Aerobic Digestion of Sewage Sludges

An Operational Guide

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PRESENTATION

- Section 1: The Basics
- Section 2: Aerobic Digester Design
- Section 3: How Do We Make That Work
- Section 4: Nitrification
- Section 5: Augmented Aerobic Digestion
- Section 6: Examples of Augmented Aerobic Digestion
- Section 7:
- Section 8: Conclusion

Section 1: The Basics

What is Aerobic Digestion

Waste from a sewage treatment process is **Oxidized** with aerobic bacteria.

- Primary Sewage Sludge
  - Organic Solids
- Trickling Filter Secondary Sludge
  - Bacterial Cells
- Waste Activated Sludge
  - Bacterial Cells
  - Organic Solids

How Does That Happen

1. Biological Sludges Contain hungry BACTERIA
2. Aerobic Digesters don't have a food supply
3. Strong Cells (bacteria, protozoa, etc.) eat weak cells

Results

- Carbon Dioxide
- Water
- Ammonia NH_3
  - Nitrite NO_2
  - Nitrate NO_3

Why Do We Digest Sludge

- Minimize Odors during Storage
  - Waste Solids Daily
  - Dispose Solids weekly or monthly
- Reduce Sludge Quantities
  - Reduce VSS (Volitile Suspended Solids)
  - Remove Water (Decant)
- Improve Thickening & Dewatering
  - Reduce Liquid Volume for Hauling
  - Higher Percent Solids in Cake
- Save Money

The Basic Controls

- Sludge Wasting
  - Take the Waste Solids from Process to Digester
- Aeration
  - Oxidize the Solids
- Settling & Thickening
  - Leave the solids, take the water
- Remove the Solids
  - Haul liquid or Dewater
- Repeat

Section 2: Aerobic Digester Design

PADEP Aerobic Digester Design Criteria

- **PA DEP Design Manual (10/97)**
  - Volatile solid loading
    - $\leq$ 100 lbs/day/1,000 ft^3
  - Solid retention time
    - 15 – 20 days @ 15 ^oC
  - Aerobic condition
    - D.O. 1 ~ 2 mg/l
  - Air mixing
    - $\geq$ 30 cfm/1,000 ft^3

TANK SIZE

- 50 -100 lb VSS day / 1,000 ft^3
  - 1MGD @ 200mg/l BOD yeilds 1,200 lb VSS/day
  - 1,200 lb VSS/day waste / 50lb/day X 1,000 ft^3 X 7.48 gal/ ft^3 = 180,000 gallon digester
  - 2 Tank Better than 1, use 2 @ 90,000 gal. each
    - Better Process Efficiency
    - Maintenance

TANK SIZE

- Solids Retention Time at 1.5% Solids
  - 180,000 gal X 8.34 X .015 = 22,500 lb Solids
  - 22,500 lbs capacity / 1,200 lbs / day wasted = 19 days
- Solids Retention Time at 2% Solids
  - 180,000 gal X 8.34 X .02 = 30,000 lbs Solids
  - 30,000 lbs capacity / 1,200 lbs / day wasted = 25 days

Blower Capacity

- Each lb of VSS needs 1.42 lbs Oxygen
  - 75% - 80% VSS oxidized. Remainder is inert.
  - 1,200 lbs VSS X .8 X 1.42 = 1,365 Lbs O_2/day
  - Approximately XXXX cfm
- Tank Mixing 30 cfm / 1,000 Cu. Ft.
  - 180,000 gal / 7.48 gal / Cu. Ft. = 24,000 Cu. Ft.
  - 24,000 Cu. Ft. X 30 cfm / 1,000 Cu. Ft. = 720 cfm

Challenges Faced by PADEP Design Criteria Aerobic Digestion

- High Energy Costs
- Cold Weather Efficiency
- Nitrification/pH effects
- Poor Pathogen Reduction
- Odor problems

Section 3: How Do We Make That Work

Sludge Wasting
Take the Solids from Process to Digester

- Waste the Thickest Sludge Possible
  - Maximizes Digestion
    - Minimizes Volume of Sludge Wasted
    - Increases Solids Retention Time
  - Less Decanting
  - Less BTU Loss
    - It stays warmer
    - The warmer the digester, the better the digestion

Sludge Wasting
Take the Solids from Process to Digester

- Wasting from Primary Clarifier's
  - Sludge Pocket
    - Ability to Thicken
    - Sludge Thickens as it sits in the pocket
    - Take the thickest, leave the rest for later
    - Solids Range $1^1/_2$% - 3%
  - From RAS flow (Return Activated Sludge)
    - Inability to Thicken
    - Solids Range $^1/_2$% - 1%

Sludge Wasting
Take the Solids from Process to Digester

- Wasting from Activated Sludge Clarifier's
  - Thickening RAS in Clarifier
    - Stop or reduce RAS Flow for 1 or 2 rake revolutions
    - Re-start RAS Flow directly to Digester
    - Waste until it starts to thin
    - Solids Range $1^{1}/_{2}\%$ - 3%
  - What's the Difference ?
    - 1,200 lb Solids at $^{1}/_{2}\%$ = 28,000 gallons
    - 1,200 lb Solids at 1% = 14,000 gallons
    - 1,200 lb Solids at 2% = 7,000 gallons

Aeration
Oxidize the Solids

- Provide Aerobic Bacteria with Oxygen
  - They consume food
    - Organic material
    - Bacterial Cells
    - Measured as   Volitile Supended Solids
  - Dissolved Oxygen Levels
    - 1 – 2 mg/l sufficient due to long detention times
    - Cycling Air On / Off. DO < 0.3 mg/l for 2 – 3 hours
      - Anoxic condition, reduces NO_2 & NO_3
      - Controls Filaments, Reduces Energy Cost

Settling and Thickening
Leave the Solids, Take the Water

- Settling is Slow
  - Solids are already thick
  - May Contain Filaments
- Allow Several Hours
  - Watch for Odors when aeration is restarted
  - Combine Settling with Cycling Air On / Off
    - Set air off during nite, ready to decant in the morning.

