Dry litter and ventilation

The elements of drying litter

There are four critical elements to evaporating water from litter:

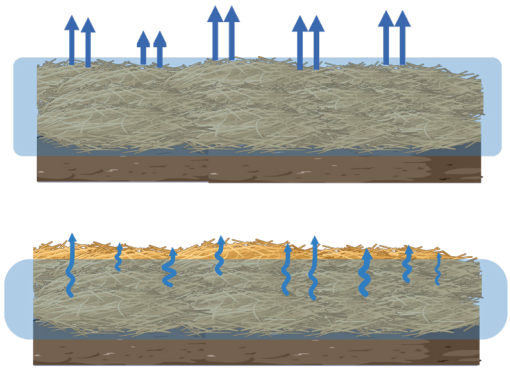
1. Bringing the moisture to the surface
2. Adding heat to the litter
3. Warming the air and reducing the relative humidity
4. Increasing airspeed at the litter surface.

This fact sheet goes through each of these elements in detail and introduces management concepts to improve litter drying.

There is no single solution to improving water evaporation from the litter. Growers need to consider their own situation and choose which of the elements is likely to give them the most cost-effective improvement in litter conditions.

Bringing the moisture to the surface

Water evaporates from the litter surface. Once the surface of the litter starts to dry out, the evaporation rate of water from the litter reduces greatly. Experiments have shown that the evaporation rate from litter will be about six times slower after 24 hours if the litter is not stirred. Water will move up through the litter on its own, but the process is very, very slow.



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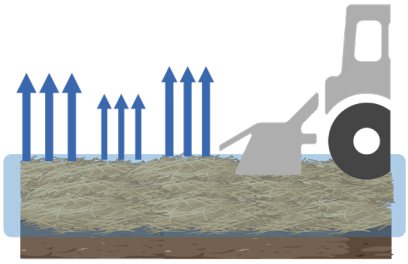
Evaporation is greatest when moisture is at the surface and then slows down as the surface dries.

Chickens 'working' the litter will freshly expose moist litter at the surface, resulting in more water being available for evaporation. This is one of the benefits of keeping litter friable and allowing the chickens to work it. If moisture is deeper within the litter or the surface is caked, tilling will be required to break up the surface and bring moisture to the surface where it can evaporate.



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In laboratory experiments where litter was mixed to simulate tilling, the following increases in evaporation rate were measured.

	Increase in evaporation rate after tilling	
Duration after tilling	**Caked litter**	**Friable litter**
First 4-6 hours	12-15x	4-5x
12-15 hours	7x	2.5x
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

Adding heat to the litter

Heating the air used to dry the litter is also important because it allows the air to carry more water, but this will be covered in the next section.

Adding heat to litter requires careful consideration:

1. **Pre-heating litter (to 30–32 °C) before chick placement is essential** for maintaining their body temperature during brooding, however, if the litter is wet it will be difficult to warm and the batch will have ongoing challenges. Drying the litter before pre-heating is essential for the success of the batch, as it removes excess water and increases the water holding capacity of the litter. For more information, refer to fact sheet *Drying and pre-heating litter before chick placement*.
2. **Chicken heating and cooling demands change as they grow.** Having warm litter at the start of a batch is necessary but becomes less desirable as the chickens grow. This is because they start to produce more metabolic heat and are less able to remove heat from their bodies. Cool litter will reduce litter drying but contributes to the chickens' ability to remove bodily heat through conduction to the litter.
3. **Heat requires energy input.** Gas or electric heating adds to production costs. Taking advantage of biological heat produced by the chickens and litter can improve litter drying while minimising production costs. Heat produced by young chicks and fresh bedding is minimal, which makes supplemental gas or electric heating necessary.
4. **Heat is produced by microbial activity in the litter.** The microbes need the right conditions to grow. Generally speaking, less heat will be produced if the litter is too dry or too wet, if there is insufficient oxygen, or if the carbon:nitrogen ratio is not ideal. Microbes are active during the grow-out and also between batches on farms that re-use litter. Growers who re-use litter can take advantage of the heat produced in windrows or while the litter is spread across the floor to start heating the shed floor. Heat will be absorbed into the shed floor and ongoing self-heating of the litter maintains more heat in the litter during the grow-out.
5. **More heat is retained in the shed** if it is well insulated, the insulation isn't damaged, and if the shed is well sealed. Regularly checking insulation and performing static pressure tests will reduce heat loss.
6. **Heat needs to be brought down to the litter surface.** Space heaters are commonly used in poultry sheds for supplemental heating. But these heat the air, which rises to the ceiling, away from the litter. To get the heat into the litter, it must be brought down and blown across the litter surface. This can be achieved with well-adjusted mini-vents, which direct incoming air along the ceiling to the roof apex before circulating it towards the litter, or by using circulation fans (see the picture below and fact sheet *Circulation fans*).

Adding heat to the litter does two things in the drying process:

1. Heating the litter helps turn water from liquid into vapour, so it can be removed by ventilation.
2. Heating the litter and shed floor helps prevent water condensation in the litter.

