Windrow Composting Broiler Litter Between Flocks

Windrow composting broiler litter between flocks has become an accepted and increasingly popular method for reducing the microbial loads in broiler houses. Integrators and growers have discovered that windrowing litter can improve bird performance and reduce likelihood of disease spread when a total cleanout is not undertaken. In many broiler complexes today, a total cleanout may occur only every several years. Windrowing allows the natural metabolism of bacteria present in the litter to cause a partial composting process to take place and, under the right conditions, generates enough heat within the windrow to destroy many pathogenic bacteria and other microorganisms. This results in well-conditioned litter for the next flock with a decreased microbial load.

Litter Management

Bacteria and other microorganisms have always been a part of poultry production. Even with the best efforts of growers and integrators, it is impossible to totally sterilize the poultry house environment. However, by properly managing litter moisture, ammonia, and pH, growers can maintain acceptable bacterial levels that help reduce disease challenges and maintain bird performance.

A variety of microorganisms, including *Salmonella*, *Escherichia coli*, *Clostridium*, *Campylobacter*, *Staphylococcus aureus*, and others, are pathogenic to humans and also to poultry, causing serious infections that can lead to death (Lavergne et al., 2006). However, poultry litter, with its high pH and high ammonia concentrations, is a harsh environment that can help control many microorganisms. Unfortunately, *Salmonella* and *Clostridium* can survive in poultry litter, making litter management more challenging.

Even though the bacterial makeup and population in a broiler house is quite dynamic, given time the litter begins to stabilize and develops predictable patterns unique to a grower's management style, housing design, internal environment, and the birds themselves (Hess et al., 2007). **Bacteria in litter can be classified as either spore formers or non-spore formers.** Non-spore-forming bacteria (*Escherichia coli, Staphylococcus*, etc.) increase with the presence of birds in the house and increasing amounts of fecal matter. Spore-forming bacteria such as *Clostridium perfringens*, the causative agent for necrotic enteritis and gangrenous dermatitis, tend to increase with time as litter ages and number of flocks increase.

Spore formers are difficult to destroy because they have the capability, when environmental conditions worsen, to form a metabolically inactive body (called a spore). Spores are able to withstand harsh environmental conditions that kill many bacteria. Macklin et al. (2007) reported that the rapid temperature change of the litter with windrow composting may catch *Clostridium* unprepared to form a spore, resulting in decreased populations of spore-forming *Clostridium*.

Keep in mind that windrow composting will not reduce the amount of litter that accumulates in the house. The small amount of time litter is actually spent "composting" in a windrow is not long enough to degrade or reduce any appreciable amount of litter. When litter levels get too deep, growers will still have to remove some of the litter from the house. However, by leaving litter in the house for extended periods, growers are better able to choose the ideal time to remove excess litter based on agronomic or economic considerations.

Litter Moisture Concerns

Growers often wonder about how litter moisture levels affect the heating process and how higher litter temperatures affect the potential for ammonia volatilization. Two frequently asked questions concerning management options immediately before windrowing are 1) whether or not to decake and 2) whether or not to add additional water to the litter (Liang et al., 2013). It is a common belief that incorporating caked litter helps retain moisture, allowing the windrow to heat properly and avoiding the extra fuel and labor associated with decaking. However, some operations require cake removal before windrowing.

Liang et al. (2013) added 900 gallons of water to one windrowed house and no additional water to another. With 900 gallons of added water, moisture content was expected to increase by 3.5 percent after two flocks on the same litter, but only by about 2 percent after five flocks. A **significant decrease in litter moisture content occurred after 7 to 13 days** of windrowing, although moisture content of the windrowed litter with water addition was slightly higher than that without water addition. However, windrows with water addition had higher temperatures and stayed hotter longer.

Water soluble phosphorus increased in both the windrowed and non-windrowed litter (Liang et al., 2013).

This indicated that an appreciable degree of biotic (living factors—bacteria, fungi, and viruses) and abiotic (non-living factors—temperature, ammonia, season, etc.) activity occurred in the litter with both treatments after flocks were removed. Overall, there were no negative impacts of windrow treatments on litter quality (Liang et al., 2013). However, high ammonia emissions persisted for several days after windrows were spread back out. **Without a litter amendment, at least 4 days** were necessary to purge ammonia with proper ventilation before chick placement. In this situation, using a litter amendment is a better choice than running the fans more often during cold weather without a litter amendment.

Paw Quality

It may seem hard to believe, but broiler feet, or **"paws," are now the third most profitable part of the chicken**. Only the breasts and wings are more valuable. The paw is the portion of the leg below the spur. Litter conditions have a large impact on paw quality. Controlling paw quality has become an important issue because of the potential profit associated with the overseas paw market and because paw quality is now one of the variables used in animal welfare programs. Many cases of footpad dermatitis are the result of poor litter conditions. Footpad dermatitis is inflammation and ulcers on the footpad and toes of broilers, which cause paws to be downgraded or condemned during processing. It appears increasingly evident that footpad dermatitis can begin the first week, based on litter quality. Therefore, **it is critical that the litter stay dry!**

Litter that has been properly windrowed will be drier than non-windrowed litter and have a decreased bacterial load. This is important, especially for young chicks, when the feet are tender and wet litter and ammonia can cause cracked skin and ammonia burns. The result can be serious paw damage that may linger and worsen throughout the flock. Early paw damage can lead to product downgrades, food safety issues (lesions can serve as entry points for bacteria and other microorganisms), and animal welfare concerns. Bird performance may also be affected if foot pain prevents birds from feeding and drinking properly. The percentage of birds with paw quality issues may also be seen as a reflection of a grower's concern for animal welfare and the well-being of the birds in that grower's care. Paw quality scores can affect pass/fail on animal welfare audits, which are now common practice in the poultry industry.