Settling and Thickening
continued

- Decant the clear Liquid
  - Telescopic Valves
  - Pump on a rope
  - Taps and Valves along Vertical Wall
- The water isn't always on top
  - On the bottom
  - In the middle
  - This is a good time for Pump on a rope

Settling and Thickening
continued

- Foam
  - Aerobic Digesters often have Foam
    - Very high in solids, will cloud final effluent
    - Its where certain types of filaments live
    - Try to keep it out of the decant
    - Cells die off and cause large sudden increases in foam
    - High aeration rates and mixing can make heavy foam

Remove the Solids When ???

- When they are well digested
  - VSS Reduction
  - Well thickened and won’t settle
- The digester is full
- There is no room to Waste Solids
  - You must waste, solids will “automatically” waste to effluent otherwise
- The “Boss” said “No, too expensive”
  - Not an optiion

Section 4: Nitrogen Removal

RELATIONSHIP BETWEEN SLUDGE PROCESSING AND NITROGEN REMOVAL IN THE SEWAGE TREATMENT PLANT

- Nitrogen is present in the digested sludge and later returned to the treatment process during decant of the digesters and sludge dewatering

  - Organic material is converted to NBOD primarily in the form of Ammonia, Nitrate and Nitrite.
  - Ammonia, Nitrate and Nitrite are in the Liquid Phase
  - The Liquid Phase is low pH water which consumes alkalinity required for Nitrification.

Nitrification Process

- Under Aerobic Oxidation, Bacterial Decomposition converts the Nitrogenous Organic Compounds into Ammonia by Deamination.
- Under continued Aerobic Oxidation and the presence of Nitrifying Bacteria, the Ammonia is then converted to Nitrite (NO_2^-) and then to Nitrate (NO_3^-), which is known as the NITRIFICATION PROCESS

Nitrification Process

Step 1: $NH_4^+ + 1.5\ O_2 \xrightarrow{\text{Nitrosomonas}} NO_2 + 2H^+ + H_2O$

Step 2: $NO_2 + 0.5\ O_2 \xrightarrow{\text{Nirtrobacter}} NO_3$

Overall Reaction: $NH_4^+ + 2\ O_2 \longrightarrow NO_3 + 2H^+ + H_2O$

- **4.6 lbs O_2 / lb NH3-N**
- **7.14 lbs alkalinity destroyed / lb NH3-N**
- **0.1 lbs VSS generated / lb NH3-N**

Temperature and Nitrification

Temperature, ☜C	Effect on Nitrification
28 to 32	Optimal temperature range
15 to 16	Approximately 50% of maximum rate
10	Significant reduction in rate, approximately 20% of rate at 30☜
< 5	Nitrification ceases

Denitrification Process

Under anaerobic or anoxic conditions with bacterial denitrification, the Nitrate (NO_3^-) is then converted to Nitrogen Gas (N_2), which is known as the DENITRIFICATION PROCESS.

- Majority of denitrifying organisms consist of facultative anaerobic bacteria.
- Approximately 80% of the bacteria in the activated sludge process are facultative anaerobic bacteria
- This happens when aeration is stopped in the digester for a minimum of 3 to 4 hours daily

Denitrification Process

$$NO_3 + \text{organic carbon} \xrightarrow{\text{carb. bacteria}} N_2 + CO_2 + OH + H_20$$

$$CO_2 + OH \longrightarrow HCO_3$$

$$NO_3 \longrightarrow NO_2 \longrightarrow NO \longrightarrow N_2O \longrightarrow N_2$$

- 2.86 lbs oxygen recovered / lb NO_3-N
- 3.57 lbs alkalinity recovered / lb NO_3-N

Operational Factors Affecting Denitrification

- Significant Operational Factors:
  - Presence of substrate (soluble cBOD)
  - Absence of O_2 (turn off the blowers)
  - Presence of NO_3^- or NO_2^-
  - Adequate and active population of denitrifiers
  - pH of 6.8 to 7.2
  - Temperature
  - Nutrients
  - ORP: -100 to +100 - Range for Denitrification

Benefits of Denitrification

- Generally Improve Settling
  - Control of undesired filamentous
  - Reduces Floating Sludge
- Return of alkalinity to treatment process
- Less Nitrogen To Plant Influent
- Less Phosphorus To Plant Influent
  - Literature, tests and papers show P reduction with blower cycling
  - Liquid Phase contains 40 to 100+ mg/l P

Conditions

Terminology	Dissolved Oxygen mg/l	Oxidation Reduction Potential	Nitrates Nitrites	What's Happening?
Aerobic	> 0.5	> + 100	Present When Nitrifying	cBOD Removal NH3 to NO2 & NO3
Anoxic	0 – 0.3	-100 to +100	Present	cBOD Removal, NO2 & NO3 Converting to Nitrogen Gas
Anaerobic	0	< -100	Not Present	**cBOD Removal, VFA Production, Phosphorus Release for Biological P Removal**
Anaerobic	0	< -200	Not Present	**Poorly Operated Anaerobic Sludge Digester**
Anaerobic	0	< -300	Not Present	Well Operated Anaerobic Sludge Digestion

Section 5 : Augmented Aerobic Digestion

Class B Biosolids Requirement Design Criteria

- **Class B biosolids requirement – landfill disposal** (25 PA Code Article 273.513 & 271.932 – 12/00)

  Pathogen Reduction:
  - Fecal coliform ≤ 2 million MPN / 1 g dry TS
  - Solid retention time ≥ 40 days @ 20 °C
    or ≥ 60 days @ 15 °C

  (Remember: PADEP Design Criteria)

    - Operate in series (CREDIT)
      - Reduced sludge retention
      - ≥ 28 days @ 20 °C or ≥ 42 days @ 15 °C
        (EPA Manual – 625/R-92-013 Rev. 10/99)

  Vector Attraction Reduction:
  - VS reduction ≥ 38%
  - SOUR ≤ 1.5 mg/L oxygen / hour / g TS

Key Parameter Calculation

$$\text{Solid Retention Time} = \frac{\text{Total Digester Volume} \times \text{Primary Digester Total Solid Concentration}}{\text{Digested Sludge Discharge Daily} \times \text{Total Solid Concentration of the Sludge}}$$

Key Parameter Calculation

$$\text{Volatile Solid Reduction} = 1 - \frac{\text{Average WAS Daily Flow} \times \text{Average Total Solid (\%)} \times \text{Volatile Solid (\%)}}{\text{Digested Sludge Daily Discharge} \times \text{Average Total Solid (\%)} \times \text{Volatile Solid (\%)}}$$

