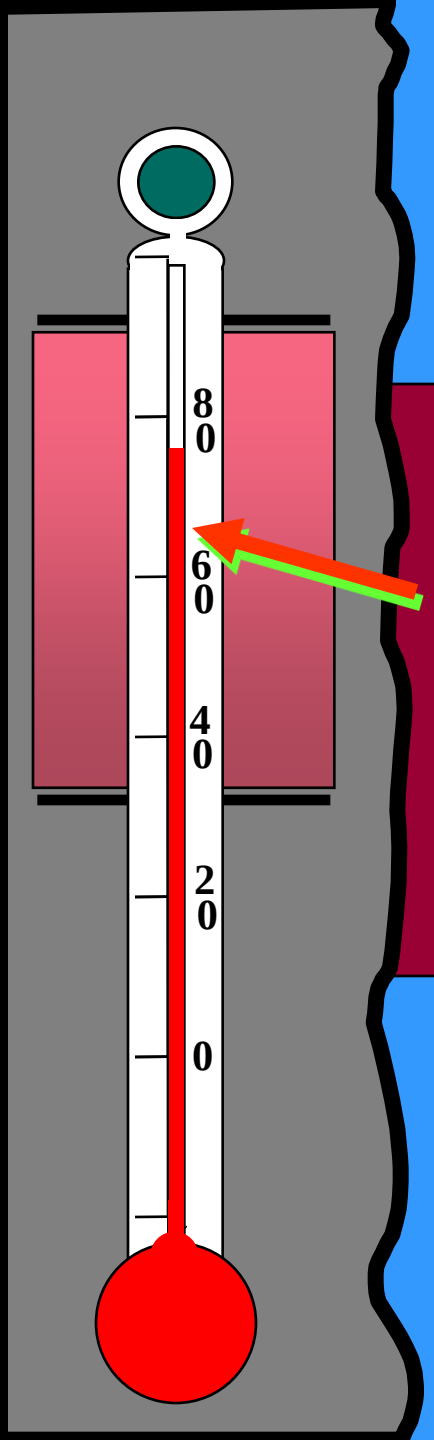


OTCO Waste Water Workshop

March 26, 2014

ThermAer

Autothermal Thermophilic Aerobic Digestion

Biosolids Treatment

Thermal Process Systems

Smith Environmental

ThermAer Process

ThermAer System

- Thickening step (WAS, MBR, SBR, etc)
- Main processing reactor (ThermAer)
- Liquid storage and nutrient reduction (SNDR)
- Dewatering (belt press, centrifuge, etc.)
- Class A disposal (land application, soil blending)