Several possible causes of footpad dermatitis have been identified:

- Litter—type, quality, and quantity
- Drinker design and management
- House humidity
- Ventilation program
- Diet composition
- Gut health

Of these, litter is likely the most important factor. From chick placement to harvest, footpads are in **constant contact with the litter surface.** Wet litter (greater than 30 percent moisture) is often associated with the occurrence and severity of footpad dermatitis. Still, there are **exceptions that defy explanation**. There are occasions at the processing plant when birds on good-quality litter have poor paw quality and birds on poor litter have good-quality paws. In addition, the location of birds in the house can make a difference in paw quality, especially during the summer. More damp, caked litter and slow air speeds in the cool cell end leads to more paw quality problems in that end compared to the fan end where the litter is usually drier. Proper windrowing may result in litter that starts out in excellent condition, but it takes good management throughout the flock to maintain litter quality.

Figure 1. Build the windrow and leave at least 3 days before turning.

Figure 2. Make sure the litter is level for baby chicks.

Season can also play a role in litter quality. Ventilation to remove excess moisture is important to keeping dry floors. Plenty of ventilation during the summer is usually not a problem. However, adequate ventilation during the winter becomes a challenge due to high fuel prices. Growers may choose to conserve heat by sacrificing ventilation, which increases the likelihood of wet litter. Winter is always a critical period for footpad dermatitis, and often we see an increased incidence in winter.

Other Issues

There are a host of other important factors to keep in mind when considering windrow composting:

- Downtime between flocks
- Number and dimensions of windrows to build
- Tractor time required
- Turning and leveling litter before chick placement
- Litter depth
- Insecticide application (must be timely)
- Ventilation schedule (should have continuous ammonia removal)

A minimum of 12 to 14 days is required if windrow turning is included. Turning is important to ensure that all the litter is adequately heated. If decaking before windrowing, do it as soon as possible after flock removal. Build the first windrow(s) as soon as possible after the flock is removed, and leave them in place at least 3 days (**Figure 1**). Turn the first windrow(s) after 3 days and leave in place for an additional 3 days. **Spread litter back out and level at least 4 days** before chick placement. Make sure the litter is level (**Figure 2**). Baby chicks are not good at navigating the hills and valleys of uneven litter. The number of windrows will depend on litter depth and the equipment used. Windrow height should be at least 18 inches but no more than 4 feet, and windrow(s) should run the length of the house. Windrow width can vary and isn't that critical as long as height and length are correct.

Windrowing does take some tractor time and is dependent on grower expertise and the equipment used. If you use a contractor or share equipment with a neighbor, make sure all equipment is clean before coming on the farm. If you do it yourself, allow 1 to 4 hours to build the first windrow(s), depending on your expertise. Turning may require the same or less time as initial construction. Leveling generally requires more time than windrowing because the surface has to be smooth and flat for baby chicks. Be sure to **incorporate the hardpan** into the windrow, but do not dig into the dirt floor. Pull ALL the litter into the windrow (**Figure 3**). Do not leave a 6- or 8-inch strip along the side walls untouched.

If the litter is too deep, remove excess litter either before or after windrowing but before the litter is leveled for the final time. Check with your service tech or broiler manager on the proper depth. In most cases, 3 to 6 inches of litter works best for optimal bird performance. Fewer than 3 inches is not enough (birds will dig down to the pad), and more than 6 inches makes it more difficult to manage. The windrow will begin to heat shortly after construction. The heating process will quickly drive litter beetles to the top of the windrow (**Figure 4**). Therefore, make plans to **apply insecticides within 24 hours** of windrow construction. Spray the windrow(s) and the exposed footers for maximum effect.

Ventilation should be continuous from flock harvest until preheating for the next flock. End doors should remain closed (unless you are working with heavy equipment in the houses) for biosecurity purposes. Curtains can be dropped on curtain-sided houses, while solid sidewall houses should run either one 48-inch or two 36-inch fans to remove ammonia on a continuous basis. After litter is leveled, consider using a litter amendment to help control ammonia in the days just before and immediately after chick placement.

Figure 3. Pull all the litter away from the footing and into the windrow.

Figure 4. Windrow heating will drive litter beetles to the top of the windrow.

Summary

Due to the increasing difficulty and cost associated with obtaining quality poultry bedding materials, it is now common practice for broiler growers to grow multiple flocks over perhaps multiple years on built-up litter. This presents challenges in terms of an increase in litter moisture, ammonia production, and bacteria numbers. Windrow composting built-up litter in-house, when done correctly, can offset some of these challenges. The technique takes advantage of heat produced by microorganisms during organic matter degradation to help dry the litter and kill many bacteria that are present.

Windrowing litter is a process that requires at least 12 to 14 days of downtime. It includes building, turning, and leveling windrow(s) based on a specific time frame. Number of windrows and windrow height are important and are determined by litter depth. A litter depth of 3 to 6 inches usually works best. Strategic timing of insecticide application is necessary for maximum beetle kill. Ventilation should be continuous from harvest to preheating. Windrows should be leveled at least 4 days before placement in order to allow litter to cool down and further dry out. In most cases, paw quality can be improved if the litter can be kept relatively dry throughout the flock. **Windrow composting is a cost-effective method of litter management and disease control** that can improve litter quality and extend the life of built-up litter.

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