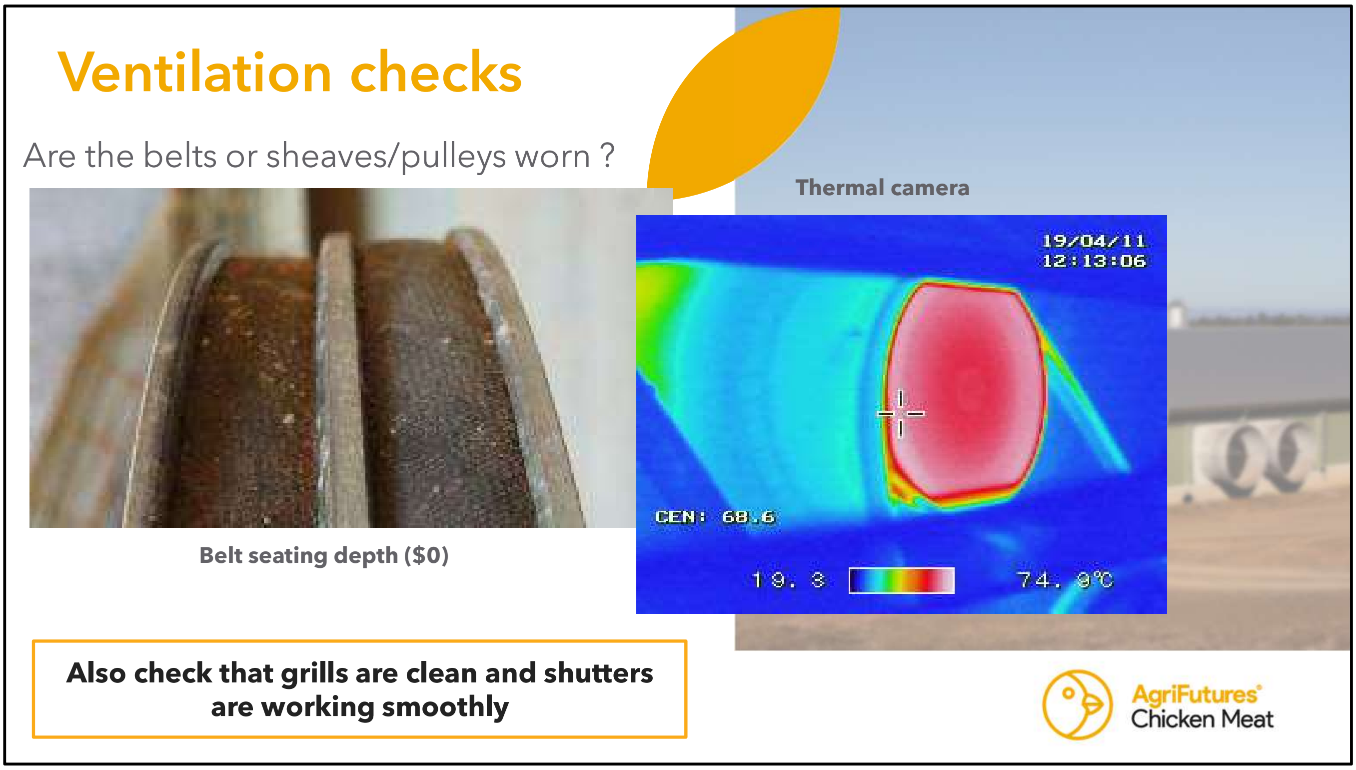


If either the belt or pulley are worn, the belt will ride lower in the pulleys and change the ratio between the motor and fan impeller pulleys, which will change the fan RPM.

Gauges are available to measure the wear on v-belts and pulleys (also called sheaves).

The belt gauge has lines on it that indicates if the belt has worn down.

On pulleys, the gauge allows you to see if there is wear (indicted by the arrow). If the pulley is worn, new belts will wear out much quicker than normal and the bets will loose tension and start to slip much more quickly. Often, the pulley on the electric motor will wear more quickly because it is smaller.



On the pulley in the picture, it is easy to see that one belt is riding lower than the other. How low a belt is riding in the pulley can be used as a first indication of belt or pulley wear. Compare the belt riding depth between fans of the same type. If a belt is riding low, then check if it or the pulley are worn.

Using a tachometer might also confirm if the fan RPM has changed.