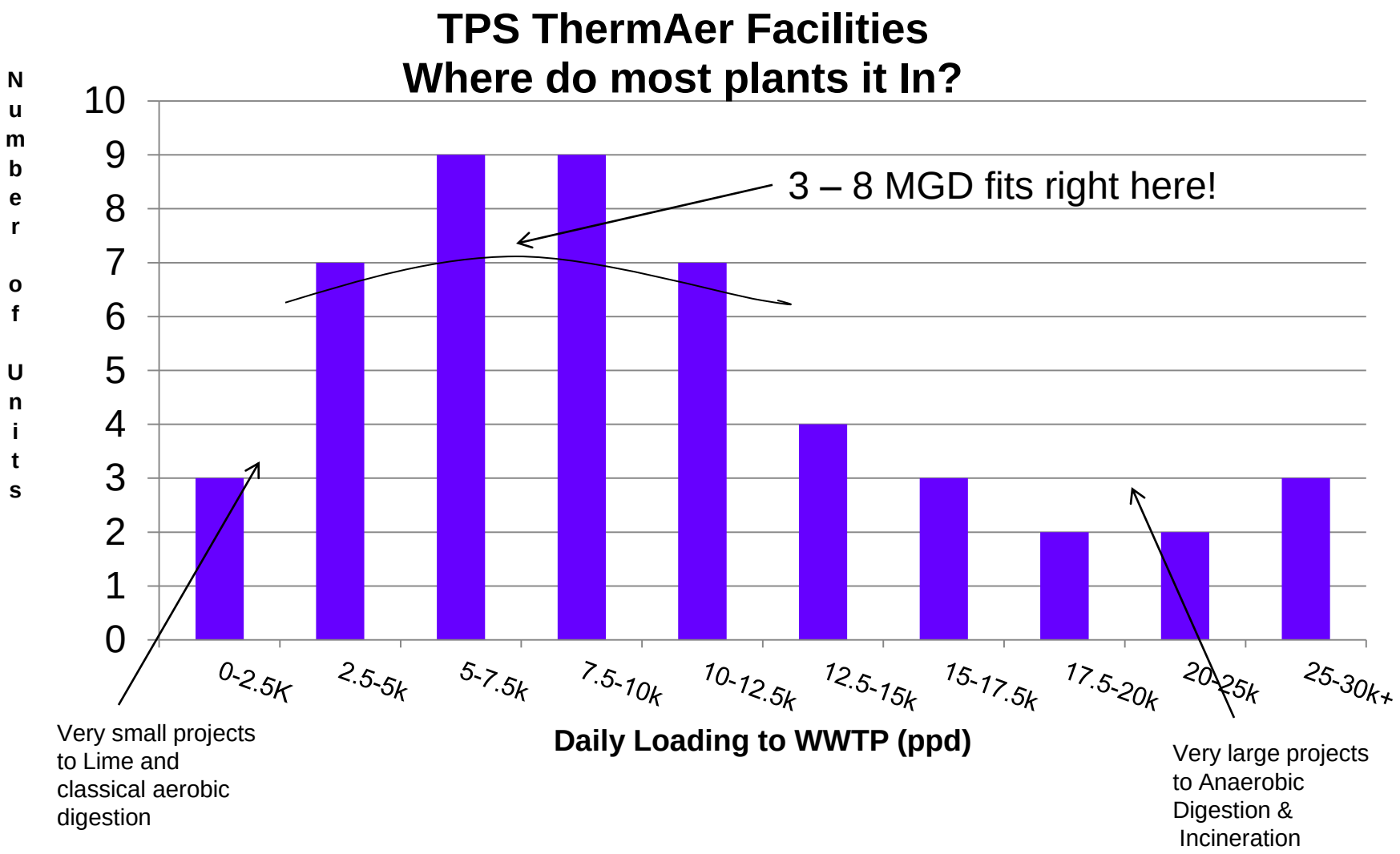
ThermAer System

- Maintains thermophilic temperatures of 131°-160°F without an outside source of heat (typically 145°F for ease of operation)
- Provides for approximately 50% total solids reduction
- Provides for 60 – 70% volatile solids reduction
- Produces a Class A end product that is easily dewaterable for storage and land application

SNDR

- Maintains mesophilic conditions (95°F) and pH control allowing for nitrification/denitrification and ammonia reduction
- Allows for an additional 10% TS destruction by satisfying additional residual oxygen demand
- Reduces overall dewatering costs by conditioning the sludge
- Lowers N & P recycle
