THE SECOND GENERATION ATAD: AN OVERVIEW

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WHAT IS AN ATAD?

- ATAD STANDS FOR
- **A**utothermal
- **T**hermophilic
- **A**erobic
- **D**igestion

WHAT DOES THAT MEAN?

- Autothermal – the sludge is self heating from the heat given off by digestion
- Thermophilic – The sludge temperature is above 110 degrees F (Actually it will be between 140 and 150 degrees F , or 60 – 65 degrees C)

WHAT DOES THAT MEAN?

- Aerobic – the sludge is in an oxidizing state. There may be dissolved oxygen at some times
- Digestion – the process destroys solids

HOW MUCH HEAT IS IN SLUDGE?

- AUTOTHERMAL means that the sludge is self-heating.
- Digesting one pound of volatile solids releases, in theory, 9000 BTU
- One BTU raises the temperature of one pound of water one degree F

HOW MUCH IS THAT IN PRACTICAL TERMS?

- 2000 Lbs of sludge at 75% VS has 1500 Lbs of volatile solids
- If you destroy 50% of that, 750 Lbs are destroyed
- 750 X 9,000 = 6,750,000 BTU
- If the sludge is 5% TS , then the volume is 4800 gallons (40,000 Lbs)
- Temperature rise = 6,750,000/40,000 = 168 degrees F PRETTY HOT!

SO WHY DON'T NORMAL AEROBIC DIGESTER GET HOT?

- Because they are open to the air and the air is an enormous heat sink and…
- Because there is a high flow of air taking the heat away
- Actually, they do , sometimes, and it often isn't pretty

LIKE THIS

HOW DO WE KEEP FROM LOSING THE HEAT?

- Cover the tank
- Insulate the walls
- Use a volumetrically-efficient aeration system

