Managing Ammonia and Built-Up Litter

Effects on Bird Health and Performance

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Jones- Hamilton Company – PLT®

Fayetteville, Arkansas
What is Ammonia?

- **Ammonia** - byproduct of decomposition
  - undigested feed protein
    - contaminated feed, water / litter eating -> “flushing”
    - primary intestinal disease – enteritis, coccidiosis, etc.
    - excess crude protein / amino acid imbalances
    - inadequate energy: protein ratios
  - ventilation, temperature → feed passage
- **In poultry; urease is excreted with urates**
  - moisture and heat needed for activity
- **Bacteria**
  - Bacillus, Pseudomonas – intestine, wet areas
  - Nitromonas, others in litter
Why care about ammonia?

- **Bird health issues**
- **Economic factors**
- **Human exposures**
  - upper respiratory
  - eyes, skin irritation

- **Environmental**
  - Component of “odors”
  - “PM” as in PM 2.5
    - Ammonia gas in atmosphere
    - Combines with sulfates and nitrates
    - Ammonium compounds make small molecules
    - “acid rain”
Impact of Ammonia

Direct Health Effects
Other Conditions

- **Paws**
  - damp litter sticks to bottom of foot
  - moisture holds ammonia $\rightarrow$ NH$_4$OH

- **Scabby hips**
  - poorly feathered regions of skin
  - birds rest in dusty/damp areas in litter (hot)
  - epithelial erosion w/o cellular infiltrates

- “chemical burns”
Financial Impacts

Management Expenses
Performance Losses
Processing Effects
Mechanical Reduction of Ammonia in Broiler Houses

- Dr. Ivan Berry - Univ. of Arkansas, 1994
- Broiler Energy Project test houses - Savoy
- Litter removed once/year in Spring
  - Highest ammonia levels/highest heat required
- One flock in Winter on Energy Project
  - Required an additional 620 gallons propane just to maintain NH₃ at acceptable levels (<30 ppm?)
- Energy to remove NH₃ > moisture removal
## Effects of Ammonia on Body Weights
7 Weeks (Miles, et al 2002)

<table>
<thead>
<tr>
<th>NH₃ (ppm)</th>
<th>4 WKS</th>
<th>7 WKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2.99</td>
<td>6.74</td>
</tr>
<tr>
<td>25</td>
<td>2.95</td>
<td>6.55</td>
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<tr>
<td>50</td>
<td>2.41</td>
<td>6.24</td>
</tr>
<tr>
<td>75</td>
<td>2.47</td>
<td>6.23</td>
</tr>
</tbody>
</table>
Weight Distributions
Measuring Ammonia Objectively

- Many growers and service people are “desensitized”
- Animal welfare concerns (<25 ppm)
- Potential for future emission regulations
Benefits of “built-up” Litter

- **Cost savings**
  - lower bedding expenses
  - clean-out labor saved

- **Time savings**
  - fewer cleanouts
  - less “out-time”?

- **Environmental**
  - lower volumes of waste
  - timely application
  - water quality and odor issues

- **Insulation**
  - warmer floors
  - finer, denser

- **Moisture management**
  - adsorbs > absorbs

- **Bacterial flora**
  - -> chicks
  - -> poults

- **Pathogen suppression**
  - Aspergillosis in new litters
  - Salmonella – cidal? “Aw”
Ecology of Litter

- "Built-up litter" is more dried manure than bedding material.
- Litter is an enriched environment for microorganisms, insects, and waste gases.
  - can be positive or negative
- Litter is manageable micro-environment for benefit of producers and birds.
Litter Management

- Litter management for the next flock starts before the previous flock moves out.
- Controlling the housing environment immediately after each flock is necessary.
- House temperature and moisture conditions determine litter characteristics.
- Keeping houses closed vs. open between flocks affects:
  - Temperature
  - Relative humidity
  - Ammonia production
Open Housing
Closed Housing
Higher RH%
Compost Activity
Higher temp $\rightarrow$ purge of Ammonia
Litter Management Tools

Hygrometers

- Inexpensive
- Keep RH between 50-70%
- Don’t leave in chicken house
  → “sensor fatigue”

