Effect of Litter Moisture Content on Ammonia Emissions from Broiler Operations

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Objectives

To investigate the effect of litter moisture content on ammonia emissions from broiler litter. The long term goal is to develop a multi-variable emission model that combines the effects of temperature, air exchange rate, pH, litter nitrogen content and litter moisture content.

Introduction

Broiler chickens are normally raised on litter made up of wheat straw or wood shavings. Broiler serves as manure absorbance and it represents a significant source of ammonia emissions. Ammonia emissions from broiler litter can not only cause environment problems, but also be detrimental to the health and performance of birds. However, their contributions to the national emission inventory have not been properly documented.

From published ammonia emission data, it can be seen that ammonia fluxes from broiler operations vary in a very wide range and are greatly dependent on seasonal weather conditions and management practice.

The mechanisms related to ammonia emissions from litter involve many processes. Factors that may influence ammonia emissions from broiler litter include:

- Air and litter temperature
- Air exchange rate
- Litter pH
- Litter nitrogen content
- Litter moisture content

Experimental setup

A dynamic flow-through chamber system was developed for measurement of ammonia emissions from broiler litter under lab controlled conditions. Broiler litter samples were put into the chamber and a given amount of water was applied by uniformly sprinkling and incorporated into the litter to achieve various levels of moisture content. Ammonia concentration in each chamber was simultaneously measured by a boric acid scrubber and a Thermo Environmental Instruments (TEI) chemiluminescence ammonia analyzer (Model 17C).

Wood shaving litter samples of three ages from commercial broiler farms in North Carolina were tested in this study. The litter ages are one-year, two-year, and four-year respectively.

Results and conclusions

The experimental results suggest that ammonia emissions are very sensitive to litter moisture content. For the one-year litter sample tests, ammonia concentrations increased dramatically as litter moisture contents increased from 26% to 34%. However, ammonia concentrations began to decrease with increase of litter moisture contents when litter moisture contents were above 34%. Optimal litter moisture content at low moisture level that minimizes ammonia emissions was observed for the one-year litter samples.

For two-year and four-year litter samples, no optimal moisture content was observed, possibly due to unavailability of data at very low litter moisture level. A decrease of ammonia concentrations was reported as litter moisture contents increased from 23% to 51% and above. Further tests need to be performed to explore the possible optimal litter moisture content that minimizes ammonia emissions.

It was observed that NH\(_3\)-N to TKN ratio were 16.1% for the for-year litter, while just 4.5% for the two-year litter. For litter samples with higher NH\(_3\)-N content, higher ammonia concentrations and larger slopes of regression line of ammonia concentration vs. litter moisture content were observed, which indicated that the sensitivity of ammonia concentration to litter moisture content was positively related with NH\(_3\)-N content of litter