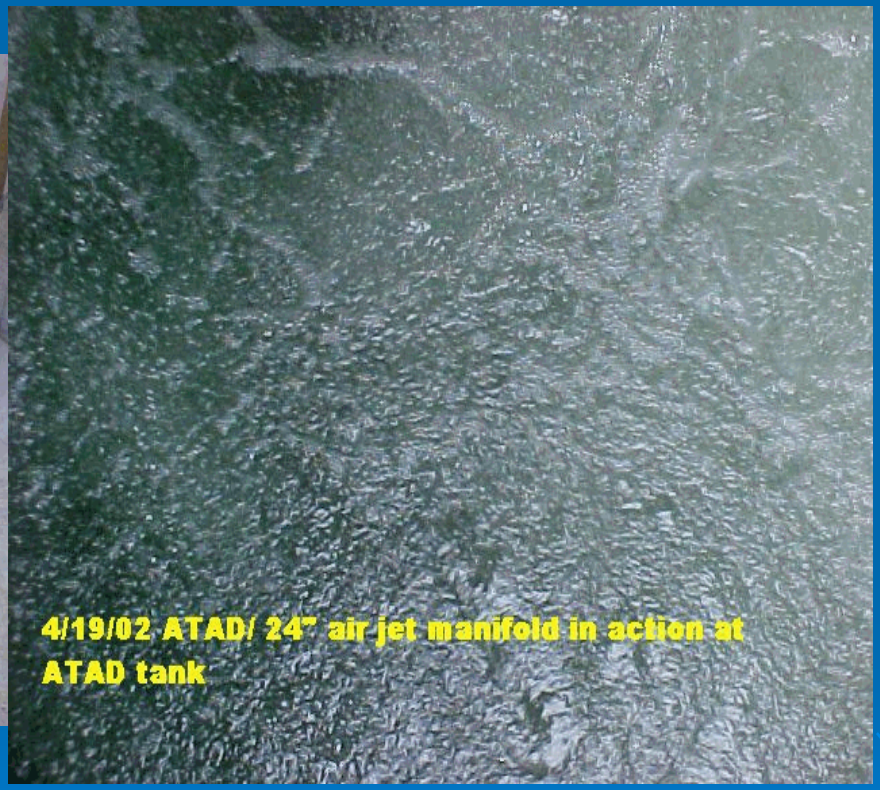
COVERED TANK

ANOTHER COVERED TANK ANAEROBIC/ATAD CONVERSION

INSULATED WALLS

EFFICIENT AERATION

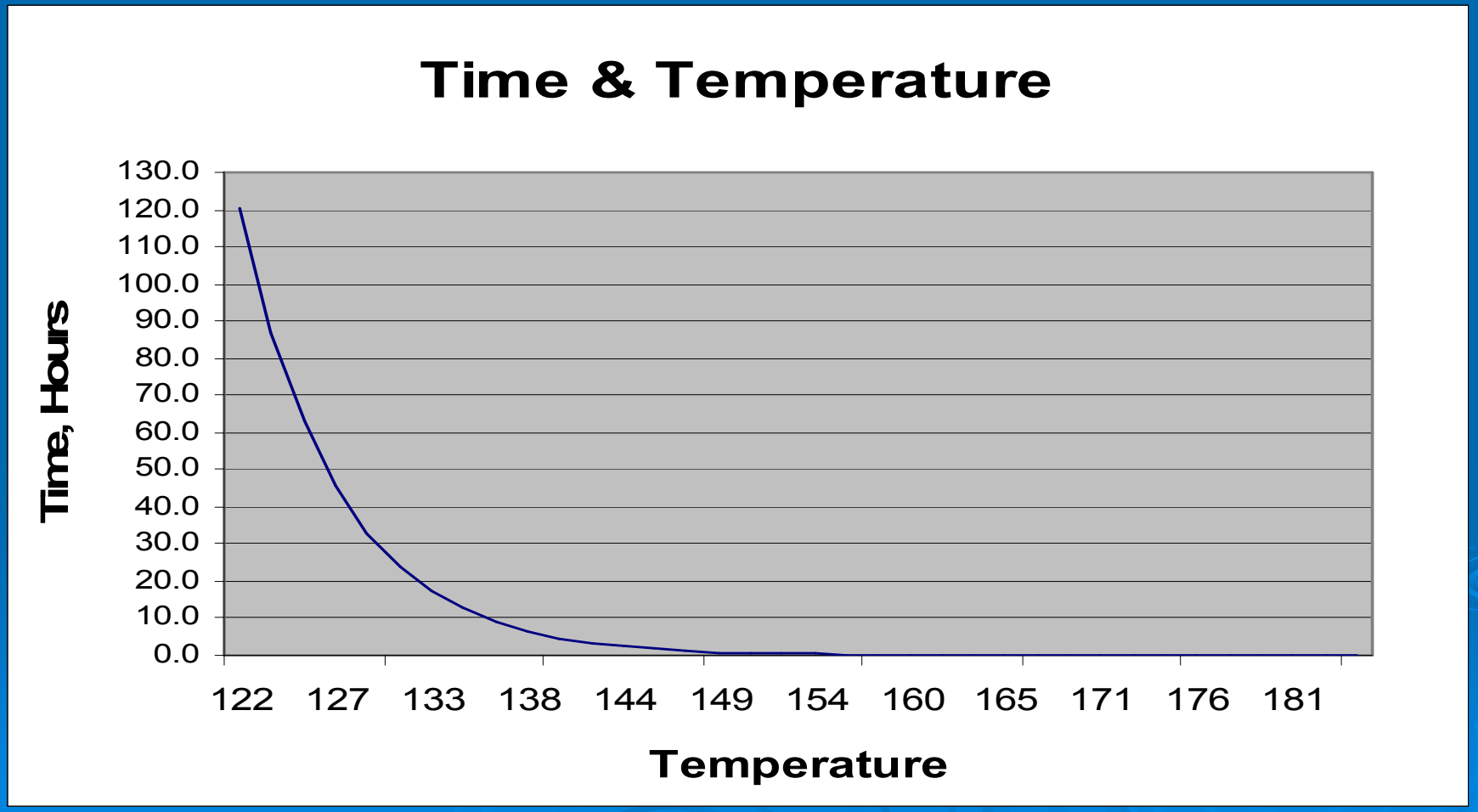
AERATION SYSTEM
THREE RIVERS, MI



WHAT'S SO GOOD ABOUT THERMOPHILIC OPERATON?

- The high temperatures kill pathogens. The bacterial kill rate is related to the temperature
- The bugs work a lot faster, meaning the detention time can be shorter for good volatile solids reduction

TIME AND TEMPERATURE



SYSTEM COMPONENTS

- ATAD REACTORS
- SNDR REACTOR
- STORAGE TANKS
- ODOR CONTROL

JET AIR HEADER

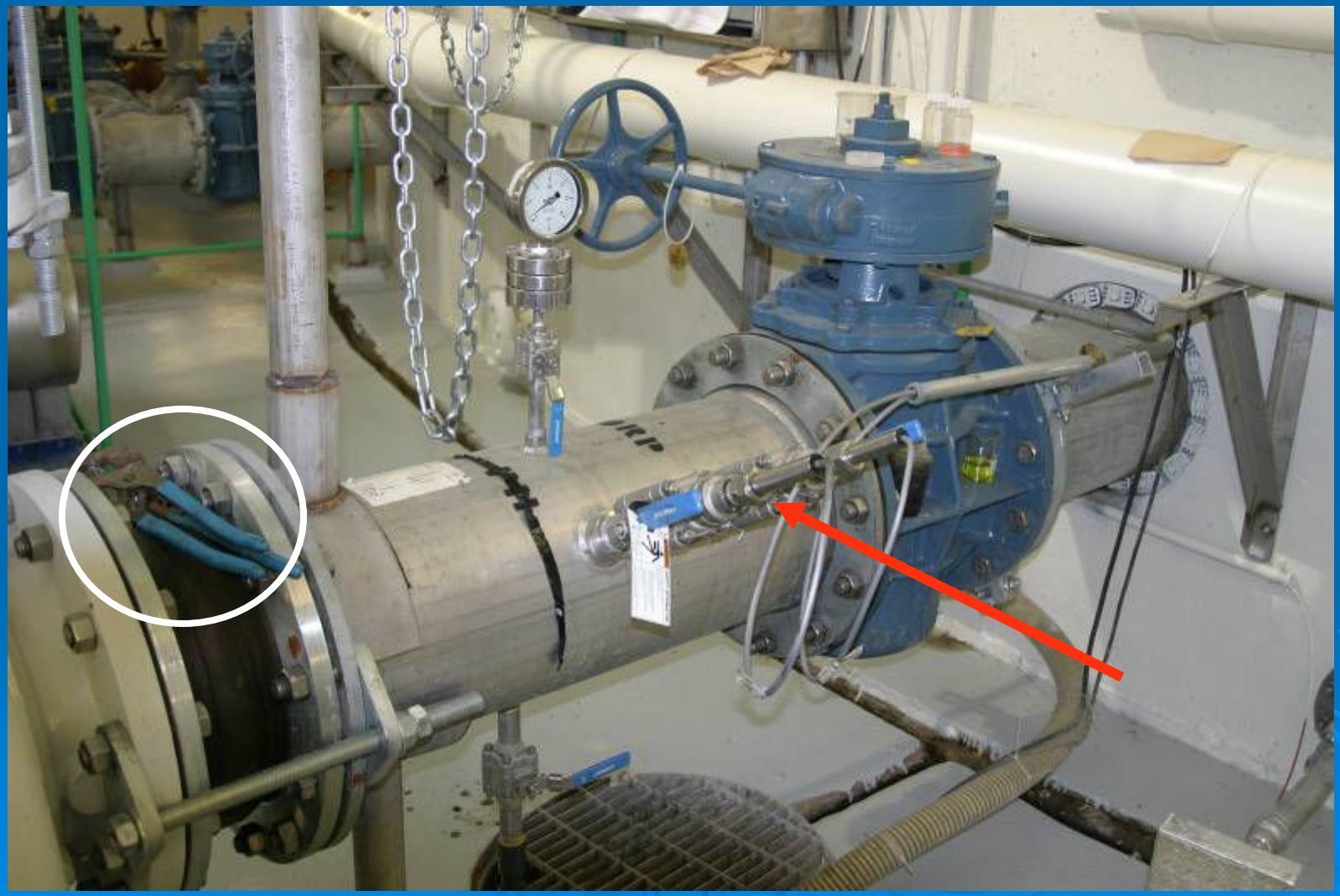
- Made of Fiberglas
- Provides mixing and aeration
- Outlet velocity 30 fps

