Mitigation of Ammonia Emissions from Poultry

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Part I: Mitigation through Housing & Manure Handling and Dietary Manipulation

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Sources of Emission Mitigation

- **Pre-excretion**
  - ✓ **Dietary manipulation**
  - ✓ Feed or water additives
  - ✓ Genetics
- **Post-excretion**
  - **Housing and manure handling schemes**
  - Indoor treatment (to reduce generation)
  - Exhaust treatment (to reduce emission)

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Post-excretion Mitigation

Housing and Manure Handling Schemes

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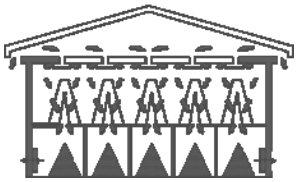
High-Rise Hen House






Manure-Belt House + Manure Storage

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Forced Air Drying of Manure on Belt

Courtesy of Tom Lippi, CTB

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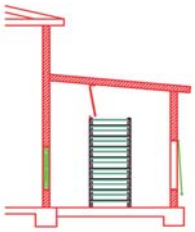
Supplemental Air Drying Chamber



Courtesy of Tom Lippi, CTB

U.S. Layer & Pullet Housing Style Distribution (2008)

Layers

Housing Style	Birds (millions)	%
Manure-belt	71	24%
High-rise	207	69%
Shallow pit	3	1%
Cage-free	17	6%
Total	298	100%

Pullets

Housing Style	Birds (millions)	%
Manure-belt	22	21%
High-rise	73	70%
Shallow pit	<1	0%
Cage free	9	9%
Total	105	100%

Courtesy of Tom Lippi, CTB

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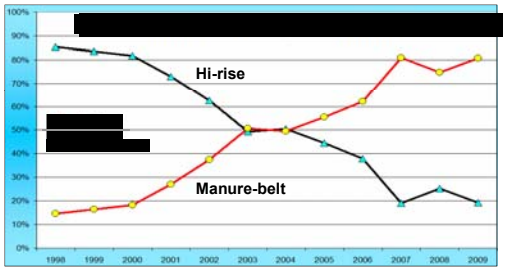
U.S. Trend in Layer Cage Systems



Courtesy of Tom Lippi, CTB

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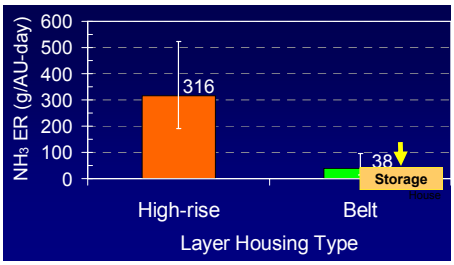
High-rise vs. Manure Belt Layer House NH_3 Emission Rate



AU = animal unit = 500 kg live body weight

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Factors Contributing to Lower Emissions of MB Systems

- Reduced manure residence time and hence its decomposition in the hen house
- Reduced emission surface area in storage
- Generally cooler environment in storage
- Drying manure

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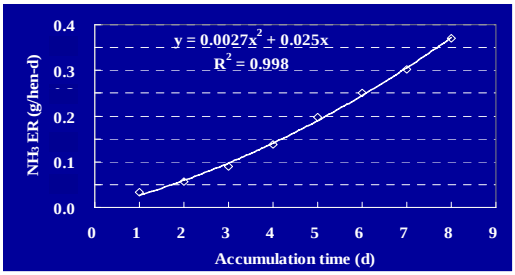
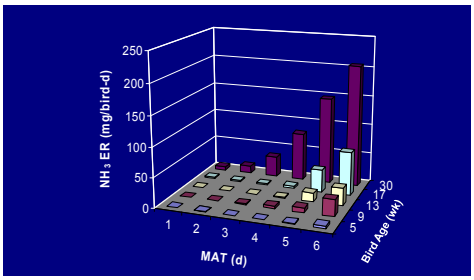
NH_3 Emission *(g/hen-d)* vs. Hen Manure Accumulation Time



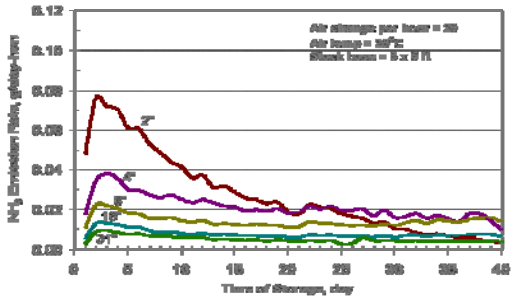
Source: Ning (2008)

