Pre-heating and drying litter:

Drying and pre-heating litter before chick placement

Drying and pre-heating litter before chick placement is essential for maintaining chick body temperature during brooding. It is important to dry litter before placement to ensure the success of the batch. Dry litter has many benefits, including warm and dry conditions for the day-old chicks, removal of moisture and ammonia, increased water holding capacity of the litter during brooding and reduced heating costs.

This fact sheet addresses the problems that litter with high moisture content at placement can cause, and the best ways to achieve dry litter before placement.

Why it is necessary to have dry and warm litter before chick placement

Having a cold floor adds stress to chicks. They will spend more time inactive and huddling to keep warm rather than actively eating and growing. If litter has a high moisture content when pre-heating starts, it will need a lot more energy (at great expense) to warm it up and the floor under the litter will stay damp and cool. If the litter has a high moisture content at chick placement, it will make the floor feel cold, increase the risk of the litter and feed going mouldy, and increase ammonia production. All these things can stunt the growth of chickens and make them more susceptible to health problems.

Managing litter moisture during brooding is much easier when the litter and shed floor are pre-warmed and dry. This is because the stored warmth in the floor and litter will accelerate drying and reduce the risk of condensation within the litter. In short, having warm and dry litter throughout brooding will get the chickens off to the best start and allow you to focus on growing chickens rather than litter.

If the litter is high in moisture content at the beginning, it won't be able to be heated and warmed effectively. Therefore, it is important to understand how to dry litter before pre-heating and placement.

Pre-heating and drying litter

When pre-heating the shed, the goal is to achieve warm litter. Warming dry bedding materials is relatively straight forward and can be achieved in one or two days when pre-heating the shed. On the other hand, drying and pre-heating bedding that has a high moisture content is much more challenging and will need combinations of time, heat, air flow, fresh air exchange and physical mixing to get it sufficiently warm and dry before chick placement.

Damp litter will also have reduced insulation capacity and chicks will become cooled as water evaporates from the litter surface due to evaporative cooling. It will require more energy to heat the litter and maintain temperature, which can be costly.

Management guides for modern, commercial meat chickens recommend that poultry houses are pre-heated at the required temperature and stabilised for at least 24 hours before chick placement. Recommended temperatures vary slightly between different breeds, weather conditions and chick size (which varies depending on the breeder flock age), but in general, air and litter temperature should be 30-32 °C (with air relative humidity 60-70%) and the shed floor under the litter should be 28-30 °C.

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. As air warms up it can hold more water, so relative humidity will decrease. On the other hand, as air cools it is less able to hold water, so relative humidity will increase. However, it can only increase until the relative humidity reaches 100%. At this point, the air is holding all the water it can. If the air temperature goes any lower, there will be more water than the air can hold and droplets will form. This temperature, where relative humidity reaches 100%, is known as the 'dew point'.

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Concrete floors

Growers with concrete floors have found it takes longer to heat the concrete than it did with compacted earth floors. It may be beneficial to pre-heat for longer, or at a higher temperature in sheds with concrete floors.

Another experience with concrete floors is that they must be completely dry before spreading bedding. Any moisture will be drawn out of the concrete and into the bottom of the litter when it is spread, which leads to damp rising up through the litter. To reduce this problem, either:

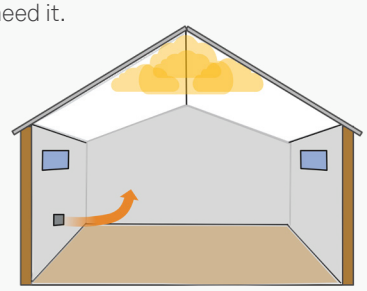
1. ensure the floor is completely dry and warmed before spreading bedding
2. spread the bedding, allow time for it to draw moisture out of the concrete. Then turn the litter, add heat and ventilate to remove water from the litter and out of the shed.

Heat must be added to achieve a litter temperature of 30 °C, however, if the bedding material is wet, more heat may be required to counteract the cooling effect of from water evaporation. For example, if the litter is 15% moisture content (MC), one space heater needs to run about three quarters of the time (three minutes on, one minute off) to counteract the warmth lost from water evaporation. But if the litter is 25% MC, 1.3 heaters need to run constantly, and if the litter is 35% MC then 2 heaters running constantly is required. This explains one reason why damp litter is expensive to keep warm.

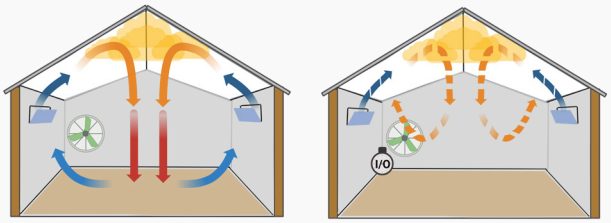
Young chicks add about 2 to 4 L/m² of water onto the floor over the first 4 to 6 days of brooding, so the bedding material needs to be as absorbent as possible. Most bedding materials don't hold as much water as expected. The difference in water content of sawdust at 30% MC and 15% MC is just 2.2 L/m². For pine shavings, the difference is only about 1.2 L/m². For rice hulls it's about 1.7 L/m² and for hardwood sawdust it is 4.0 L/m². With such low water holding capacity it only takes a few days of water accumulation and poor drying conditions for the litter moisture content to increase and the litter to become wet.

Circulation fans bring heat down to the floor

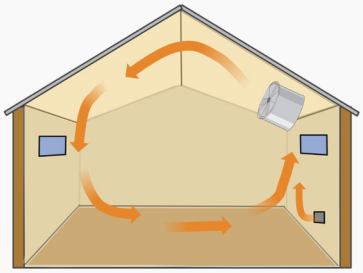
Space heaters are great for heating the air in the shed, but hot air rises to the ceiling rather than staying at the floor where you need it.