JET MOTIVE PUMP


2/15/05--Looking N @ the connection of pump #2 to flange pipe/suction valve (#10) in the northern pump gallery.

- Provides motive power for jet aeration system
- Provides mixing as well
- Turnover time is about 35 minutes

PUMP WITH ORP PROBE



TANK COVERS

- Covered to retain heat and to contain odors
- Can be poured in place concrete, Concrete planks or Flat Panel Aluminum, or Combination

ATAD COVER

11/4/04--Looking W @ placement adjustment of a section of the 8" precast concrete deck for ATAD tank #2.

ALUMINUM PORTION

FOAM CONTROL/TRANSFER PUMP


3/22/05--Looking NNE @ a painted pump #7 and sludge transfer main line behind it in the northern pump gallery.

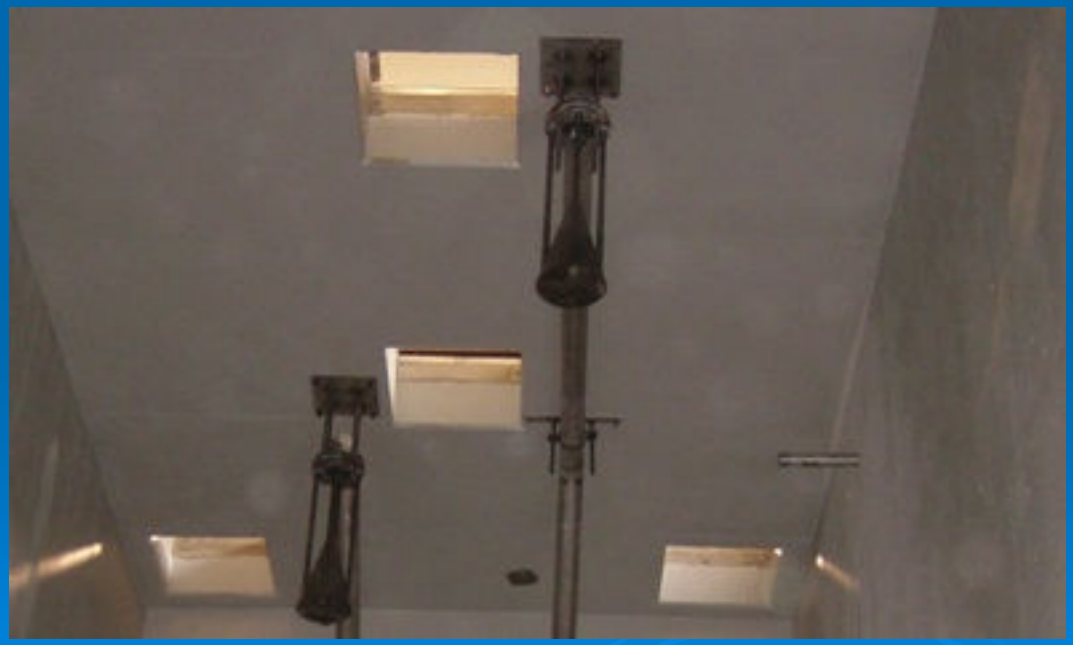
- Provides foam control and sludge transfer from reactor
- Piping is HOT and will be insulated

ANOTHER FOAM CONTROL PUMP

FOAM CONTROL PIPING TOPSIDE

SPLASHCONE

- Sprays sludge down on foam layer



SLUDGE TRANSFER PIPING

AIR SUPPLY

- Normally dedicated PD blowers
- Can be from central air supply by motor-operated valves
- Flow controlled to maintain ORP

PD BLOWERS IN SOUND REDUCING ENCLOSURES – DELPHOS OH

HOW IS THE ATAD REACTOR CONTROLLED?