NH_3 Emission *(g/bird-d)* vs. Manure Accumulation Time at Different Ages



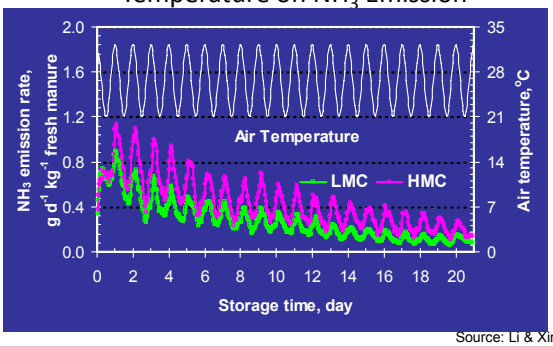
Source: Mendes (2010)

Effect of Stacking Configuration on NH_3 Emissions from Hen Manure Storage



Source: Li & Xin (2010)

Effects of Hen Manure Moisture & Air Temperature on NH_3 Emission



Source: Li & Xin (2010)

Some Practical Aspects of Manure-Belt Layer Systems

- Higher construction costs (~50% more)
- Potentially higher maintenance needs due to longevity of manure belt and conveying system
- Need of separate manure storage facility

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New *vs.* Built-Up Litter of Broiler Houses on NH_3 Emissions

Broiler (4.6 lb, 40 d)		Heavy Broiler (5.4 lb, 49 d)		Roaster (7.2 lb, 63 d)	
Built-up	**New**	**Built-up**	**New**	**Built-up**	**New**
25	17	38	28	63	50
32%↓		26%↓		21%↓	

Emission unit: g NH_3/bird marketed

Note: New bedding does not necessarily change max daily NH_3 emission.

Gates et al. (2007)

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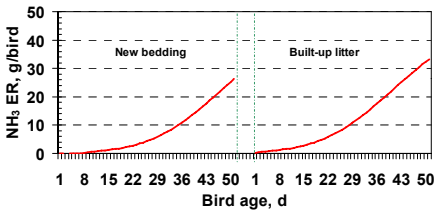
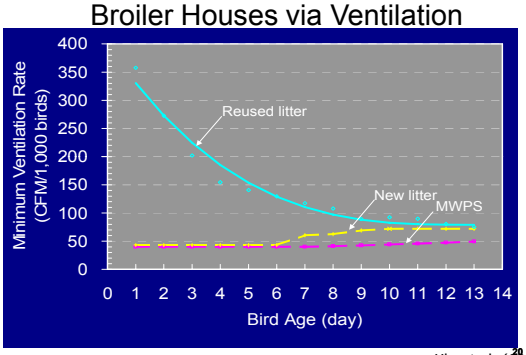
Cumulative per Bird NH_3 Emission of Commercial Broiler Houses



Burns et al. (2007)

Controlling NH_3 Level to 25-30 PPM in Broiler Houses via Ventilation



Xin et al. (1996)

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Factors to Consider in Using New vs. Built-Up Litters

- Availability and price of bedding materials
- Higher energy cost helps offset high price of bedding, hence may justify its use every flock.
- Improved bird health and performance
- Built-up litter requires more ventilation to control NH_3 level – likely increase emissions.
- Break-even LP gas price in 1992 was $0.75/gal. Analysis based on current pricing is needed.

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Pre-excretion Mitigation

Dietary Manipulation

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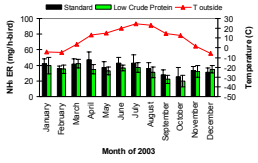
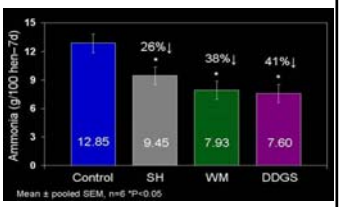
Dietary Effect on NH_3 Emission of High-Rise Layer Houses

- 1% lower CP → 11% reduction in NH_3 emission





Roberts et al. (2007)

NH_3 ER (g/hen-d)	
Standard Diet	**LP Diet**
0.90 (0.24-1.58)	**0.80** (0.19-1.37)

23 (Liang et al., 2005)

SUMMARY

- Frequent removal of manure from animal houses improve IAQ and reduce house-level emissions.
- Daily ammonia emission increases with hen manure accumulation time (1 - 7 days).
- Reducing manure storage surface area reduces ammonia emissions.
- Ammonia emissions increases with higher manure moisture and ambient temperature.

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SUMMARY

- Nutritionally balanced hen diets with lower crude protein helps reducing ammonia emissions w/o adverse impact on production performance.
- EcoCal (7%) and DDGS (10%) diets have been shown to reduce ammonia emissions from high-rise layer houses by 39% and 14%, respectively, based on a 2-year field study.
- The EcoCal diets showed economic advantages over control or DDGS diet.

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