7. **Litter depth and insulation properties play a part.** Dry litter has good insulating properties. Shallow litter is beneficial if the intention is to use space heaters to heat the litter from the surface-down. The internal insulation of deep litter will prevent the heat going all the way down to the shed floor and the bottom of the litter will cool as the batch progresses. On the other hand, if re-used (or manure rich) litter is being used, and the intention is to allow microbial activity to self-heat the litter, then deeper litter is preferable as more heat will be produced and retained within the litter and transferred into the shed floor by conduction.

Warming the air and reducing relative humidity

As air warms up, it can hold more water so relative humidity will decrease. As a general guide, heating air by 10 °C will reduce the relative humidity by about half. As an example, if the air temperature is 22 °C and the relative humidity is 60%, heating it to 32 °C will reduce the relative humidity to about 30% and the air will be able to absorb more water vapour.

In meat chicken sheds, there are a few ways to keep the relative humidity low, depending on the weather and stage of the batch:

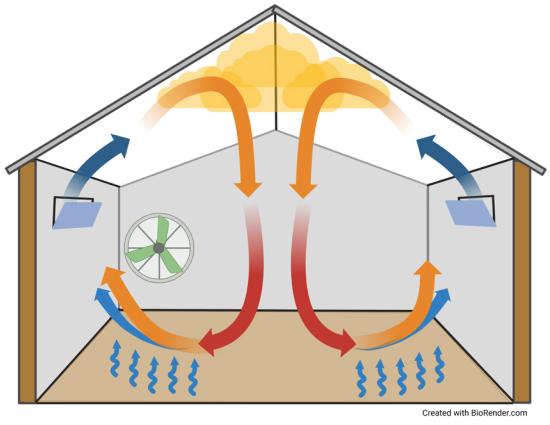
1. Heat the air to reduce relative humidity.
2. Use ventilation to remove water vapour from the shed and bring in fresh, dry air.
3. Minimise use of evaporative cooling.

After the brooding period, the target relative humidity target should be around 50% to 60% to dry the litter. This is a general rule and should not be simply adopted as a trigger level in ventilation controllers that can use relative humidity as a control parameter because it may lead to excessive ventilation, supplemental heating and running costs. Ideally, the relative humidity will be kept low throughout the entire shed. However, to dry litter, the most important place for the relative humidity to be as low as possible is where the air is circulating to be in contact with the litter surface.

The drier and warmer air is, the more water vapour it can hold. Relative humidity describes the amount of water that is in air relative to the maximum amount of water it can hold at a given temperature.

Warming the air to reduce the relative humidity

For most of the grow-out, the relative humidity of incoming air is reduced by correct mini-vent ventilation before the air reaches the litter (see figure below). This is achieved by having properly adjusted mini-vents and correct shed static pressure to project incoming air across the ceiling and into the roof apex before circulating back down to the litter and across the floor. The roof apex stores heat from the chickens or supplemental heaters. This heat warms the incoming air and reduces the relative humidity before it reaches the litter. Water will be removed from the litter as the warm, dry air passes over the litter surface. The downside to using exhaust fans to generate air movement within the shed is that they will also exhaust the heat from the shed. Circulation fans, on the other hand, recycle and retain heat within the shed while they actively bring hot air down from the ceiling, allowing you to use the heat you have paid for.



Ventilate water out of the shed

The relative humidity in the shed will increase as water evaporates from the litter. It is just as important to ventilate this water out of the shed as it is to get it out of the litter. Otherwise the drying rate will slow right down when the relative humidity in the shed increases.

On every day of the batch, minimum ventilation rates should be enough to remove the water from the shed (the amount put into the litter by the birds and spilled from the drinkers). If the water is not removed daily, the relative humidity in the shed will increase. One way to know if enough water is being ventilated out of the shed is to monitor the relative humidity in the shed. Ideally, each shed should have a humidity sensor so that the relative humidity can be monitored throughout the day. If not, a portable humidity sensor can be used. A good time to measure the humidity is in the morning while walking through the shed.

Reduce the use of evaporative cooling

At later stages of the batch, during hot weather, evaporative cooling pads will increase the relative humidity in the shed to 80-90% and this can greatly reduce litter drying. Evaporative cooling is a management tool used to prevent heat stress. Maintaining chicken health and welfare should be given first priority, but if the litter needs to dry and air speed can be used to provide adequate thermal comfort, then use of evaporative cooling should be reduced whenever possible.

Increasing air speed at the litter surface

Ventilation fans and inlet vents work together to create air movement in the shed, but unless the shed is in tunnel ventilation or higher levels of constant mini-vent ventilation, air speed at the litter surface is likely to be minimal and litter drying will be reduced. Low air-speed conditions will tend to occur at the start of the batch and during cold weather because of the reduced need for ventilation.

The evaporation rate is directly related to air speed. The higher the air speed at the litter surface, the more water will be evaporated.

More resources

- Litter playlist on the Chicken Meat RD&E YouTube site https://www.youtube.com/playlist?list=PLxHH9eLA4tnaEroY1TucFldUZL0RMpB_Y
- Poultry411 App – Litter Drying Time Calculator https://www.poultryventilation.com/wp-content/uploads/vol34n13.pdf

  Available on Apple app store and Google Play

Circulation fans

- Using circulation fans to keep litter dry – webinar with Connie Mou https://www.youtube.com/watch?v=oX2AKsZL4Pg

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