- BY ORP AND TEMPERATURE
- The controller varies blower air and pump speed to control ORP
  - Feeding ATAD drops ORP: air and pump speed increase
  - When demand is satisfied ORP increases, air and pump speed decrease

SNDR REACTOR

- Stands for “Simultaneous Nitrification/Denitrification Reactor
- Removes 50% of ammonia from off gas
- Provides an additional 15% TS reduction
- Reduces ammonia and biopolymers by 65%.
- Reduces dewatering polymer and coagulant demand
- Heat loss by radiator and heat exchanger

RADIATOR – BOWLING GREEN

RADIATOR - DELPHOS

JET MOTIVE PUMP

HEAT EXCHANGER - BG

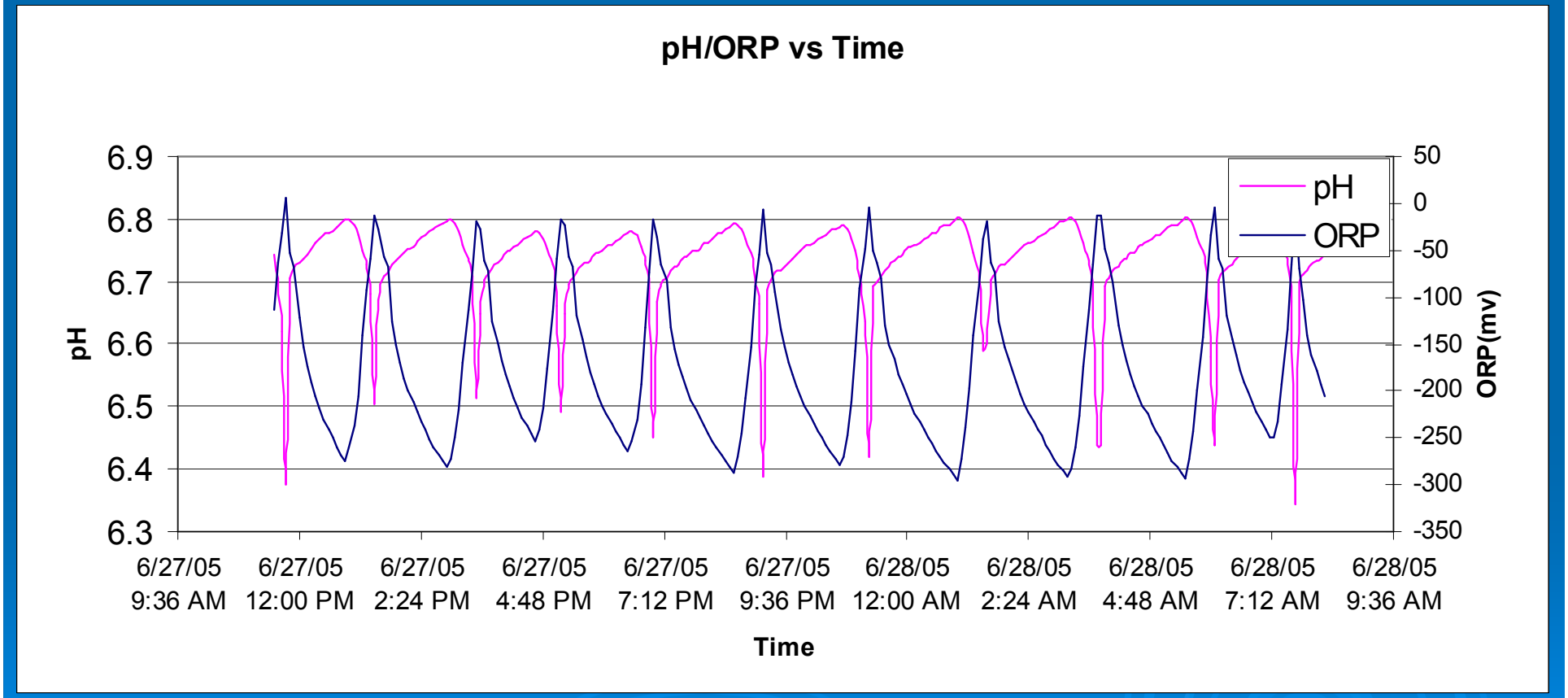
3/24/05--Looking N @ the first coat of paint applied to the heat exchanger in the northern pump gallery.

HEAT EXCHANGER - YORKVILLE

CONTROL FOR SNDR

- Monitors
  - ORP
  - Temperature
  - pH
- Controls
  - Air flow (time)
  - Flow to radiator
  - Flow to heat exchanger
  - Intent is to maintain tank temperature at 94^{o}-96^{o} F AND Ph BETWEEN 6.5 AND 6.9

NITRIFICATION/DENITRIFICATION BY PH CONTROL



SLUDGE FEEDING/TRANSFERRING

- Sludge feed can be continuous if there are 2 ATAD reactors. Only one reactor is fed in a day. Feeding alternates
- Sludge transfers to SNDR are batch transfers, done once a day

WHY ONCE A DAY?

- To conform with the EPA regulation that “every particle” has to meet the required time and temperature

WHAT ARE THE CONTROL SETTINGS ANYWAY?

