Membrane Thickening Aerobic Digestion Processes

2013 NESOWEA Operator Seminar

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Membrane Thickening Digestion

- Aerobic digestion process using a Flat Sheet Membrane Unit

Ideal for:

- Facilities obligated to meet stringent nutrient discharge limits, specifically total nitrogen and phosphorus
- Decentralized facilities or Reduced operations staff
- Class B Applications
How Does Membrane Thickening Work?

- How Does Sludge Get Thickened With a Membrane?

A membrane thickening (MBT) submerged unit is used to create a physical barrier across which to extract clear water from sludge.

- Air diffuser incorporated on the lower part of the cassette.
Membrane Thickener Key Ingredients

• Key Ingredients

  • **Flux** = Rate of filtration per unit area of membrane material. Since thickening is typically three times more than an MBR process, flux rates are significantly lower
    - MBR flux @ 20° C = 17.2 gfd vs MBT flux @ 20°C = 5.1 gfd
  
  • **Transmembrane Pressure (TMP)** = The pressure across the membrane during filtration.
    - Typical TMP at design flux rates = 0.5 to 3.0 psig
    - Maximum TMP = 5.0 psig
  
  • **Air Scour** = Air flow required to scour membranes to prevent fouling
  
  • **Biofilm** = Complex dynamic of microorganisms. The interdependency between biological process conditions and membrane filtration performance through a biofilm is termed *BioHydraulics*
The Importance of Biofilm

Biofilm Basics

• **YOU DON’T GET TO CHOOSE:** All submerged membranes have a biofilm. As soon as filtration starts and biological solids are brought to the membrane surface, biofilm formation occurs.

• **Benefits**
  • Biofilm serves as a secondary dynamic filter and represents a changing to filtrate flow.
  • Create a dense secondary membrane that can allow for enhanced nutrient removal and degradation of refractory organics.

• **Biofilm management is the key to operating a successful membrane thickening system.**
Biofilm Conditions

- Ideal
- Stable TMP
- Non-Uniform
- High TMP
What Does Biofilm Look Like?
Minimum Maintenance Requirements

SIMPLE MAINTENANCE

- Membrane Relax approximately 2 min/10 min
- Backwash: Performed during the relax cycle
- Chemical Cleaning: In-Place, approximately every 3-4 months and 2 hour duration. NO NEED TO DRAIN TANKS OR TAKE MEMBRANES OUT OF SERVICE.
Why use a Membrane Thickening Process

Operational Benefits of Membrane Thickening

1. Improved and Reliable Thickening

Polymer and Decanting
Why use a Membrane Thickening Process

Operational Benefits of Membrane Thickening

SO……

Polymer and Decanting = Reduced Operator Attention
Why use a Membrane Thickening Process

Economic Benefits of Membrane Thickening

2. Reduced Footprint

- Class B Stabilization in a Reduced volume
- Reduced Tanks Sizes and Ideal for Retrofits
- Less air requirements/energy usage.

*Digestion with Membrane Thickening*  
*Traditional Digester*
Why use a Membrane Thickening Process

Process Benefits of Membrane Thickening

3. Produces a High Quality Permeate that features:

- Minimal Total N and P without chemical addition
- Reuse quality that can be recycled to head of plant or sent to disinfection
- Protects effluent quality of BNR Process
Membrane Thickening Aerobic Digestion Process

- Digester 1
- Digester 2
- Anox. Basin
- MBT
- Permeate
- Influent
- WAS
- Digested Sludge
Case Studies

Case Studies Membrane Thickening Aerobic Digestion Processes
Dundee WWTP, Michigan

First U.S. Installation
Dundee WWTP, Michigan

Commissioned: 2005
Liquid Process: MBR (1.2 MGD)
MBT Size: 800 plates
Solid Conc.: 3%-5.25%
Chemical Cleaning: 2-3 / year (scheduled)
Dundee WWTP, Michigan

Engineer: Arcadis

History:
- Objective was to reduce the hauling to 2 times per year. Tanks are designed to store 180 days at 3% solids.
- Operator friendly when compared to other systems.
Thickening Performance

Sep & Oct 2005 Operation

% solids

Date

Dundee WWTP, Michigan

WAS
MBT Thickener
Digester #1
Digester #2
Dundee WWTP, Michigan

September 2005 to June 2008 Data

Sustainable Permeate Quality

- **BOD:** 1.12 mg/l
- **TSS:** 2.00 mg/l
- **NH₃-N:** 0.22 mg/l
- **NO₃-N:** 0.03 mg/l
- **TP:** 1.09 mg/l
McFarland Creek WWTP, Ohio

Engineer: CT Consultants

Two Stage Membrane Thickening Aerobic Digestion Process
McFarland Creek WWTP, Ohio
Membrane Units Installed Directly Inside the Digesters
McFarland Creek WWTP, Ohio

Commissioned: 2005
Waste Type: Municipal
Liquid Process: MBR (1.8 MGD)
MBT Size: 400 plates
Solids Conc.: 3.5%-5.5%
Membrane thickening at McFarland Creek WWTP was able to thicken up to 5% solids.
McFarland Creek WWTP, Ohio

McFarland Creek WWTP Improved Dewatering Operations

Annual BFP run time w/o Membrane
Thickened Aerobic Digestion 8,736 hours

Annual BFP run time with Membrane
Thickened Aerobic Digestion 3,744 hours
Reduction BFP run time 57.14%

MORE EFFICIENCY MEANS BETTER RESULTS

41% Reduction in CUBIC YARDS PRODUCED
36.5% Reduction in DRY TONS PRODUCED
41% Cost Reduction in POLYMER ($18,000 Annual Savings)
41% Cost Saving in SLUDGE DISPOSAL ($34,465 Annual Savings)
1.37% Improved Dewatering Cake (18.85% vs 17.48%)
THAT’S ALL FOLKS!

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