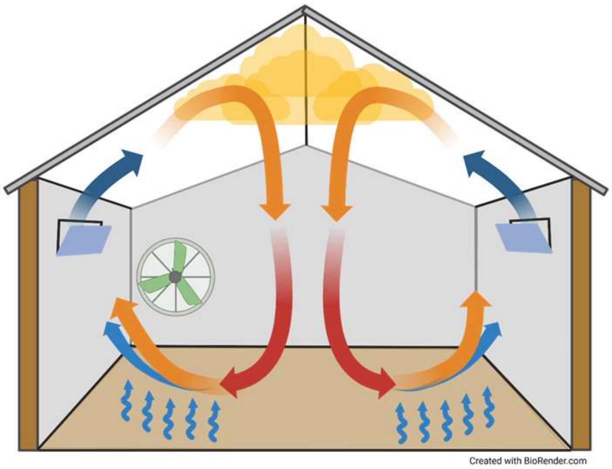
On this pulley that has 2 belts, both belts should be replaced at the same time. Otherwise, these two belts will likely be at different tensions and the tight belt will be doing more work and will wear down quickly because the other one will be slipping.

If you have a thermal camera, you can look at pulley temperatures while all the fans/most of the fans are running. Any pulley that is warmer indicates that the belt is slipping. This fan will almost certainly be running slower. A tachometer will also confirm this.

Shed static pressure test

Having a tight shed…

- Improves your control of incoming air through
  - mini-vents during low ventilation
  - cool-pads when you really need them



AgriFutures® Chicken Meat

Poultry house ventilation works in negative pressure. The fans pull air out of the shed, creating a negative pressure (vacuum) in the shed. This negative pressure draws fresh air into the shed through any opening. We think about the vents and inlets, but air will also enter though any hole, gap, crack.

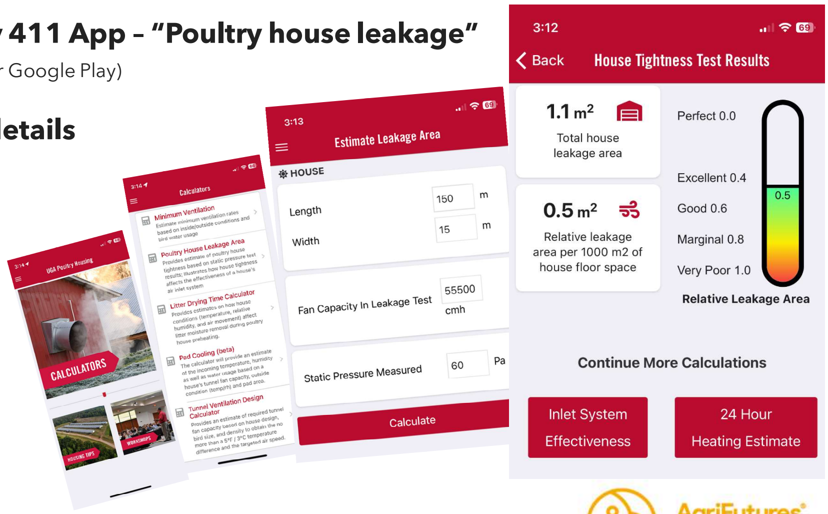
Air entering through cracks does not get conditioned the way it needs to. In side-vent (minivent) mode, air needs to enter through the wall vents and then be jetted across the ceiling where it picks up heat that rises to the ceiling. As the air is warmed up, it can carry more water. This is critical so that when it goes down to the litter surface it is able to remove water from the litter. If the air comes in through the vent and goes straight to the floor, it will be cool and unable to pick up much water from the litter.

If the shed is in tunnel ventilation with or without evaporative cooling, an air leaking into the shed will rather than entering through the tunnel inlets/cool pads will not contribute to tunnel ventilation. Air speeds will be lower and if you're using the evaporative cooling, any air entering through a crack/gap/leak will not be cooled.

Shed static pressure test

Empty shed pressure test

- University of Georgia **Poultry 411 App – "Poultry house leakage"**
  (Free app available from App Store or Google Play)
- **Enter you own shed & fan details**
- Measure the static pressure



https://www.poultryventilation.com/wp-content/uploads/vol34n12.pdf

AgriFutures Chicken Meat

An effective way to check how air-tight a shed is will be to do a pressure test. In the past, it was possible to turn on one 125 cm diameter (50 inch) fan or two 90 cm (36 inch) fans and make sure the shed achieves a set pressure (usually between 25 to 50 Pa). But different size sheds will give different pressures and the new sheds that are bigger than 150x15m will need more fans.

Rather than guessing what a 'good' pressure should be to for a shed to be sufficiently air-tight, The University of Georgia have created a calculator and added it to their 'Poultry 411' app that can be downloaded for free from the Apple App Store or Google Play store. The app allow you to enter your specific shed dimensions and the air flow rate of a fan (or multiple fans if required). Once the shed is completely closed up and the fan is turned on, you can enter the pressure that the shed reaches and the app will report how much leakage there is and give a rating about how air tight the shed is.

When entering the fan flow rate, fan test data should be referred to and the flowrate entered for the static pressure that the shed is operating at. This is because the flow rate of a fan will reduce as the static pressure in the shed becomes greater (more negative, e.g. -50Pa).

The pressure can be read from the ventilation computer or a static pressure gauge (like that shown) can be used.

