



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

Presenters: Thomas Mangione & Matthew Bronk

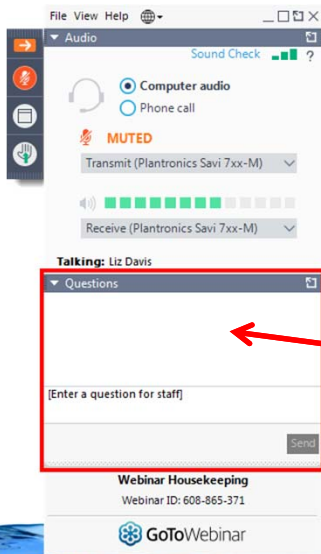


TRANSFORMING WATER. ENRICHING LIFE.

©2018 Evoqua Water Technologies

1

## How to Participate Today



- **Audio Modes**
  - Listen using Mic & Speakers
  - Or, select “Use Telephone” and dial the conference (please remember long distance phone charges apply).
- **Submit your questions using the Questions pane.**
- **A recording will be available for replay shortly after this webcast.**

2



©2018 Evoqua Water Technologies

## Table of Contents

### Assumptions

#### Gas Storage

- Storage Volume
- Operating Pressure

#### Gas Holders

- Steel Gasholders
- Dual Membrane Gasholders



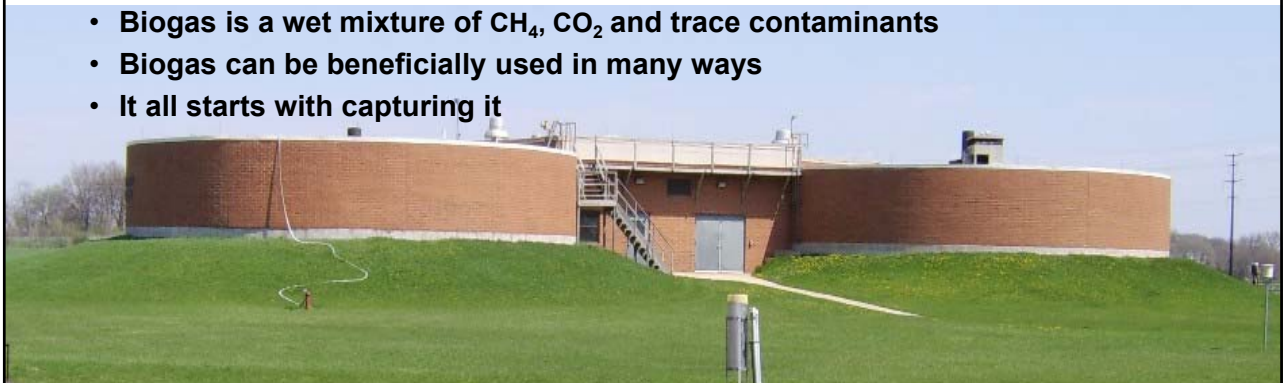
©2018 Evoqua Water Technologies

3

## 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  $\text{CH}_4$ ,  $\text{CO}_2$  and trace contaminants
- Biogas can be beneficially used in many ways
- It all starts with capturing it



4

# Gas Storage

5

## Is Gas Storage Necessary?

- Anaerobic Process is continuous but not steady state.
- Consumers of digester gas are not necessarily steady state.
- Production  $\neq$  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.



