

Ammonia emissions from dairy cattle:

What we know, what can be done.

J. Mark Powell

U.S. Dairy Forage Research Center

Madison, WI

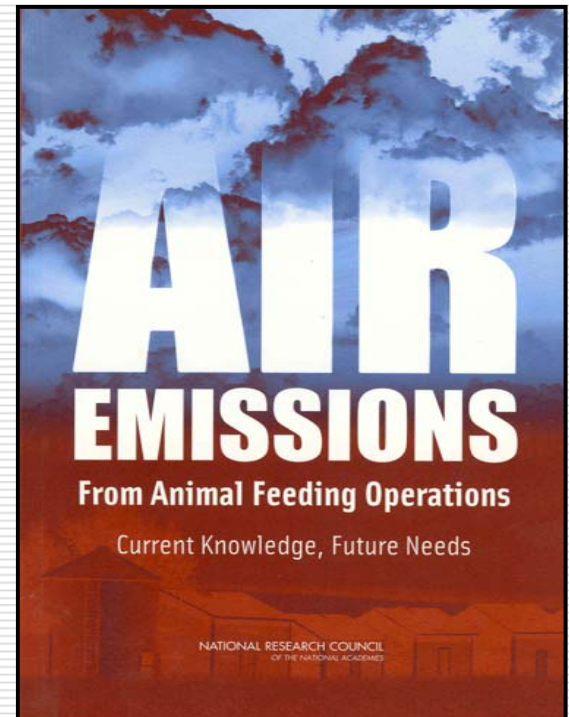


Why should dairy producers be concerned about ammonia?

Policy is being formulated to mitigate emissions of air pollutants from animal agriculture.

For the dairy industry, air emissions relate directly to ammonia.

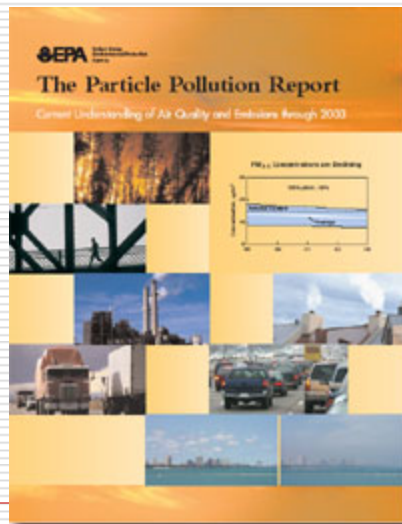
Most of the nitrogen (N) contained in the urine excreted by dairy cows can be transformed rapidly and emitted as ammonia gas.



Why the concern?

Ammonia provides the basis for particulate formation in the atmosphere, which can create haze and imperil human health.

Ammonia re-deposition can degrade natural ecosystems.



Why the concern?

Under the federal Consolidated Emissions Reporting Rule, each State in the U.S. has to report ammonia gas emissions to EPA.

These estimates will be used in air quality regulations to control the air-borne particulates and haze that affect many regions of the US.



Why the concern?

Public awareness and scrutiny.

WISCONSIN STATE JOURNAL

MAY 28, 2004

Ag conference explores importance of ammonia emissions

By JAN SHEPEL
MADISON

...really pleased with the interest we got. There were regulatory people there, ac-

...the cause 57 percent. Poultry, pigs and fertilizer are the next largest emitters.

Ammonia: Next Big Environmental Issue to Face Farmers?

By Brenda Murphy
Managing Editor

...erance levels in place. Tom Misselbrook, a visit-

Farm odor issue moves to forefront

By Jim Massey
Editor

...farms produce a considerable percentage of ammonia in the atmosphere.

