

# Production and Storage Strategies for Controlling Ammonia Emissions

Ken Kephart

Pennsylvania State University

# Typical factors affecting $\text{NH}_3$ emissions

- Concentration in the manure
- pH of the manure
- Air movement above the manure
- Temperature

# Additional Factors

- Dietary protein
- Urease enzyme
- Compounds that bind ammonia
- Moisture content of manure
- Concentration gradients & air movement
- Surface area
- Concentration in the manure
- pH of the manure
- Air movement above the manure
- Temperature

# Dietary Protein

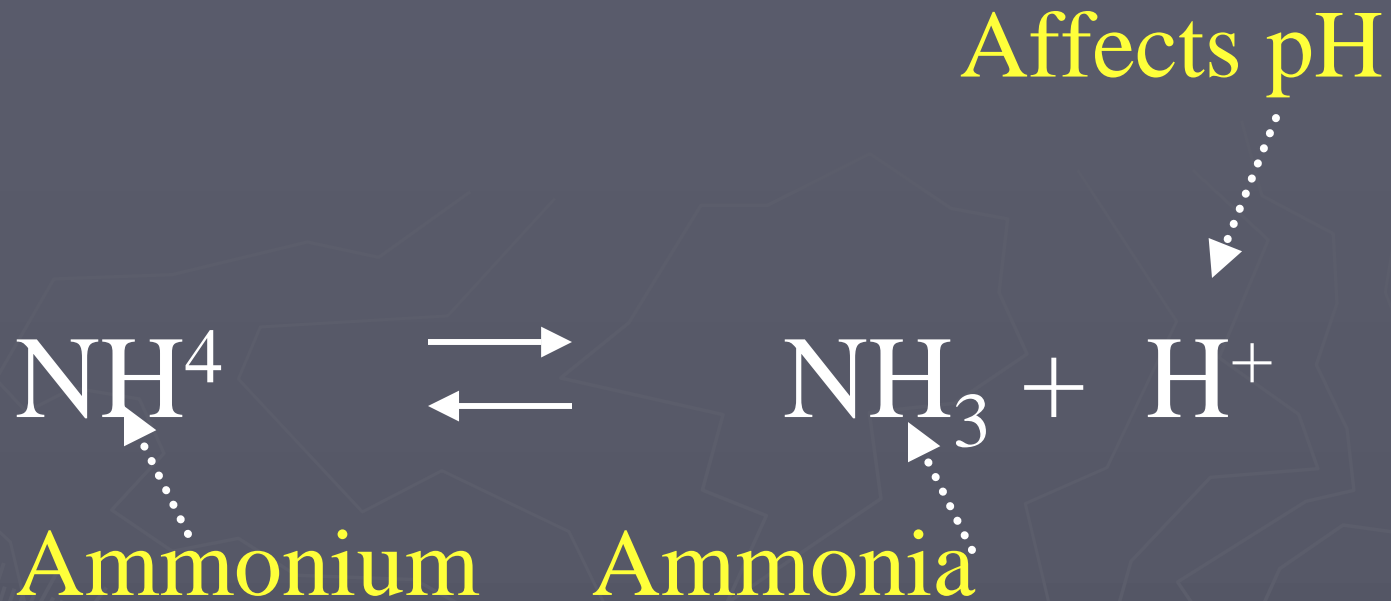
- Protein contains about 6.25% nitrogen
- More protein means more nitrogen – and more ammonia
- Non-ruminants
  - Formulate on the basis of amino acids
  - Consider using crystalline amino acids

# Use crystalline amino acids to reduce protein

- The use of lysine alone can reduce protein by 2% points.

	<u>Std Diet</u>	<u>Low Prtn Diet</u>
<u>Ingredient</u>		
Corn	1575	1671.5
Soybean meal	375	275
Vit-Min	50	50
Lysine-HCl	-	3.5
Total	2000	2000
Crude Protein, %	15.8	13.8
Lysine, %	.78	.78
N, %	2.5	2.2

# How pH impacts ammonia losses...



$\uparrow \text{H}^+ = \downarrow \text{pH} = \downarrow \text{ammonia emissions}$

# Methods for Reducing pH

- Aluminum sulfate (Alum)
  - Commonly used in poultry litter (50-200 lbs per 1000 ft<sup>2</sup> of floor space)
  - Forms ammonium sulfate - a nitrogen fertilizer
- Others
  - Calcium chloride
  - Calcium sulfate
  - Magnesium chloride
  - Magnesium sulfate