- SOLIDS RESIDENCE TIME (SRT)
  - The SRT will be 10-14 days.
  - The SRT is controlled by wasting and by tank level
- ORP
  - The program will attempt to maintain the ORP at a setpoint between +50 and -100 mV, depending upon experience.
  - Pumps will change speed and air flow will change to maintain setpoint

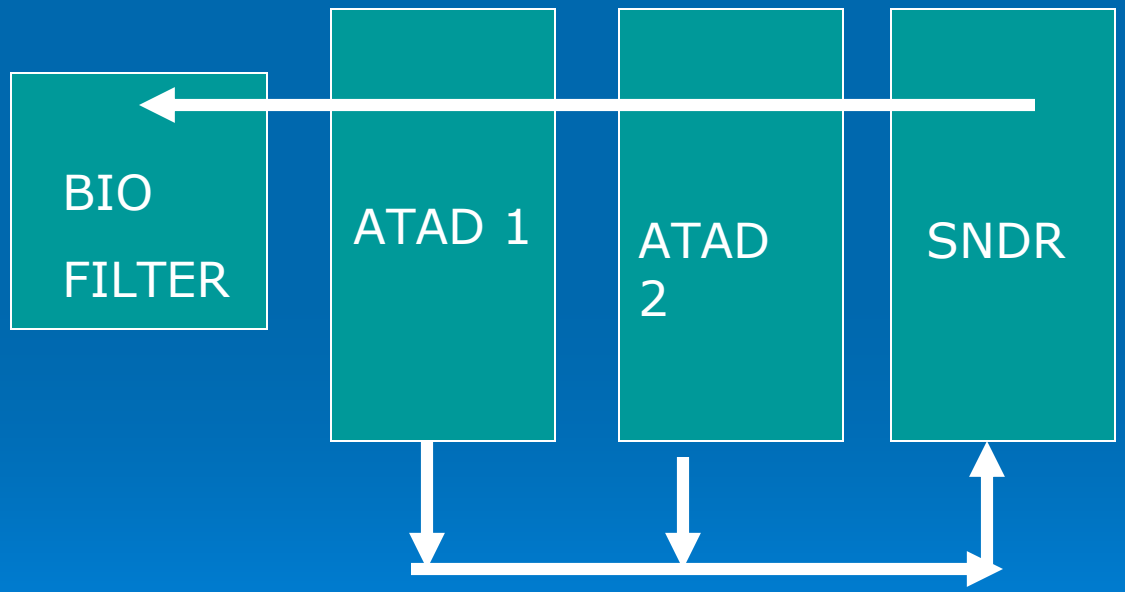
WHAT ABOUT ODOR CONTROL?

- The ATAD generates a lot of ammonia in the off-gas (about 900 ppm)
- Plus some reduced sulfur compounds from time to time
- 3-stage biofilter deodorizes off-gas

3 STAGES OF ODOR REMOVAL

- 1. Foul air is pulled from ATAD reactors to the SNDR. The foam control sprays absorb ammonia from off gas.
- 2. Spray water chamber at biofilter absorbs more ammonia. Most of ammonia is removed in stages 1 and 2.
- 3. Biofilter provides growth media for nitrifiers to consume ammonia.

