Welcome

A Lunchtime Webinar Series

Serving Pennsylvania’s Best Practices on Animal Ag, Water-, and Air Quality

On Water Quality – Manure Storage & Treatment (liquid)

- Bob Graves, Penn State Agricultural & Biological Engineering
- Heather Smeltz, Natural Resources Conservation Service
- Robb Meinen, Penn State Dairy and Animal Science

HOST: Virginia Ishler
Nutrient Management Specialist & Dairy Complex Manager
Penn State University, Dept. of Dairy & Animal Sciences
Manure Du Jour

February 5, 2009

Bob Graves

Penn State Agricultural & Biological Engineering
Liquid Manure Storage and Treatment

Robert E. Graves, Professor
Agricultural and Biological Engineering Department
201 Agricultural Engineering Building
814 865 7155
reg2@psu.edu

Penn State is committed to affirmative action, equal opportunity, and the diversity of it’s work force.
Manure Types –
ASABE (S292.5)plus 1

- Liquid manure (thin slurry)
- Slurry manure
- Semi-solid manure
- Solid manure
- Sand laden manure
  (not an ASABE designation (yet))
Consistency – “liquid manure”

• Flows
• Does not stack
• Needs to be contained (tanks and ponds)
• Handle with pumps/pipes
Manure Safety

- machinery
- pathogenic microorganisms
- drowning
- asphyxiation
- poison gas
Manure Gases

• Hydrogen Sulfide-colorless, heavier than air, can cause death in seconds.
• Carbon Dioxide –colorless, odorless, heavier than air-asphyxiating.
• Ammonia-lighter than air, irritant – eyes, throat and lungs, low continuous exposure.
• Methane-flammable and odorless-lighter than air, accumulates under roofs, covers.
Manure Treatment

• Why treat manure?
  – improve handling
  – add value
  – extract value
  – odor control
Improve Handling

• remove solids – remaining liquid easier to pump
  - solids easier to haul/market
• remove sand – easier pumping/less wear/less settling
• grind or chop; smaller particles
  – easier to pump or treat
Add value

• compost – easier to handle, less offensive, reduction in volume and weight, “better” soil conditioner; (requires addition of dry carbonaceous material to make a porous stackable material and enhance process)

• chemical additive – enhance nutrient separation/concentration, modify nutrient availability, adjust nutrient ratios
Extract Value

- biogas production – energy source
- sand separation – reuse sand
- nutrient concentration and separation
Odor Control

• biological stabilization;
  – anaerobic digestion
  – aerobic digestion

• chemical/microbial additives?

• solids separation?
Manure Treatment Systems

- Physical – solids separation, drying...
- Chemical – flocculation, disinfection
- Biological – anaerobic, aerobic, facultative
Solids Separation

- Gravity – settling tank/pond
- Screen – plugging/cleaning
  - Sloped screen
  - Cleaning mechanism
  - Vibration
- Extruder (screw press, belt)
- Cyclone
Drive in Settling Tank
Sloped Screen

Screen With Scrapper

Brush and Roller Screen

Extrusion Screen
Biological Treatment

• Manure is a biologically active (unstable) material
• Microorganisms and microbial systems will seek to stabilize (breakdown/live on) this material
• Natural systems may create undesirable side affects (odor) or end products
• Manipulating environment (temperature, oxygen, pH…) will encourage desirable microbial processes and outcomes
Terms

- Anaerobic – requires absence of oxygen
- Aerobic – requires presence of oxygen
- Facultative – can function with or without oxygen
- Endothermic – requires heat
- Exothermic – produces heat
- Psychrophilic – less than 68F
- Mesophilic – 95-105F
- Thermophilic – 110-140F
Biogas Production

• Reduces odors
• Conserves nutrients
• Produces energy
• www.biogas.psu.edu
Aerobic Treatment

• Shallow Lagoons (oxidation ponds)
• Aerated basins – compressed air, mechanical agitators
• Composting – windrow, aerated pile, in vessel
Safety is not optional!

If you are involved with manure handling, storage, treatment design, regulation, sales, education or operation safety is also your responsibility!

