W 1135

BROILER LITTER MANAGEMENT

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The U.S. is among the world's largest poultry-producing countries. Two major products include meat from broiler and turkey production and table eggs from commercial layer operations. The combined value of these two products exceeded 35 billion dollars in 2020 (USDA-NASS, 2020). Poultry production provides an affordable and important source of protein consumed in the U.S and a livelihood for 1 million citizens. Approximately 18 percent of U.S. poultry products are exported. In Tennessee, broiler production is the most important poultry sector.

The poultry industry is now facing numerous challenges including the impact of infectious diseases and a growing demand for higher welfare standards. To reduce the susceptibility of chickens to infectious disease, the poultry production environment (particularly the litter) plays a critical role in fostering immune system and overall flock health. The efficiency of poultry production as well as animal welfare is greatly affected by the conditions inside the poultry house. One crucial factor which directly affects poultry performance and welfare is litter management. Some of the important factors in litter management include moisture control, ammonia control, litter depth and type of bedding. Maintaining a good quality litter is a management challenge for poultry producers particularly because "No Antibiotics Ever" (NAE) programs are now widely used by integrators.

CONCERNS WHEN USING BUILT-UP LITTER

Reusing poultry litter is a very common and cost-effective litter management technique used by broiler producers; however, reusing litter over multiple flocks may cause issues if the litter is not managed appropriately. For instance, reusing litter means that challenges for the previous flock, such as high ammonia volatilization rates, disease pressure and high moisture content, can be carried forward to the next flock. In particular, maintaining good air quality in the presence of built-up litter can be a management challenge.

The high price and decreasing availability of quality bedding materials add to the challenge of managing built-up litter. Pine shavings are an ideal bedding material, but competing markets for this product are driving the price up and making it difficult for poultry producers to afford to use it. Therefore, the industry is looking toward some alternative bedding materials such as miscanthus grass. Another possible alternative bedding material in the future could be hemp bedding. Hemp can absorb four times its weight because of its natural folding structure, and it displays high rates of both moisture adsorption (7.43 mg/min) and moisture release (12.5 mg/min); however, hemp is more expensive than pine shavings and lacks data, making it hard for producers to currently utilize this alternative.

Pathogen build up is another concern when using built-up litter. Typically, the optimal conditions for chickens to grow in a poultry house are the same optimal conditions for the growth of pathogens. Thus, poor built-up litter management can lead to the overgrowth of pathogens. Producers must work to keep pathogen numbers below a disease pressure threshold that the flock can tolerate.

MOISTURE CONTENT

Moisture is a key factor influencing litter quality in broiler houses. Litter moisture is affected by multiple factors including the broiler house environment (temperature, ventilation rate and humidity) and litter properties (bedding material, new vs. built-up litter, litter depth and moisture content). Poor litter moisture control can cause severe footpad dermatitis (Figure 1) (Shepherd and Fairchild, 2010), which affects the performance and animal welfare of chickens. Previous studies recommend an upper threshold of 25 percent moisture litter moisture (Fairchild and Czarick, 2011). Levels higher

than 25 percent also increase the ammonia concentration in poultry houses, which can affect bird health and welfare. Maintaining litter moisture concentrations below 25 percent is not always possible especially during wither weather.

Determining exactly how much moisture is in broiler litter requires some laboratory assistance. Litter samples are collected from various locations in the poultry house, and a composite sample is sent to the lab for analysis. There, they first weigh the poultry litter as is. Then, the litter goes through a drying process, typically 24 hours. After the drying process, the poultry litter is weighed again, and the weight reduction is going to be the water content loss. From that, they can calculate the litter moisture content.

An alternative way to assess litter moisture is a rule of thumb described by Michael Czarick (Czarick, 2007) that performed by squeezing handful of litter firmly:

- If the litter stays in a ball, it is too wet.
- If the litter sticks together slightly, the moisture content is acceptable.
- If the litter does not stick together at all, it is too dry.

Growers should check the moisture content regularly. By reusing the poultry litter from the previous flock to the next flock, the moisture content in the litter will be added to daily by the birds through respiration and manure deposition. To compensate for this increase in moisture, ventilation rates must be properly maintained, especially during winter.

"NO ANTIBIOTICS EVER" PRODUCTION

No Antibiotics Ever (NAE) production requires much better management (Tabler et al., 2019); however, NAE often shows that used litter may be more beneficial with NAE production. On one hand, reusing poultry litter may increase disease challenges. On the other, if producers properly manage reused litter, it will build up good microbiota which can be beneficial to our birds (Cressman et al., 2010). NAE production means your chickens do not have a protective shield from antibiotics anymore; therefore, litter management is critical. You do not want your litter to build up pathogens because your chickens are now more susceptible to infectious diseases.

Disease control and proper mortality management are two of the important management factors that producers should emphasize for NAE flocks. There has been a steep learning curve associated with removing antibiotics from poultry production. We now know that NAE production requires (Tabler et al., 2019):

- Optimum stocking density
- Good litter management
- Ideal housing environment
- Quality pre-starter feed
- Good water quality and a sound water sanitation program

WINTERTIME LITTER MANAGEMENT

Winter litter management is discussed in detail in Litter Management (Tabler et al., 2022). Some challenges in winter months are cold outside air, a brood chamber at 90-92 F for baby chicks, minimum air flow rates that make a uniform temperature distribution difficult to achieve and expensive propane that producers must burn to keep their flocks warm.

