Sand Settling Lanes

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Univ. of Wisconsin Study

<table>
<thead>
<tr>
<th>Issue</th>
<th>Sand</th>
<th>Mattress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lameness</td>
<td>15 %</td>
<td>25 %</td>
</tr>
<tr>
<td>Hock/Legs</td>
<td>10.4%</td>
<td>24.4%</td>
</tr>
<tr>
<td>Culling</td>
<td>26 %</td>
<td>38 %</td>
</tr>
<tr>
<td>Milk Production</td>
<td>26,058</td>
<td>24,064</td>
</tr>
</tbody>
</table>

Assumptions  $12/cwt and 500 cows  
Milk Production $23,928 Lameness $7,400  Culling $18,000  
TOTAL $49,300 or Gross $500/cow/year  
Andy Johnson – sand worth $1.66/cwt more compared to mattress

Sand in Freestalls

- Clean  
- Comfortable  
- Lower Bacteria  
- Cost  
- Handling

Positive Attitude & Commitment

- Removal  
- Separation  
- Stacking

SLM Systems are Complex

- Removal of manure  
- Movement to sand recovery area  
- Sand separation  
- Move sand to storage area  
- Move liquids/solids to separation unit  
- Solids removal process  
- Move solids to storage area  
- Transfer liquid to storage area

Basics of Sand Separation

- Separation based on Density  
  - Water – 62 lbs / cubic foot  
  - Sand – 120 to 150 lbs / cubic foot  
- Mixing of Ingredients  
  - Water – Manure – Sand  
- Suspension of mixture  
  - Dilution & High Velocity  
- Change velocity of suspended mixture  
  - Sand settles out if done correctly
Why are some sand recovery systems successful?

Reclaiming sand requires water – the more the better
- Total solids content in lagoon water
  - One website – 1% total solids
  - 3% realistic
  - 5% trouble
- Sources
  - Rainwater
  - Roof / Extraneous
  - Pasture Ponds
  - Milk Parlor / Sprinkler System

Additional Water Required If 100% of Waste Stream is Diluted

<table>
<thead>
<tr>
<th>Solids in Recycle Water %</th>
<th>Separator Efficiency</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>0*</td>
</tr>
<tr>
<td>1</td>
<td>204 g/d/c</td>
</tr>
<tr>
<td>2</td>
<td>95</td>
</tr>
<tr>
<td>3</td>
<td>58</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>29</td>
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</table>

*Percent solids recovered and solids moisture content

500 Cow Dairy

<table>
<thead>
<tr>
<th>Solids in Recycle Water %</th>
<th>Annual Water Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0*</td>
</tr>
<tr>
<td>Manure</td>
<td>3,100,000</td>
</tr>
<tr>
<td>Separator</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>40,500,000</td>
</tr>
<tr>
<td>3</td>
<td>13,900,000</td>
</tr>
<tr>
<td>5</td>
<td>8,600,000</td>
</tr>
</tbody>
</table>

*Percent solids recovered and solids moisture content

WI Dairy Producers

As the solid contents in recycled water increased, satisfaction with sand quality decreased proportionally.

New vs Recycled Sand

- Annual Sand Usage (55 lb/stall/day)
  - 20,000 lbs or 10 tons
  - $10/ton = $100/stall/yr

- Extra Water (20 gal/dy/stall)
  - 7,300 gallon/yr/stall
  - $0.015/gal disposal = $110/stall

- If all of the sand/stall/yr goes on 1 acre for 10 years = equals ½ inch of sand added to field (about 1 dump truck load per acre)
Inorganic Bedding – Recycle Sand
- Scrape System – Mechanical separation
- Flush Plume System – Mechanical or gravity separation
- Flush System – Mechanical separation Gravity separation

Flushing Criteria
- 1 ½ to 2 % slope
- Flush wave velocity > 5 fps (7.5 to 10 fps)
- Contact time of 10 seconds
- Wave depth of 3 to 4 inches
- 10,000 gpm release rate
- 1 to 1 ½ gallon per sq ft of floor area
- Dilution ratio 6 to 1 (water to SLM)

DM and OM content of sand in free stalls

3 Types of Gravity Sand Recovery Systems
- Sand Trap -- KS, PA
- Sand Lane -- KS, CA, FL, GA, TX, PA, MD, IA, MN, SD, WI, MI
- Sand Beach -- VA

The challenge is once sand is in suspension to maintain the water velocity until the desired location to settle the sand – once the water velocity slows down – sand will settle and must be resuspended if it occurs in a non desirable location.
Gravity Sand Recovery

- Reduce velocity to 1 to 2 fps
- Large volume of water
- Change velocity quickly at exit
- Drying period required
- Dirty water only
- Rewash "dirty" sand

Sand Trap

- 40 ft wide, 40 ft long, 3 to 4 ft deep
- Sand storage basin (7 to 21 days)
- Manure storage when scraping
- Outlet pipe design critical
- Sand will have <3 % organic matter
- Sand may be more moisture

Organic Matter vs Ash (sand)

![Graph showing organic matter vs ash (sand)]
Sand Lane

- 12 ft wide, >150 ft long, 1 ft deep
- 1/10 to ¼ % slope
- Sand storage (<7 days)
- Redistribute dirty sand
- Slope & flush volume critical
- Sand will have <1 % organic matter

Direction of Water Flow

Longer lanes result in settling more of the finer sand particles

Sand will settle where water flow is interrupted or the water velocity is reduced. Design fine velocity is 1-2 fps – less than 1 fps results in organic matter settling.
Sand Dewatering Pad
Lane Slope 0.2 to 0.25 %
10 – 16 ft
Width based on inlet water volume
125-300 ft
30 ft min
Sand Beach

- Variable width, length and depth
- 1/10 to 1/4 % slope
- Sand storage (<45 days)
- Redistribute dirty sand
- Counter slope critical
- Sand will have <1 % organic matter

Sand Stack Pad

Inflow

Flush Plume – Width is a function of water velocity and channel slope

Transition from square to round tube causes sand to settle at entrance due to change in velocity

Solid Separation

- Mechanical Systems –
  - Stationery screens
  - Roller presses
  - Extrusion units
- Non Mechanical Systems -
  - Weep Walls
  - Trenches
  - Small Lagoons
Solid Separation

- 150 lbs/cow/day @ 87 % M.C.
  - 20 lbs solids & 130 lbs liquid
- 20 % Removal & 60 % M.C.
  - 10 lbs removed -- 140 lbs to lagoon
- 60 % Removal & 80 % M.C.
  - 60 lbs removed -- 90 lbs to lagoon

Flushing or Scraping Systems

- Sand separator
  - change water velocity and drop out sand
- Solid storage basin (trench basin)
  - settle sand and organic matter from water
- Lagoon or storage pond
  - storage structure for fresh and flush water