Biogas Storage – Don’t Let Your Renewable Energy go to Waste!

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How to Participate Today

- Audio Modes
  - Listen using Mic & Speakers
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- Submit your questions using the Questions pane.
- A recording will be available for replay shortly after this webcast.
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Assumptions

You Already Know:
• Anaerobic Digestion is used to stabilize and reduce sludge from wastewater
• Anaerobic Digestion occurs in the absence of Oxygen
• Anaerobic Digesters need to be heated and mixed
• Biogas is a product of Anaerobic Digestion
• Biogas is a wet mixture of CH₄, CO₂ and trace contaminants
• Biogas can be beneficially used in many ways
• It all starts with capturing it
Gas Storage

Is Gas Storage Necessary?

• Anaerobic Process is continuous but not steady state.
• Consumers of digester gas are not necessarily steady state.
• Production ≠ Consumption
• Differences between the design flow rate and actual flow rate, seasonal loading, taking advantage of peak electricity rates
• Yes, to fully utilize biogas in a WWTP, gas storage is necessary.
**How much Gas Storage do you Need?**

- Dependent upon project goals, consumption rate, production rate, addition of FOG, Co-Digestion
- Typical requirements are 2 to 12 hours
- Gas storage is a wide spot in the line
- Amount of storage helps determine the type of storage

**How do you Select your Operating Pressure?**

- Ideally, you need to know the minimum inlet pressure to your ultimate biogas consumer
- Then calculate the pressure drop through the system. (Accumulators, Scrubbers, Valves, Pipe Runs)
- Operating pressures are measured in inches of water column (1 psi = 27.7” w.c.)
- Typical operating pressures are 6 to 16” w.c.
Gas Storage Volume vs. Pressure

- Does increased pressure mean increased volume?
- Boyle's Law
  \[ P_1V_1 = P_2V_2 \]
- Double the Operating Pressure, Double the Volume?
- The pressure needs to be in absolute scale 0" gauge = 407" absolute
- 8" w.c. to 16" w.c. = 1.9% increase in volume
- Double the storage pressure doubles the total upward force

Gas Holders
Steel Gas Holders

- Rim skirt depth typically 10’ to 12’ deep
- There is a submerged ballast ring at the bottom of the rim skirt
- Gas storage volume calculated from ceiling plate to top of ballast ring
- Ballast ring rises out of the sludge and activates the WGB and PVR
- With a steel gasholder, to increase operating pressure, increase weight of the cover

Spiral Guided Gas Holder
Spiral Guided Gas Holder

DYSTOR® Dual Membrane Gas Holder System
DYSTOR® Dual Membrane Gas Holder System

Two Scenarios

- When consuming more than producing, air fills the air chamber keeping constant pressure on gas so that it can be fully utilized.
- When producing more than consuming, air pressure control valve opens and allows air to escape air chamber and air from fan recycles to the fan inlet.
Air System Controls

Air Control System

Loss of Power

What happens when there is a total power outage at the plant?
Advantages of Dual Membrane Gasholders

- Automatic Operation – PLC control with a user friendly touch screen interface
- Adjustable operating pressure eliminates need to modify existing covers. Operating pressure is set by an air pressure control valve.
- Proven technology, the first dual membrane gasholder was installed in 1986.
- Membranes are sealed to the top of the digester - minimizes emissions and odors.
- Sludge Level Variable through the entire sidewall depth, as long as sidewall is gas tight.
Where do you want to store your gas?

• Gas has been historically stored on secondary digesters or sludge storage tanks
• Less anaerobic activity, no foaming, no internal equipment
• Membrane can deflect down into the digester when sludge is low, increasing usable gas storage

Where do you want to store your gas?

• Gas can be stored on top of a primary digester as well
• Digester must be heated and mixed
• Foaming can be an issue
• Alternate gas take off location to minimize foam/sludge in gas lines
• Cable catcher protects membranes from internals
Where do you want to store your gas?

- Gas can be stored in a ground mounted unit as well
- Utilized where only gas storage is required
- Used in conjunction with fixed covers or where corbels can be lowered
- Mounts directly on a slab or foundation ring

Membrane Material

- All membrane material is a polyester chord
- PVC Coated
- PVDF for UV protection
- Today, there are biogas membranes specifically designed for the constituents of the anaerobic environment
- Type III fabric, 31 oz./yard is most common
- The tensile strength today is ~50% higher than the material of Y2K.
- Heavier fabrics can be used when necessary
Cables or No Cables

• Why and When do you want to use external restraining cables

• There are two reasons to use cables:
  • #1 Reduce the tension in the fabric
  • Tension = (P * R_c)/2
    • T is Tension in #/in.
    • P is pressure in #/in^2.
    • R_c is radius in inches
  • Adding the cables reduces R_c and thus the tension, therefore increasing the safety factor.

Cables or No Cables

• There are two reasons we use cables
  • #2 Hold down total upward force
  • A 95’ diameter dual membrane gasholder has ~2.02 Million sq. in. of fabric
  • Operating at 12” w.c. is .433 psi
  • ~875,000# of upward force
  • We use 48 – 5/8” 7 x7 strand bridge rope cables to hold down that force
Controls

Each manufacturer has their own take on automation

Gas Storage Conclusions

- To fully use the Biogas in your facility, you need a wide spot in the line
- To determine the Operating Pressure, you need the ultimate gas consumer inlet $P$
- Dual Membrane gasholders store more gas than steel gasholders
- Go Green
Questions

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