- Provides a wide spot in the line prior to dewatering

WWTP Size in ppd vs. Number of Plants



U.S. ATAD Facilities

TPS ThermAer
50 Operating Facilities
8 Under Construction

California (Pacifica)

Washington (E. Wenatchee)

Minnesota (Marshall & Waseca)

Wisconsin (HOV & Grand Chute)

Illinois (Yorkville, Itasca, Sycamore Bellevlille)

Michigan (Three Rivers, Traverse City)

Pennsylvania (Towanda, LATA, Middletown, Huntingdon, Valley Joint, Brodhead)

Ohio (Delphos, Bowling Green Middletown, & Portsmouth)

Indiana (Lafayette, Franklin & Decatur)

Kentucky (Morehead)

South Carolina (Brunswick County x 3)

W. Virginia (Princeton)

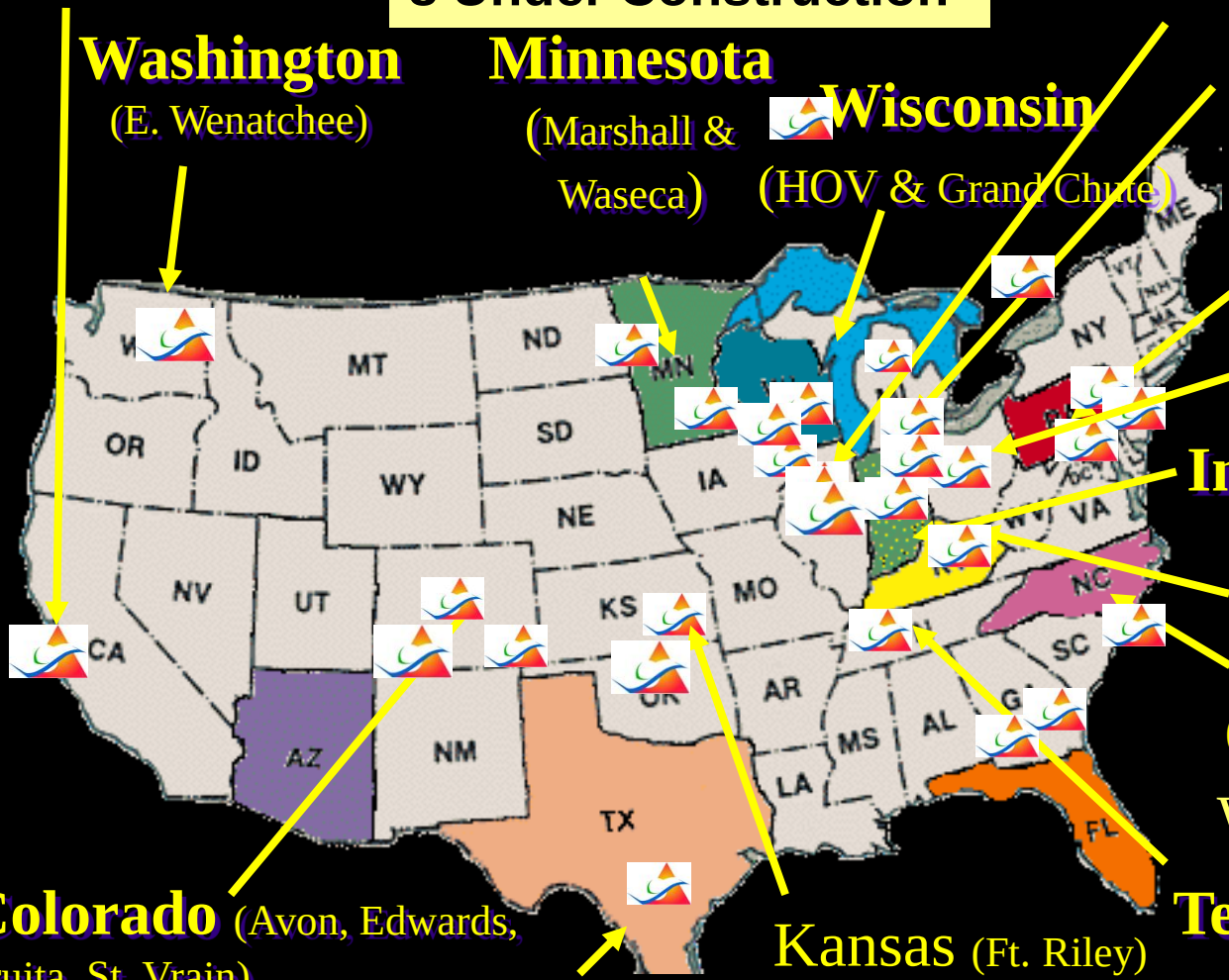
Tennessee (Lebanon, Maryville)