During pre-heating, ventilation is often minimised to keep the heat in the shed. But the only driving force to get the hot air down from the ceiling is the air coming in through properly adjusted wall vents when the shed is in negative pressure. When the exhaust fan is running continuously to maintain pressure (below left), this will bring the heat down, but when the duty fans are cycling on and off (below right), the circulating air-flow pattern may not be enough to get the heat down to the floor.



A system of circulation fans in the shed can be designed to bring hot air down from the ceiling to the floor (figure below), where it is needed to heat the floor and litter. Air speed that the circulation fans create at the litter surface will also evaporate more water from the litter. Circulation fans do not exhaust warm air out of the shed, so do not waste heat while moving the air. Exhaust fans still need to cycle on and off to remove moisture and ammonia from the shed and bring in fresh air.



Growers that have installed circulation fans say their heating bills have reduced by 25 to 30%.

Images created with BioRender.com

Management actions

Drying the litter before pre-heating involves evaporating water from the litter. This requires:

- bringing moisture to the litter surface (i.e. repeated litter tilling)
- adding heat to both the litter and air
- increasing air speed
- low relative humidity.

There is no 'perfect' combination. It will depend on the time available, equipment, labour, resources and cost of utilities. Finding the right combination of heat, air speed and tilling to dry the litter comes down to what works best for you and your operation.

Litter will dry quickly when:

- the moisture is at the litter surface, where it can be removed by ventilation. If the litter surface has dried, it is time to till it again.
- heat is added to both the air and the litter. Heating the air lowers the relative humidity, which allows the air to remove and hold more water as it evaporates. Increasing the litter temperature adds energy to the water, which makes it easier for it to turn into water vapour. The warmer it is, the more water will evaporate.
- air movement across the litter increases evaporation of moisture at the litter surface. The more air speed there is, the more water will be removed.
- air has a low relative humidity and can hold more water. Relative humidity can be reduced by heating the air.

More information can be found in fact sheets *Introduction to drying litter* and *The elements of drying litter.*

Avoiding condensation in the litter

When the floor and litter are cooler than the air temperature, condensation may occur if they cool the surrounding air below the dew point. Condensation that forms in the litter can contribute to moisture problems. This is more likely to be a problem during brooding when air temperature and relative humidity are higher.

To avoid condensation in the litter:

- pre-heat the shed floor
- use dry, pre-heated bedding
- measure litter and shed floor temperatures
- measure air temperature and relative humidity
- seal leaks to prevent cold drafts.

Heating the litter to avoid condensation

The higher the relative humidity (RH) in the shed, the warmer the litter must be to avoid moisture in the air from condensing on the litter surface. Having the recommended RH for the chicks (60 to 70%) at the start of brooding means the floor temperature must be within a few degrees of the shed air temperature.

- If the RH in the shed is 60%, condensation is unlikely if the litter is within 9 °C of the air temperature.
- If the RH in the shed is 70%, the litter needs to be within 6.5 °C of the air temperature to avoid condensation.
- If the RH in the shed is 80%, which is above recommendations for brooding, condensation will form in the litter if it is 4 °C colder than the air temperature.

Bedding materials contain moisture, which develops humidity within the litter that tends to be higher than the relative humidity in the shed.

Litter moisture content	Relative humidity within the litter
10% (crispy dry)	60-72%
15% (dusty dry)	85-92%
20% (dry)	93-98%
25% (somewhat dry)	97-99%
30% (looks and feels damp)	99-100%

When relative humidity within the litter is high, condensation will form more easily, depending on how moist the bedding materials are.

Litter moisture content	Difference between litter and floor temperature when condensation forms
10% (crispy dry)	Floor is 6–9 °C cooler than litter
15% (dusty dry)	Floor is 1.5–3 °C cooler than litter
20% (dry)	Floor is 0.4–1.4 °C cooler than litter
25% (somewhat dry)	Floor is 0.2–0.6 °C cooler than litter
30% (looks and feels damp)	Condensation always occurs

With the range of condensation temperatures shown above, the lower value is for rice hulls and the larger value is for wood products and peanut hulls (data for straw is not currently available). Rice hulls have higher humidity for the same moisture content, which means condensation will occur more easily and at a warmer temperature.

Ammonia

Some ammonia may be trapped in the shed floor (especially dirt floors) or in stockpiled litter that will be re-used for the next batch. Ammonia is water soluble, so any management actions that evaporate water from the floor may release some ammonia into the shed.

Ammonia concentration should be monitored during pre-heating, especially when there are workers in the shed and in the lead up to chick placement. If the ammonia concentration is above 15 to 20 ppm, increase ventilation to remove it.

It is better to ventilate the ammonia out of the shed during pre-heating rather than needing to increase ventilation to control ammonia concentration after the chicks are placed.

Poultry411 - Litter Drying Time Calculator

The Litter Drying Time Calculator in the Poultry 411 App (available from the App Store and Google Play) has been developed to provide a relatively simple way of exploring how the various environmental factors affect litter moisture removal rates during preheating. The calculator can be used to estimate litter drying times before chick placement or for when the birds are older, providing an opportunity to better understanding how management of shed air temperature, humidity and air movement can help keep litter dry and for optimal bird health and productivity.

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More resources

- Poultry411 App – Litter Drying Time Calculator
  https://www.poultryventilation.com/resources/poultry411-app-litter-drying-time-calculator/
- Litter playlist on the Chicken Meat RD&E YouTube site has videos and webinar recordings.
  https://www.youtube.com/playlist?list=PLxHH9eLA4tnaEroY1TucFldUZL0RMpB_Y