



Poultry Litter Management: Keeping Litter Dry

Litter condition is one of those areas in raising poultry that is often overlooked in preparation of the pen for growing birds. The ability of a litter material to absorb and release moisture is the key property in maintaining an optimum pen environment. Litter material like softwood shavings is ideal for this use.

Increased moisture levels in the litter material will be problematic to the poultry flock. Litter moisture should be in the range of 30-70% moisture. When the litter is too dry (<30%), dust conditions may persist in the pen as birds move about. In active flocks this can be a problem of introducing microorganisms into the air that the birds breathe. This will overload the birds' respiratory and digestive system with pathogens.

On the other hand, the litter material should not exceed 70% moisture in the poultry pen. High litter moisture provides an ideal environment for microorganisms to grow and multiply, increasing the possibility of pathogen exposure to the birds. High moisture also decreases the bird comfort in their environment as they seek comfortable dry bedding areas. Higher moisture means higher ammonia production and that can lead to problems with bird health as increased intake of ammonia will increase stress on the birds. High ammonia levels can affect the bird physically as well in their upper respiratory tract, eye lesions from ammonia burn and the possibility of carcass quality being compromised as birds succumb to ammonia burn on exposed skin as they lay on the ammonia producing manure/litter mix. The stress from increased levels of ammonia exposure decreases the bird's ability to handle other infectious agents. Ammonia burn on affected bird carcasses will lead to increased trim as birds are processed.

How does pen moisture level increase?

1./ **Birds dissipate moisture from their bodies through breathing and fecal discharge.** As water consumption increases as the bird grows, and due to higher temperatures or diet salt levels, water expulsion will increase. Birds use breathing as a way to cool their bodies, so expulsion of moisture in warmer weather through breathing is essential for bird health and maintenance of body temperatures. Birds don't sweat - they use increased consumption of cool water to keep their body temperature in check. Water consumption will almost double in hot weather. Bird water consumption is shown in Table 1 - Poultry Moisture Production. The difference in water pen temperature has a marked effect on water consumption. As water consumption rises, the bird drinks more to help maintain body temperature and expels more moisture into the litter. This increased moisture then needs to be removed from the pen by increased ventilation rates.

Table 1: Poultry Water Consumption Affected by Pen Temperature (Leeson & Summers, 2005)			
Poultry	Age	@ 20 C	@ 32 C
Pullet (Egg)	4 wk	50	75
	12 wk	115	180
	18 wk	140	200
Layer	50% production	150	250
	90% production	180	300
Broiler Breeder	50% production	180	300
Broiler Breeder	90% production	210	360
Broiler	1 wk	24	40
	3 wk	100	190
	6 wk	240	500
	9 wk	300	600
Turkey	1 wk	24	50
	4 wk	110	200
	12 wk	320	600

To remove the moisture that birds are depositing in the pen environment and to maintain a proper litter moisture level, a minimum ventilation rate needs to be maintained. That rate is 1 cfm/lb or 3.8 m³/hr/kg. This minimum ventilation rate will also remove excess gases produced by the bird and litter and refresh the pen with outside air.

Example: 10,000 week old chicks at .115 kg (.25 lb)
= 1150kg (2500 lb)
Requires 4370 m³/hr (2500 cfm) of air exchange/exhaust.

2./ **Litter will contain some moisture.** High initial litter moisture can be problematic if the moisture level is not quickly reduced. Early exposure of chicks to a moisture-laden litter will decrease the chick's ability to find that comfort zone and may cause them to put off drinking and eating as they seek warmth. Litter should have some moisture as it is beneficial to chicks when they are placed, to reduce dehydrating potentials from their floor environment. In-floor heat can increase this kind of effect as very little litter is used with this type of heating system making the pen environment at chick level quite dry.

With conventional heating systems, a layer of litter material 2-4 inches is used. With 2-storey (+) barns, the bottom floor usually gets an extra inch to add to the insulation affect from the cooler cement floor. The second floor or others are warmer due to the heat from the pens below and can get away with less litter material. This layer of litter helps absorb moisture introduced to the pen, thus maintaining a comfortable environment for the young birds. It is also made of a material like softwood shavings that easily absorbs moisture but also easily dissipates it into the pen air as air moves across it. Moisture is also added to the pen through the feed, as it normally contains about 10% moisture. This moisture level is not considered problematic in increasing pen moisture level but must be considered when moisture levels increase.

3/ **Waterlines can introduce excess moisture into the pen through:**

a. **Leaks.**

Leaks in the water line may be due to improper pipe and nipple drinker connections, leaking drinkers due to build up around nipple drinker parts not allowing a complete seal and low pressure not forcing a tight seal with drinker parts. Build up around drinker parts and in the water line of slime and material can be overcome through regular flushing of the water line system. Usually, this is done between flocks but in some flocks like layers/breeders or in barns with water source problems; this should be done on a regular schedule. Between flocks, use a citric acid water solution to fill the water system and let set 24-48 hours. Open the end of the water line and allow water to flow and flush out the system. For barns with continuing problems there are 2 ways to cover the problem:

- i. Run a line sanitizer (ex. low concentration of citric acid) continually throughout the flock, or/and;
- ii. Open end of line and flush through on regular schedule

**If you are not sure if there is a build-up of material, an easy check is to test chlorine levels of the water at the pump or entry end of the pen and at the far end of the water line. As chlorine is taken up by the in-line build-up of material, a difference in chlorine levels will indicate if there is a build-up problem.