During wintertime, producers must balance between the expense of heat loss and ventilation to remove ammonia and moisture. Failure to balance heat loss and ventilation properly could mean:

- High NH_3 concentrations
- Increased pathogen growth/disease challenge
- High litter moisture concentrations

Moisture is the key factor influencing litter quality during winter. There are two major sources where this moisture comes from: The first one is the birds. Birds consume approximately two pounds of water for each pound of feed consumed.

Eighty percent of this water is added back to the house environment in the form of manure and respiration. Second is the brooders. For each gallon of propane burned, 6.8 pounds (0.8 gallons) of water is produced. Producers must control this moisture with ventilation, and the amount of ventilation needed will vary continuously. The ventilation rate needs are necessary to ideally keep ammonia at less than 25 ppm and maintain relative humidity in the 50-70 percent range (Tabler et al., 2020).

PATHOGEN CONTROL

During wintertime, litter pathogen concentrations tend to increase when ammonia and moisture control is poor. To address this problem, some common methods are:

- Pasteurization — uses heat to kill microbial disease organisms
- Composting — well-known and commonly used method
- Windrowing — reliable and cost-effective way to reduce pathogen load
    - It is not true composting because composting takes a longer time
    - Heat buildup in windrows can kill the majority of pathogens.

Windrowing (Barker et al., 2013) is an attractive litter management practice that is a reliable and cost-effective way to reduce the pathogen load in built-up litter. It is not true composting because the windrows are in place for only a short time between grow outs, but when done correctly heat buildup in the windrows will kill many microbial pathogens.

Windrowing can be challenging to manage (Figure 2) (Hawkins et al., 2010). For instance, litter moisture must be adequate (25-30 percent), or the windrow will not heat properly. If the windrow doesn't heat, the windrowing process has done little good, and time and diesel fuel are wasted. There also must be enough downtime between flocks to windrow properly.

Given enough time to do it correctly, and with the right moisture content for the windrow to heat to around 130-140 F, many of the pathogens in the litter can be killed. Depending on the litter moisture content, it may be necessary to leave the caked litter in place to have enough moisture to make the windrow heat. Consult your service technician about leaving or removing the caked litter before windrowing. The initial windrow should be built within two days following flock departure and allowed to remain windrowed for three days. Then, turn the first windrow and create a second windrow that will similarly remain in place for three days. After three days, level the second windrow. Allow the litter 3-4 days to dry and cool after the windrows have been re-spread before applying a litter amendment. Otherwise, the amount of ammonia emitted by the litter can rapidly overwhelm the litter amendment, rendering it ineffective. Litter over 6 inches deep is difficult to windrow because of the amount of material in the house. Windrowing works best at litter depths of 3-6 inches.

LITTER TREATMENTS

There must also be enough downtime between flocks to windrow properly. Less than 10 days is not long enough to properly windrow litter. Especially after applying windrowing, it is important to use litter treatments to manage ammonia levels. Some litter amendments can also reduce pathogen loads built up in used litter. However, some amendments can increase the nitrogen (N) content in the litter, and the conversion of nitrogen (N) compounds in manure to NH3 is a source of environmental concern. Ammonia is a serious animal welfare and economic threat to the poultry industry and must be managed as such. Most litter treatments are acidifiers, and growers should follow manufacturers' recommendations, guidelines and precautions for their safe use and handling. Commonly available litter treatments include:

- PLT (sodium bisulfate)
- Alum (aluminum sulfate)
- Poultry Guard (claylike particles soaked in sulfuric acid)
- Klasp (iron sulfate)
- Liquid A7 (sulfuric acid and aluminum sulfate)

INDOOR PARAMETER ASSESSMENT

Ammonia, humidity, temperature and carbon dioxide are the critical influencing factors of poultry production and animal welfare. To properly assess these parameters, producers must acquire measurement devices such as humidity and ammonia sensors. In some cases, when growers are exposed to ammonia over a long period of time, they may not be as sensitive to noticing high levels of ammonia inside the house as others. However, these measurement devices are always considered support tools, they do not replace the role of producers in properly managing poultry farms. Nothing can work better than the human senses. Previous authors (Tabler et al., 2022) promote the "5-gallon bucket" method as the best way to assess the indoor environment of the poultry house. Basically, you find a 5-gallon bucket and sit down in the poultry house. Watch the birds. See how they respond to ideal conditions. Learn how they behave when they are too hot, too cold, etc. They can tell you what's wrong if you learn how to recognize what they are telling you. You can only learn these things by being in the chicken house. The house controller cannot grow the chickens for you. The controller can assist you, but you must grow the chickens. And the only way to do that successfully is for you to be in the chicken house.

SUMMARY

There are two take-home messages that you should always keep in mind:

- Litter moisture and ammonia control are critical to maintaining productivity and bird welfare.
- No Antibiotics Ever production has made litter management a much more critical issue.

Trade names are for educational purposes only and do not imply endorsement by the UT Institute of Agriculture or the University of Tennessee Department of Animal Science.

Fig. 1. *Footpad dermatitis caused by wet litter.*

Fig. 2. *Windrowing litter in poultry houses.*

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