Managing relative humidity

Aim for RH below 60%

- Best to look at data from humidity sensors
- OR measure at the same time each day

If the RH in your shed is trending upwards, it is a sign that your litter is getting wetter

- If RH is greater than 75-80%
  - wetter litter
  - more caking
  - more ammonia
  - more tilling, heating and ventilation

Air speed, Temperature & humidity
($100-300)

AgriFutures® Chicken Meat

Relative humidity is a measure of the amount of water that air can hold at a given temperature. As air warms up, it can hold more water than if it is colder.

Some sheds have relative humidity sensors installed. If you have these, and they have been checked for accuracy, the best way is to look at the relative humidity over a few days. If it is trending upwards, then it is a strong sign that the litter is getting wetter and more ventilation is needed.

In general, the relative humidity in the shed should be maintained below 60%. If it is higher than this, litter will be slow to dry or it will absorb more water out of the air. The heat produced by the chickens (or by using heaters) contributes to warmer air in the shed, and the relative humidity should be lower in the shed than outside, especially while the shed is in side-vent mode. When the shed is in tunnel ventilation mode, the throughput of air through the shed may be too much for it to increase in temperature in any meaningful way.

A rule of thumb is that if air temperature increases by 10 °C, the relative humidity will halve. In tunnel ventilation. The difference in air temperature from the front to back of the shed should be kept less than 3 °C. With such a small temperature increase, the relative humidity is unlikely to reduce very much.

Trying to achieve lower relative humidity is complex and challenging. In side-vent mode, ventilation should not be excessive otherwise too much heat is removed from the shed and relative humidity won't be reduced enough by the time fresh incoming air reaches the litter. So it is necessary to balance heat retention with ventilation rate, especially if outside relative humidity is very high. However, in general, higher ventilation rate will still be effective at removing more water from the litter.

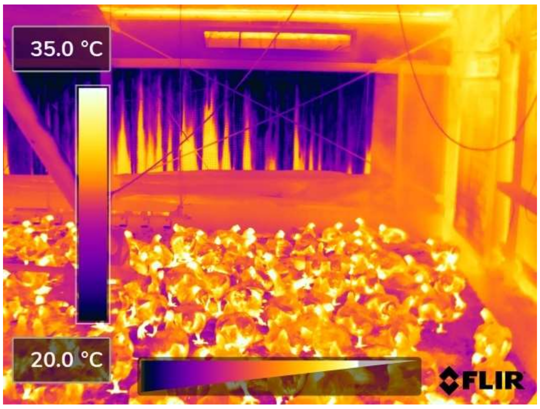
Growers may need to rely on their experience and monitor the trend in relative humidity with balancing an increase in air flow rate to prevent the in-shed relative humidity from trending upwards, and ideally keeping it below 60%.

Managing relative humidity

Aim for RH below 60%

- Increase ventilation
- Concentrate on increasing air speed before using evaporative cooling
- Minimise use of cool pads
  - Avoid use at temperatures below 29.5°C
  - Avoid use at RH above 80%
  - Avoid using at night (8pm until 8am)
- Use the heat in the shed