Georgia (Villa Rica, Walnut Creek)

Kansas (Ft. Riley)

Texas (HCID)

Colorado (Avon, Edwards, Fruita, St. Vrain)



TPS ThermAer Vs Lime

- Replaced 6 Liming Units in Midwest
  - Middletown, OH
  - LATA, PA
  - Middletown, PA
  - Maryville, TN
  - Huntingdon, PA
- Reduces volume, not increases it (x5)
-

TPS ThermAer Vs AnD

- Unclassified versus Class 1 Div 1
- Lower solids volume for T&D
- Corrosive atmosphere for Dewatering
- Retro-fitted 13 anaerobic digestors
- Smaller tank volumes – no new tanks
- Plants rethinking – NG prices drop
- Class A – easy disposal

TPS ThermAer Vs AD

- Lower Energy (approximately 50% bhp)
- Much smaller tank size 5% feed
- Better VSR
- Drier cake solids
- Class A disposal options

TPS ThermAer Vs ATAD

- Retro-fit 8 - 1st Generation Systems
  - 5 Fuchs Systems
  - 1 Jet Tech
  - 1 Dayton Knight
  - 1 CBI Walker
- Process Control
- No odor generation

TPS ThermAer Vs TPS

- ~50 Installations in US
  - All (every plant) are still in operation
- 5 plants have included in Phase 2
- Continued Plant Operator Support
- Growing US small company (20 years)

TPS ThermAer

- T & D
  - Most WWTPs have free land app.
  - Should use $0 as T & D
- Electric Cost
  - Use bhp not nphp
  - Significantly lower – PLC
- Green Technology

Delphos, Ohio

- 3.83 MGD design (1.5 MGD average)
- 70% combined / 7 permitted CSOs
- 8,700 lbs/day (2006)
- 72% VS and 52% TS reduction
- 25% average TS off of belt press
- 350 to 450 dry ton per year
- Land application by farmers (lottery system)

2009 Loadings

Month	Avg. TS lb/day Feed	Avg. VS lb/day Feed	TS Dest. %	VS Dest. %
January	4547	3169	53	67
February	5432	3394	48	65
March	6258	4180	50	69
April	5694	3821	62	77
May	6630	4555	62	76
June	8098	5701	74	81
July	5827	4166	51	68
August	2129	1509	30	58
September	2768	1860	42	64
October	5009	3486	42	63
November	4094	3242	40	63
December	4130	3250	30	54
Average	5051.3	3527.8	49	67

2011 Loadings

Month	Avg. TS lb/day Feed	Avg. % VS in feed	TS Dest. %	VS Dest. %
January	5951.0	75.7	49	63
February	7370.0	78.9	60.3	72.6
March	5563.0	80.1	57.2	70.6
April	7645.0	81.2	47.1	61.2
May	6417.3	81.7	64.3	73.6
June	7027.0	77.5	59.3	67.5
July	5159.0	78.5	45.5	56.9
August	2546.4	68.5	68.1	71.2
September	3856.7	74.5	48.6	57.2
October	3823.4	75.4	24.3	39.8
November	3076.5	77.9	65	73.7
December	3285	76.5	32.2	48.7
Average	5143.4	77.2	51.7	63