TYPICAL FOUL AIR FLOW DIAGRAM

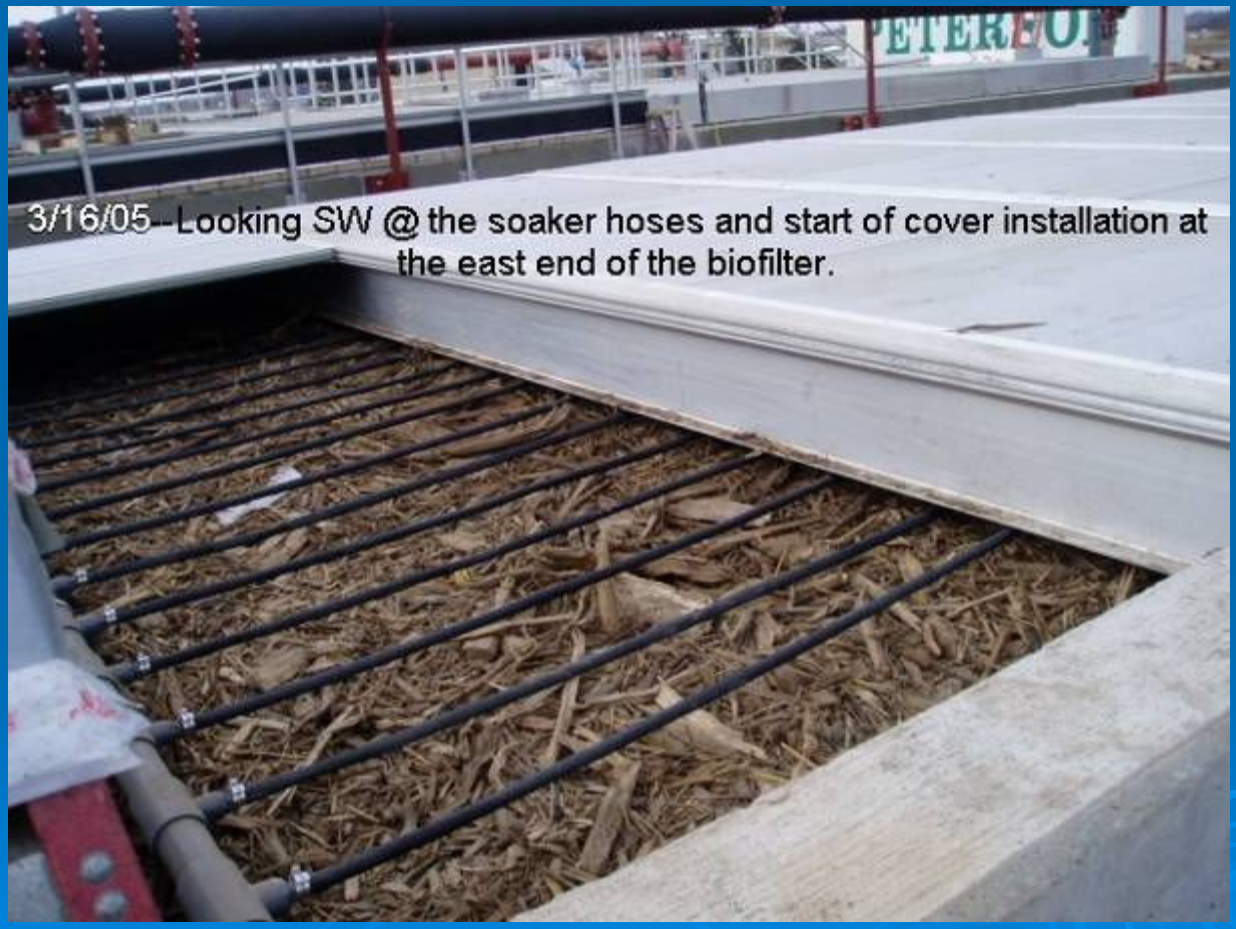


BIOFILTER AIR DUCT

LAVA ROCK UNDERBASE

SHREDDED TREE ROOTS

SOAKER HOSES AND COVER ON TOP



BIOFILTER FAN PULLS FOUL AIR THROUGH FILTER

PERFORMANCE AT INSTALLATIONS

STALEY STARCH, W.LAYFAYETTE IN

- First Plant
- 15 Dry Tons/day (TPD)
- Industrial
- Invented here because they were drowning in biosolids

BEFORE AND AFTER

- Dewatering 24 Hrs/day
- 12-14% solids
- Land applied after reliquefacation
- Odor Complaints
- Angry Neighbors
- Holding up plant production

- Dewater 3 days wk, 8 hrs day
- 18% cake solids
- Mixed with horse stall waste
- Everyone is happy

THREE RIVERS MICHIGAN

- 2.5 MGD Design
- Odor Complaints
- Failing Digesters
- Septage overloaded plant

INNOVATIONS

- New foam control scheme
- Treats septage primary and TWAS

THE RESULTS

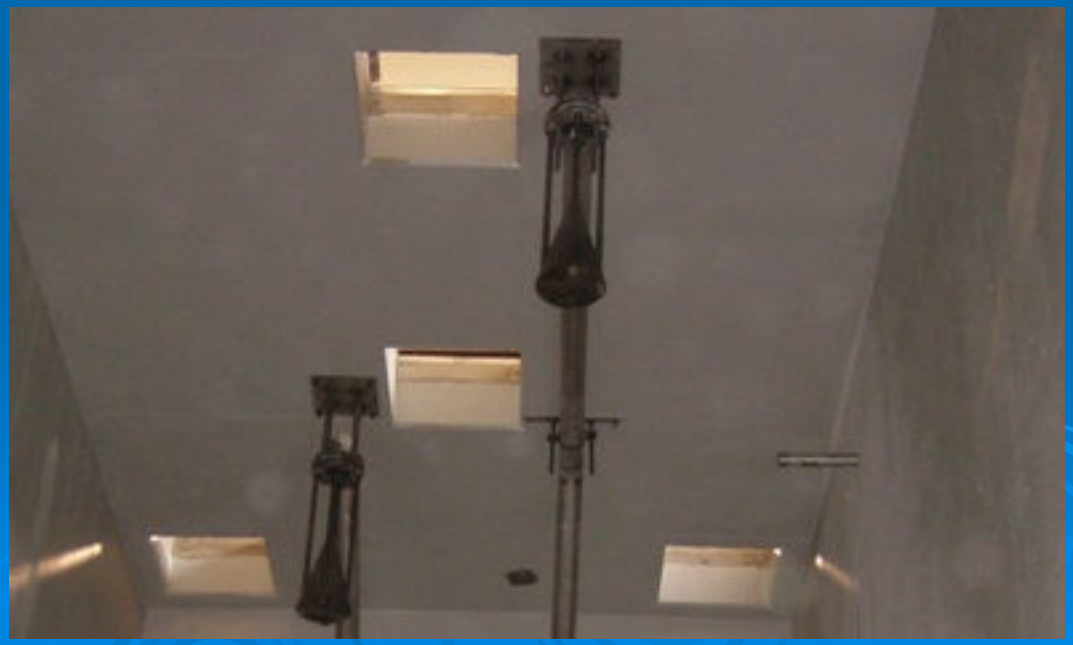
- 45% TS Reduction
- Feed sludge thinner than design
- Hydraulic loading rate more than design
- Accepts 25,000 gpd septage at 1.5 MGD flow
- No problems

YORKVILLE ILLINOIS

- 2. MGD
- Plant expansion
- Tight Site
- Wanted to Reduce Biosolids Production

INNOVATIONS

- New foam control scheme
- Heat exchanger to cool down sludge
- First SNDR tank



THE RESULTS?

- 50% TS Reduction
- SNDR reduced polymer and chemical dose
- Cake solids 28% with 100% WAS feedstock
- Cake certified as compost

BOWLING GREEN OHIO

- 5 MGD Flow
- Plant expansion
- Stinky aerobic digesters
- High power cost
- Capacity is 15,800 Lbs/day

WHY ATAD?