Increasing air temperature by 10°C reduces RH by about half



AgriFutures® Chicken Meat

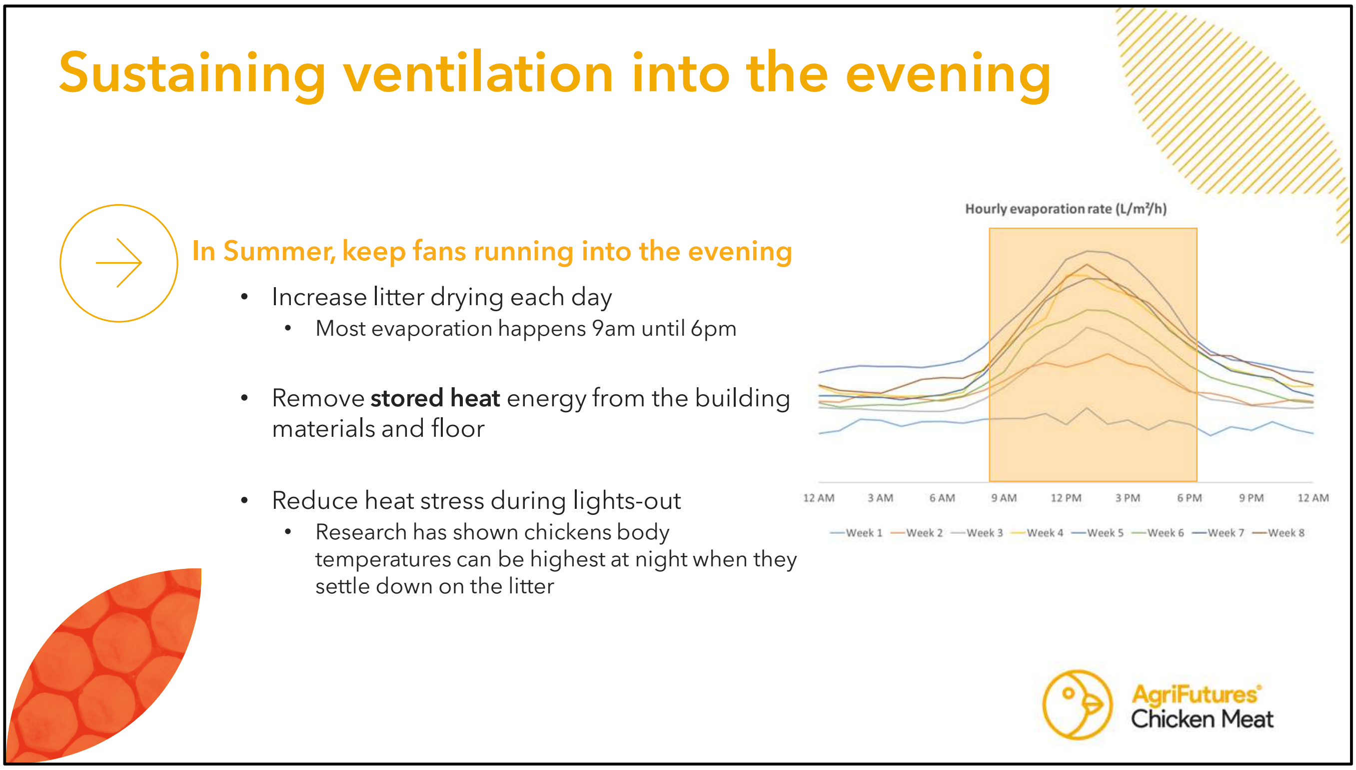
In summer, increasing ventilation rate is usually not a major problem.

During very hot weather, however, excessive use of evaporative cooling can contribute to long periods of high relative humidity in the shed. This can contribute to litter becoming wetter.

Balancing fundamental principals in chicken cooling processes and operation of ventilation and evaporative cooling, University of Georgia have developed some rules of thumb for reducing evaporative cooling use at times when it isn't necessary. These include not using evaporative cooling when the temperature is less than 29.5°C. Up to this temperature, the focus should be on increasing and using air speed to remove heat from the chickens.

Another time to avoid cool pad use is when the outside relative humidity is above 80%. When it is humid, the evaporative cooling pads will not effectively reduce air temperature, and it will increase the relative humidity in the shed to nearly saturation (100% RH). At such high humidity, the litter will almost certainly increase in moisture content. Chicken will also be less able to expel heat energy from their body, which they do most effectively by evaporating water from their lungs. At high relative humidity, they are almost unable to evaporate this water.

At no time should ventilation rate or air speed be reduced when evaporative cooling is being used. Ventilation rate and air speed is necessary to remove the heat energy from the chickens. Lower ventilation equals less heat removal.



Modelling of evaporation rates from litter has indicated that the majority of litter drying occurs from 9am until about 7pm. This coincides with the time of the day when daily ventilation rates are higher and outside relative humidity is lower.

Fortunately in summer, warmer temperatures and longer days contributes to a longer window of opportunity for drying litter and removing moisture from the shed. Take full advantage of this by allowing fans to run on for longer into the evening than may be required strictly for heat removal.

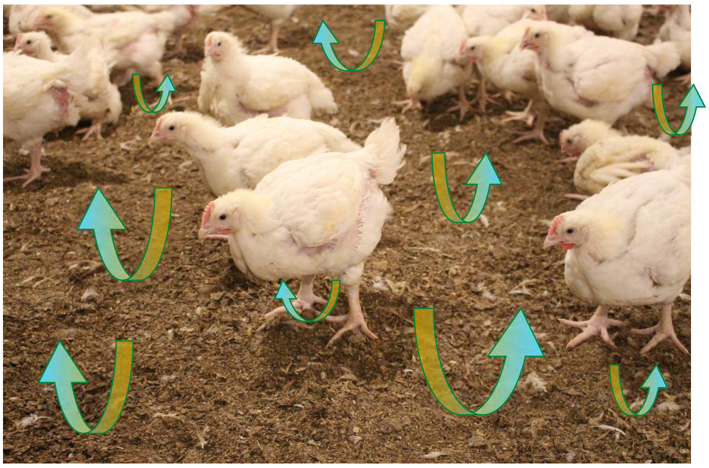
Additionally, research has shown that chickens often feel hottest and experience heat stress in the evening when the lights turn off and the chickens sit down. Maintaining higher rates of ventilation into the night, for several hours AFTER the lights go out helps to keep air moving around the chickens and removing heat from them. This is beneficial for removing heat energy that is stored in the litter, floor and other building surfaces.

If the ventilation reduces too early, heat radiates out of the floor and the shed temperature will rapidly increase. Fan activity will be seen to fluctuate with fans increasing and decreasing. If you observe this happing, change the ventilation setting to increase ventilation to remove more heat for longer into the night.