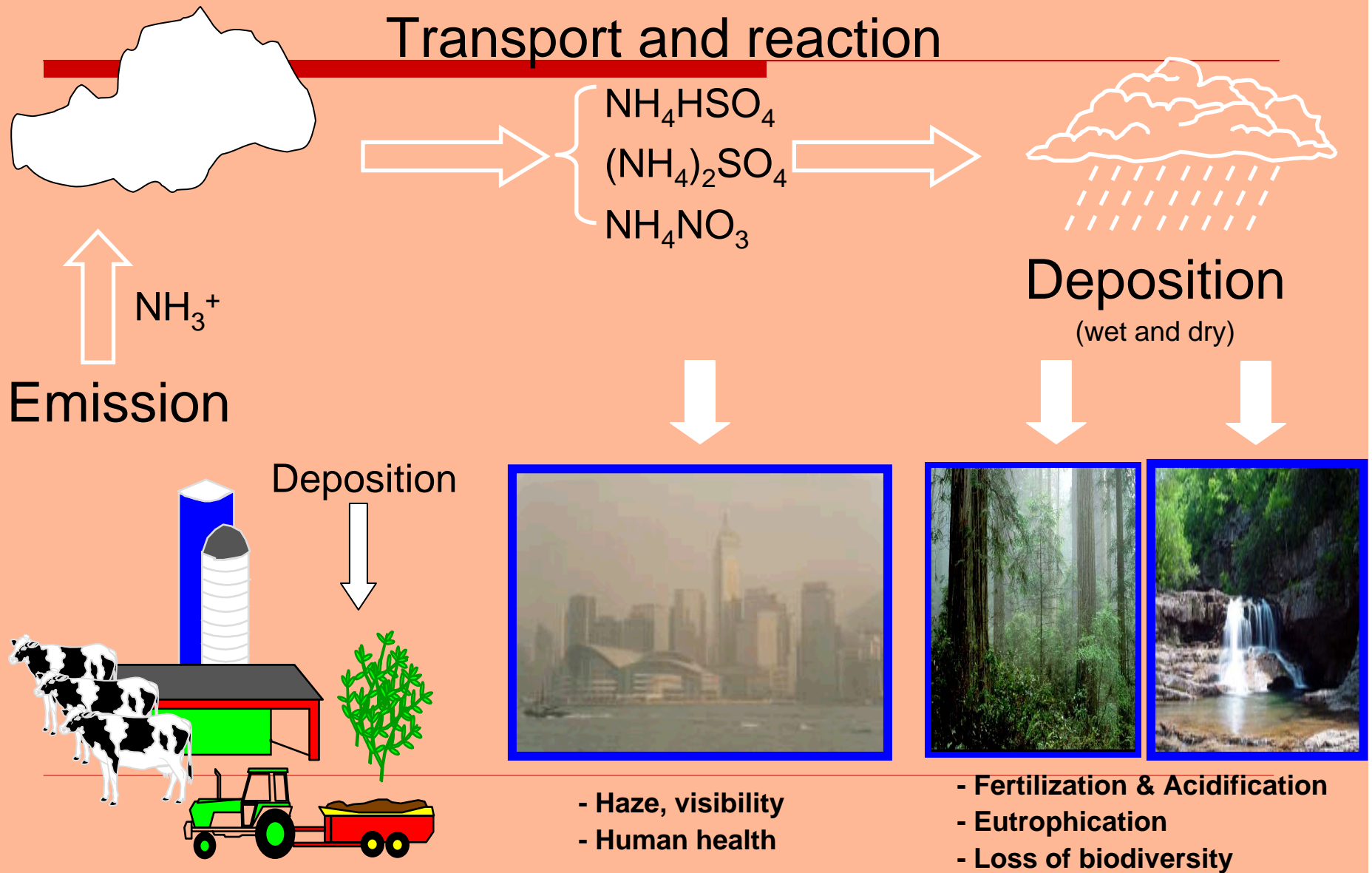
...particularly high level of ammonia emissions, Mr. Powell said. Much of that can

...Mr. Jacobson said state officials have about two years to pull together information on

The following page shows:

- **the processes involved in ammonia formation and emission from dairy farms;**
 - **ammonia transportation and transformation in the atmosphere;**
 - **and ammonia's re-deposition as:**
 - **particles (dry deposition) which creates haze;**
 - **and/or as acid rain (wet deposition) which 'ages' natural ecosystems.**
-

Ammonia cycle



What we've learned . . .

Studies at the U.S. Dairy Forage Research Center and other locations have endeavored to gain a better understanding of the nitrogen cycle on dairy farms.

Where in the cycle do we lose nitrogen?

How do various management decisions affect the loss of nitrogen?

What practices can impede the loss of nitrogen?

Here are some of the answers research has found in recent years . . .

What we've learned . . .

How much of total feed nitrogen (crude protein) is converted into milk?



Only 20 to 35%
of the nitrogen cows consume is
converted into milk.

**Feed nitrogen use inefficiencies are
inevitable. But we can do better!**

What we've learned . . .

How much of total manure nitrogen is recycled through crops on a 'typical dairy farm' ?

(a farm that grows most of its own forage & grain)



Only 10 to 40 %

of manure applied on fields is subsequently used by the crop.

Manure nitrogen use inefficiencies are inevitable. But we can do better!

What we've learned . . .

