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Technologies to Reduce Ammonia Emissions in Poultry Farms

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Ammonia is the primary gas that is emitted from poultry houses. Ammonia (NH_3) is produced by the microbial decomposition of nitrogenous compounds coming from the excreta of animals, mortality and feed wastage. Ammonia has been shown to be directly involved in the generation of 2.5 µm particulate matter ($PM_{2.5}$) which adversely impacts broiler morbidity and mortality as well as human health. Such particulate matter is also involved in the transport of odors beyond animal houses. Once NH_3 is emitted from poultry houses it can be a major contributor to ecosystem acidification and the eutrophication of surface waters.

Exposure to ammonia, dust, and airborne microorganisms significantly affect poultry welfare and human health. The scientific evidence suggests that air pollutant causes irritation of mucous membranes in the eyes and the respiratory system, increases susceptibility to respiratory diseases, and it affects feed intake, feed conversion and growth rate. Thus, reducing NH_3 emissions is important not only to comply with current environmental laws (Clean Air Act, Public Law 80-159, 1955 – EPA, 1993), but is also important for increasing broiler live performance, for improving poultry health, for reducing respiratory diseases, and for improving general profitability.

Controlling Ammonia in Broiler Houses

In poultry production, acceptable in-house ammonia levels are maintained through ventilation. In the future, emitting ammonia into the atmosphere may no longer be acceptable or could be controlled. In consultation with animal industry representatives, state and local government officials, environmental groups, and citizens, the United States Environmental Protection Agency announced an 'Animal Feeding Operations Air Compliance Agreement' (hitherto, referred to as the Agreement) (EPA, 2005b). The Agreement's goals are (a) reduce air pollution, (b) ensure compliance with applicable Clean Air Act, Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and Environmental Planning and Community Right-to-Know Act (EPCRA) provisions, (c) monitor and evaluate AFO emissions, and (d) promote national consensus on methodologies for estimating AFO emissions (EPA, 2005b). In return for certain protections, animal producers are required to pay a civil penalty fee, a monitoring fee of $2,500, make their facilities available for the scientific study, and comply with provisions of the air quality laws (mentioned above). Air emissions from 28 farms (housing, storage, and treatment components only) of all major species have been monitored by an independent organization funded with monitoring fees (EPA, 2005b). In the case of broilers, two sites (one in the Southeast) are to be monitored (EPA, 2005c). An important objective of the EPA's Agreement is to develop emission factors for various pollutants emitted by various species from houses and storage/treatment components, expressed as mass per unit time per animal [or animal unit, AU (500-kg live weight)]. The results of these studies and their impact on regulations for ammonia emissions for animal agriculture will be known in 2009.

Independently of the regulations, it is important to implement management and dietary strategies to reduce nitrogen (N) excretion from poultry houses. Three factors are important to reduce ammonia production: pH, humidity, and nitrogen content of the manure.

Technologies to Minimize Ammonia Levels

Maintaining the litter and manure pH below 7 is critical to reduce ammonia release. Bacteria and enzymatic activity responsible of ammonia production are very active at pH close to 9. Typically, the litter pH in a broiler house ranges between 9 and 10. Consequently the use of acidifiers is recommended. Currently there are several dry products in the market that contain granulated sulfuric acid, granular sodium bisulfate or aluminum sulfate (alum). These acids can lower the pH of the litter to less than 4 for some weeks, reduce the bacteria populations and transform the gaseous NH_3 to ammonium (NH_4) which further reacts with sulfate ions to form a salt of ammonium sulfate $(NH_4)SO_4$. Ammonium sulfate is a water soluble fertilizer. Additionally, the addition of alum precipitates soluble phosphorus and reduces phosphorus and heavy metal runoff, which is an additional environmental benefit. Normal application rates range from 50-100lbs./1000 sq. ft. If you have a higher ammonia challenge from older litter, short layouts or stressed litter conditions, you may need to apply at the higher end of the range.

The emissions of gases from poultry farms can be minimized when the litter humidity and excreta are low. It is possible to reduce humidity in the house by keeping good ventilation, reducing water wastage, keeping adequate pressure in the drinkers, and with adequate maintenance of lines, nipples, and drinkers to avoid dripping. It is important to maintain the litter dry with moisture between 15 and 30%, and try to keep relative humidity between 50 and 60%. If the relative humidity is above 70% first thing in the morning, the minimum ventilation setting is probably too low and should be increased. Humidity of droppings increases when there is high consumption of water due to heat stress or health problems. Monitoring these factors may help to take appropriate corrective measurements to avoid that the problem increases with time.

To reduce ammonia one of the more effective methods is to reduce the protein content of the diet while maintaining the essential amino acids with crystalline forms that are available. In the feed is also possible to supplement enzymes, organic acids, use of gypsum in commercial layer diets,and other products as extracts of plants like *Yucca shidigera,* and zeolites to reduce ammonia production.

The ammonia emissions can be reduced by utilization of technologies such as air scrubbers, misting screens, filters, and biofilters. These technologies are available, but their cost of installation and maintenance is prohibitive at the moment. The use of trees 18 ft (5.5 m) downwind of the fans to trap dust and ammonia is very effective. Willow (*Salix purpurea*) is the tree that has shown more efficacy at trapping ammonia. A mixed buffer of evergreen and deciduous species would be recommended for foliage biomass in all seasons in North America.