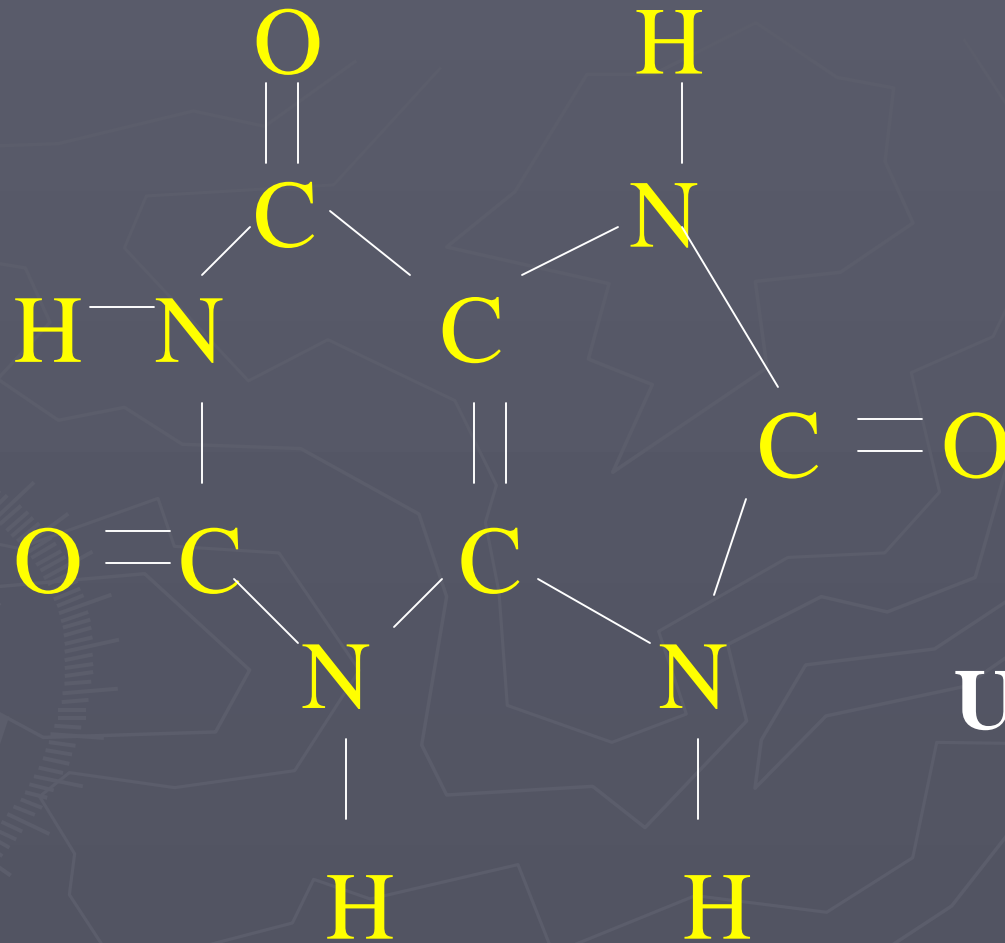
# Urease catalyzes ammonia release from urea



# Urease Control Strategies

- Urease inhibitors
  - Cyclohexylphosphoric triamide
  - Phenyl phosphorodiamidate
- Keep manure and urine separate
  - Collect urine separately on a belt

If you happen to be a bird or a  
lizard...