b. **Improper drinker height and water pressure.**

Both will show a lack of water equipment management and will lead to abnormal bird drinking behavior. Poor line height adjustment will cause abnormal bird drinking behavior as they adjust to drinker height. Too high and too low a level will end up causing the birds to spill water as they drink. Nipple drinkers need to be at eye height the first few days to allow the chicks to get a good start. They are then adjusted so that they are at a 45 degree angle for birds to drink properly. The drinkers need to be adjusted daily as birds grow. When water lines are uneven, there could be air pockets in higher parts of the line leading to the overuse of lower drinker areas of the water line. Water pressure should also be adjusted upwards so water delivery is adequate for the growing bird.

c. **Cold water lines provide a surface for air moisture to condensate.**

This condensation then drips and is deposited into the litter under the drinker lines. As the temperature difference between the cold water line and warm air is reached (dew point), air moisture condensates on the water line pipe. The first part of the line where the cold water from the well enters the pen is usually worse for this. In times of increased water consumption, this phenomenon may extend further down the line. High humidity in the pen will aggravate this more. To overcome this, water needs to be warmed before entry into the warmer for a more humid poultry pen. This can be accomplished by heating the water in the pipe to a level where the dew point difference of the pipe and air is not reached. Running water through a water heater, solar panel, roll of pipe by a warm furnace, etc., are ways of overcoming temperature differences. The reduction in the amount of moisture added to the litter by taking these precautions can be dramatic.

4./ The facility itself may be adding moisture to the pen.

Barns with little or no grade around them impede water drainage away from the barn. Instead, when it rains the water runs into the building, not away. Some barns with end clean-out doors are not properly graded away from the building and allow water to run in the big door openings adding huge amounts of moisture to the litter in that area of the bottom floor pen. When snow banks accumulate around the exterior of some poultry barns, the barn may end up having water run right into the building, as it has nowhere else to drain or run to.

Poor building maintenance with leaky roofs or openings where rain/water can enter add moisture to the poultry pen litter. This type of problem can only be overcome by getting proper grade around the poultry facility and drainage away from the poultry barn.

5./ One of the bi-products of propane heaters is moisture.

If the propane heater is not vented to the outside, moisture will be added to the pen. Though the level of moisture shouldn't be problematic, if it is in conjunction with other moisture problems, litter moisture problems will be aggravated.

6./ The air brought in from outside as the ventilation system moves air through the pen contains moisture.

The moisture level of outside air varies throughout the year. In warmer weather the air moisture carrying capacity increases. Therefore, when warm air is being drawn through the barn, it has less ability to pick up pen moisture for exhaust. Therefore, with warm outside air, larger volumes of air are moved through the pen to compensate for this lesser capacity.

The moisture holding capacity of cold outside air is much lower meaning that the moisture level of cold air being pulled into the barn is low. Due to this lower moisture, bringing cold dry air into the pen and warming it as it mixes with warm pen air increases its moisture holding capacity. This air then picks up moisture as it moves through the pen and is exhausted. Using this drier air in the colder months with its increased ability to pick up pen moisture is the basics of cold weather ventilation.

7./ Improperly set minimum ventilation levels can aggravate litter moisture problems.

The gradual increase in minimum ventilation rate should follow bird size increases. In most ventilation systems, there are a number of stages or series of fans that are turned on as pen temperature increases. A norm would be the first and second stage fans being used for minimum or cold weather ventilation.

Some ventilation systems do not allow a gradual increase in ventilation rate until the minimum ventilation fan maximum capacity is reached. Going through the first stage using variable speed fans, the increase can follow the gradual body weight increase of the birds. This gradual increase seems ideal but reality may be that Stage 1 fans have to run at a set rate to ensure the propane heater is vented properly when the heater is running.

In the transition to Stage 2 fans, the jump in ventilation rate can be dramatic if the Stage 2 fans are not variable speed or if their minimum ventilation rate is high. The pen can be cooled off very quickly as air speed picks up and the air inlets open wider to allow more air to flow. Since fans, air inlets and heaters don't start and stop on a dime, this type of big jump in ventilation rate/air flow means an up and down pattern in pen temperature. This variability will add stress to the flock leading to decreases in daily growth performance. Too much cold air being introduced into the pen, as well as at the wrong speed, will decrease the potential of pen air picking up moisture. The temperature of the litter will decrease and the litter moisture level will gradually increase as the litters' ability to release moisture is impeded.

Using heat to warm the pen up in this situation can help dry the pen, but will be at a substantial increase in energy costs. It is better to have all variable speed minimum ventilation fans so the ventilation rate can be increased gradually and litter moisture can be kept at a minimum.

Table 2: Minimum Poultry Ventilation gives an example of the gradual minimum ventilation rate increases as the broiler chicken grows.

Table 2: Minimum Poultry Ventilation: 10,000 Birds/Pen: Based on Ventilation Rate of 1.1 cfm/kg (.5 cfm/lb)				
Day	Body Weight	Required CFM	1st stage Fan Capacity 2 x4000 CFM= 8000cfm Ventilation Rate %	2nd Stage Fan Capacity 3 x 4500CFM =13500cfm Ventilation Rate %
0	.042	462	6	
4	.105	1155	14	
8	.209	2298	28	
12	.358	3938	49	
16	.560	6160	77	
20	.812	8932	100	7
24	1.100	12100		30
28	1.419	15609		56
32	1.757	19327		84
36	2.107	23177		100
40	2.463	27093	Temp. Control: 3rd, 4th, 5th + Stages	
42	2.642	29062		



Only an effective approach to prevention of moisture build-up in pen litter, proper maintenance, drinker line management and proper ventilation settings will ensure litter moisture levels are kept acceptable.

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