

MANAGING BUILT-UP LITTER

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Introduction

“As the litter goes, so goes the flock!” This saying has a lot of truth as it relates to managing litter and the subsequent effect it has on air quality. For the most part, litter management often has more to do with managing the systems that influence litter quality rather than managing the litter *per se*. Litter conditions are often a reflection of how well one has done in managing these systems.

The key areas where growers can have an influence on managing built-up litter include; managing for proper litter moisture and litter temperature; and reducing disease challenge and stress from ammonia. In managing our systems, we often have a good understanding of *what* needs to be done and each company has general recommendations on *how* it is to be accomplished. However, we sometimes fail to explain to growers *why* our recommendations are so important. A grower may be more likely to change their practices if they have a solid understanding of why it is important and the potential impact it may have on their profitability. Hopefully, the following information will aid in a better understanding of some key management concepts with built up litter.

The frequency of total cleanout of broiler houses in the U.S. has steadily decreased over the years. Due to high bedding and cleanout costs, limited bedding supplies, short layouts, nutrient management issues, greater use of litter amendments, and/or low industry profitability, total cleanouts in many areas of the U.S. have gone from once per year to every two or more years. To remain competitive on a built-up litter program one must fine-tune the management of their litter. This is further compounded by the fact modern broilers are less tolerant to stress and adverse environmental conditions. With a narrowing of production cost between “good” and “poor” growers, one must seek every opportunity in managing litter and air quality to remain competitive. During the past few years on Delmarva we have seen the following events that have had a detrimental influence on litter quality; wet and/or very cold winters, high fuel cost, limited bedding supplies, short layouts between flocks, and extended reuse of litter.

Litter Moisture

Dry, dusty litter may contribute to increase chick dehydration, respiratory disease, and condemnations. However, wet litter is generally recognized as having a much greater negative impact on performance, health, and overall profitability. Ideally, litter should be managed to have ~25 percent moisture. Litter moisture control starts with building houses on an elevated pad and maintaining good drainage throughout the life of the facility. Over time drainage around houses

deteriorates, causing ponding and water seepage into the house. During wet weather or intense rain events, this can represent a major source of wet litter in houses having poor drainage.

Managing litter depth is critical in a built-up litter program. This starts with placing an adequate initial depth of **3 inches** or more. At depths less than this amount, caking is often excessive and leads to greater bedding replacement costs over time. Another source of wet litter is high moisture bedding materials. Mill-run sawdust that has been stored outside often exceeds 45 percent moisture. This can represent up to 6 to 7 tons of water that must be removed from the house when used as the bedding source. If one starts with a wet bedding material or has moisture seepage/condensation at the house pad interface, only the top two inches of the litter surface will be reduced by the ventilation system during a flock. Undisturbed, it may require several flocks to dry the lower profile in built-up and with very deep litter, drying on top of a wet pad may never occur.

Another major opportunity in optimizing litter quality is the selection, operation and maintenance of nipple drinkers. In a study of seven different nipple drinker systems Cornelison, *et al.* (2006) found litter moisture under the lines ranging from 28% to 47%. Although nipple type had a significant influence on litter moisture, broiler performance was similar for all nipple systems. Timely replacement of worn nipples is another critical litter management necessity. Regardless of manufacture, all nipples should be evaluated after five years for evidence of wear. Reductions in cake volumes of 50 to 90 percent are often reported following replacement of worn nipples. Other management opportunities include regular pressure adjustment, proper line height, and routine flushing and line sanitation. When excessive caking develops under drinkers, it may be necessary to stir the litter or top with fresh, dry bedding.