Delphos ThermAer Advantages

- Provided a Class A biosolids product that Delphos gives away resulting in an annual savings of up to $200,000
- Odor free biosolid material that dewaters on a belt press up to 28% TS (average is 22-25%)
- 50% TS reduction (meant less storage for cake)
- 60 – 70% VS destruction

Bowling Green, Ohio

- 10 MGD design (5.0 MGD average)
- 60% combined / 1 permitted CSO
- 15,430 lbs/day (2005)
- 65% VS and 60% TS reduction
- 38% TS off of the centrifuge
- ~850 dry tons per year
- Topsoil generator
- Total cost savings of over $188,000 annually

Middletown, Ohio

- 16.5 MGD Average Daily Flow
- 33,800 lbs/day (2009)
- 50% VS and 35% TS reduction
- 34% TS off of the centrifuge
- ~ 1845 dry tons per year
- Land application by contract operations
- Estimates total savings of at least $216,000 annually

Lower Allen Township Authority, Pennsylvania

- 6.25 MGD Average Daily Flow
- 9,000 lbs/day (2011)
- 74% VS and 50 - 60% TS reduction
- 26% TS off of the centrifuge
- Land application program both liquid and solid
- Single stage reactor – wants to add on

Decatur, Indiana

- 2.6 MGD Average Daily Flow
- 4,100 lbs/day (2008)
- 78% VS and 54% TS reduction
- 26% TS off of the belt press
- 299 dry tons produced in 2011
- Reduced dewatering practices from 3 days/week to 5 days/month
- Land application at no cost

Maryville, Tennessee

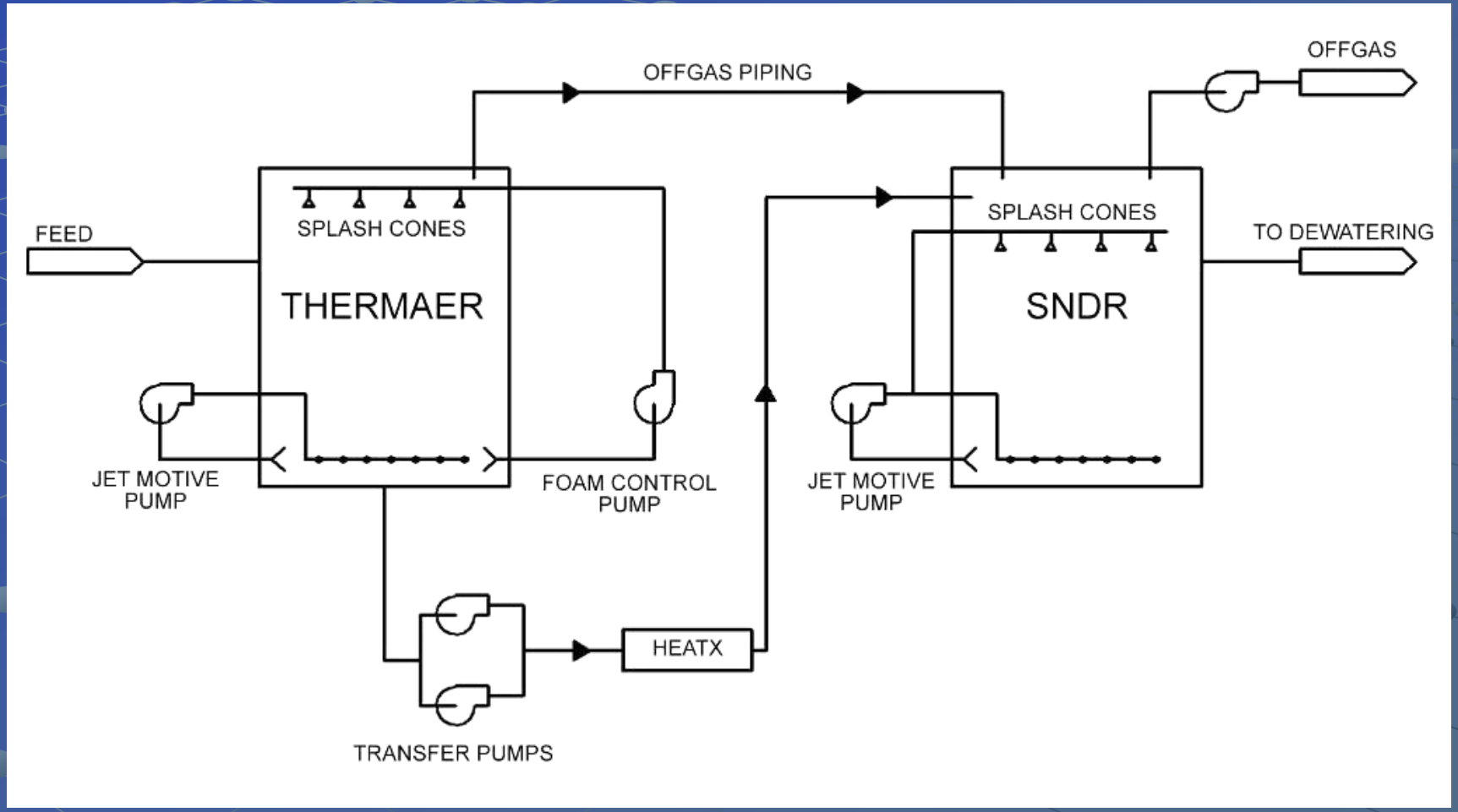
- 9.0 MGD Average Design Flow
- 16,000 lbs/day (2012)
- 60% VS and 54% TS reduction
- 26% TS utilizing a belt press
- 866 dry tons produced annually
- Land application program and community give-away program
- Saving the utility between $117k and $324k annually