What happens to manure nitrogen?



Lost as ammonia (20-40%)

Taken up by plants (20-40%)

Lost as nitrate (10-20%)

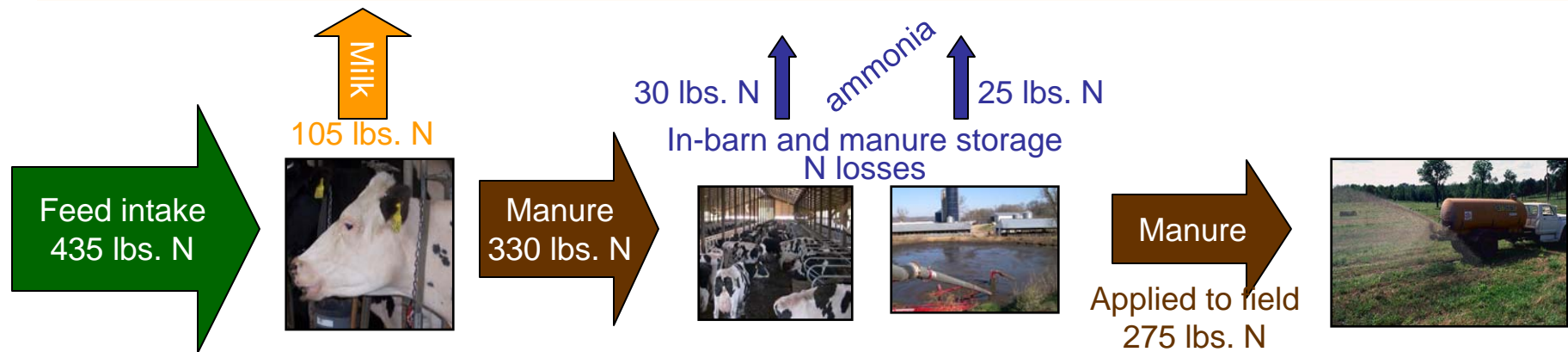
Denitrification* (3-5%)

Immobilized by soil microorganisms (?)

* To remove nitrogen from a material or chemical compound.

From feed to field: Nitrogen flow on a typical confinement dairy operation

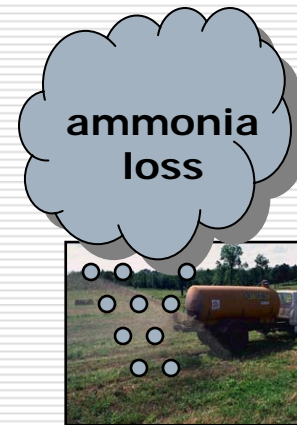
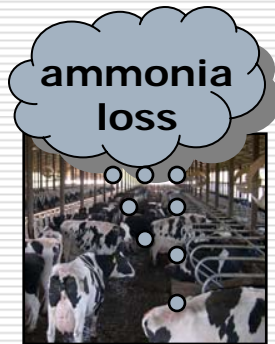
(pounds nitrogen/cow/year)



Impact of manure application on nitrogen cycling	Manure application method			
	Knifing in	Injecting in open slots	Band spreading	Broadcasting
Ammonia N loss	5	15	24	70
N going to soil	270	260	251	205

What we've learned . . .

Ammonia production and loss occur almost immediately in the barn and continue through manure storage and land application.



This loss of nitrogen can greatly reduce the fertilizer value of manure.

What we've learned . . .

Because ammonia is a gas, losses are inevitable.

But ammonia nitrogen loss can be reduced, and the fertilizer value of manure can be maintained through management.

We'll look at what we know about abating ammonia emissions . . .



. . . via feeding



. . . in the barn



. . . in the field.

Feeding . . .



Only 20 to 35% of the nitrogen (crude protein) fed to dairy cows is converted into milk. The rest is excreted in manure.



Feeding nitrogen (crude protein) to dairy cows in excess of their requirements decreases the relative amount of feed nitrogen (N) converted into milk and increases urine N excretion.

Feeding . . .



After land application, ammonia loss is less when the manure comes from cows fed a CP-adequate diet (13.6%) rather than a CP-excessive diet (19.4%).

Percent of applied N that's volatilized		
	Liquid manure type	
Diet CP* level	Fresh	Stored
13.6%	31%	12%
19.4%	68%	29%

***Crude protein**

Conclusion . . .



Remove excess protein from the cow's diet. This normally saves on feed cost, as well as reducing ammonia N loss.