Key Parameter Calculation

$$SOUR = SOCR \times \frac{VS}{TS}$$

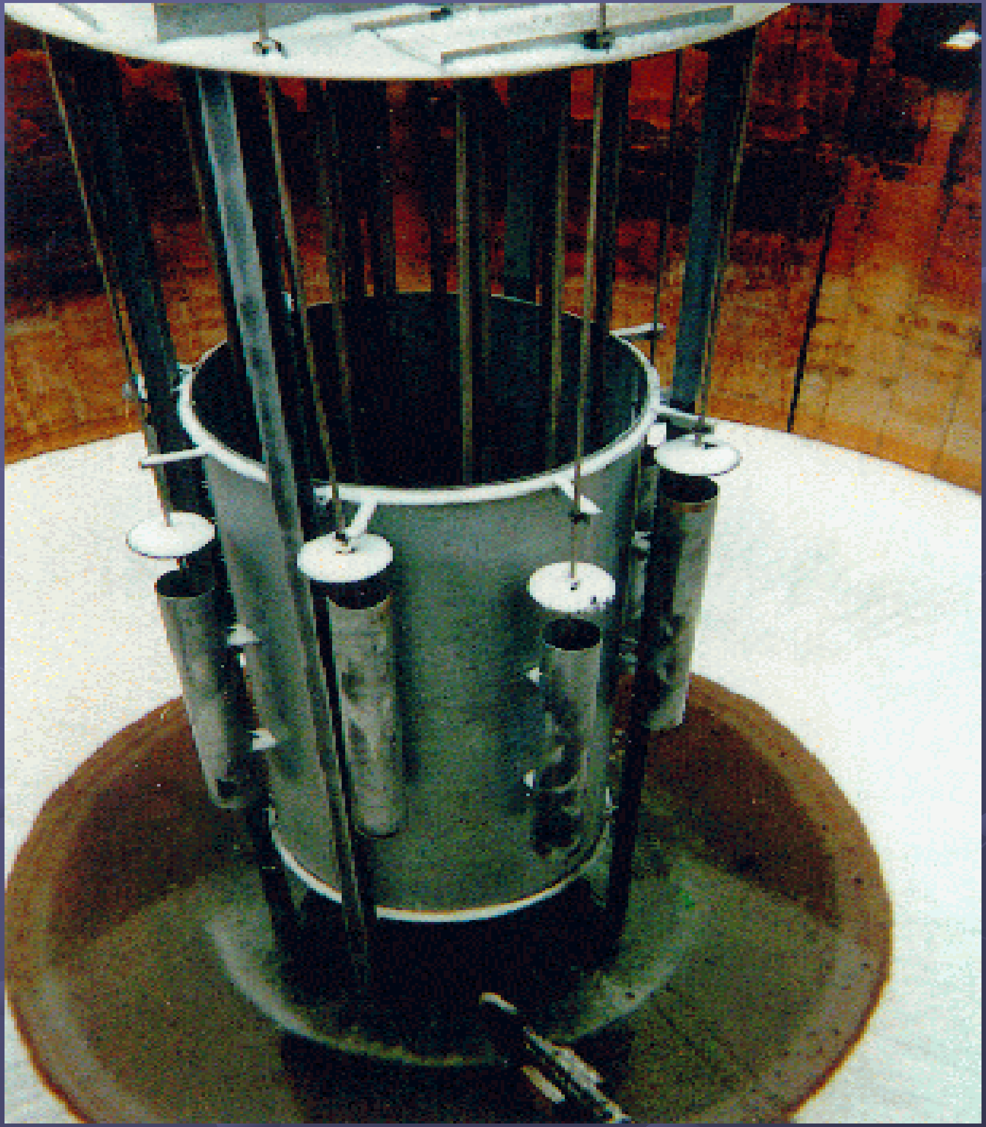
SOUR – Specific oxygen uptake rate (mg/g/hr)

SOCR – Specific oxygen consumption rate (Standard Methods 2710B)

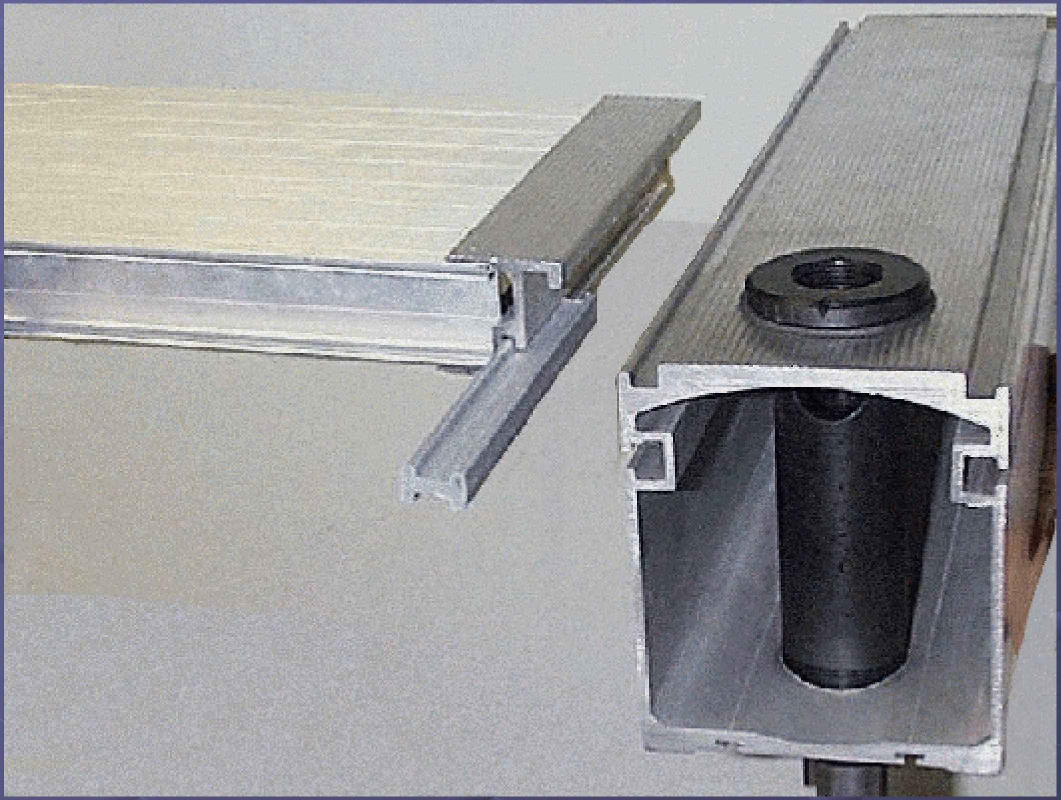
Selection of Aeration / Mixing equipment is critical. The equipment must provide high shearing, non-clog aeration with high mixing capability.

