Manure Systems & Irrigation: Technology and Operation

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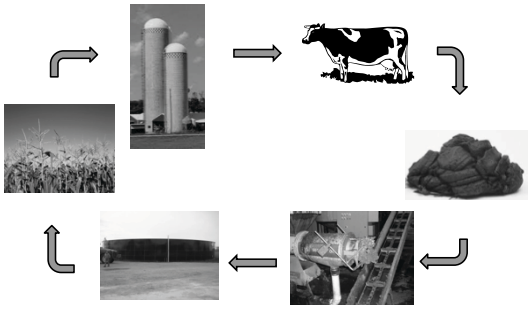
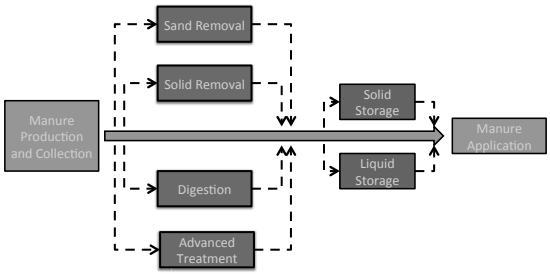
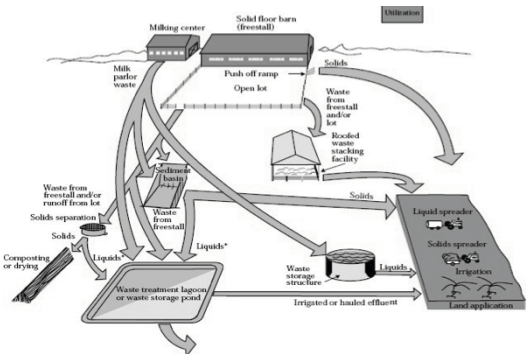
Sustainability & Manure Cycling



Manure System

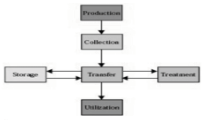


Dairy Manure Management System



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*

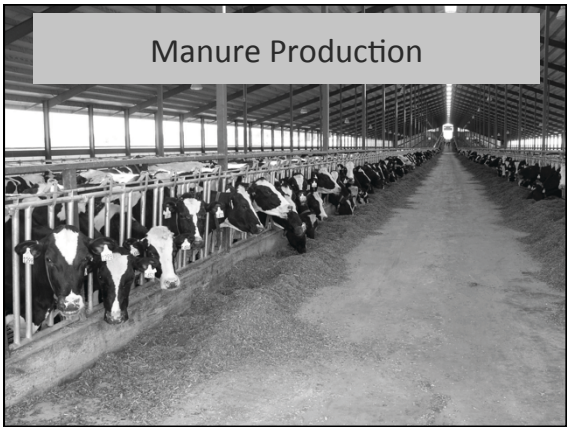
3) **Treatment:** Reduce the pollution potential (physical, chemical, biological).
   - *waste characteristics (before and after treatment); size, type, and location*

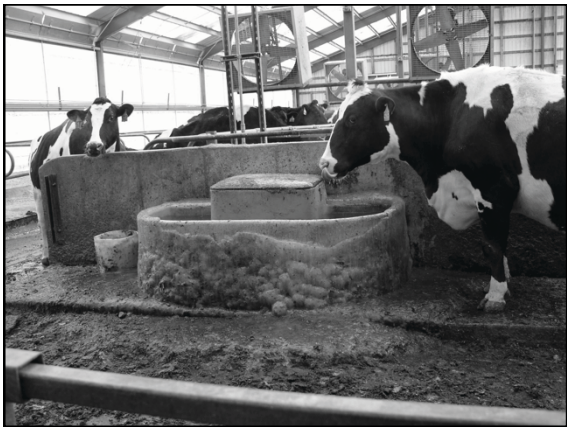
4) **Storage:** Temporary containment, which gives flexibility
   - *storage period; volume; type, size, location of facility*

5) **Transfer:** Movement and transportation of manure
   - *waste consistency being moved; method; distance; frequency/scheduling*

6) **Utilization:** Reusable vs. non-reusable products. Land application most common.
   - *used as energy source, bedding, mulch, animal feed, plant nutrients*
   - *select fields; schedule applications; distribution systems; rate/volume*

