Emissions Management Practices

Protecting Air Quality

Poultry Litter Moisture Management to Reduce Ammonia

Author: Dana Miles, USDA-ARS, Mississippi State, MS

Definition:

Ammonia generation in poultry houses results from the breakdown of nitrogen containing compounds in the poultry litter. Litter is defined as the bedding material that covers the facility floor, such as pine wood chips or rice hulls, with deposits of feces, feathers, spilled feed and water.

Purpose:

Good poultry litter management practices can reduce ammonia concentrations in poultry houses. This factsheet relates findings from a recent publication (Miles et al., 2011) that reported the amount of ammonia generated from broiler litter under specific conditions. The most relevant findings are: 1) increasing litter moisture content increases ammonia emissions; 2) high temperatures encourage greater ammonia emissions; and 3) there is a critical moisture level at which ammonia generation is maximized.

Over half of the nitrogen excreted by chickens is lost to the atmosphere as ammonia before the litter is removed from poultry houses. Lowering ammonia levels in poultry houses results in improved production efficiency by yielding heavier birds with better feed conversion and decreased mortality. In addition, reducing ammonia losses establishes better growing conditions for the birds and caretakers, maintains more nitrogen in the litter and lessens possible negative impact of ammonia on the environment outside houses.

How Does This Practice Work:

The temperature of the poultry house is determined by the birds' growth phase. Therefore, the major focus for house and litter management lies with litter moisture control. Growers should manage houses to avoid unnecessary water inputs to the litter: maintain leak-free watering systems, properly operate evaporative cooling pads, and prevent condensation on interior surfaces (walls, ceilings, and equipment).

Where This Practice Applies and Potential Limitations:

This practice applies to all poultry operations that use dry litter. There is no known limitation of this practice.

Effectiveness

Slight increases in litter moisture can translate into substantial increases in ammonia generation (Figure 1). The ammonia released at 75°F with 25% litter moisture is 1.4 times more than at the same temperature with 20% litter moisture. Further rise in litter moisture to 30% releases 1.8 times the ammonia. At 75°F, maximum ammonia volatilization occurs at approximately 42% litter moisture. As temperatures increase, the amount of ammonia produced is even greater. At 95°F and 20% litter moisture content, approximately 2 times more ammonia is produced than with litter at the same moisture content at 75°F. From that point, each additional 5% rise in moisture produces 3 and 4 times more ammonia when litter moisture is at 25% and 30%. At 95°F, the maximum generation occurs near 46% litter moisture.

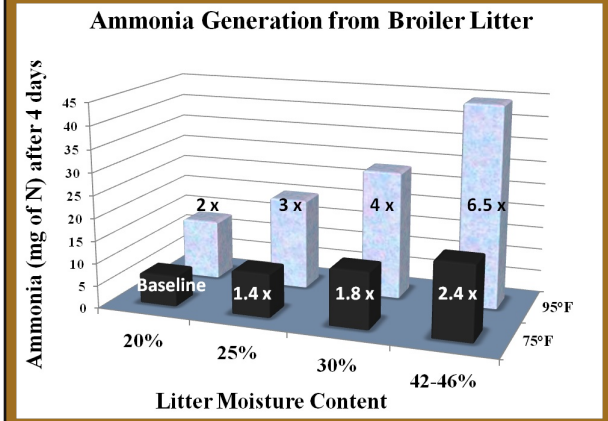

Figure 1: Ammonia generation from broiler litter at temperatures of 75°F and 95°F with litter moisture content increasing from 20% to 46%. Increases in ammonia are shown relative to the baseline and depicted on the columns as numerical multipliers (e.g. 2 x = 2 times more ammonia than the baseline).

Authors e-mail:

Dana.Miles@ars.usda.gov

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Once the litter surface is compacted (caked), it creates a physical barrier which prevents the release of ammonia. This is true for compacted litter before it is removed from the house and as long as it has not been tilled or chopped into the litter base.

Cost of Establishing and Putting Practice in Place:

Reducing litter moisture can be accomplished with minimal additional cost to the grower. Improved profits from improved production can be sizeable. Attention to routine maintenance and daily operation are all that are required.

The maximum recommended ammonia concentration in poultry houses is 25 ppm. Research quantifying the detriment of ammonia exposure showed approximately a 0.5 lb reduction in broiler body weight at 7 weeks of age when ammonia exposure increased from 25 to 50 ppm (Miles et al., 2004). The authors estimated economic returns from poultry production. Applying 2010 production statistics (National Agricultural Statistics Service, 2011) to those estimates indicates that an increase of just 0.1 lb in the average broiler weight in 10% of U.S. integrators would generate additional grower profits totaling $41.5 million.

Operation and Maintenance:

Litter moisture can be determined simply by weighing a small sample, drying that sample, and reweighing using this calculation:

% litter moisture = 100 x (initial-dry) / initial.

Inexpensive methods to measure ammonia concentration include ammonia test paper or gas detector tubes. Growers could perform these two simple measurements to know if they need to improve litter management to reduce ammonia concentrations. Beyond good house and litter management in preventing unnecessary water inputs to litter, growers can use chemical litter treatments to reduce ammonia generation in houses. Additional chemical and mechanical mitigation techniques will likely be developed in the near future. Currently, poultry integrator nutritionists are working on feeding strategies to reduce nitrogen excretion.

Because many litter moisture management factors are interrelated within houses and highly variable among farms, no optimal litter moisture content has been defined. However, producers may see an increase in disease sustainability when litter moisture is 35% or higher.

Nipple waterers, the standard in broiler production, they offer better sanitation and reduced spillage over their older, open counterparts. Inspecting water lines for drips and replacing damaged nipples will maintain a leak-free watering system. Further, installation of pressure regulators, filters to prevent valve clogs, and leveling waterer lines may be required to prevent leaks (Poultry Pro, 2010). Evaporative cooling pads should not be operated at night during hot weather or other times when incoming air relative humidity is at 100%; this can cause wet litter near the tunnel inlet. Adequate ventilation and roof insulation may be required to prevent condensate from forming within houses.

The research supporting this factsheet demonstrated lower litter moisture is essential to litter ammonia control. The data provide incentive for researchers and the poultry industry to develop strategies to reduce ammonia emission from litter. Opportunities arise for industry and researchers to analyze the modern broiler house structure and operation so that maintaining ideal litter moisture is more farmer friendly.

References:

Miles, D. M., S. L. Branton, and B. D. Lott. 2004. Atmospheric ammonia is detrimental to the performance of modern commercial broilers. Poultry Science 83:1650-1654.

Miles, D. M., D. E. Rowe, and T. C. Cathcart. 2011. High litter moisture content suppresses litter ammonia volatilization. Poultry Science 90:1397-1405.

National Agricultural Statistics Service. 2011. Poultry – Production and Value 2010 Summary. http://usda.mannlib.cornell.edu/usda/current/PoulProdVa/PoulProdVa-04-28-2011.pdf accessed June 2011.

Poultry Pro. 2010. Causes and prevention of wet litter. http://www.poultrypro.com/poultry-articles/poultry-health/causes-and-prevention-of-wet-litter/ accessed June 2011.

For Further Information:

Contact Dana Miles at 662-320-7481 or dana.miles@ars.usda.gov.

Also, see additional fact sheets on litter ammonia management such as Treating Poultry Litter with Aluminum Sulfate