High Shear Mixing for Thickened Sludge

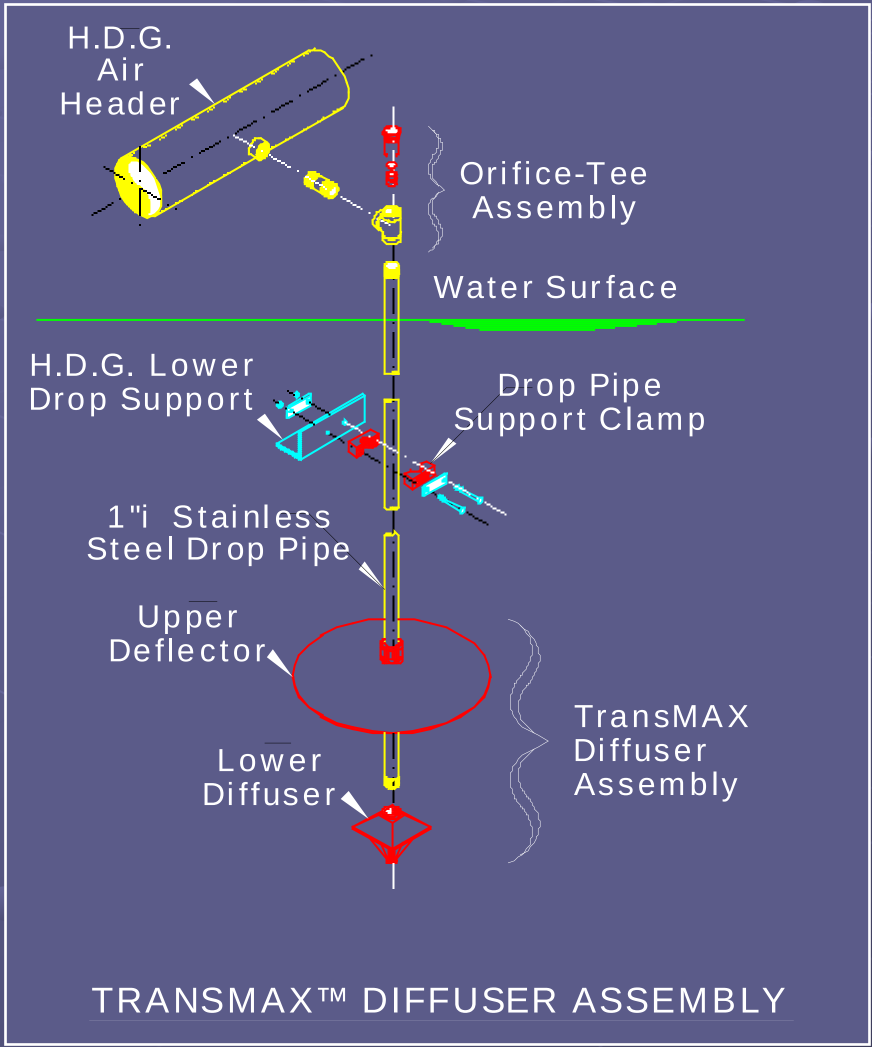
Multi-Eductor Draft Tube

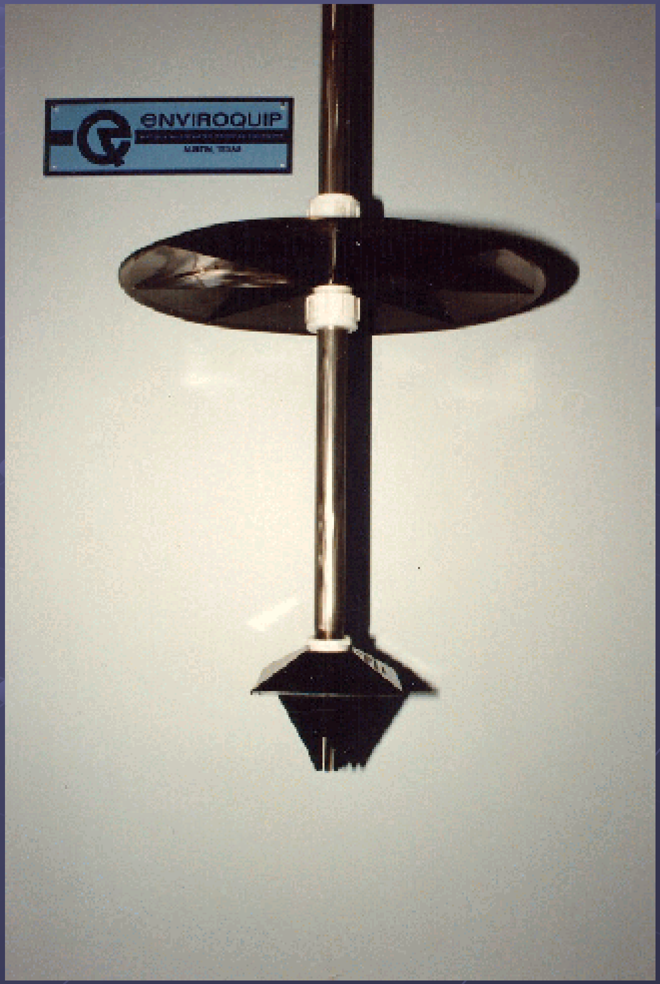


AirBeam Components



Enviroquip's diffuser eliminates clogging and enables pre-thickening





What is Augmented Aerobic Digestion?

- Augmented Aerobic Digestion is digestion operated in series in aerobic and anoxic cycles designed to meet the Class B Biosolids Requirements.
  - Longer Detention Times
  - Higher Temperature
  - Aerobic / Anoxic Cycles
    - Nitrification/Denitrification

Advantages of Augmented Aerobic Digestion

- Able to meet Class B Biosolids Requirements.
- Solids Reduction.
- Loss of Nitrogen through Nitrification / Denitrification Process within Digesters.
  - Denitrification: Less Oxygen & Alkalinity Req.