Data Loggers

- Measures temperature and RH%
- Graphs of house conditions over time
“Donuts” or “Pancakes”
Wet Spots under Waterlines
Litter and “Lake Effect”
Relative Humidity

“water holding capacity”

Bird performance and litter amendments
ideal RH of 50-70%
Litter Assessment

- Litter assessed after movement:
  - Farm management
    - Ventilation requirements met or not
      - Floor moisture
    - Equipment failure
      - Poor drinker management, dirty fans, air leaks
  - Flock health
  - Ammonia production
  - Disease incidence
  - Darkling beetle reproduction
Litter Preparations

- “Decaking” or “Crusting” vs.
  - Tilling
  - Skimming
  - Partial litter removal

- The goal is to minimize surface area
  - Increased litter surface area results in greater ammonia levels in air and decreased litter moisture.
Decaking

- **When?** - after bird movement and litter base has cooled to outside temperature.

- **How?** - litter conditioner machine or blading

- **Where?** - most vital in brood area
  - reduces ammonia exposure
  - manages bacterial challenge
Preparation

- Ventilate ammonia to protect workers
  - Lower curtains when personnel in house decaking or other work. Raise when done.
  - Solid sidewall? Run fans during worktime.

- Raise all equipment
  - Allows access to all areas of the litter surface.
Preparing to Crust

- Assess litter conditions - i.e., wet, rutted, dry, dusty, etc.

- “Fork out” sidewalls, all corners, under space heaters and fans.

- Determine depth of cake, THEN set up tractor mounted equipment.
Getting deep...
Tilling

- No advantages in broilers
  - Tilling is a turkey production practice

- Disadvantages
  - Mixes wet cake back into litter
  - Increases ammonia release from deep litter
  - Moves bacteria to surface – increased challenge?
  - Uneven litter => hard to adjust feed / waterlines
  - Higher fuel and electricity cost
Partial Litter Removal

- **Side walls vs. Center**
  - “Sides” usually have spilled feed and excess moisture
  - Bugs live where there is feed and moisture

- **Timing**
  - Season of year – late Spring / Summer / Fall
  - When needed due to waterline breaks, etc.

- Only recommended when litter too deep
Litter Treatments

- **Dry and liquid forms**
  - **acid based**
    - “dry” products probably most attractive at this time
    - liquid mineral acids are hazardous to handle (reactivity)
  - **enzyme based**
    - success dependent on specific conditions
    - may see used as “feed through” or direct applied
  - **“cultures” → probiotic or “CE” approach**
    - probably work best in damper litters
    - temperature dependent?
Litter Amendments

- Choose a product that is safe and effective
  - Use proven products
  - Read and understand MSDS
  - Follow manufacturer’s guidelines
- Select a treatment that provides both ammonia binding and significant pH reduction.
- Be cautious of treatments that may hamper desirability of treated litter.
Litter Acidification

- Ammonia reduction
- Organophosphate insecticides
  - darkling beetle control
- Microbial suppression
  - pathogens
- “Growth promotion”
Motor Homes
Disease Causing Agents Transmitted by Beetles

- **Fungi**
  - Aspergillus
- **Bacteria**
  - *E. coli*
  - *Salmonellae*
  - *Bacillus*
  - *Streptococcus*
- **Parasites**
  - *Eimeria* (coccidiosis)
  - Tapeworms
  - Cecal worms (blackhead)
- **Viruses**
  - Infectious bursal disease
  - Marek’s disease
  - Fowl pox
  - Avian influenza
  - Newcastle disease
  - Reovirus
  - Rotavirus (poul enteritis)
  - Turkey enterovirus
### Effect of pH on Insecticide Longevity