Safety is more than signs!
Related ASABE Standards

www.asabe.org

- S292.5 FEB04 – Uniform Terminology for Rural Waste Management
- S393.3 FEB04 – Manure Storage
- EP403.3 FEB04 – Design of Anaerobic Lagoons for Animal Waste Management
- S466.1 FEB04 – Nomenclature/Terminology for Livestock Manure Handling Equipment
That’s all I have for now and it is time to move on to Heather Smeltz P.E. NRCS
Liquid Manure Design Considerations

Heather Smeltz, P.E., NRCS
Lebanon Technical Center
2120 Cornwall Road, Suite 4
Lebanon, PA 17042
mailto: heather.smeltz@pa.usda.gov
February 5, 2009
Liquid Manure Design Considerations

• Objectives
  – Landowner
  – Environmental

• Design Considerations
  – Sizing
  – Siting
  – Storage “Type”
Liquid Manure
Design Considerations

• Objectives
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• Design Considerations
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  – Storage “Type”
Landowner Objectives

- Storage Duration
- Accessibility
- Cleanout
- Maintenance
- Appearance
- Cost
Environmental Objectives

• Store manure until it can be properly applied
• Keep clean water clean!
  – As soon as clean runoff touches manure, it becomes “dirty”
  – Dirty water must be collected and/or treated

It is easier (and cheaper) to prevent clean water from becoming dirty than to treat/store dirty water.
Liquid Manure
Design Considerations

• Objectives
  – Landowner
  – Environmental

• Design Considerations
  – Sizing
  – Siting
  – Storage “Type”
Design Considerations – Sizing

- Animal Data
  - Animal Numbers and Types
  - Size
  - Herd Average (if applicable)
- Bedding (if applicable)
  - Amount
  - Type
    - Straw
    - Sand
    - Others
Design Considerations – Sizing

- Runoff/Lot Water (if applicable)
- Milk House Water (if applicable)

\[(\text{Manure} + \text{Bedding} + \text{Runoff} + \text{Milk House}) \times (\text{Storage Duration}) = \text{Total Storage Volume}\]

- 25-year Rainfall (~0.5’)
- Pump Out/Sludge Build-Up (~0.5’)
- Freeboard (1’)

A 12’ deep structure only has 10’ usable storage...
Design Considerations – Siting

- Diversion of Clean Water
  - Diversions/Waterways
  - Curbing/Drop Boxes
  - Gutters/Downspouts

- Rock
  - Cost
Design Considerations – Siting

- Footer Drain
  - Leak Detection
  - Groundwater
Design Considerations – Siting

• Convenient to farming operation
• Safety
Design Considerations – Storage “Types”

• Glass-Coated Steel
  – Above Ground Storage
Design Considerations – Storage “Types”

- Concrete – Round Tank
  – Below Ground Storage
Design Considerations – Storage “Types”

• Concrete – Round Tank with a Ramp
  – Below Ground Storage
Design Considerations – Storage “Types”

- Concrete – Slatted
  - Under the barn floor
Design Considerations – Storage “Types”

- Lined Pond – Clay
  - Not recommending
Design Considerations – Storage “Types”

• Lined Pond – HDPE
Design Considerations – Storage “Types”

• Retrofits/Upgrades

Before – Clay Lined

After – Concrete Lined
Summary – Take Home Points

• Keep clean water clean!
• Size correctly – Haven’t had a complaint that manure storages was too large.
• Pick a type based upon operation and management of farm.

• For more information – NRCS Design Standard 313:
Thank You!

On to Robb Meinen…

CONTACT INFO
Heather Smeltz, P.E., NRCS
Lebanon Technical Center
2120 Cornwall Road, Suite 4, Lebanon, PA 17042,
heather.smeltz@pa.usda.gov

Liquid Manure - Design Considerations
Liquid Manure Storage
- Management -

Manure Du Jour
February 5, 2009

Robb Meinen MS
Senior Extension Associate
Department of Dairy & Animal Science, Penn State University
(814) 865 – 5986       rjm134@psu.edu
Who should know this…

For webinar audience:
- Important considerations for those who site, design, manage, or work with liquid manure.
- Management education should be part of the product.

Another audience:
- PA Act 49 – Commercial Manure Hauler & Broker Certification Act
  - Tune into 2/19/09 Manure Du Jour for a brief update on Act 49!
- Storage safety and management are incorporated into Act 49 curricula.
Know Your Freeboard

- Exceeding freeboard without an “Act of God” could be considered *negligent* management.
- Primarily producer responsibility.
- Overflowing manure may cause erosion that can lead to failure.
Exceeding Freeboard

Here freeboard is exceeded and forces throughout the structure are increased due to additional volume and weight of manure.

