Manure Systems & Irrigation: Technology and Operation

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Sustainability & Manure Cycling

Manure System

Dairy Manure Management System

Manure Management System

1) Production: Determine the kind, consistency, volume, location, and timing
2) Collection: Initial capture and gathering
   - collection method, location, scheduling, labor, impact on consistency
3) Treatment: Reduce the pollution potential (physical, chemical, biological)
   - waste characteristics (before and after treatment); size, type, and location
4) Storage: Temporary containment, which gives flexibility
   - storage period, volume, type, size, location of facility
5) Transfer: Movement and transportation of manure
   - waste consistency being moved; method; distance; frequency/scheduling
6) Utilization: Reusable vs. non-reusable products
   - used as energy source, bedding, mulch, animal feed, plant nutrients
     - select fields; schedule applications; distribution systems; rate/volume
Manure Production

Manure Composition

- Variable due to feed, animal, environmental conditions
- Macro and Micro Nutrients (N-P-K)
  - Soluble and insoluble
  - Organic and inorganic
- Organic Matter
- Water
- Fiber
- Pathogens

Percent Solids

<table>
<thead>
<tr>
<th>Animal</th>
<th>Solids Content</th>
<th>Handling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swine</td>
<td>As received</td>
<td>Irrigation Equipment</td>
</tr>
<tr>
<td>Poultry</td>
<td>As received</td>
<td>May require special pumps (chopper pump)</td>
</tr>
<tr>
<td>Beef cattle</td>
<td>As received</td>
<td>Too thick for pumping, too thin to scoop - typically add water</td>
</tr>
<tr>
<td>Dairy cows</td>
<td>As received</td>
<td>Stacking, moved with bucket loaders (&gt;25% typically seepage, no longer a concern)</td>
</tr>
</tbody>
</table>

Solids Content
Manure Collection

Manure Processing Anaerobic Digester

Nutrients & Anaerobic Digestion

Dr. Becky Larson, UW Madison
**Phosphorus**

![Phosphorus Graph]

**Total Nitrogen**

![Total Nitrogen Graph]

**N-P-K**

<table>
<thead>
<tr>
<th>Concentration</th>
<th>N (g/kg)</th>
<th>P₂O₅ (g/kg)</th>
<th>K₂O (g/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manure</td>
<td>50</td>
<td>18</td>
<td>41</td>
</tr>
<tr>
<td>Liquid</td>
<td>101</td>
<td>27</td>
<td>75</td>
</tr>
<tr>
<td>Solid</td>
<td>15</td>
<td>14</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ratio</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manure</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Liquid</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Solid</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**Sand Separation**

![Sand Separation Image]

**Advanced Treatment**

![Advanced Treatment Image]
Manure Application Methods
Manure Irrigation Equipment

Use of Irrigation Equipment

- Must adapt system
  - Lower solids content required
- Typically results in decreased application costs (~ $0.01/gal but largely variable)
- Can have water quality benefits
- What about air quality and pathogen transport?
- Odor will always be an issue
- Wide variety of rules throughout the country and world, not a lot of information that is science based

Previous Research

- Transport affected by
  - Physical properties of droplet (shape, size, density)
  - Meteorological factors (wind velocity, relative humidity, temperature, precipitation)
- Transmission on pathogens through airborne routes is unknown and controversial
- Factors affecting airborne microorganism survival
  - Relative humidity
  - Temperature
  - Solar irradiance
  - Oxygen (bacteria)
- Limited information on manure irrigation application systems and pathogens (1-2 peer reviewed studies)

Pretreatment for Irrigation

Traveling Gun
Manure and Water?

- There is the possibility of running manure and water through one system
- Producers must demonstrate ways in which they will avoid contamination
  - Check valves/back flow preventers
  - Physically changing lines
  - Avoiding direct hookup of water

Drop Nozzles
Operation
Can control many pieces on the system:
• Speed of travel
• Pressure
• Nozzle type
• End gun shut off
• Computerized systems which detect wind speed, etc.
• More specialized application

What do we want to know?
• Setback distances
• Beneficial management practices
• Risk assessment
• Operational choices and impacts
• Equipment options and impacts
• Weather/meteorological impacts
• The list goes on....

Thank You!
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