Challenges and Solutions to Managing Digesters Receiving Substrates

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First Principles for Co-Digestion ...

#1 – Know what you are adding to the digester at all times
#2 – Treat every new substrate event likes it’s a digester start-up
#3 – Have a contingency plan in case the substrate is problematic

... of sewage sludge and new substrates.
Know What You are Adding ...

- Physical, chemical & biological characterization including Biochemical Methane Potential
- What you are trying to avoid:
  - Chronic or acute foam formation
  - Struvite or vivianite precipitation
  - Ammonia toxicity
  - Other

... It is better to pass on a waste than to have a stuck or damaged digester...
This digester was unhappy with its new substrate
Challenges with Digesters Today

- Most municipal digesters date from the Construction Grants era of 20 to 30 years ago, with dated equipment, sediment deposits and overloading.
- Funding for solids projects is discretionary; funding for effluent quality projects is not.
- Skilled operators are retiring faster than can be replaced.
- Digesters today are viewed as factories where resource extraction can be maximized.

How to turn a great idea into practice?
The Opportunities Abound ...

- More biogas yield with no additional digester volume required.
- Direct transfer of wastes to the digesters rather than via the sewers.
- Better knowledge of the more desirable substrates to capture for a project

... but can be realized only with the proper supporting infrastructure
Supporting Infrastructure Needs

- Receiving, blending and transfer stations
- Scum buster systems to keep the liquid surface free of a scum layer
- Adequate gas and condensate collection capacity
- Biogas utilization capacity
- Emergency outlet and pressure relief systems that can function with low-density sludges
Receiving tanks for industry-specific wastes ...
Digester Start-Ups Are Not Simple

- Seed sludge in place at proper temperature
- Gas handling system fully operational
- Sampling and analytical programs in place
- Pressure relief and emergency outflow systems at fully operational status
- Team assignments understood
- Contingency plan in place
Foaming – The Real Challenge

- Foam (not scum) is a frothy digesting sludge in which gas hold-up occurs causing volume expansion
- Rapid rise foam formation can cause significant damage from rapid volume expansion

Frothy sludge can elude capture
Foaming – Typical Causes

- Lowering of gas pressure
- Temperature swings
- Cold starting a seeded digester
- Intermittent feeding and mixing intervals
- Excessive mixing

Frothy sludges can have 50% of the density of water
Rapid-Rise Foam Formation

- Transient rather than sustained event
- Ejection of large amounts of frothy sludge from whatever portals are available
- Usually will trigger a shutdown of feeding leading to decline in ejection
- Typical causes include mixing shutdown from a power outage, extended period of feeding below meso temperature then rapid heat-up

_Ejection rate can be up to 10-times the inflow rate_
Rapid Rise Foam Formation Event

- Rising Leg of Event
- Shutoff of Feed
- Declining Leg of Event

Flow Rate vs. Duration, hours
Rapid Surges Can Inflict Severe Damage on Floating Gasholder Covers
The Usual Safeguards May Not Work With Low Density Digesting Sludge

Pressure Relief Valve

Emergency Outlet
Don’t Let Your Evening Get Ruined

Rapid Rise Foam Formation at Peak Surge Rate
First Principles for Co-Digestion of Sewage Sludge and Substrates

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#3 – Have a contingency plan
Questions?

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