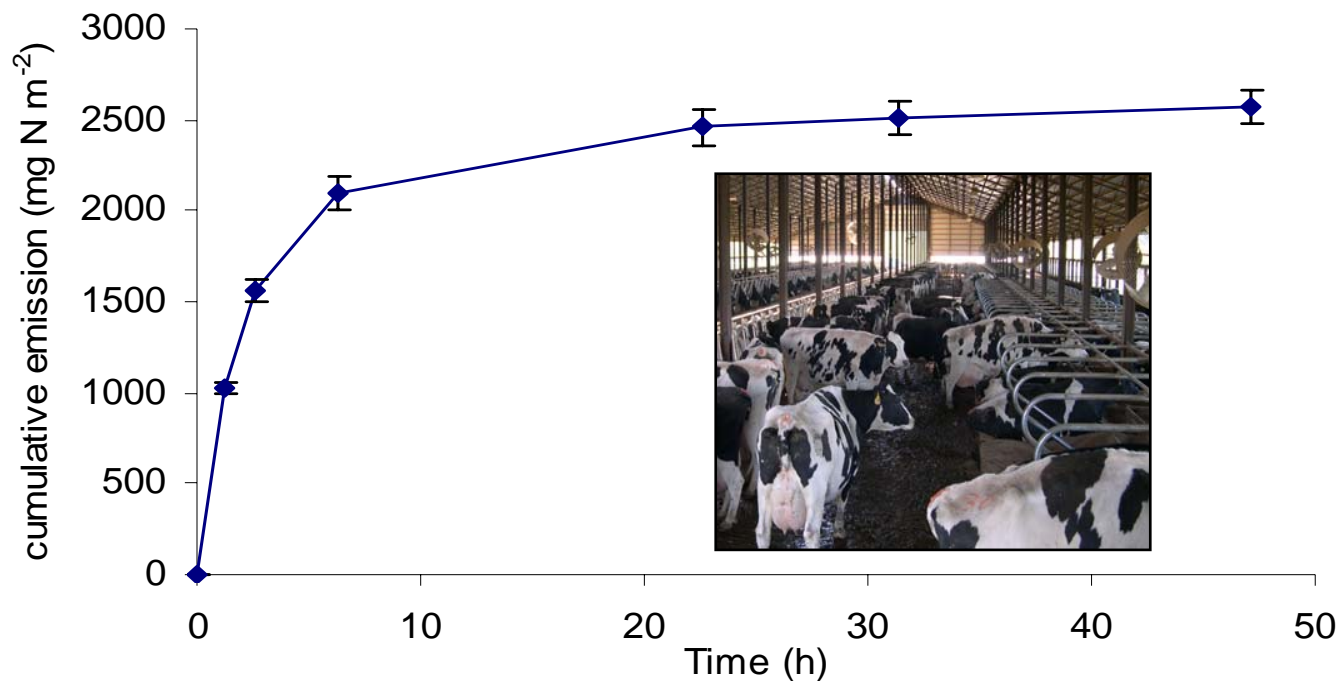
Studies at the U.S. Dairy Forage Research Center have shown that feeding protein in excess of 16-17% does not increase milk production, but does increase the amount of nitrogen excreted.



In the barn . . .