Marshall, MN

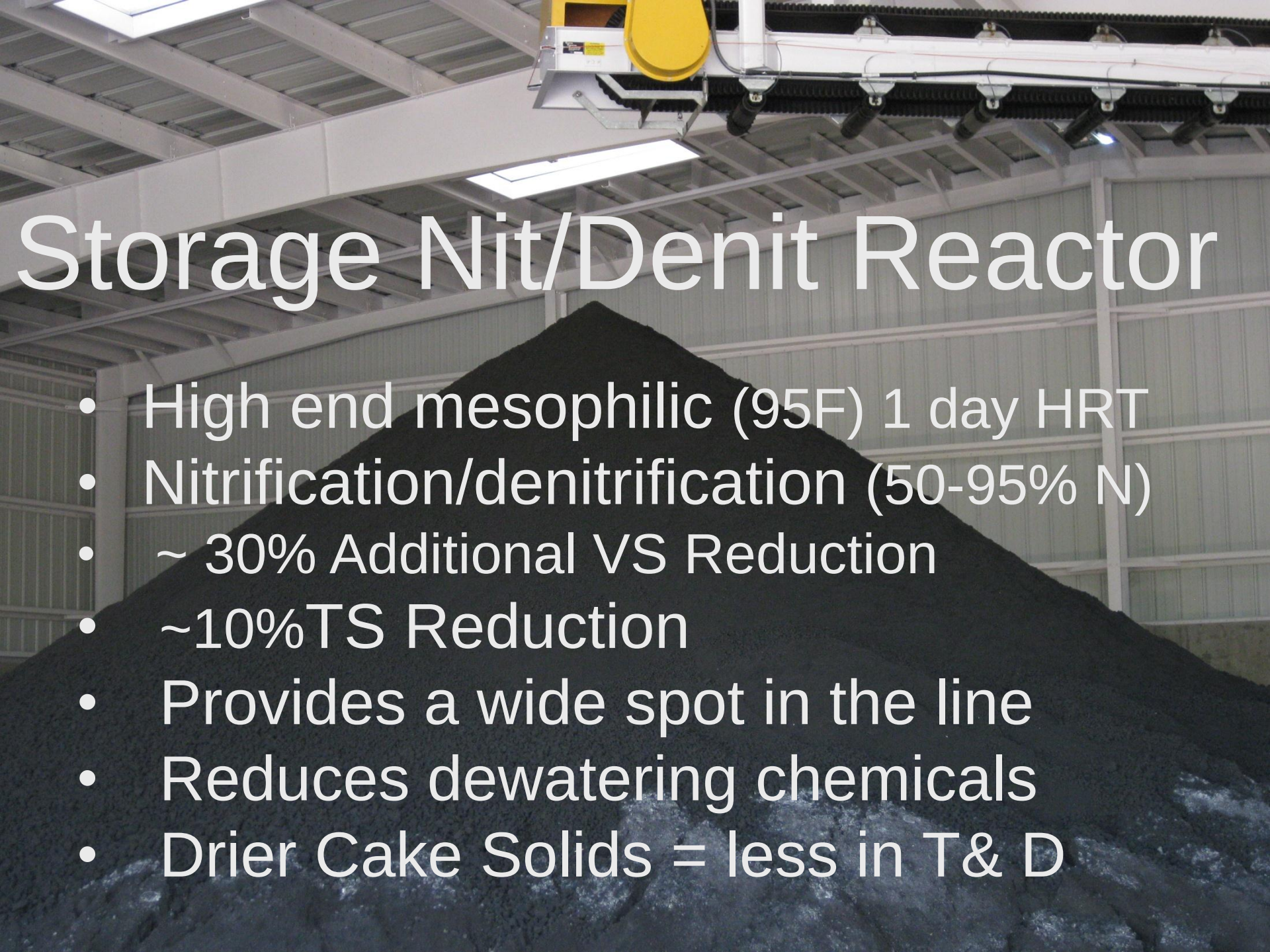
Product Parameters

Parameter	Concentration
N	2.3 – 5.5 %
P	1.3 – 3.6 %
K	0.5 – 1.0
OM	50 – 60 %
C/N	6 -10 : 1