6

## 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



7

## 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.

8

## 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

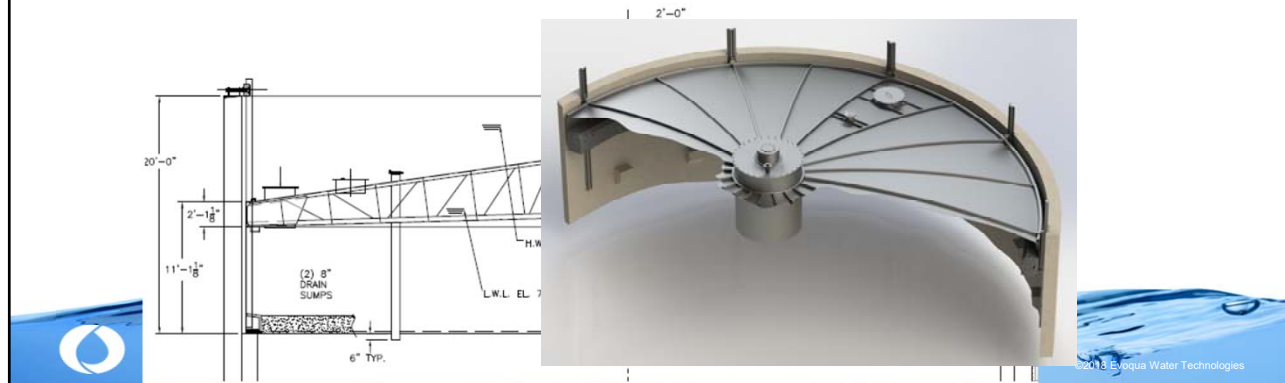


## Gas Holders



## 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



11

## Spiral Guided Gas Holder



12

## Spiral Guided Gas Holder



©2018 Evoqua Water Technologies

13

## DYSTOR® Dual Membrane Gas Holder System



©2018 Evoqua Water Technologies

14

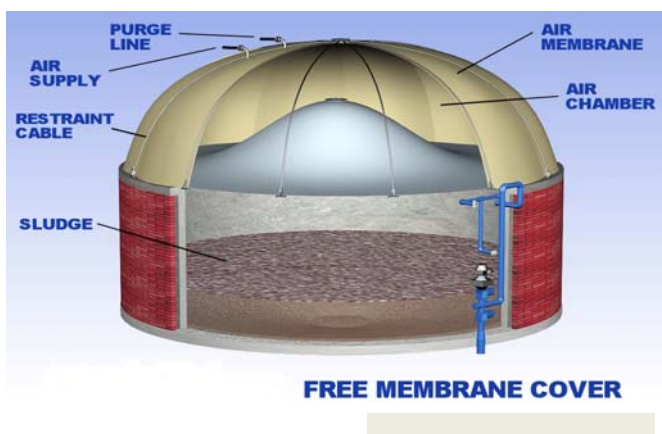
## DYSTOR® Dual Membrane Gas Holder System