Manure Production

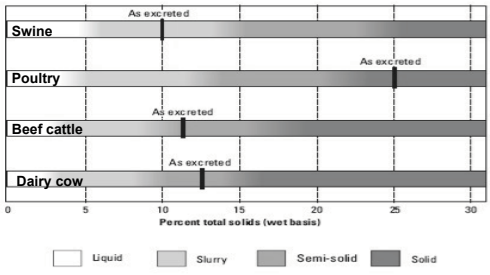




Manure Composition

- 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

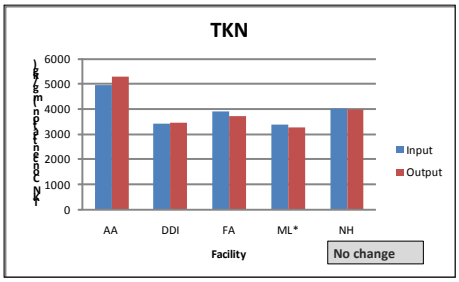


Solids Content

Manure	Solids Content	Handling
Liquid	$M_{solids} \leq 4\% M_{manure}$	Irrigation Equipment
Slurry	$4\% M_{manure} < M_{solids} \leq 10\% M_{manure}$	May require special pumps (chopper pump)
Semi-Solid	$10\% M_{manure} < M_{solids} \leq 20\% M_{manure}$	Too thick for pumping, too thin to scoop – typically add water
Solid	$M_{solids} \geq 20\% M_{manure}$	Stacking, moved with bucket loaders (>25% typically seepage no longer a concern)

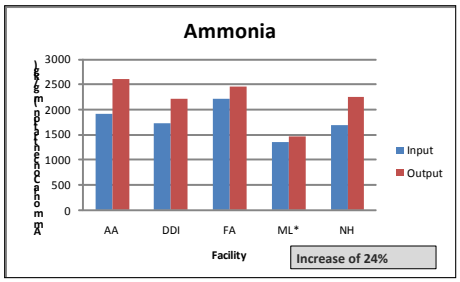
Manure Processing Anaerobic Digester

Nutrients & Anaerobic Digestion



Wright, et al. 2004. Preliminary Comparison of Five Anaerobic Digestion Systems on Dairy Farms in New York State

Nutrients & Anaerobic Digestion



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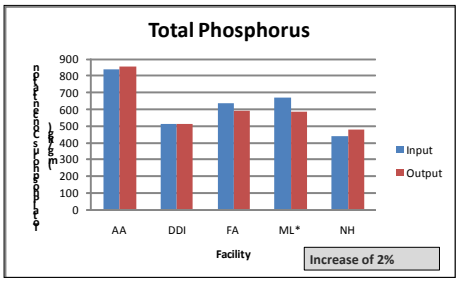
Nutrients & Anaerobic Digestion



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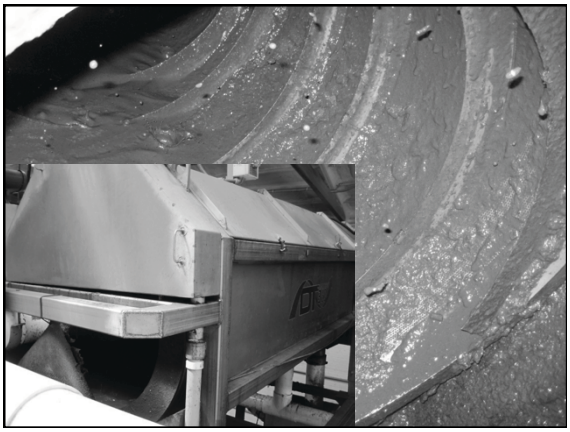
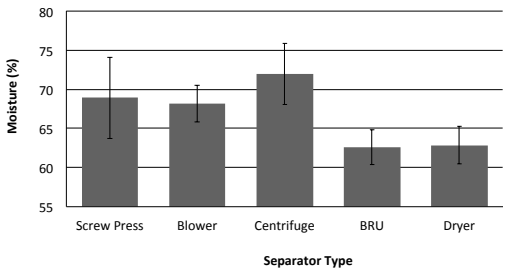
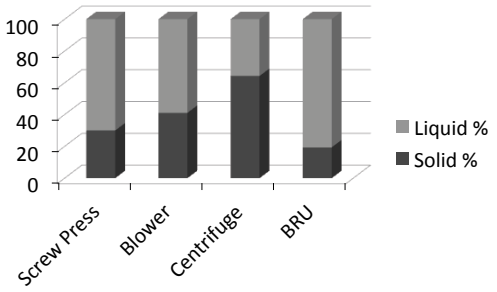