ThermAer Process Flow

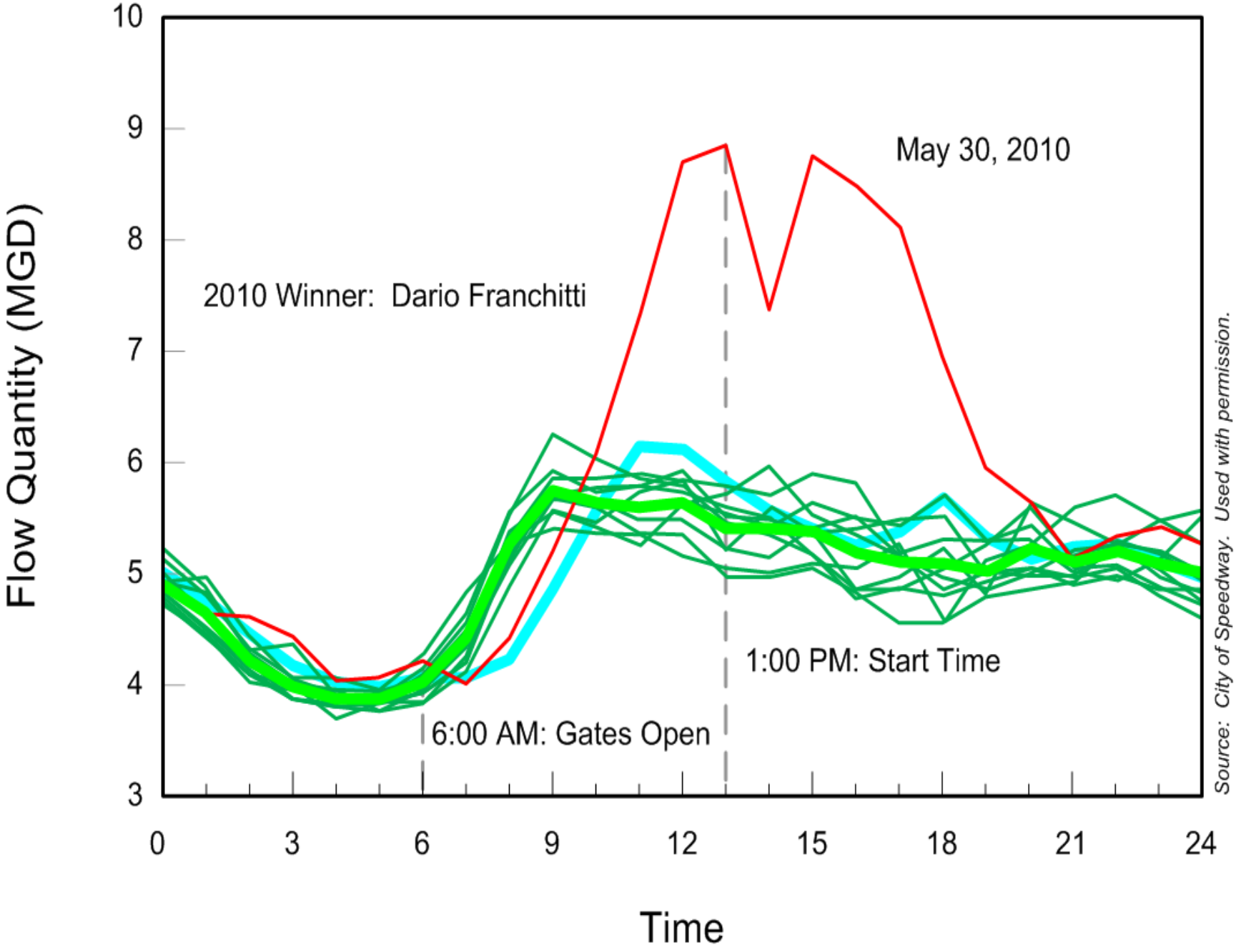



Storage Nit/Denit Reactor
SNDR
Follows the ThermAer



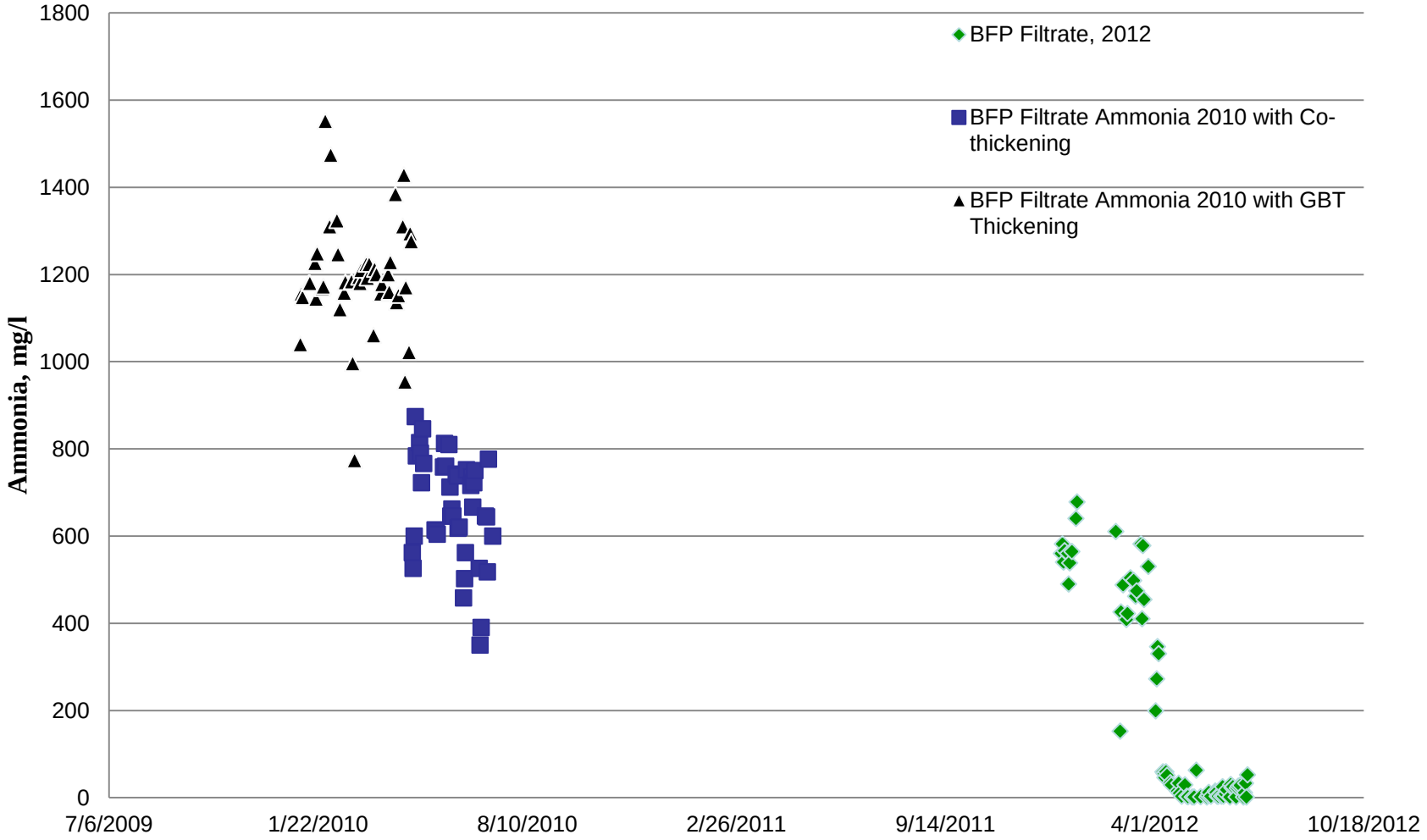
Storage Nit/Denit Reactor

- High end mesophilic (95F) 1 day HRT
- Nitrification/denitrification (50-95% N)
- ~ 30% Additional VS Reduction
- ~10%TS Reduction
- Provides a wide spot in the line
- Reduces dewatering chemicals
- Drier Cake Solids = less in T& D


Flow Quantity (MGD)
10
9
8
7
6
5
4
3
0
3
6
9
12
15
18
21
24
Time
May 30, 2010
2010 Winner: Dario Franchitti
1:00 PM: Start Time
6:00 AM: Gates Open
Source: City of Speedway. Used with permission.