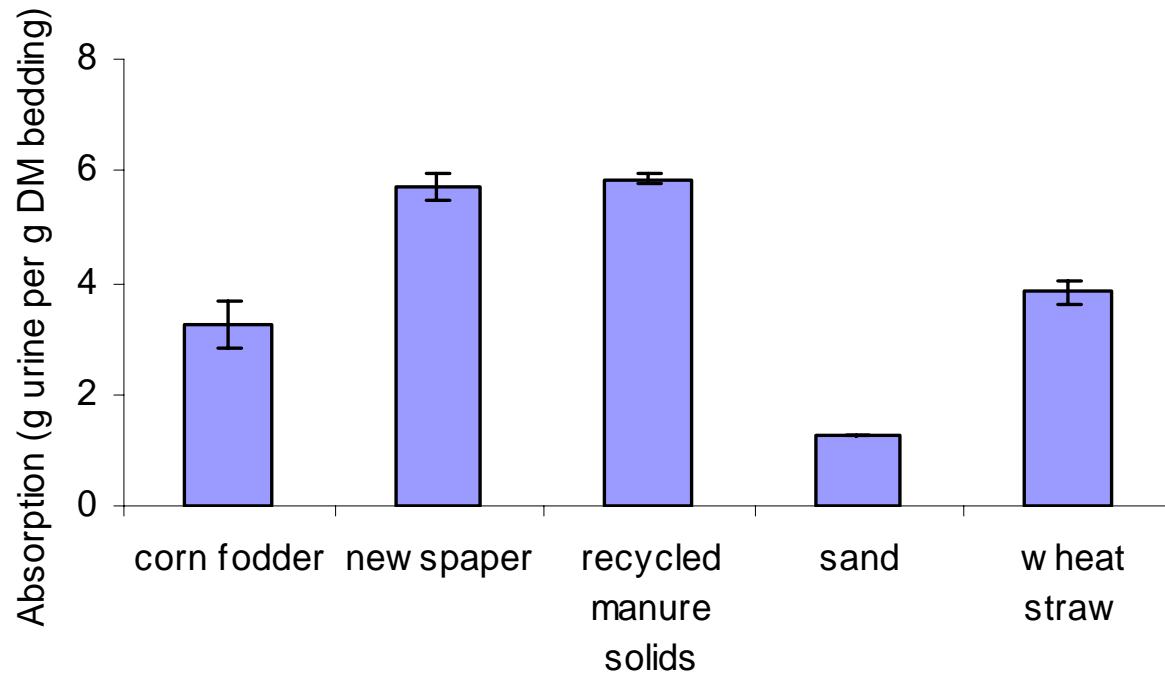
Most ammonia loss occurs within 4-6 hours after manure excretion.



In the barn . . .

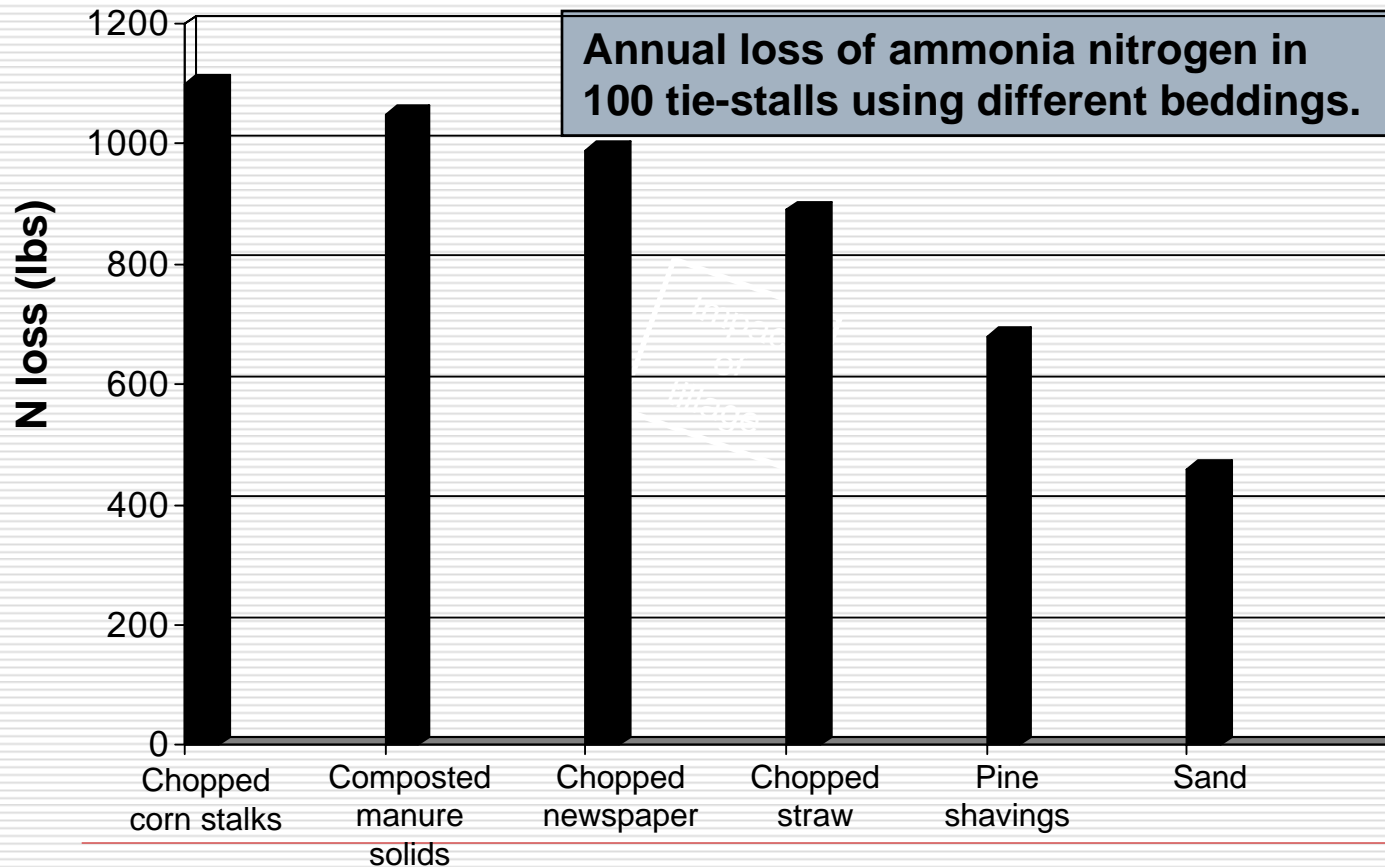
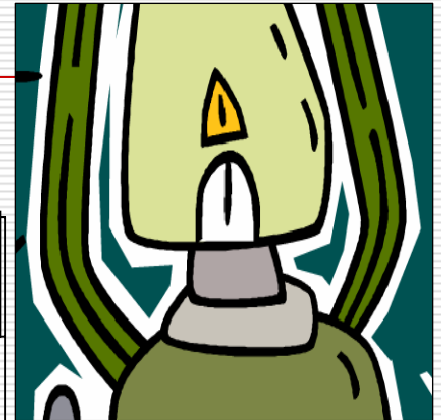