- Potential for cost savings
- Biggest reduction – aeration power reduced from 900 Hp to 450 Hp

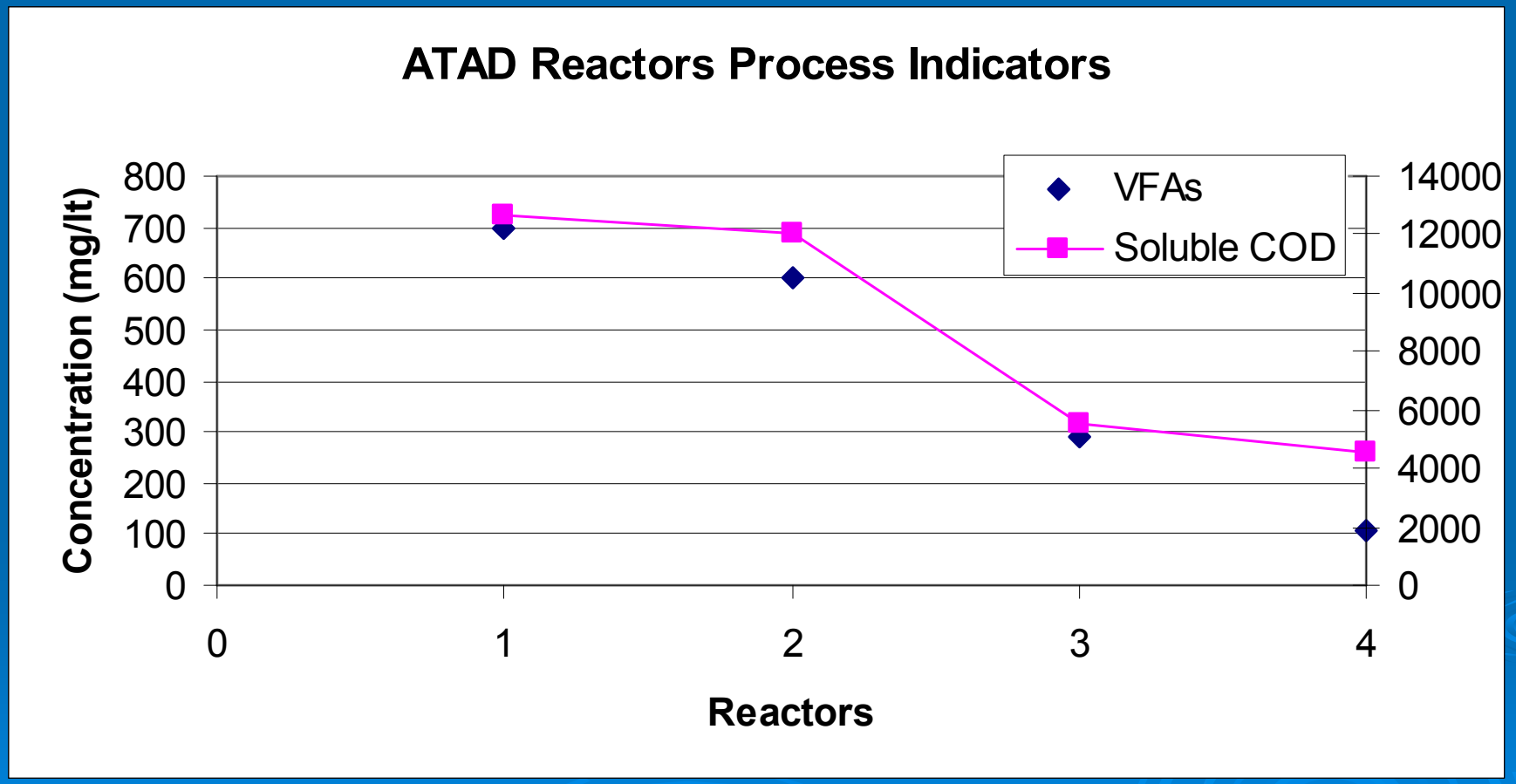
INNOVATIONS

- Passive radiator to cool SNDR
- Continuous feed-2 reactors
- Air from common header with aeration tanks
- Open storage tanks