Speedway, IN SNDR

Ammonia at the Indy 500



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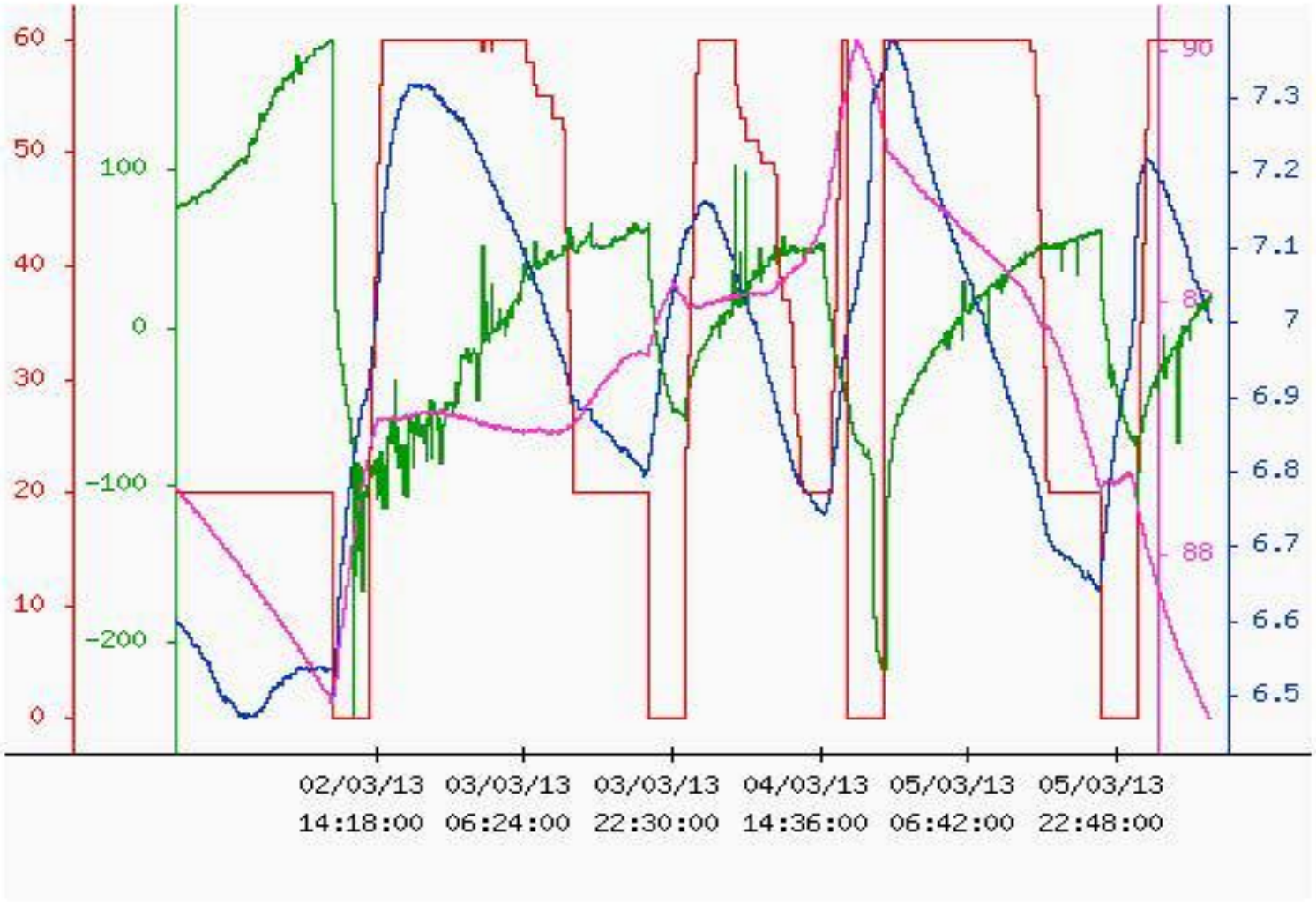


SNDR_BLOWER_SPEED	CURRENT SNDR PD BLOWER SPEED
SNDR_ORP	CURRENT SNDR ORP VALUE
SNDR_pH	CURRENT SNDR pH VALUE
SNDR_TEMP	CURRENT SNDR TEMPERATURE

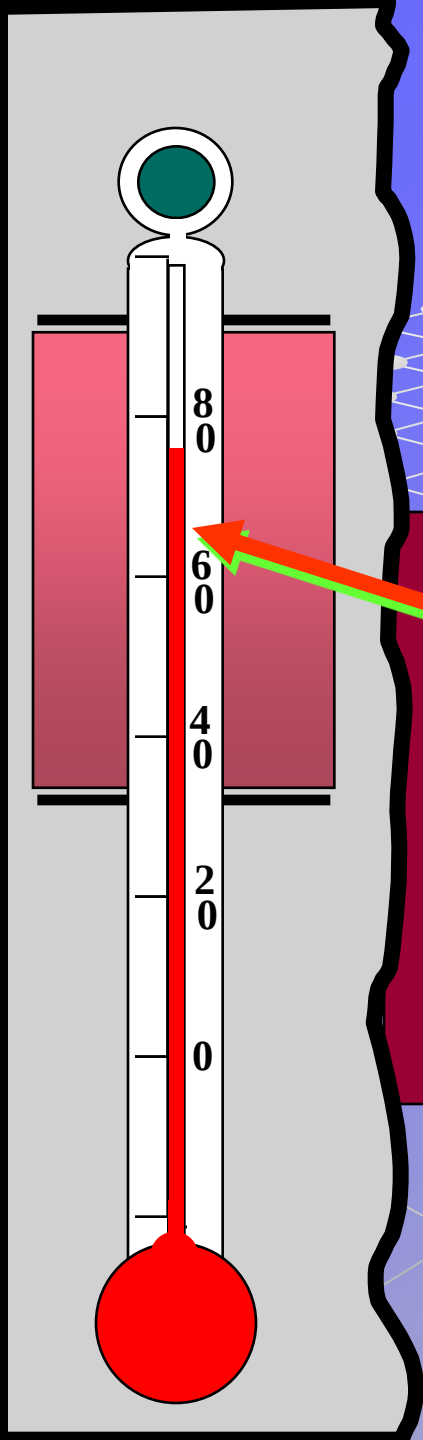
Current Research

- Golf Course fertilizer study
- Animal manures
- Solar Drier

Conclusions

- Although most facilities surveyed are not yet selling their biosolids product, each has realized significant savings over previous methods of disposal in both hard costs and man hours.
- As fertilizer costs continue to rise, it will not be unrealistic to assign a value to their biosolids and perhaps even start selling it.

Questions?



ThermAer

Autothermal Thermophilic Aerobic Digestion

Biosolids Treatment

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