Airspeed at the litter surface

Air movement is needed to get air around the birds

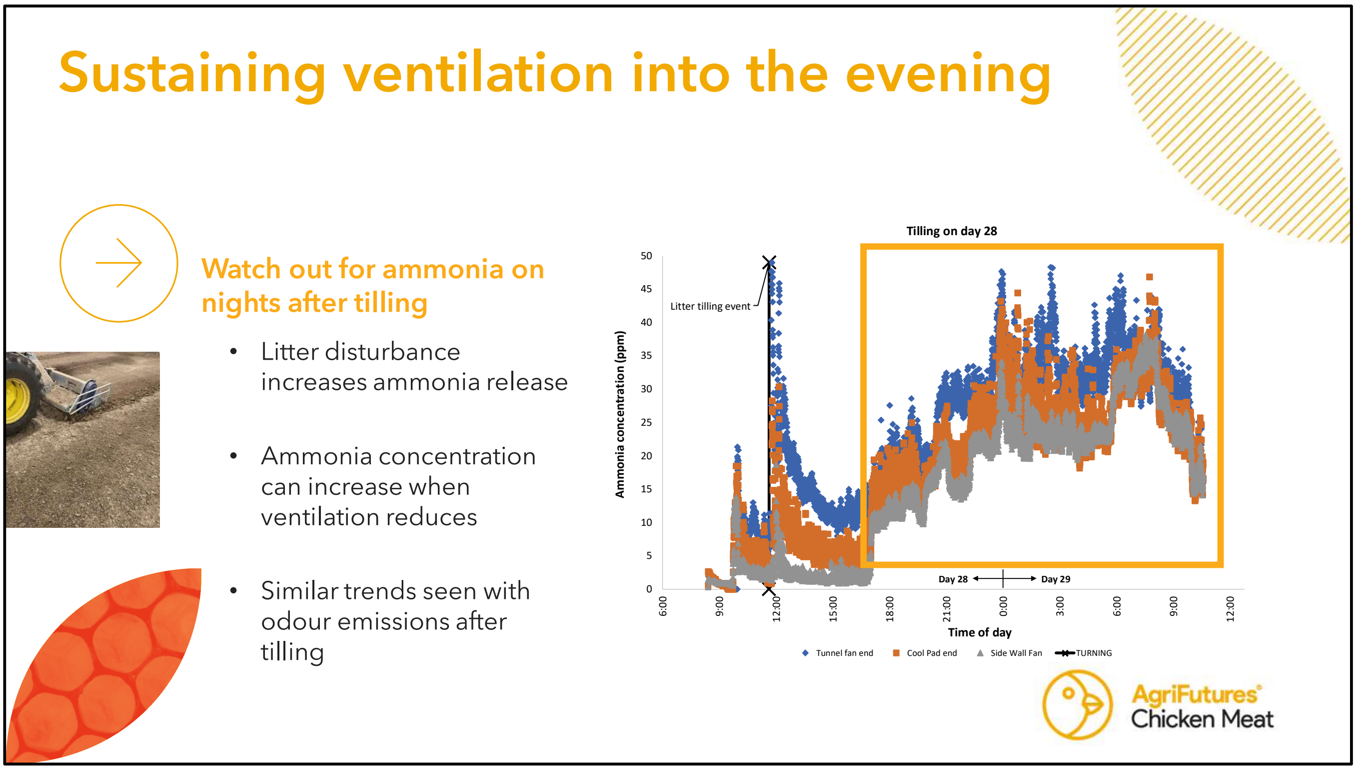
- for cooling
- remove water from the litter



AgriFutures® Chicken Meat

To get water to evaporate and be removed from the litter, there needs to be enough air movement down through the birds and to the floor to evaporate and remove water.

Increasing ventilation and air speed is effective for both removing heat energy from the chickens and removing water from the litter.



Another time to increase ventilation in the evening/night is after tilling.

For 24 hours after tilling, more ammonia (and water) will be released from the litter. For these reasons, ventilation should be increased above normal levels.

Significantly more ventilation is needed for 4-6 hours after tilling. But additional ventilation is needed for about 24 hours after tilling.