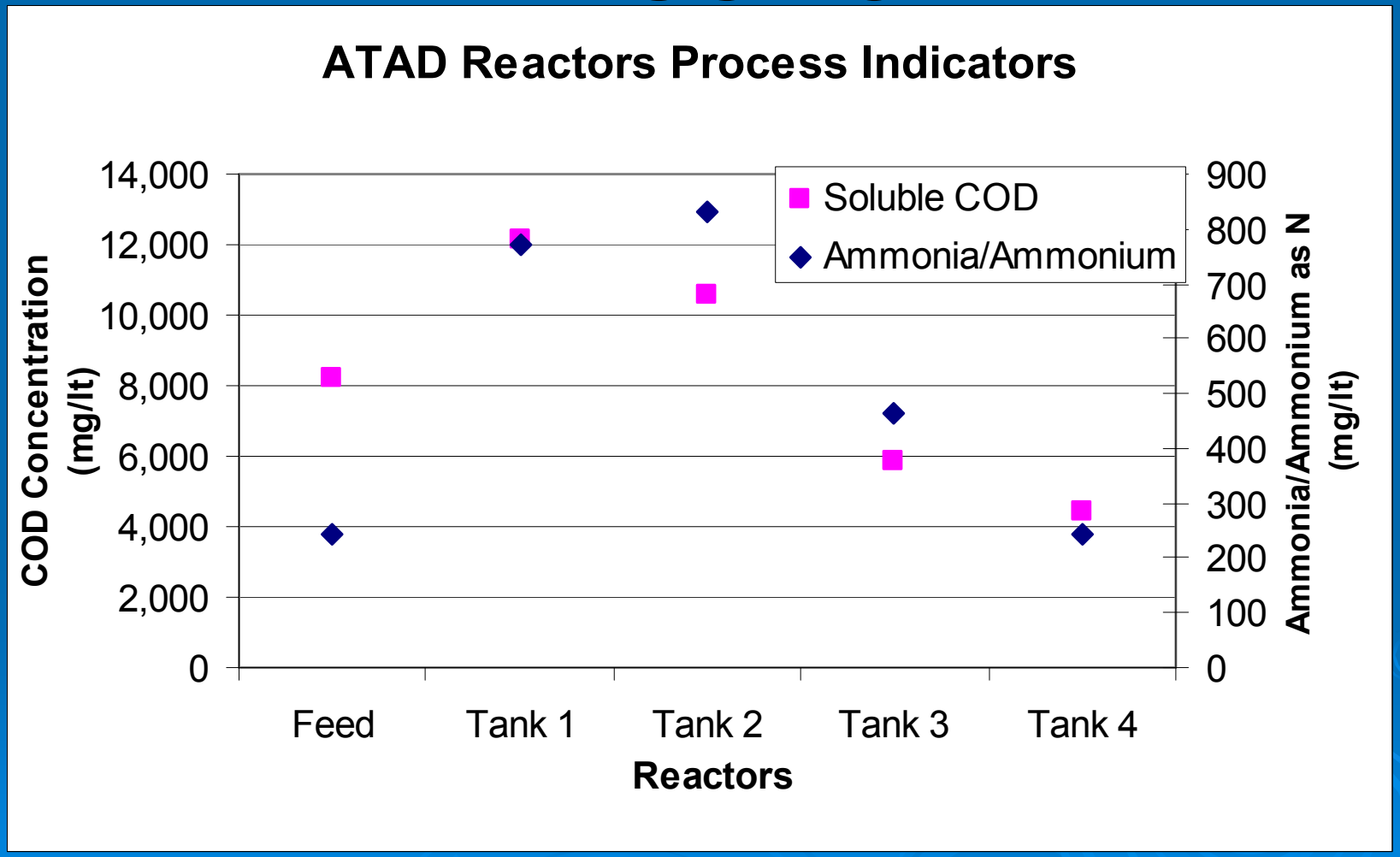
THE RESULTS

- Up to 65% TS reduction
- 75% VS reduction
- 32% cake solids
- Polymer dose of 7 Lbs active/dt with centrifuge
- Biosolids cake now sent to soil blender
- Costs reduced $390,000/yr compared to aerobic digestion

SOLUBLE COD (EXOCELLULAR POLYMER) REDUCTION



AMMONIA, TOO – 65% REDUCTION



MORE GOOD STUFF

- COD and NH3 reduction reduces polymer dose and allows for settling
- Supernating for volume reduction possible
- With powdered bentonite
- Without powdered bentonite

MOREHEAD, KY

- Retrofit of anaerobic digesters
- Capacity 6,600 Lbs day

MORE PICTURES

THE RESULTS

- 60% reduction in sludge cake to fields
- Cake solids went from 15% to 21%
- Elimination of anaerobic digester recycle caused aeration tank blower to be oversized (OOPS!)
- Maintains temperature with only 2% feed solids

DELPHOS OH

- Part of new plant design
- Digests MBR sludge, which is well-oxidized
- Capacity is 8,800 Lbs/day

INNOVATIONS

- Treats gravity belt thickened MBR WAS, a low volatile waste

THE RESULTS

- 63% VS Reduction
- 22% cake solids with belt press
- $170,000 savings/yr in dewatering/disposal costs (sludge is given away)

Heart of the Valley, Wisconsin

- Treats Actiflo primary sludge and Biostyr WAS
- Capacity 21,800 Lbs/day

INNOVATIONS

- Treats Actiflow primary waste and Biostyr secondary waste

THE RESULTS

- 63% VS reduction
- 56% TS reduction
- No odors
- Good supernating
- Liquid land application

MARSHALL MINNESOTA

- Anaerobic digester retrofit
- Capacity 12,000 Lbs/day
- Plant flow 2 MGD, heavy industrial waste from ADM
- Primary and TWAS

WHY AN ATAD?

- Anaerobic digester covers failed after 11 years: $1 million to replace. Other equipment in need of replacement.
- ATAD produced fewer biosolids for equivalent costs

EQUIPMENT LAYOUT

INNOVATIONS

- Liquid storage in covered tanks (4 MG volume)
- Good supernating without chemical addition

THE RESULTS

- 50% TS reduction
- 65% VS reduction
- Digested biosolids decant to 5% + TS
- Anaerobic sludge only decanted to 2.5%
- 67% reduction in land application cost
- Supernatant ammonia only 56 mg/L
- Reactor Temp: 155F 21 minutes pathogen kill time

CONCLUSIONS

- ATAD is cost effective
- 50-65% TS reduction
- 55-75% VS reduction
- Good supernating
- Good cake solids
- Low polymer dose
- Non-farm market for end product