Covered Lagoon Digesters (Ambient Temperature)

Mark Moser
RCM International
Oakland, CA
510-834-4568
RCM International LLC
Digester Solutions

- >25 years building digesters on farms
- >85 digesters operating
- Digesters are our **only** business
- Complete Mix, Plug Flow, Covered Lagoon
- Staff in CA, NY and PA, Projects worldwide
RCM Plug Flow Digester
Langerwerf Dairy, Durham, CA 1983,
300 cows, 70 kW,

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contact@rcmdigesters.com
510-834-4568
RCM Complete Mix Digester
Kreider Dairy – Quarryville, PA
700 cows, 225 kW

RCM International
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510-834-4568
RCM 28,000 beef plus stillage complete mix digester w concrete cover
Tollenaar Dairy, CA, 1000 cows, 225 kW
Heated Mixed Covered Lagoon

RCM International
contact@rcmdigesters.com
510-834-4568
238,000 Finishing Pigs, Heated Covered Lagoon Digester, Chile

RCM International
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510-834-4568
Covered Lagoon Digester

- Aka “Ambient Temperature Digester” or Psychrophillic Digester
- Single Purpose Lagoon with optimized design to produce biogas
- Used for flush or dilute manure
- Not a manure storage facility
Covered Lagoon Digester
Castelanelli Brothers, Lodi CA

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Covered Lagoon Digester

- Receives dilute manures with < 2% solids
- Best used in warm climate
- No supplemental heat required
- HRT > 30 days
- Remove floatable solids and sand before digester
Advantages

- Low Cost to Build/Operate at any size
- Extremely low cost at large sizes
- Very easy to operate
  - Feed the digester the designed amount and it will make gas
  - Nothing to adjust
- Maintenance should be almost zero
600 Cow Covered Lagoon Digester, California

RCM International
contact@rcmdigesters.com
510-834-4568
6,000 Cow Covered Lagoon Digester, Chihuahua, Mexico

RCM International
contact@rcmdigesters.com
510-834-4568
4,000 nursery pigs – Ecuador
Covered lagoon digester

RCM International
contact@rcmdigesters.com
510-834-4568
103,000 Finishing Pigs, Covered Lagoon Digester, Chile

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510-834-4568
Limitations

- Biogas production varies seasonally
- Difficult to build in high ground water area
- Manure pre screening/settling required
IJ Digested Solids for Cow Bedding and Sale – 20 years of profit

Illustration of Monthly Mean v. Annual Mean

Cubic Feet CH₄ per Day

Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec

0  20,000  25,000  30,000  35,000
Digester Design

- NRCS Practice Standard 366
- Design based on waste strength or Hydraulic Retention Time (HRT)
- Consider Soil Type
- Liner may be needed
- Gas seal critical
- Inlet/Outlet location recommendation
Sizing a Covered Lagoon
NRCS Practice Standard 366

Figure 1. Covered lagoons - maximum loading rate (lb VS/1,000 ft$^3$/day).

Figure 2. Covered lagoons - minimum hydraulic retention times (MINHRT) in days.

Minimum HRT if minimum treatment volume is < minimum HRT to achieve ~60% VS destruction

Map showing hydraulic retention times for different regions.
USDA NRCS Guidance – Use of Biogas

Figure 3. Covered lagoons - locations suitable for biogas to energy conversion generally fall below the 40th parallel.

Figure 4. The type of digester selected is affected by multiple parameters and subject to specific design considerations (US EPA – AgStar).
Baldwin Dairy, Baldwin, WI
Odor control, rainfall exclusion cover

Built 1999
Gas flaring 5 –6 months per year
Lagoon by NRCS, Cover by EFI
Gas handling by RCM Digesters

RCM International
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Castelanelli Brothers Dairy Lodi, CA
Covered Lagoon Digester 2,000 cows, Sand Bedding, Flush

300 kW Generator

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La Ramirana 30,000 pigs
Covered lagoon digester
Covered Lagoon Digester Components

1. Digester
2. Solids/Sand Recovery
3. Digester
4. Gas Management and use
   Compression, cleanup, use, safety
Components
Lagoon Digester

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Components – Cover

5000 cows, Covered Lagoon Digester, California

Cover Collects and Directs Gas
and Manages Rainwater

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Component Solids Separator before Covered Lagoon Digester

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contact@rcmdigesters.com
510-834-4568
Component – H2S Gas Scrubber

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contact@rcmdigesters.com
510-834-4568
Gas Handling
Castelanelli, Lodi, Ca

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contact@rcmdigesters.com
510-824-4568
Component Gas Use: 300 kW

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contact@rcmdigesters.com
510-834-4568
800 kW Generator

RCM International
contact@rcmdigesters.com
510-834-4568
400 hp Biogas Boiler and Gas Skid, Chile

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contact@rcmdigesters.com
510-834-4568
Component - Safety Flare

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Can you add Food waste to a covered lagoon? Plan for it
Can you heat a covered lagoon digester?

- The answer: Maybe
- Lagoon temperature can be raised depending on the climate
- Results of heating a covered lagoon are better gas production in colder months
- Typically there is not enough gas or waste heat to raise a digester into mesophillic temperatures in the winter.
Nitrogen removal after Covered Lagoon Digesters

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RCM International – What we do:

RCM Digesters:
Plug Flow, Complete Mix, and Covered Lagoon digesters

RCM Services
1. Cost Estimates
2. Detailed Feasibility Studies
3. Design and equipment supply
4. Equipment Manufacturing
5. Turnkey construction
## Manure Odors

<table>
<thead>
<tr>
<th>Sample</th>
<th>TON*</th>
<th>Odor Impact</th>
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<tbody>
<tr>
<td>Undigested Influent</td>
<td>247</td>
<td>--</td>
</tr>
<tr>
<td>3-day Storage</td>
<td>437</td>
<td>77% Increase</td>
</tr>
<tr>
<td>Digested Effluent</td>
<td>7</td>
<td>97% Reduction</td>
</tr>
</tbody>
</table>

*Total Odor Number*