Section 6 : Examples of Augmented Aerobic Digestion

Muncy Wastewater Treatment Plant

- **Wastewater treatment plant capacity**
  - Annual average daily flow – 1.4 MGD
  - Average organic load – 1,400 lbs BOD/day
    - Include food processing WW – 500 lbs BOD/day
- **Sludge generation**
  - Primary & secondary clarifiers
  - Trickling filters
- **Sludge processing facilities**
  - Aerobic digesters
    - Primary (110,000 gal) – converted exist anaerobic digester
    - Secondary (140,000 gal) – converted exist Imhoff tank
  - Belt Filter Press – dewatering digested sludge

Muncy Borough Municipal Authority Retrofitting to Aerobic Digestion

Muncy Digestion Improvement Major Benefit

- **Quality decant from digesters**
  - Relatively low ammonia and nitrate
  - Adequate pH
  - Adequate alkalinity
  - No routine chemical addition
- **Sludge volume reduction**
  - Volatile solids $\rightarrow CO_2$ and H_2O
  - Dewatered sludge – approx. 134 dry tons of year 2000
    - – approx. 68 dry tons of year 2003
    - – approx. 78 dry tons of year 2005
    - – approx. 76 dry tons of year 2006
    - – approx. 86 dry tons of year 2007
- **Project cost**
  - $ 850,000 $ 480/lb-VS/day

Muncy Aerobic Digester Operation Data

(January 2003 – April 2004)

Parameters	Warm Season	Cold Season
Monthly average SRT (days)	29 – 54	32 – 75
Temperature (^oC)	22.5 – 30.5	15.5 – 22.5
Dissolved oxygen (mg/L)	0.3 – 2.1	0.5-3.4
VS reduction – Class B $\geq$ 38%	69% – 84%	62% – 84%
SOUR – Class B $\leq$ 1.5 mg/g/hr	0.60	0.62
F. Coliform – Class B $\leq$ 2 million/g TS		80,000
Average NH_3-N (mg/L)	1.1 – 10	1.1 – 8.5
Average NO_3/NO_2-N (mg/L)	0 – 7	0 – 8.5
pH range	6.5 – 8.1	6.7 – 7.6
Average alkalinity (mg/L)	79 – 1,140	100 – 275

Muncy Aerobic Digester Operation Data
(January Thru December 2007)

Parameters	Primary Digester	Secondary Digester
Monthly average SRT (days)	40 days Annual	Avg. Combined
Temperature (^oC)	12 – 20	14 – 25
VS reduction – Class B ≥ 38%	77.8%	Annual Average
Average NH_3-N (mg/L)	6 – 12	0.3 – 2.5
Average NO_3/NO_2-N (mg/L)	0 – 9.36	4.66 – 9.36
pH range	7 – 7.2	6.9 – 7.1
Average alkalinity (mg/L)	120 – 480	90 – 560
Pounds Dry Solids Disposed per Pound BOD Influent	Avg. 2005, 06, 07 Range	0.378 0.27 – 0.47

WAA Wastewater Treatment Plant

- **Wastewater treatment plant capacity**
  - Annual average daily flow – 0.715 MGD
  - Average organic load – 2,250 lbs BOD/day
- **Sludge generation**
  - Sequence batch reactors (x 3)
- **Sludge processing**
  - Gravity thickening
  - Primary & secondary aerobic digestion
  - Digested sludge dewatering – Belt Filter Press

WAA Aerobic Digester Design

- **PADEP Manual – design criteria for aerobic digesters**

  (aforementioned VS loading and air requirement)

- **Class B biosolids requirement**
  - SRT ≥ 40 days @ 20 °C or ≥ 60 days @ 15 °C
    - Extend sludge retention in SBRs and thickeners
    - Feed thickened sludge
    - Cover to maintain temperature
    - Operate in series with aerobic and anoxic cycles

Waymart Aerobic Digester
2004 Operation Data

Parameters	Warm Season
Monthly average SRT (days)	168 - 200
Temperature (^{o}C)	24 – 32
Dissolved oxygen (mg/L)	0.05 – 1.73
VS reduction – Class B $\geq$ 38%	$\geq$ 55%
SOUR – Class B $\leq$ 1.5 mg/g/hr	1.8
F. Coliform – Class B $\leq$ 2 million / g TS	4,000
Average NH_3-N (mg/L)	7.6 – 43.2
Average NO_3/NO_2-N (mg/L)	10.4 – 92.1
pH range	6.2 – 7.3
Average alkalinity (mg/L)	162 – 188

Waymart Aerobic Digester Operation Data
(January 2006 Thru December 2007)

Parameters	Primary Digester	Secondary Digester
Monthly average SRT (days)	56 days Annual	Avg. Combined
Temperature (^{o}C)	12 – 32	14.67 – 35
F. Coliform – Class B ≤ 2 million / g TS	9,000,000	2,400,000
Date Fecal Sample, Feb. 13, 2008		
Average NH_3-N (mg/L)	0.02 – 40	
Average NO_3/NO_2-N (mg/L)	0.3 – 75	
pH range	6.4 – 7.4	5.2 – 8.1
Average alkalinity (mg/L)	100 – 310	
Pounds Dry Solids Disposed per Pound BOD Influent	Avg. 2007	0.348

KEY POINTS

- Nitrogen removal is difficult in cold weather at wastewater temperatures < 8 ºC
- Solids Digestion processes add significant Ammonia, Nitrate and Nitrite to the influent load which can increase Total Nitrogen in discharge.
- Digestion can also add BOD (interfering with Nitrification) and consume Alkalinity needed for Nitrification.