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Proprietary Names</th>
<th>Selected pH Ranges</th>
<th>Half-Life</th>
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<tbody>
<tr>
<td>Carbaryl</td>
<td>SEVIN</td>
<td>6.0</td>
<td>100-150 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.0</td>
<td>24-30 days</td>
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<td>8.0</td>
<td>2-3 days</td>
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<tr>
<td></td>
<td></td>
<td>9.0</td>
<td>&lt;1 day</td>
</tr>
<tr>
<td>Cyfluthrin</td>
<td>COUNT-DOWN TEMPO</td>
<td>5.0</td>
<td>Stable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.0</td>
<td>193 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.0</td>
<td>30-60 minutes</td>
</tr>
<tr>
<td>Permethrin</td>
<td>Numerous AMMO</td>
<td></td>
<td>Most incompatible with alkalies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9.0</td>
<td>35 hours</td>
</tr>
<tr>
<td>Tetrachlorvinphos</td>
<td>RABON</td>
<td>3.0</td>
<td>54 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.0</td>
<td>44 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.5</td>
<td>3.3 days</td>
</tr>
<tr>
<td>Dichlorvos</td>
<td>VAPONA</td>
<td>7.0</td>
<td>8 hours</td>
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### Effects of pH on Bacteria Growth

<table>
<thead>
<tr>
<th>pH</th>
<th>E. Coli</th>
<th>Clostridium</th>
<th>Salmonella</th>
<th>Pasteurella</th>
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<tbody>
<tr>
<td>7.4</td>
<td>Heavy</td>
<td>Heavy</td>
<td>Heavy</td>
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</tr>
<tr>
<td>7.0</td>
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<td>Heavy</td>
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</tr>
<tr>
<td>6.8</td>
<td>Heavy</td>
<td>Heavy</td>
<td>Heavy</td>
<td>Moderate</td>
</tr>
<tr>
<td>6.5</td>
<td>Heavy</td>
<td>Heavy</td>
<td>Heavy</td>
<td>Light</td>
</tr>
<tr>
<td>6.4</td>
<td>Heavy</td>
<td>Heavy</td>
<td>Heavy</td>
<td>Light +</td>
</tr>
<tr>
<td>6.3</td>
<td>Heavy</td>
<td>Heavy</td>
<td>Heavy</td>
<td>Very Light</td>
</tr>
<tr>
<td>6.2</td>
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<td>Heavy</td>
<td>Moderate</td>
<td>Very Light</td>
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<tr>
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<td>Light</td>
<td>Heavy</td>
<td>Light</td>
<td>VV Light</td>
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<tr>
<td>5.7</td>
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<td>Very Light</td>
<td>No Visible Growth</td>
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<tr>
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<td>Moderate</td>
<td>Very Light</td>
<td>No Visible Growth</td>
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<td>VV Light</td>
<td>No Visible Growth</td>
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<tr>
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<tr>
<td>4.5</td>
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<td>Very Light</td>
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<td>No Visible Growth</td>
<td>No Visible Growth</td>
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<tr>
<td>4.0</td>
<td>No Visible Growth</td>
<td>No Visible Growth</td>
<td>No Visible Growth</td>
<td>No Visible Growth</td>
</tr>
</tbody>
</table>

Alabama State Lab, Boaz – Boyd and Roney
Benefits of Proper Litter Management

- Reduce ammonia production
- Improve fuel utilization
  - preheating and brooding
- Maintain litter moisture (15-25%)
- Increase litter amendment longevity
Long Term Benefits

- Reduce need to add new bedding ($aves)
- Helps leveling of feeders and waterers
- Decrease bacterial challenge to chicks
- Reduce human health effects
- Assist in “nutrient management”
  - Better able to control volumes (litter removal)
There's plenty of room for all God's creatures.
Right next to the mashed potatoes.
www.jones-hamilton.com
(800) 379-2243
“Smooth and Go”
Does not need much!
Preparing to Crust

- Adjust cruster’s blade to depth of cake left from previous flock

- No more than 5 inches

- Observe cruster’s screen - adjust blade not to remove fines

- Remove extremely wet areas
Crusting (cont.)

- Only crust areas that need attention
  - ruts from live-haul are preventable
    - do not overdo crusting – manage top 2-3 inches of litter
    - deep crusting fluffs litter – breaks physical barriers
  - disturb damp areas as little as possible
  - minimize crusting area
- Focus on brood area during short down times
  - can prepare “off-chamber” after flock is placed