©2018 Evoqua Water Technologies

15

## 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

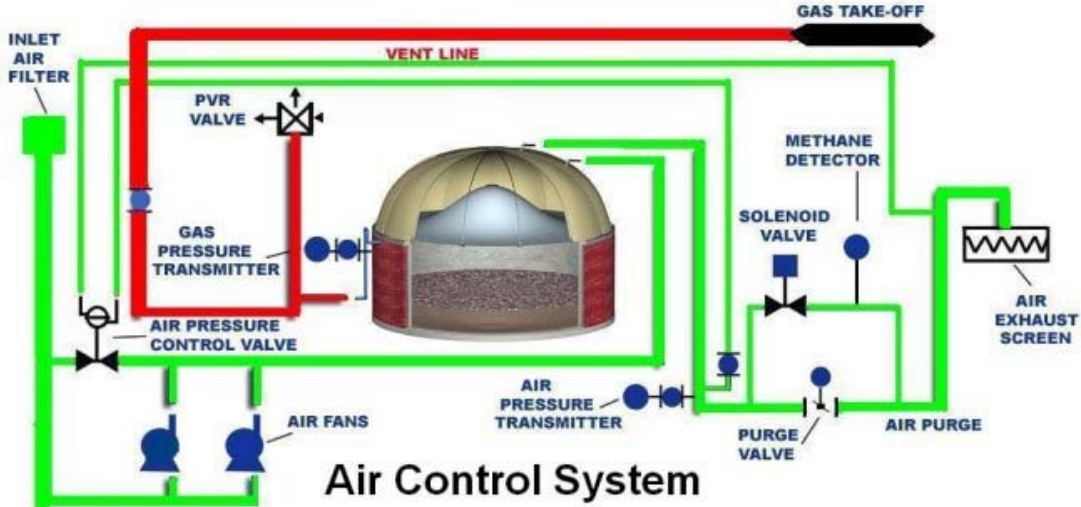


©2018 Evoqua Water Technologies

16



# Air System Controls



©2018 Evoqua Water Technologies

17

# Loss of Power

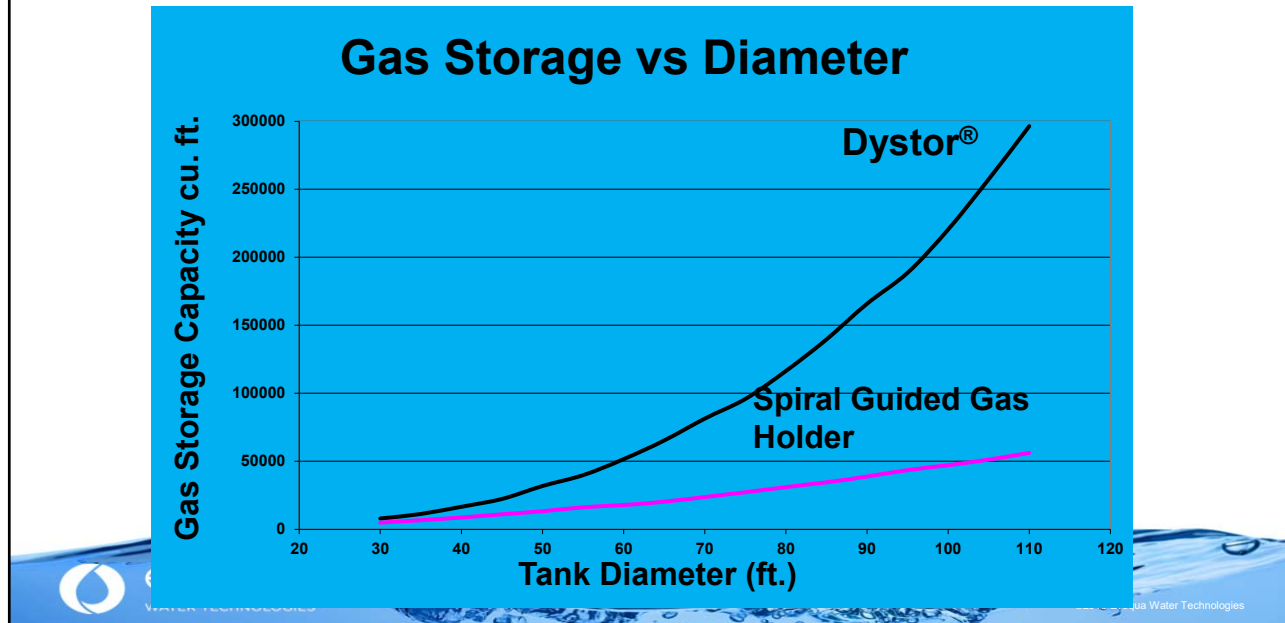
What happens when there is a total power outage at the plant?



©2018 Evoqua Water Technologies

18

## Advantages of Dual Membrane Gasholders



19

## 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.



20

## 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



21

## 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



22

## 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



23

## 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

24



## 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<sup>2</sup>.
  - R<sub>c</sub> is radius in inches
- Adding the cables reduces R<sub>c</sub> and thus the tension, therefore increasing the safety factor.



©2018 Evoqua Water Technologies

25

## Cables or No Cables

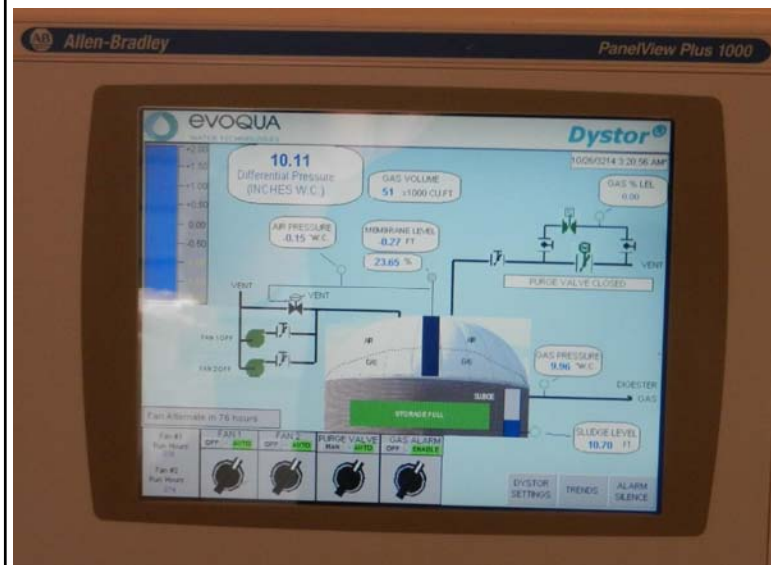
- There are two reasons we use cables
  - #2 Hold down total upward force
- A 95' diameter dual membrane gas holder has ~2.02 Million sq. in. of fabric
- Operating at 12" w.c. is .433 psi
- ~875,000# of upward force
- We use 48 – 5/8" 7 x7 strand bridge rope cables to hold down that force