Sustaining ventilation into the evening

Prepare for the night by drying litter to reduce ammonia

- Ventilate as much as possible the afternoon after tilling
  - Removing water and ammonia
  - Diluting ammonia
- Till in the mid- to late-morning to ventilate for as long as possible

Duration after tilling	Increase in evaporation rate after tilling: Caked litter	Increase in evaporation rate after tilling: Friable litter	
First 4-6 hours	12-15x	4-5x	Afternoon
12-15 hours	7x	2.5x	Night
Up to 20 hours	4-5x	1.5x	
After 24 hours	friable litter has 3x ongoing drying rate compared to caked litter	Returns to normal drying rate	

Dry litter reduces relative humidity, ammonia & odour

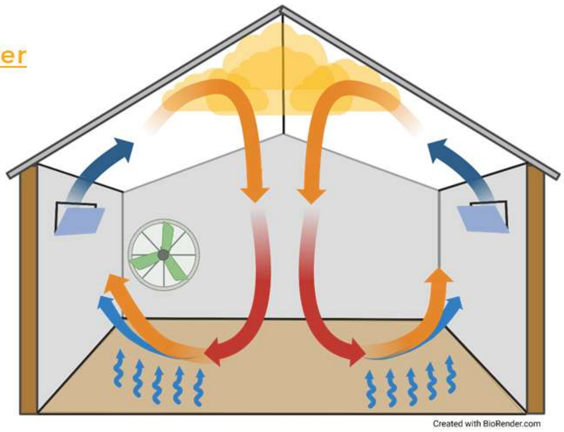
AgriFutures® Chicken Meat

To maximise the benefits of tilling for drying litter and to reduce risks with increased ammonia concentration after tilling, try to till the litter in the mid-to-late morning to so that maximum ventilation can be used throughout the afternoon to coincide with the highest temperature of the day. Maximising ventilation in the afternoon to remove as much moisture and ammonia as possible will reduce the need for maintain high ventilation during the night when you may want or need to reduce it, in the event of a cool/cold evening.

Managing relative humidity

Correct airflow is essential to reduce RH at the litter

- Bring warm air down
- Break up the cold & humid air at the litter
- Reduce RH at the litter
- Air movement removes water from litter
- Ventilation fans extract the moisture



AgriFutures® Chicken Meat

Bringing together everything about ventilation, for moisture to be removed from the litter, air needs to be entering the shed, being warmed so that it can have greater capacity to hold water, then moved across the litter surface so it can remove moisture.

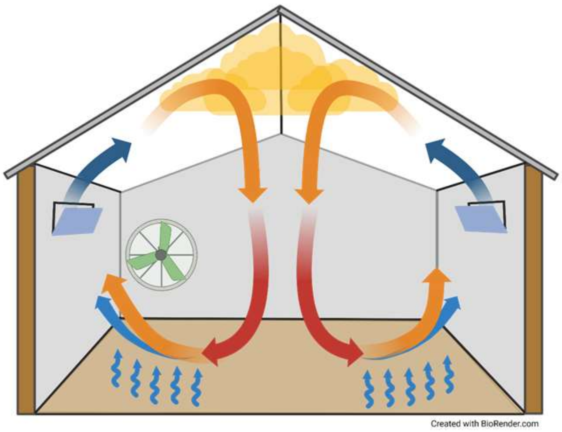
The movement is a very important aspect. Without air movement, a layer of still air develops above the litter surface and prevents moisture moving from the litter into the ventilation air. The more air movement there is, the thinner this layer will be and so the less resistance there will be for moisture moving from the litter surface into the ventilation air.

Managing relative humidity

Side-vent mode is designed for drying litter

But this assumes that air is circulating
- Exhaust fans running
- Correct shed pressure
- Side-vents adjusted
- No obstructions

- **Fans pump out heat to get air moving**



What happens when the fans cycle off?

AgriFutures® Chicken Meat

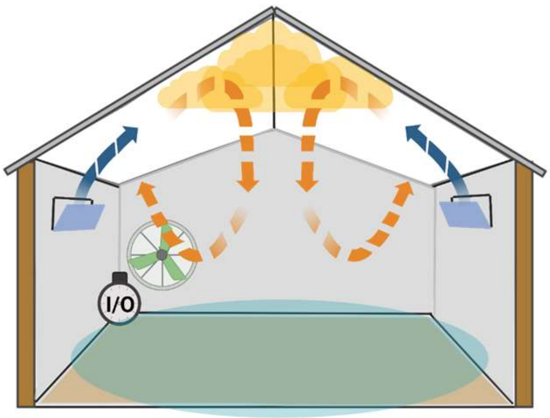
Whenever ventilation fans turn off, air movement stops. This means that litter drying stops.

Managing relative humidity

Side-vent mode is designed for drying litter

When fans cycle

- Air currents don't fully form
- Air speed is minimal at the litter surface



Where does the cold air settle?

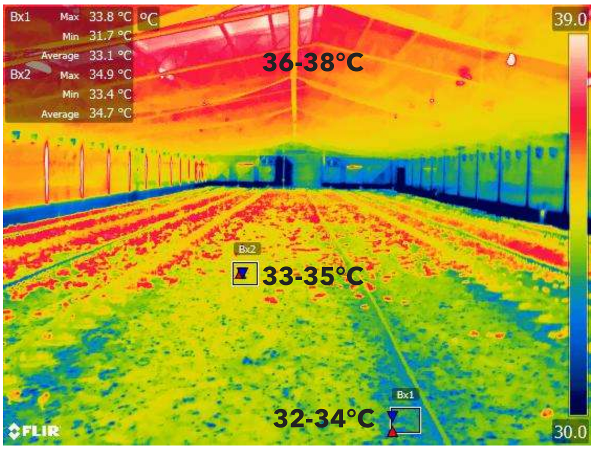
AgriFutures® Chicken Meat

Fans cycling on and off is no better. It takes quite a while for air currents to start moving and to get air momentum to build up.