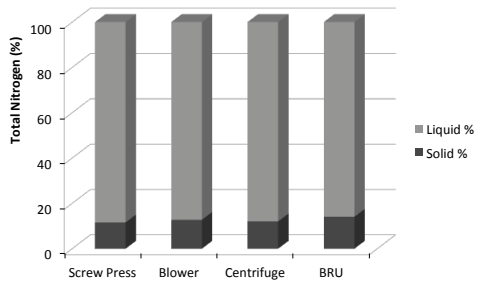
Moisture of Solids - By Separator Type



Phosphorus



Total Nitrogen



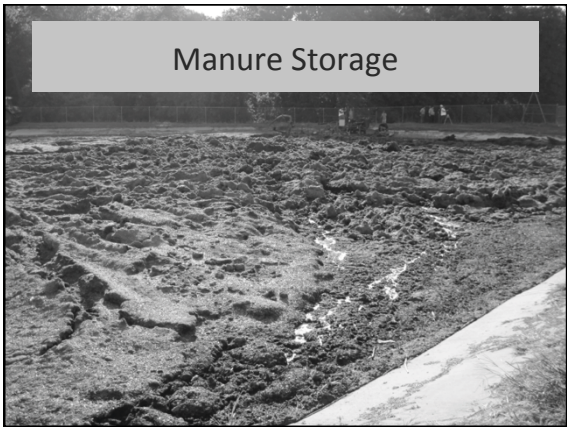
N-P-K

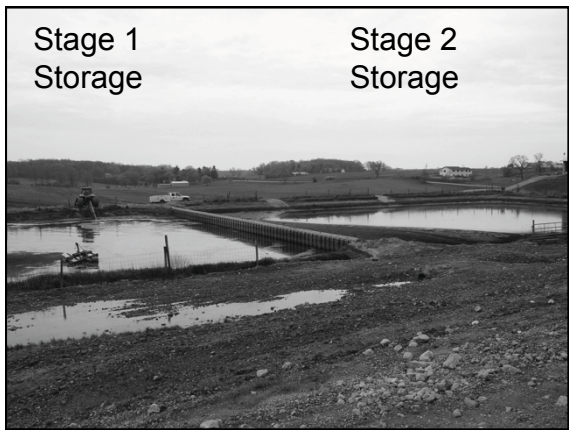
Concentration	N (g/kg)	P_2O_5 (g/kg)	K_2O (g/kg)
Manure	50	18	41
Liquid	101	27	75
Solid	15	14	8

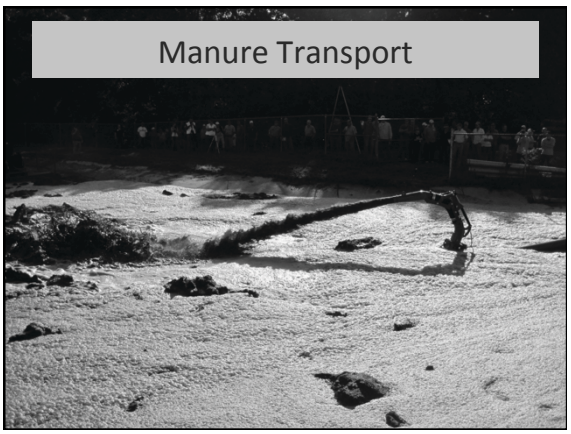
Ratio	N	P_2O_5	K_2O
Manure	3	1	2
Liquid	4	1	3
Solid	2	2	1

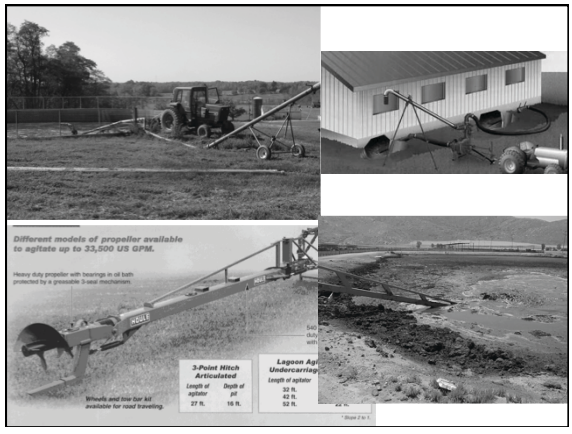
Sand Separation

Advanced Treatment


Manure Storage


Stage 1
Storage
Stage 2
Storage

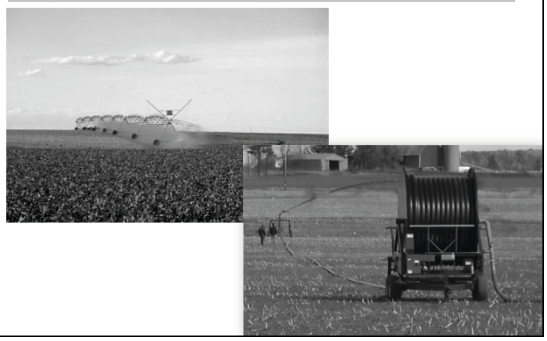

Manure Transport


Different models of propeller available to agitate up to 33,500 US GPM.
Heavy duty propeller with bearings in oil bath protected by a greaseable 3-seal mechanism
3-Point Hitch Articulated
Length of agitator
27 ft.
Depth of pit
16 ft.
Wheels and tow bar kit available for road traveling.