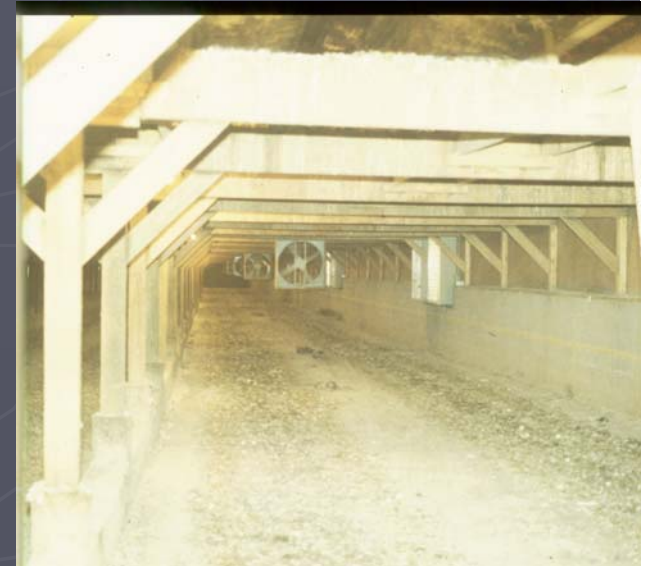
**Uric Acid**

# Zeolites - A clay-like mineral (aluminosilicate)

- 6.25% zeolite added to dairy manure will reduce ammonia emissions by 50%
- After manure is land applied, zeolite releases  $\text{NH}_3$  slowly to plants.
- Reduces nitrification (conversion of  $\text{NH}_3$  to nitrate), which minimizes nitrate leaching

# Moisture Content

- Little  $\text{NH}_3$  released if manure is very dry
- Strategies
  - Minimize water wastage in poultry litter
  - Use rapid drying technologies



# Moisture Control Strategies ( cont)

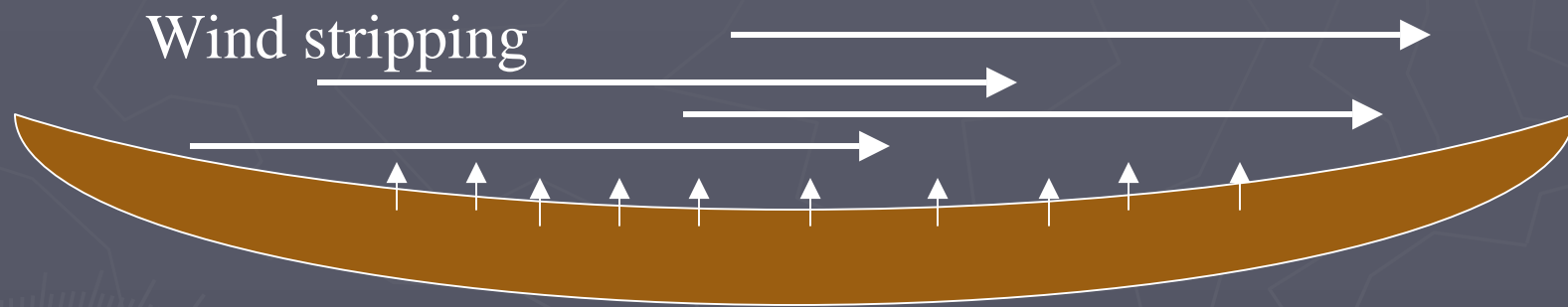


- Strategies
  - Minimize the wet-dry cycle in feedlots by removing manure more often
  - Drain water from feedlots
  - Add a source of carbon

# Temperature

- Chemical reactions and volatilization increase with temperature
- Change in temp of 18° F impacts ammonia gas pressure in slurry by 65%
- Therefore:
  - More ammonia released in summer
  - Covering manure storage will help

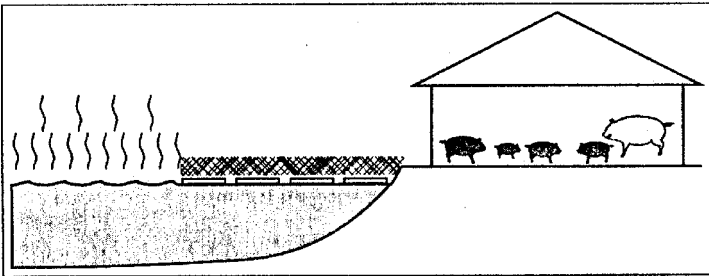
# Concentration gradients and air movement



Concentration just above the surface affects  $\text{NH}_3$  release

# Strategies to Reduce Surface Area

and District 21 ADD Board)



- Straw covers
- Stacking
- Crust formation
- Biofilters
- Oil layer



# Summary

- Formulate diets to for optimal protein. Formulate non-ruminants on basis of A.A.
- Reduce pH - Alum reduces  $\text{NH}_3$  emissions and ties up phosphorus.
- Add zeolite to tie up  $\text{NH}_3$ .
- Store manure under roof will reduce surface temperature
- Covering with straw will reduce emissions
- Dry, remove manure more often, or add carbon.