Anaerobic Digestion Practices as it relates to Nutrient Removal

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Your Pooh in my Anaerobic Digester......
• Anaerobic Digestion Process
• Nutrient Removal Process
• Supernatant
• Sludge Preparation
• Struvite
• Tips, Tricks, & Keys
Anaerobic Digestion – What is it?

Heat source for digester

Methane

Energy source

Insulation or heating element
98–130°F (37–54°C)

Wastewater sludge

Anaerobic bacteria

Fluid layer

Active layer

Solids

Methane 50–80%
Carbon dioxide 20–50%
Other gases <2%

Odors

High-nutrient sludge
The Steps......

• Four overall stages:

• Two basic stages:
  1. Acid Formers – Organics changed to simple organics/organic acids
  2. Methane Fermenters – Uses VFA’s to form methane and CO₂. This is where waste stabilization occurs
Another View....
• CH₄ will burn at around 56% but needs to reach 62% to be considered fuel. 65-70% is typical for a well running digester.

• Should achieve a 40-60% reduction in volatiles

• pH typically around 6.6 to 7.6.
Nutrient Removal
(The Who’s & What’s)

• Chemical
  • Iron Salts (such as Ferric Chloride) are commonly used.
• Biological
  • Luxury Uptake
Sludge Pre-Treatment

• Sludge Thickening
• Cell Lysis thru Ultrasound
  • High intensity to create cavitation
• Thermal Hydrolysis
  • Heat & Pressure followed by rapid decompression
Supernatant

- High in Solids
- High in Nutrients
- High in BOD
Figure 15: Prediction of soluble magnesium and phosphorus concentrations released into the Digester as a result of BPR sludge digestion.
Struvite

- Formed by magnesium, ammonium, phosphate (MAP)
- Who’s got the Formula? ..........NH$_4$MgPO$_4$·6H$_2$O
- Can cause clogging in pipes, valves, etc.
- Struvite as an industry.
Struvite as an Industry
Feed Rates

Tips, Tricks, & Keys

• Digesters (like many of us—more specifically Chuck Kronk) are looking for a continuous food source
• Continuous feeding is always better than slug-loading.
• Overfeeding/Unbalanced feeding leads to foaming
• Mix well (homogenized.......not stirred, please)
• Keep an eye on that VA/A
• BNR Removal in WWTP’s, WEF, McGraw-Hill, 2005
• Anaerobic Sludge Digestion Process Control, DEQ, 1998
• InfoBase Publishing via Google Images
• Anaerobic Digestion of Phosphorous Rich Sludges, C.M. Carliell-Marquet, A.D. Wheatley, & J. Churchley,
What is the name of a type of Sludge Pretreatment?

- Cell Lysis
- Thermal Hydrolysis
- Ultrasonic Cavitation
What is one of the two methods used remove phosphorous in secondary treatment?

• Biologically
• Chemically
What is the phosphorous mineral called that can develop in digesters and ancillary equipment?

• Struvite
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