Litter quality can deteriorate (wetness and caking) rapidly at high stocking density. Performance; carcass, litter and air quality; and ultimately bird welfare are negatively influenced when birds are subjected to the stresses associated with high density. In a major study in the United Kingdom, Dawkins *et al.* (2004) found these environmental conditions (poor litter and air quality) had more direct impact on broiler welfare than stocking density itself. Maintaining uniform bird density throughout the house is essential in tunnel as well as conventional housing. In a study to determine the amount of cake produced in conventional houses several years ago, the author found that 25 of the 30 tons of cake removed during a summer flock on one farm was confined to one end of the house where the birds had migrated toward the direction of air flow. The installation of migration fences will help prevent the detrimental effects of high bird density due to migration in response to differences in temperature, light intensity, and wind direction within houses. Also timely movement of birds from brood to growout chambers is essential in reducing the deterioration of litter quality due to high stocking density. Uneven density can also occur if the birds are temperature stressed due to improper design or operation of the heating and ventilation system. Finally, cull birds utilize precious floor, feeder and drinker space, and increase the potential for disease transmission. Culls should always be removed promptly.

Of all house systems and management practices, proper ventilation is **the** primary means available to growers to maintain good litter and air quality. With the advent of tunnel ventilation and evaporative cooling pads, litter conditions during hot weather have greatly improved. However, setting evaporative cooling pads to operate at too low a temperature may lead to wet litter at the tunnel curtains (Czarick and Fairchild, 2003). House sweating and condensation in cold weather can also create wet litter. Donald *et. al.* (2004) suggest maintaining <70% relative humidity, operate 0.10 static pressure with 1 to 1 ½ inch inlet opening, seal cracks and air leaks, consider using mixing fans, check for areas of inadequate ceiling insulation, use caution when using only off chamber fans during brooding, and use heat with large birds if needed to maintain air and litter quality.

From an environmental standpoint maintaining good quality litter will be more important in the future. As phosphorus-base nutrient management plans are implemented, transport of nutrient-dense litter (*ie.* built-up litter) to alternative uses will become more critical. Excessively wet litter has less nutrient density and more costly to transport. Many pellet or granulation facilities are not able to use litter in excessive of 28% moisture. Wet litter has more offensive odors and may create nuisance complaints from the production facility or following land application. And, with potential reporting and regulation of ammonia release from poultry houses in the future, maintaining drier litter will aid in reducing volatilization losses.

Litter Temperature

Rearing birds on wet, cold bedding can have major negative consequences on performance and carcass quality. With wet, cold, ammonia-laden built-up litter it is essential, particularly during cold-weather flocks, to preheat houses at least 24 to 48 hours prior to chick placement. Managed properly, deep litter can benefit production by providing a greater insulating layer on the pad, allowing for greater moisture absorbency, and can generate heat in winter via its composting action. To reduce added heat load in houses from this built-up litter program in warm weather, it is a practice by some growers to reduce litter depth to approximately four inches going to summer. For a multi-year built-up litter program, this involves “cutting-the-centers” of houses. Litter is removed from the center of the house, often feed line to feed line, and the remaining litter from the sidewalls leveled out across the house. From a nutrient management standpoint, this practice may aid some growers in that it provides an even distribution of litter from year to year.

Disease Challenge

Litter management and its indirect affect on air quality has a major influence on poultry health. Wet litter supports higher pathogen loads! The following are a few examples of recent research that supports this statement. A study of commercial farms by Stayer, *et al.* (1995) found 12 times more cocci oocysts/g of feces on “poor” farms and the oocysts increased during the flock on these farms compared to “good” farms. The “poor” farms were identified as having wet litter due to poor drinker management and drainage. In a survey of Delmarva farms having an early respiratory disease challenge, Tablante (1998) found drinker age and layout time as factors influencing the challenge on farms. Compared to control farms, the challenged farms had older, worn nipple drinkers (5.2 vs. 4.9 years) and short layout times (15 vs. 17 days). One could speculate that the older nipples produced wetter litter resulting in a greater challenge.