Advantages of Augmented Aerobic Digestion

- **Augmented Aerobic Digestion utilizes elevated temperatures & Oxic/Anoxic cycling to meet Class B biosolids requirements and significantly reduces sludge disposal quantities.**
- **Augmented Digestion lowers the ammonia (by nitrification) and TN (by denitrification) returning to the treatment system.**

Advantages of Augmented Aerobic Digestion

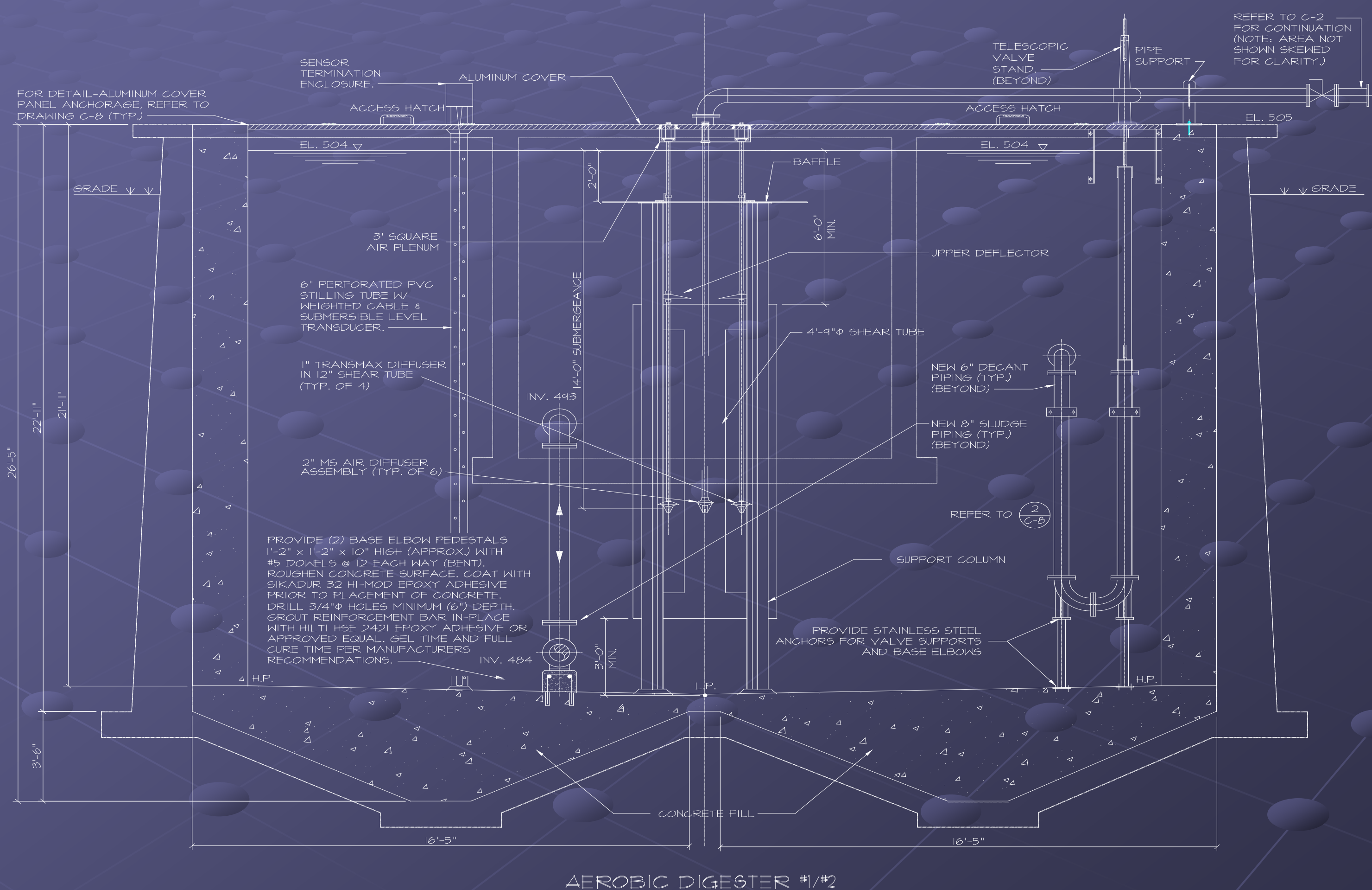
- **Decant water and filtrate from dewatering can have Total Nitrogen concentrations in the range of the Chesapeake Bay Requirements.**

- **Augmented Aerobic Digestion can be a source of Nitrifying organisms during cold weather operations (AAD maintains >15 ^{o}C and Nitrification during cold weather)**

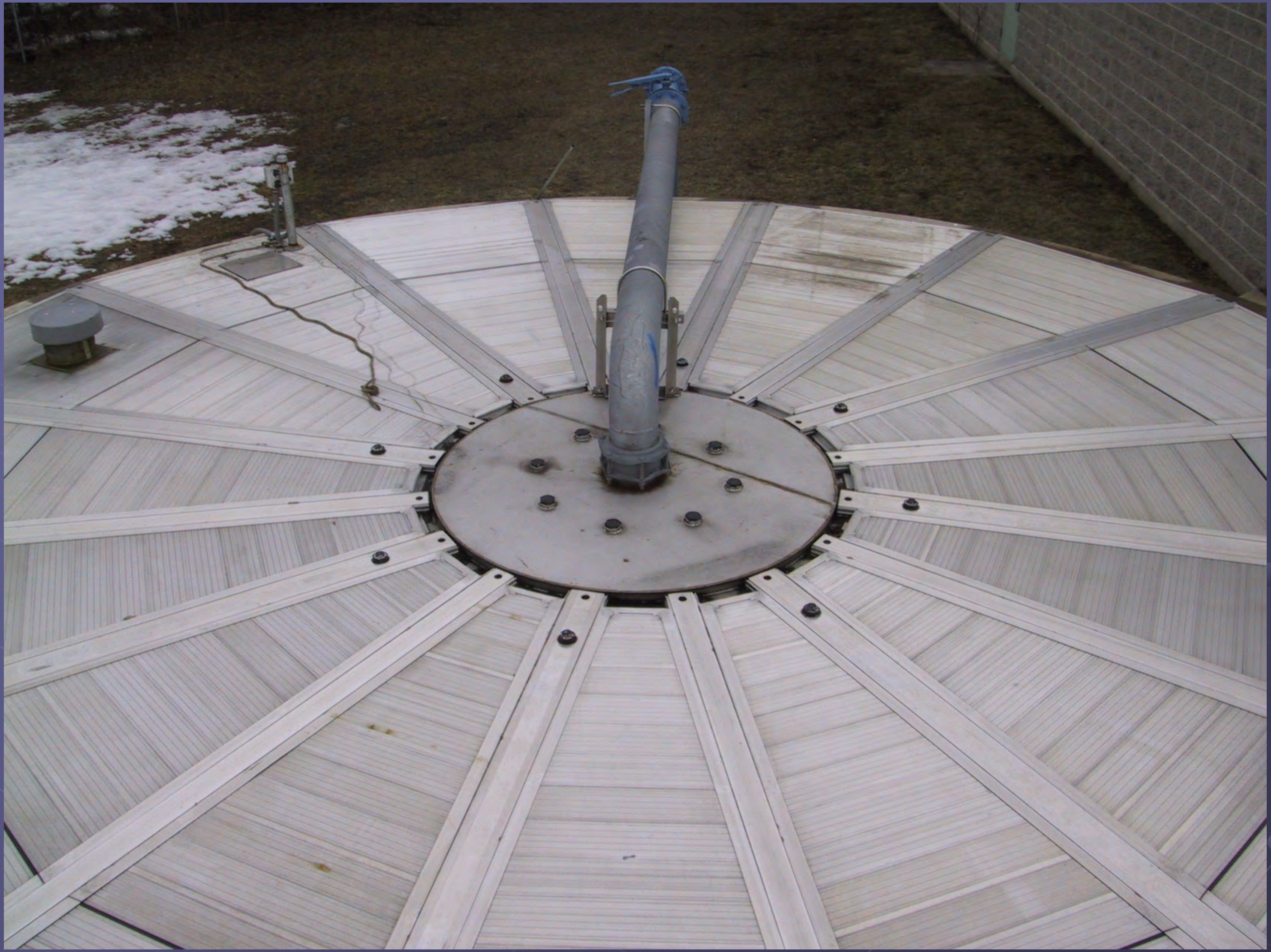
Muncy Borough Municipal Authority Retrofitting to Aerobic Digestion