Therefore – risk is increased.

Exceeding freeboard is of greater concern for older or poorly managed structures.
Good Storage Management

- No large vegetation.
- Keep surrounding mowed & trimmed.

Roots can act as short circuits liquid flow paths. Roots can decrease the integrity of storage structures.
Storage Management

- Avoid animal damage
  - Keep banks mowed

“When the groundhog meets the muskrat you have trouble.”
Storages…

- Should be fenced.
- Pit access should be covered and locked.
Storages

Warning signs should be visible from all approaches.
Storage Egress

- There should be a simple way for someone to get out of a storage should they fall in.

- Some egress methods:
  - Ramps
  - Chains
  - Chain ladder
  - Rebar ladder
  - Depth gauge
Good Storage Management

- Follow BMP’s of Nutrient Management Plan

- Approaches & Loading Areas
  - Stable roadways
  - Large maneuverable areas
  - All-weather access
  - Free of
    - Mud
    - Water
    - Manure
Routine Inspection

- A record book should be kept by farm management.
- Demonstrates sound management.
- Provides liability protection.

- Monthly monitoring is a must.  
  Weekly is preferred.
Good records include....

- Depth gauge
  - Record depth weekly
  - Know max & min depths
  - Know freeboard depth
  - Before/after pumping
  - Develops knowledge of historic changes in levels
  - Early detection of concerns

- Leak detection system

- Rain gauge

- Records
  - Dated
  - Initial/signed
Confined Spaces

- **Do not** enter them!!
  *They’re like a closet door in a horror movie.*
- Gases can cause loss of consciousness and death.
- Always assume there are gases present.
Gases

- Some are odorless
- Most are colorless
- Some are explosive
- Some sink
- Some rise

- If it ain’t Oxygen –
  you ain’t breathing!
If someone is overcome by gas

1. **Ventilate** – turn on fans
   - open doors, curtains, covers
2. **Call 911** – mention confined space
3. **Cease agitation or manure movement**

- Do not go in after an unconscious person!
- > 50% of confined space deaths occur to rescuers.

- Always carry a mobile phone or radio when working around manure.
Environmental Emergencies and Spill Response

5 steps to minimize negative impacts on the environment:

1. Assure human safety.
2. Stop the flow at the source.
3. Contain and control existing spill.
4. Notify the proper authorities.
5. Clean up the spill.
Success Story

In April 2008 a trained applicator in Wisconsin lost control of a tanker. The photos below document spill response.

1) Incident with early containment dam.
2) Manure flow from was contained in several dams.
3) Up slope containment to slow potential rainwater.
4) Secondary dam with adsorbent material
5) Sand and straw dams catch manure and hosed water.
6) Cleaning road surface. Water & manure were removed from dam.
Informal poll of commercial haulers – some advice

- Saving time saves the producer money:
  - 12’ gates, lots of turning room, no backing up, pull-through loading is nice
  - Bedding decisions impact pumping/mixing
  - “Tons of access” requested

- Round, concrete, in-the-ground pits are the easiest to empty & agitate

- Ramps can impede agitation – acts as a dam
Industry advice
– under-floor pits

- Under-floor pits
  - Difficult to work with – especially cattle
  - “Never enough access pits”
  - “Always too small”
Thank you!

Feel free to contact me to discuss any of these issues in greater depth.

Pennsylvania will host the 2010 Northeast Manure Handling Expo
Thursday, July 15, 2010
PSU Ag Progress Days Facilities, Rock Springs, PA
Question and Answers

• Questions received in writing will be directed to the speakers by the host.
• Questions not answered during the time remaining, will be posted with answers at [www.aec.cas.psu.edu](http://www.aec.cas.psu.edu)
• Recordings of this session can also be viewed at the URL listed above.
Next Week on Manure Du Jour

On *Water Quality – Manure Storage & Treatment* (the solid variety)

- **Ann Swinker**, Penn State Dairy and Animal Science
- **Peter Vanderstappen**, Natural Resources Conservation Service

For more information
[www.aec.cas.psu.edu](http://www.aec.cas.psu.edu)