©2018 Evoqua Water Technologies

26

## Controls



Each manufacturer has their own take on automation

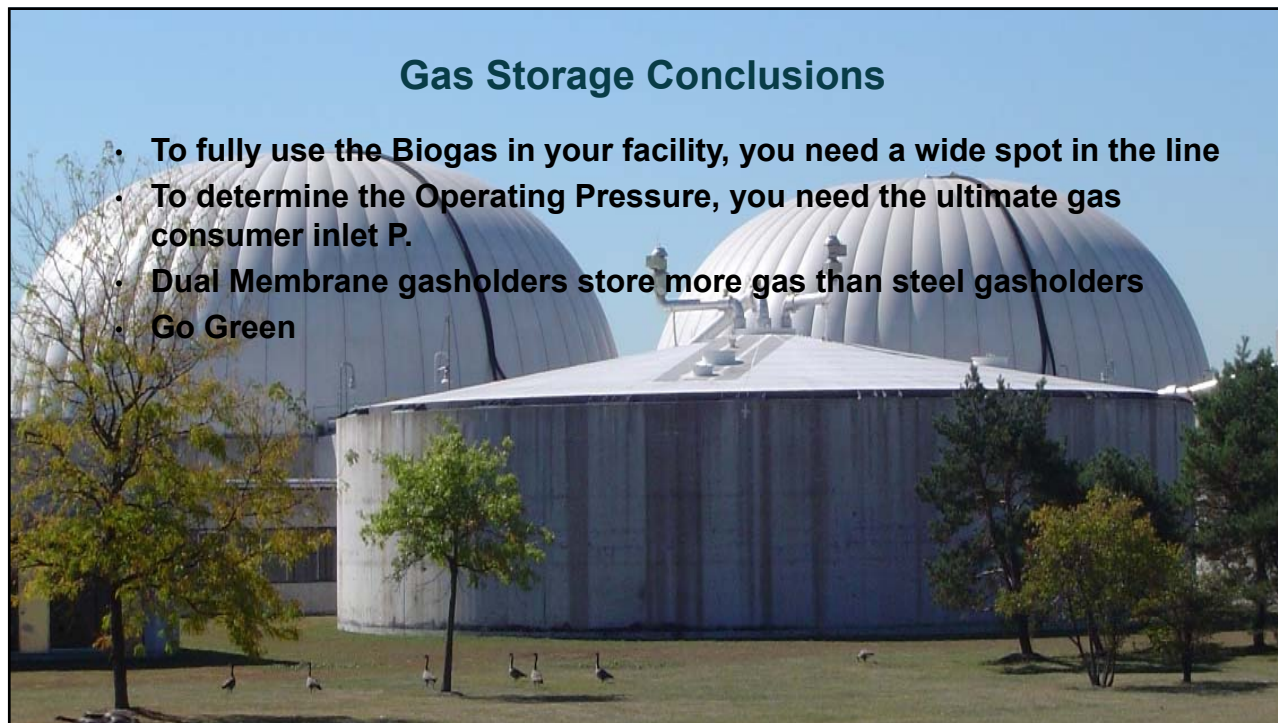


©2018 Evoqua Water Technologies

27

## 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



28

## Questions



29

## Contact Information

**Thomas Mangione**  
Technical Sales Manager  
Anaerobic Digestion Products  
North and East US and Canada  
[thomas.mangione@evoqua.com](mailto:thomas.mangione@evoqua.com)  
262-378-1297

**Matthew Bronk**  
Product Engineer  
Anaerobic Digestion Products  
[matthew.bronk@evoqua.com](mailto:matthew.bronk@evoqua.com)  
262-521-8484



©2018 Evoqua Water Technologies

30