If the fans turn on for only short times (less than 5-10 minutes), then the air in the shed doesn't fully mix and hot air shifted down from the ceiling will simply go straight back up there before it reaches the litter and certainly before it removes water.

And if the hot is going up, where does the cold air settle? On the floor of course. Then when the fan cycles back on and air starts to shift, the chickens experience movement of cold air….drafts.

Managing relative humidity



What are the temperature sensors measuring ?

Relative humidity will be higher at the litter surface because it is cooler

AgriFutures® Chicken Meat

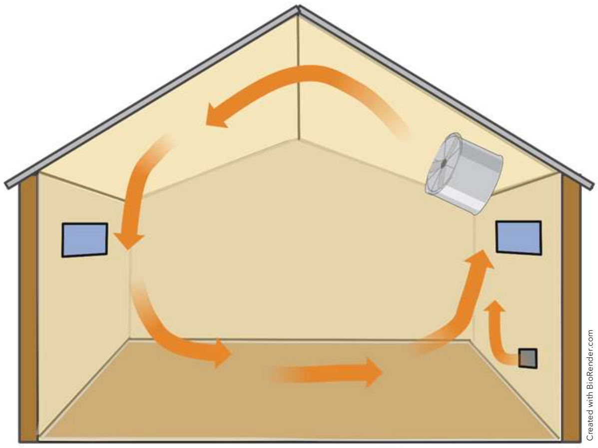
Thermal imaging of temperature stratification in sheds show how hot air rises to the ceiling and cold air settles on the floor.

To make matters worse, the cold air will also have lower ability to hold water, and will therefore have higher relative humidity. This means that not only is it likely to create drafts for the chickens, but will either not remove water from the litter or might even put water back into the litter.

Circulation / stirring / destratification fans

About 20-25% of growers surveyed have circulation fans

- Bring down the heat
- Prevent cold air settling
- Improve temperature uniformity
- Temperature, RH and ammonia sensors will respond more quickly and better represent the conditions
- Reduce heating costs by 25-30%



AgriFutures® Chicken Meat

If you’re heating, you’ll probably want to conserve heat rather than exhaust it out.

Using circulation fans is one way to improve temperature uniformity throughout the shed and utilise the heat that you’re paying for.

Using fans to constantly mix the air ensures that there are fewer pockets of cold air selling on the floor (causing condensation in the litter). Air movement may also reduce condensation forming on shed surfaces.

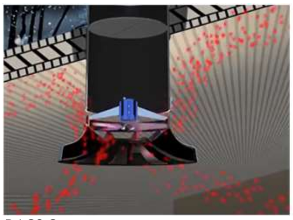
Circulation fans WILL increase the amount of water being taken out of the litter and therefore may increase the relative humidity in the shed. If this occurs, ensure there is sufficient ventilation to remove the moist air.

Circulation / stirring / destratification fans

zone stirring or whole-shed circulation

Photo courtesy of University of Georgia

https://www.choretime.com/product/air-mixers-for-broilers/



DACS Corona
https://youtu.be/cFF9inrpDyc

https://www.wattagnet.com/agriculture-products/product/15481943/dacs-a-s-coronad-inlet-fan

https://www.skov.com/products/air-inlet/da-65-600-chill-unit/

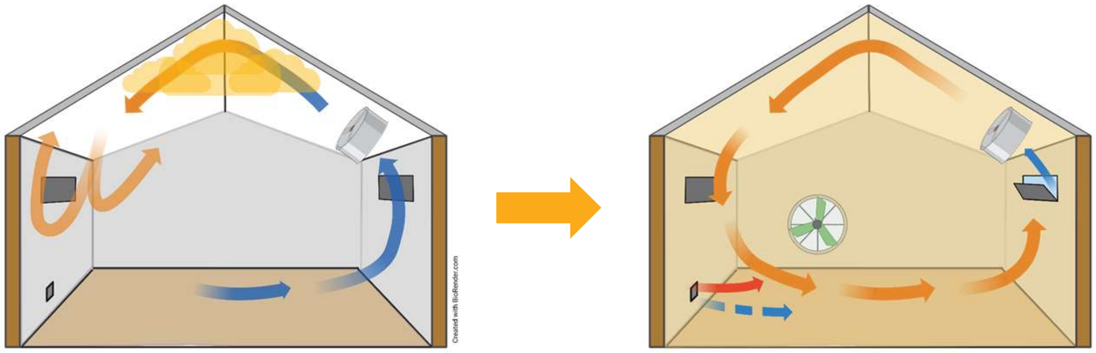
AgriFutures® Chicken Meat

There are a range of circulation fan designs. These ones re-distribute the heat and improve uniformity throughout the shed but are designed not to create air speed across the litter surface.