Manure Application Methods

Midwest Plan Service

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)

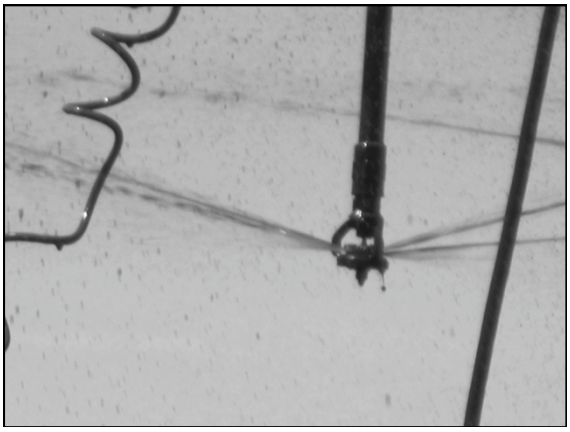
Pretreatment for Irrigation

Traveling Gun

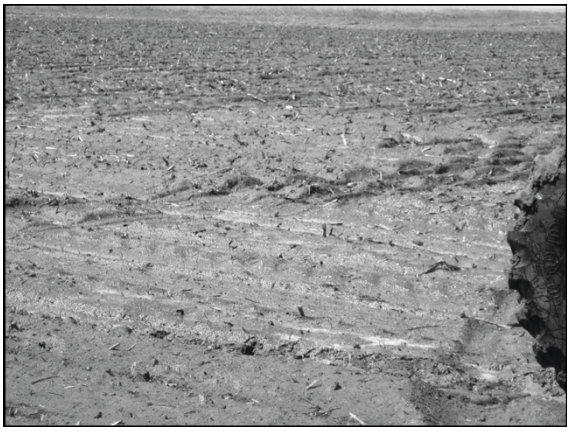

Center Pivot

Manure and Water?

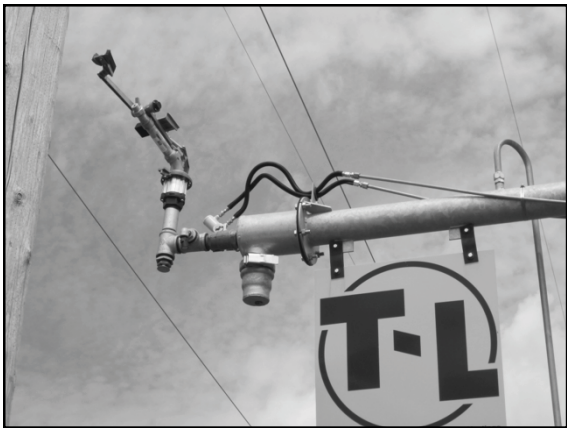
- There is the possibility of running manure and water through one system
- Producers must demonstrate ways in which they will avoid contamination
  - Check valves/back flow preventers
  - Physically changing lines
  - Avoiding direct hookup of water



Drop Nozzles



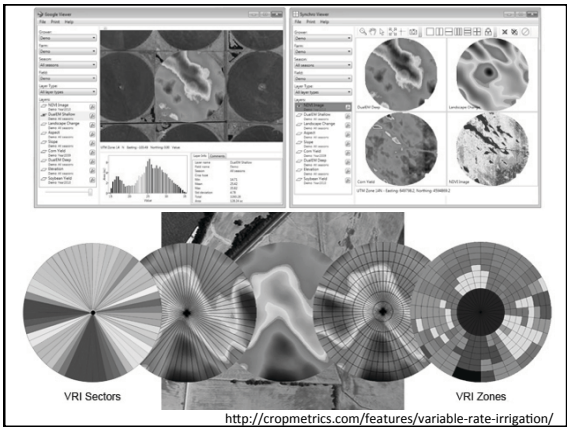
End Gun



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



http://cropmetrics.com/features/variable-rate-irrigation/

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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