Mitigating emissions from storage and Treatment

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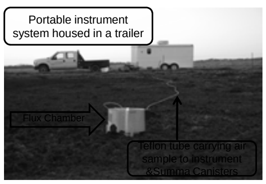
2009 Western Dairy Air Quality Symposium, Albuquerque, NM April 16, 2009

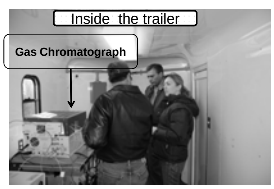
Current Research

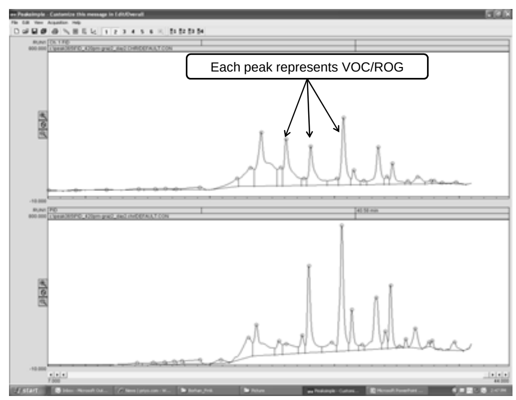
Seasonal Variations of Volatile Organic Compounds (VOCs) from Ground Level Area Sources of a Free-stall Dairy

by

Sergio Capareda and Saqib Mukhtar







Preliminary Results, Winter 2009

Compounds (μg/m³)	Settling basin	Grazing lot	Walking alley	Manure flush alley	Primary lagoon	Secondary lagoon
Acetic Acid	0.18	0.16	0.07	0.02	0.07	0.01
Propionic Acid	2.16	6.44	2.64	2.30	1.43	0.07
Isobutyric Acid	20.09	1.37	13.92	12.46	3.80	14.75
Butyric Acid	0.03	0.01	0.08	0.01	0.05	0.01
Isovaleric Acid	3.36	15.6	8.31	5.00	0.76	0.39
Valeric Acid	34.9	0.19	0.09	3.34	4.48	3.69
Hexanoic Acid	2.44	3.82	0.04	0.01	0.01	0.00
Phenol	0.77	1.02	0.11	0.09	0.24	0.04
P-cresol	0.95	6.09	2.34	0.58	0.06	0.00
4-ethylphenol	0.29	0.04	0.02	0.01	0.01	0.01
Indole	0.01	2.80	0.00	0.00	0.00	0.00
Skatole	0.00	0.00	0.00	0.00	0.00	0.00

Preliminary Comparisons

Compounds (μg/m³)	Winter, Franklin, Texas	
	Primary lagoon	Secondary lagoon
Acetic Acid	0.07	0.01
Propionic Acid	1.43	0.07
Isobutyric Acid	3.80	14.75
Butyric Acid	0.05	0.01
Isovaleric Acid	0.76	0.39
Valeric Acid	4.48	3.69
Hexanoic Acid	0.01	0.00
Phenol	0.24	0.04
P-cresol	0.06	0.00
4-ethylphenol	0.01	0.01
Indole	0.00	0.00
Skatole	0.00	0.00

Ammonia Volatilization

- Crude protein in dairy diets
- Total ammonium concentration
- pH
- Moisture content
- Air velocity
- Source and ambient temperature…

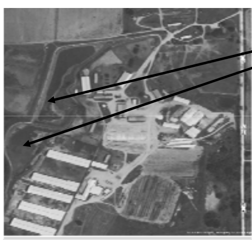
Technologies to reduce NH3 emissions from Treatment and storage?

Open-lot Dairy ~ 2000 Lactating Cows

secondary (11.5 ac) lagoons = 13 ac

-Total surface area of primary (1.5 ac) and -

Hybrid Dairy ~ 2000 Lactating Cows



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-Total primary and secondary lagoons area = 8.2 ac

Lagoon Sampling

NH_3 Emissions from Open-lot Dairy

Lagoons contributed

– 37 % to summer emissions
– 5% to winter emissions

NH_3 Emissions from Hybrid Dairy

Lagoons contributed

– 65 % to summer emissions
– 2% to winter emissions

Mitigation Practices

– Proper management of lagoons
– Summer irrigation of lagoon effluent during cooler temperatures
– Lagoon covers (Porous and non-porous)
– Aeration of the storage (secondary) lagoon
– Gas permeable membranes??

Lagoon Cover: Gaseous Emissions Control–Flaring-Energy

Management Issues

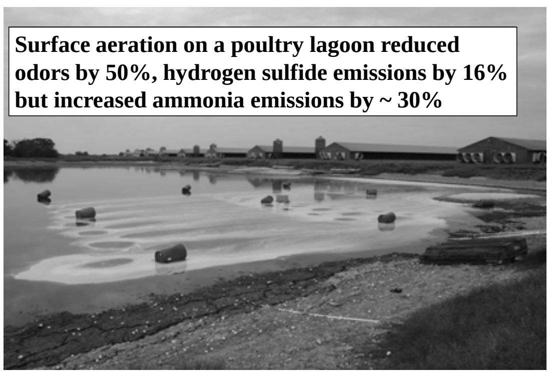
Agitation/Irrigation/Sludge Management

Large surfaces– Rainwater Debris & Silt Management

Porous Covers*

- Porous covers were tested on hog lagoons to reduce odor, total reduced sulfur (TRS) compounds, ammonia, total hydrocarbons, VOCs.
- Cover types- Geotextile, Recycled Foam, Natural (shredded straw and chopped redwood)
- All covers substantially reduced TRS emissions and odor.
- Geotextile fabric and the recycled foam cover caused greatest reduction in total hydrocarbon emissions
- Natural covers were less effective.