Muncy Secondary Aerobic Digester

Converted from Existing Imhoff Tank



Muncy 1st Stage Digester



Converted Anaerobic Tank

Muncy Borough Municipal Authority Retrofitting to Aerobic Digestion

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  - Aerobic digesters
    - Primary (110,000 gal) – converted exist anaerobic digester
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  - Belt Filter Press – dewatering digested sludge

Muncy Aerobic Digester Design Criteria

- **PA DEP Design Manual (10/97)**
  - Volatile solid loading
    - ≤ 100 lbs/day/1,000 cf
  - Solid retention time
    - 10 – 20 days @ 15 ^{o}C
  - Aerobic condition
    - D.O. 1 ~ 2 mg/l
  - Air mixing
    - ≥ 30 cfm/1,000 cf

Muncy Aerobic Digester Design Criteria

- **Class B biosolids requirement – landfill disposal**

  (25 PA Code Article 273.513 & 271.932 – 12/00)

  - Sludge retention ≥ 40 days @ 20 ºC
    or ≥ 60 days @ 15 ºC
    - Utilize existing anaerobic digestion tankage
    - Cover to maintain temperature
    - Operate in series with aerobic & anoxic cycles
      - Reduced sludge retention
      - ≥ 28 days @ 20 ºC or ≥ 42 days @ 15 ºC
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(January 2003 – April 2004)

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Monthly average SRT (days)	28 – 42	32 – 67
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SOUR – Class B ≤ 1.5 mg/g/hr	0.60	0.62
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- **Quality decant from digesters**
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  - Adequate alkalinity
  - No routine chemical addition

- **Sludge volume reduction**
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  - Dewatered sludge – approx. 134 dry tons of year 2000
    – approx. 68 dry tons of year 2003

- **Project cost**
  - $ 850,000
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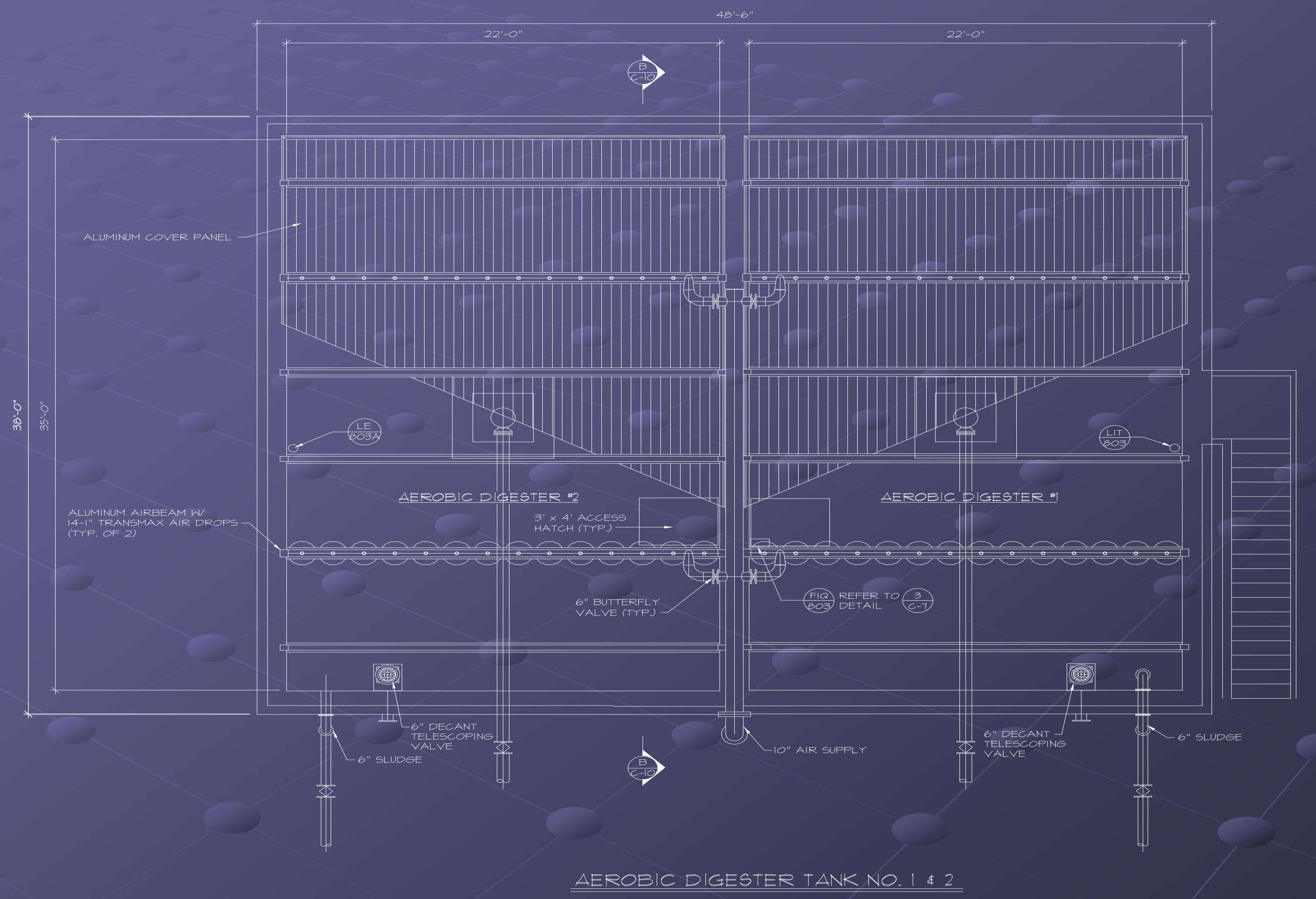
Waymart Area Authority
Wastewater Treatment Plant Digesters