Circulation / stirring / destratification fans

Run the fans continuously

- Any hot air will quickly return to the ceiling



AgriFutures® Chicken Meat

It is a false economy to turn circulation fans on and off.

Circulation fans should be installed in the shed in a way that works with the existing airflows that you want. That way the ventilation fans and heaters can turn on and off and not create confusion or turbulence.

Whenever the fans turn off, cold air will settle on the floor and then when the ventilation or circulation fans turn on again, they will create a draft for a little while until the air in the shed is mixed again.

It's better to turn circulation fans on and leave them running until the ventilation fans are running continuously. In colder weather, if fans return to cycling on and off at night, it might be worth turning the circulation fans back on to run through the night.

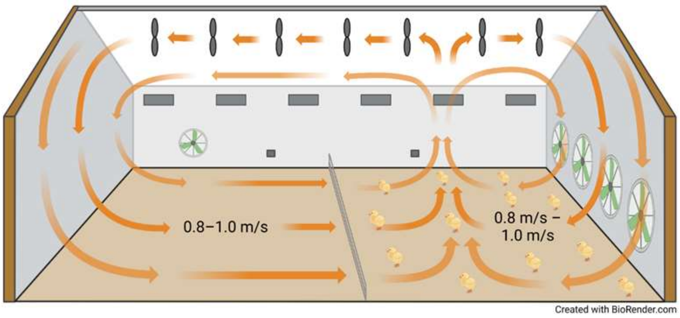
The added benefit of running circulation fans constantly is that they create more uniform conditions throughout the house. From end to end and floor to ceiling. Your temperature sensors will be measuring the overall, average conditions rather than fluctuating as warm and cool air moves over them for short periods.

Circulation / stirring / destratification fans

The best air circulation systems

(either circulation fans normal air movement from ventilation fans)

- Move air to each end of the shed
- Uniform conditions everywhere
  - Not waiting to fill the whole shed with heat before the temperature sensors realise that it is already time to turn the heaters off
- Some air movement on the litter surface and temperature sensors
- Work with air currents from side-vents and heaters



AgriFutures® Chicken Meat

Any circulation, stirring or destratification fan will move air around. It is better if you can have a system of fans that will create uniform conditions throughout the shed and will also create some movement on the litter surface.

This has been demonstrated by University of Georgia, who have demonstrated that this type of circulation fan system reduces the wetness of wet litter in the shed and subsequently reduces the occurrence of footpad dermatitis (FPD).

The research has been published - https://doi.org/10.1016/j.japr.2024.100476

They also have a Poultry Housing Tip (https://www.poultryventilation.com/resources/) that describes this circulation fan system
Poultry housing tips Vol. 35, no. 3 - https://www.poultryventilation.com/resources/using-circulation-fans-to-improve-foot-pad-health/

There are also other fact sheets about circulation fans in general
Poultry housing tips Vol. 35, no. 2 - https://www.poultryventilation.com/resources/basic-circulation-fan-system-design/
Poultry housing tips Vol. 35, no. 4 - https://www.poultryventilation.com/resources/vertical-vs-horizontal-circulation-fan-systems/

Wrapping up

Summer is a great time for checks

- Drinkers
- Fans
  - RPM
  - Shutters
  - Grills
  - Belts
- Shed
  - Pressure test
  - Vent adjustment

AgriFutures®
Chicken Meat

Wrapping up…

Summer is just as good a time as any to check the flow rate of drinkers and the operation of fans and inlets and to pressure test sheds. For the fans, a laser tachometer is one of the easiest tools to use and can be used with all the fan safety grills fitted and the fan running.

Wrapping up

Take advantage of summer weather

- Sustain ventilation into the evening
  - Watch for fans cycling on and off
- Ventilate more after tilling

Increase air movement

- Consider circulation fans for next winter
- Help sensors to respond more quickly
- Get drier litter, less ammonia and reduced heat stress

AgriFutures® Chicken Meat

Take advantage of warmer summer weather by ensuring that fans run on longer in to the evening, especially after the lights are turned off.

If the litter has been tilled during the day, it is especially important to maintain a higher-than-normal ventilation rate to dilute and flush ammonia out of the shed. Loosening up the litter will result in more ammonia being released for about 24 hours until the litter settles back down. Tilling in the morning and ventilating as much as possible in the afternoon will remove as much water and ammonia as possible from the litter, reducing the risk of higher ammonia concentration during the night.

This concludes the webinar.

More information about drying litter and litter moisture, follow the links to the videos on the AgriFutures Litterpedia website.

Please contact me if you have any questions.

Thank you for your time.