Different bedding types absorb different amounts of urine.



However . . .

... bedding types that absorb the most ammonia also have highest loss of ammonia nitrogen into the air; this is due to the 'wicking effect.'



Conclusion . . .



For new construction, floors that divert urine away from feces can reduce ammonia emissions. Slatted floors facilitate this.

Select bedding (e.g., sand, pine shavings) that separate feces and urine, which reduces ammonia losses.



In the field . . .



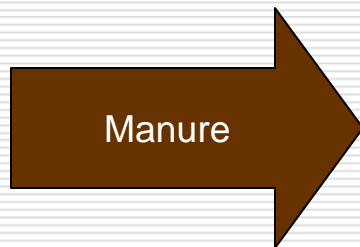
As can be seen from the table, much less nitrogen (N) is lost to ammonia when manure is knifed into the soil.

However, there is a trade-off; injection of manure may increase nitrate leaching. This is an area of our current research.

Impact of manure application on nitrogen cycling	Knifing in	Injecting in open slots	Band spreading	Broadcasting
Ammonia N loss	5	15	24	70
N going to soil	270	260	251	205

Quiz time:

How much of total manure nitrogen *is* recycled through crop on a dairy farm?



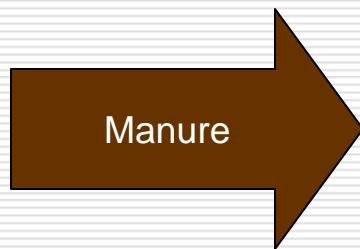
Answer:



10 to 40 %

Quiz time:

How much of total manure nitrogen *can be* recycled through crops on a dairy farm?



Answer:



40 to 60%

Improvements can be made with reductions in ammonia production and loss through:

- land application
 - diet manipulation
 - bedding, scraping interval
-

Quiz time:

How much of total feed nitrogen (crude protein) is converted into milk?

Answer:

Only 15 to 25%

of the nitrogen cows consume is converted into milk.

**Feed nitrogen use inefficiencies are inevitable.
But we can do better!**

Summary

Impact of improved management on reductions in ammonia emission

Management practice	Mechanism for decrease in ammonia loss	Approximate decrease in ammonia loss
Remove excess protein; feed a diet balanced properly for protein.	Decrease N output in urine	10 to 15 %
Cover manure storage	Decrease ammonia escape	20 to 30 %
Incorporate or inject manure	Reduce ammonia production and loss	30 to 50 %

Implementation of these management practices has the potential to reduce ammonia N loss from about 115 to 30-40 lbs/cow/yr . . .

. . . a 65-70% reduction.

Summary

This means that an additional 70-80 lbs N per cow would be available annually for application to field crops.

At a fertilizer N value of \$0.34/lb N, this can mean annual savings of

\$2,300 to \$2,700
per 100 dairy cows
on fertilizer costs.



This material courtesy of:

U.S. Dairy Forage Research Center

USDA-Agricultural Research Service

1925 Linden Dr. West

Madison, WI 53706

608-890-0050

Contact: Lori.Bocher@ars.usda.gov

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