*Regmi et al., 2007. Effectiveness of Porous Covers for Control of Ammonia, Reduced Sulfur Compounds, Total Hydrocarbons, Selected Volatile Organic Compounds, and Odor from Hog Manure Storage Lagoons." Journal of the Air & Waste Management Association, Volume 57, pp761-768.



Surface aeration on a poultry lagoon reduced odors by 50%, hydrogen sulfide emissions by 16% but increased ammonia emissions by ~ 30%

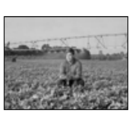
Limitations to Implementing Mitigation Practices

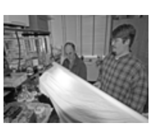
- Chemical or biological additives with staying power??
- Costs-Lagoon covers, Aeration etc.

New Technologies??

USDA, ARS
Florence, South Carolina

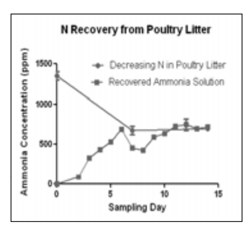
Recovery of ammonia From Liquid Manure using gas membranes





Courtesy of Drs. Matias Vanotti and Ariel Szogi

Recovery and Concentration of Ammonia at Florence, SC

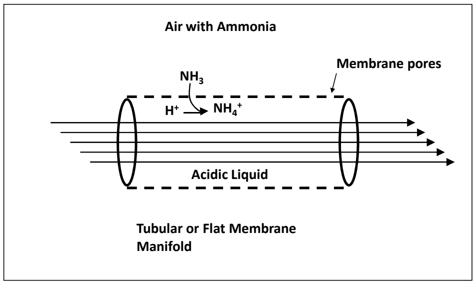


o **Ammonia permeation through novel materials**

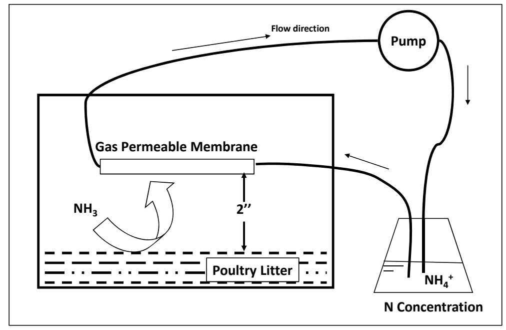
o **Applications include removal and recovery of ammonia from <u>chicken houses</u> and from <u>liquid manure</u>**

o**Product is ammonia solution with 10,000 to 50,000 ppm N**

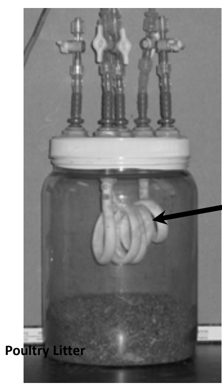
Concept of Capturing Ammonia Using Gas Permeable Membranes



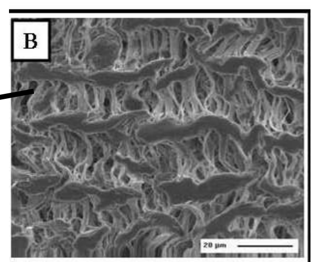
Capture and Recovery of Nitrogen From Air in Poultry Houses



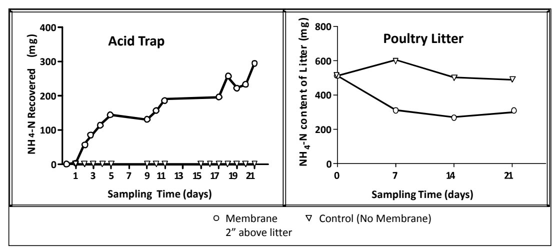
Laboratory Test – ePTFE Membrane



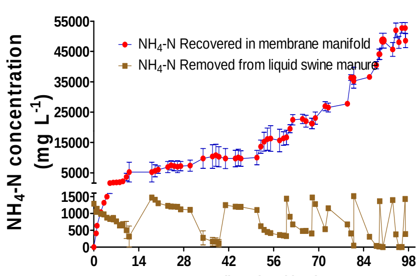
Gas Permeable Membrane
Microscopic structure



Nitrogen Recovered from Poultry Litter Using Gas Permeable Membrane Lab Test Results



Recovery and Concentration of Ammonia from <u>Liquid</u> Swine Manure using Gas Membranes (10 batches)



Thanks! Questions!!