Providing adequate layout time is a key tool in reducing disease challenge. This critical period in the production cycle allows time for the litter to release moisture and ammonia, and for pathogens to die-off. Layout time should not be measured from the day of movement, but from the day of cake removal. Since cake is the most concentrated source of pathogens and ammonia producing material in the house, effective and timely removal of this product is an essential component of a litter management program. For Delmarva, the order of preference for machinery to “remove” cake between flocks has been crushers (de-cakers) and skid-steer machines with forks. Weather permitting, following crust-out, the house should be aired-out to dry the litter. Additional moisture and ammonia release can be achieved with stirring or raking litter following cake removal. Operating the ventilation fans may be needed to adequately dry litter and remove ammonia from solid sidewall houses during layout. The use of tillers or pulverizers to break up cake instead of removing it should only be considered when there is minimal cake, adequate layout time between flocks, and outside temperatures permit effective ventilation to remove moisture and ammonia from the built-up litter.

Mallinson and co-workers at the University of Maryland have demonstrated the role of water activity in litter on the incidence of Salmonella. Litter with a water activity $<.83$ is usually negative

while that $>.90$ is almost always positive for Salmonella. Since water activity is a key factor in bacterial reproduction, management programs to reduce litter moisture (water activity) will reduce bacterial challenges. In addition to the wet areas of the house (*ie.* cake under nipple lines), Mallinson *et al.* (1999) found Salmonella (and general bacterial populations) “hot spots” are also associated with the dead air spots on the litter surface (*ie.* in corners having poor air circulation).

From a disease standpoint, many factors determine how many flocks can be reared on built up litter prior to requiring a complete clean out and disinfection. Unless a house has a major disease challenge, some poultry complexes essentially never require a complete clean out, only manage the litter depth. In a 57-house study having 4 to 28 flocks litter base, Thaxton, *et al.* (2003) found once a stable microflora population is established it does not tend to change with increasing flocks on built up litter. If numbers of pathogenic organisms are reflective of their total aerobic and anaerobic bacteria, staphylococci, mold & yeast, and coliform counts, they suggest only cake removal may be adequate cleaning for built-up litter.

Ammonia

The negative effects of ammonia on broiler performance, health and carcass quality have been well documented. Maintaining desirable litter moisture and reducing litter pH are two means frequently used to reduce ammonia volatilization (and bacterial populations) in used litter. Chemical, microbial and enzymatic litter treatments are being used to reduce ammonia and/or bacterial populations. Selecting the best litter treatment is dependent on matching the characteristics of the product with treatment goals. The acidifying litter treatments currently dominate the market due to their efficacy in reducing ammonia and lowering litter pH which aids in suppressing microbial populations. The following are some of the reasons why these acidifying products have not met ammonia control expectations; uneven or timely applications, inadequate moisture for chemical activation, improper or inadequate ventilation following treatment, and insufficient amounts of chemical to meet the ammonia challenge in houses.

Summary

For the past 30 years there has been a general trend in the U.S.A. to reuse litter for longer periods of time. Factors driving this trend have been improved health programs, better housing and equipment, increased use of litter amendments, shortages and higher cost of bedding, and nutrient/waste management issues. There are four interrelated components to managing built-up litter. These include managing for proper litter moisture and temperature, and reducing the challenge from disease and ammonia stress.

Farm-related factors that contribute to poor litter conditions may include; wet or poor bedding quality, inadequate litter depth, poor site drainage, house condensation problems, improper management of the drinkers, cooling and ventilation systems, and not maintaining uniform bird density in houses. Controlling the depth of litter in a built-up program can be an important tool in managing litter temperatures. Disease challenges associated with built-up litter can be minimized by reducing litter moisture and ammonia, litter treatments to alter microflora populations, and timely plus effective removal of cake between flocks. The proper use of litter treatments and managing the factors influencing wet litter conditions are often key to reducing ammonia levels with built up litter. Failure to management litter quality in a built-up litter program can be very costly and have negative environmental consequences.

In conclusion, the way in which we manage built-up litter will continue to change as we are challenged with evolving production, food safety, welfare and environmental issues.

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