WAA WWTP Aerobic Digesters



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  (aforementioned VS loading and air requirement)

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    - Cover to maintain temperature
    - Operate in series with aerobic and anoxic cycles

WAA Aerobic Digestion
Cost and Benefit

- **Major treatment equipment**
  - Sludge transfer pumps
  - Blowers
  - Aluminum covers
  - Aeration diffusers

- **Cost**
  - $ 800,000
  - $ 720/lb-VS/day

- **Benefit**
  - Disposal flexibility (Class B biosolids)
  - Ease of operation and maintenance
  - Minimum public nuisance

Aeration & Mixing Optimization

Reduced Energy Use

$18,000 Annual Power Savings

$27,503 Energy Efficiency Rebate from PPL

Improved Sludge Reduction

2009 Disposed of 1,036 wet tons @ $26,000

2011 Disposed of 444 wet tons @ $11,000

57% reduction in sludge disposal

Annual Savings $15,000

Reduced Labor and Chemicals

Belt Press Operations 2009, 45+ hrs./week

Belt Press Operations 2011, <30 hrs./week

Less Polymer, Less Lime for Land Application

Eliminated Ferric Use for P removal

SLUDGETREATMENT

AN EXERCISE IN AEROBIC DIGESTION

By Bryen Woo & Douglas Cleary

Pennsylvania municipality improves sludge digestion & reduces energy use

ARTICLE SUMMARY

Challenge: The Frackville Area Municipal Authority sought to upgrade and improve its aerobic digestion system.

Solution: The engineering firm proposed retrofitting the two existing aerobic digestion tanks with a new aerobic digestion system to minimize operating and capital costs and provide maximum mixing and aeration efficiency of waste-activated sludge.

Conclusion: The new system has improved digestion performance and substantially reduced energy usage without creating a need for additional tank volume.

The Frackville Area Municipal Authority (FAMA) Wastewater Treatment Facility (WWTF) in Frackville, Pa., currently operates an Ovivo Airbeam cover aerobic digestion system that was commissioned in October 2010.

FAMA was seeking to upgrade and improve its aerobic digestion system, so it contacted Entech Eng. to design a new system that would reduce the amount of solids that needed to be disposed for land application.

Aerobic Digestion System Design

Previously, aerobic digestion at the FAMA WWTF was conducted through a floor-mounted coarse-bubble diffuser system in uncovered aerobic digester tanks. Entech proposed to retrofit the two existing aerobic digestion tanks with an Ovivo Airbeam cover aerobic digestion system. This would minimize operating and capital costs and provide maximum mixing and aeration efficiency of waste-activated sludge while using minimum energy requirements, reducing odors and providing optimum temperature control to improve digestion. Covering the aerobic digester tanks provided faster kinetic reactions in the system, resulting in shorter solids retention time in the existing tanks to obtain Class B stabilized sludge, which eliminated the need to construct new tanks.

Each aerobic digester tank was designed with an Airbeam cover integrating Ovivo's Mansel Smith diffusers and shear tubes. The shear tubes allow the diffusers to be submerged several feet above the bottom of the tank floor, reducing the blower discharge pressure, resulting in lowering energy requirements of the aerobic digestion operations.

Reduced Energy

In comparison with the prior floor-mounted diffuser system, the shear tube design is capable of lowering the discharge pressure of the blower system by nearly 1.5 psig, resulting in a reduction of more than a 15% in annual energy usage at the FAMA WWTF since its incorporation of the new aerobic digestion system. The reduced energy usage from this system saves FAMA $18,000 annually in energy costs.

Pennsylvania Power & Light (PPL) Electric Utilities currently offers financial incentives under its E-power Program to facilitate the implementation of cost-effective, energy-efficient equipment for commercial, industrial, governmental, institutional and nonprofit customers. The E-power incentive program pays on a per-unit-of-energy-saved (in kilowatt hours) basis. Due to the reduction in energy usage provided by its new aerobic digestion system, FAMA applied for this incentive. It was granted a $27,503 energy efficiency rebate from PPL in February 2012.

Reduced Sludge Disposal

Enhanced temperature control provided by the new aerobic digestion system greatly improved digestion performance at the FAMA WWTF. After the solids are digested by the aerobic digestion system, they are dewatered with a belt press; then the Class B solids are land applied. Prior to incorporation of the new system, 250 acres were used to land apply the solids. After installation, 172 acres are used, resulting in a reduction of more than 30%.

Prior to the new aerobic digestion system, FAMA disposed of 1,036 wet tons of solids in 2009, costing $26,000. After installation, it disposed of 444 wet tons of solids in 2011, costing $11,000. By substantially improving sludge digestion, the new system provides an almost two-and-a-half times reduction in sludge disposal, generating savings of $15,000 annually in disposal costs.

Improved Digestion Performance

The Airbeam Cover aerobic digestion system at the FAMA WWTF has improved digestion performance and substantially reduced energy usage without having the facility having to build additional tank volume. The improvements have resulted in a 57%-plus reduction in solids disposed and a 15% reduction in annual energy costs. FAMA is able to save a total of $33,000 annually through reduced energy and disposal costs alone.

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For more information, write in 1108 on this issue's reader service form on page 54.

Techniques to Improve Process Performance:

1. Series or Batch Operation
2. Thickening to 3% - 6%
3. Aerobic & Anoxic Operation
4. Temperature Control
5. Operational Flexibility

THANK YOU