

Sewage Sludge Incineration

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Service:
Serves ~185k, population
equivalent 1300-1800k
Average ~36mgd

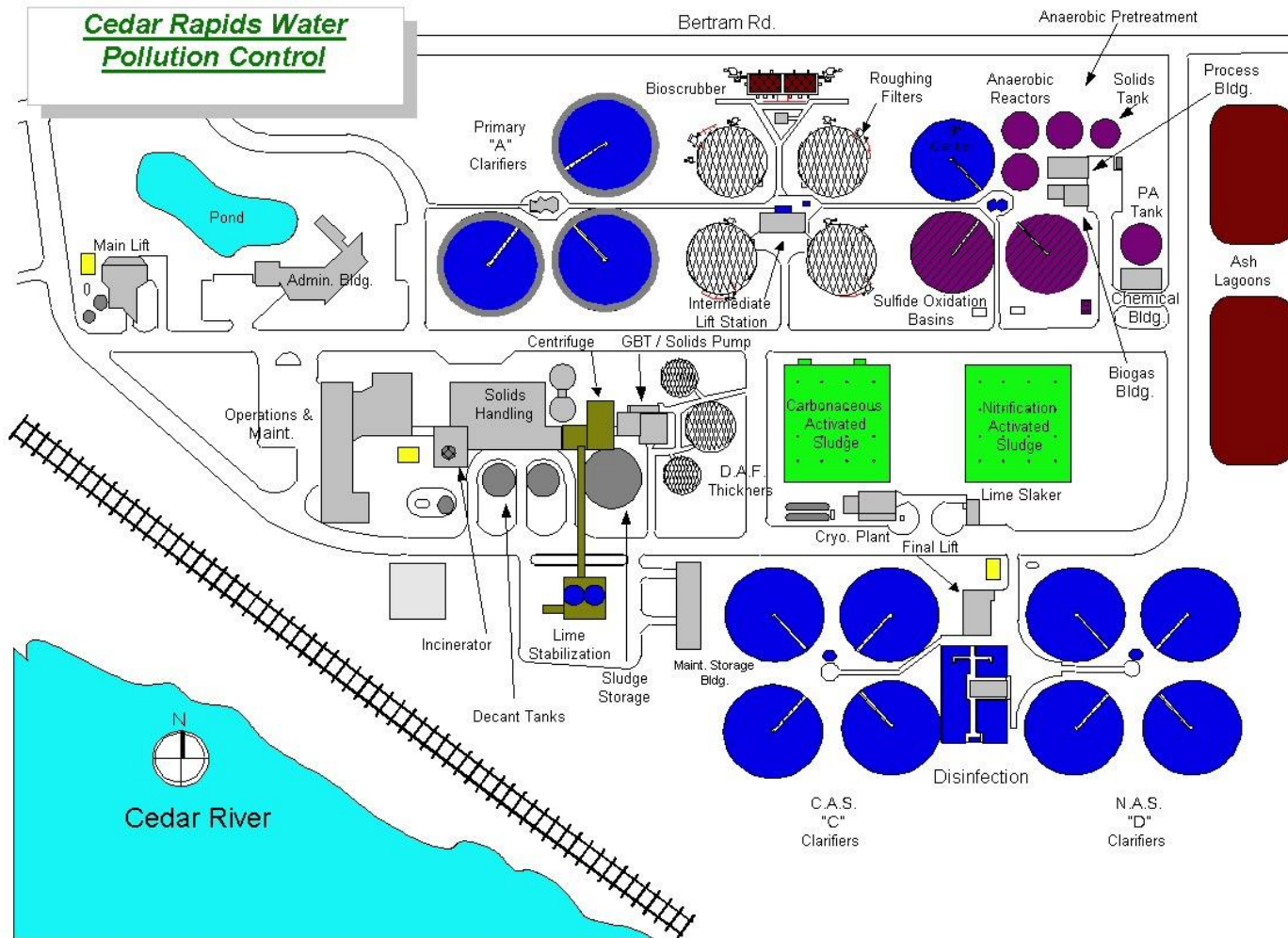
From Industry:
~85% of CBOD load
~50% of solids load
~50% of flow

Waste characteristics:
-High BOD, solids, N, and P
-High sulfate content

Average Sludge Production:
~94,000ppd primary
~56,000ppd secondary



Solids Handling Process Flow



Solids Handling

- Two waste streams – Primary and WAS
- Run 24/7 except for routine shutdowns
- Primary sludge (typically <1% solids) pumped to:
 - Cyclone Degritters
 - Drum Screen
 - Dissolved air flotation (exits approx. 4-6% solids)
 - Blend Tank
 - Belt filter presses (exits approx. 25% solids)





Grit Chamber





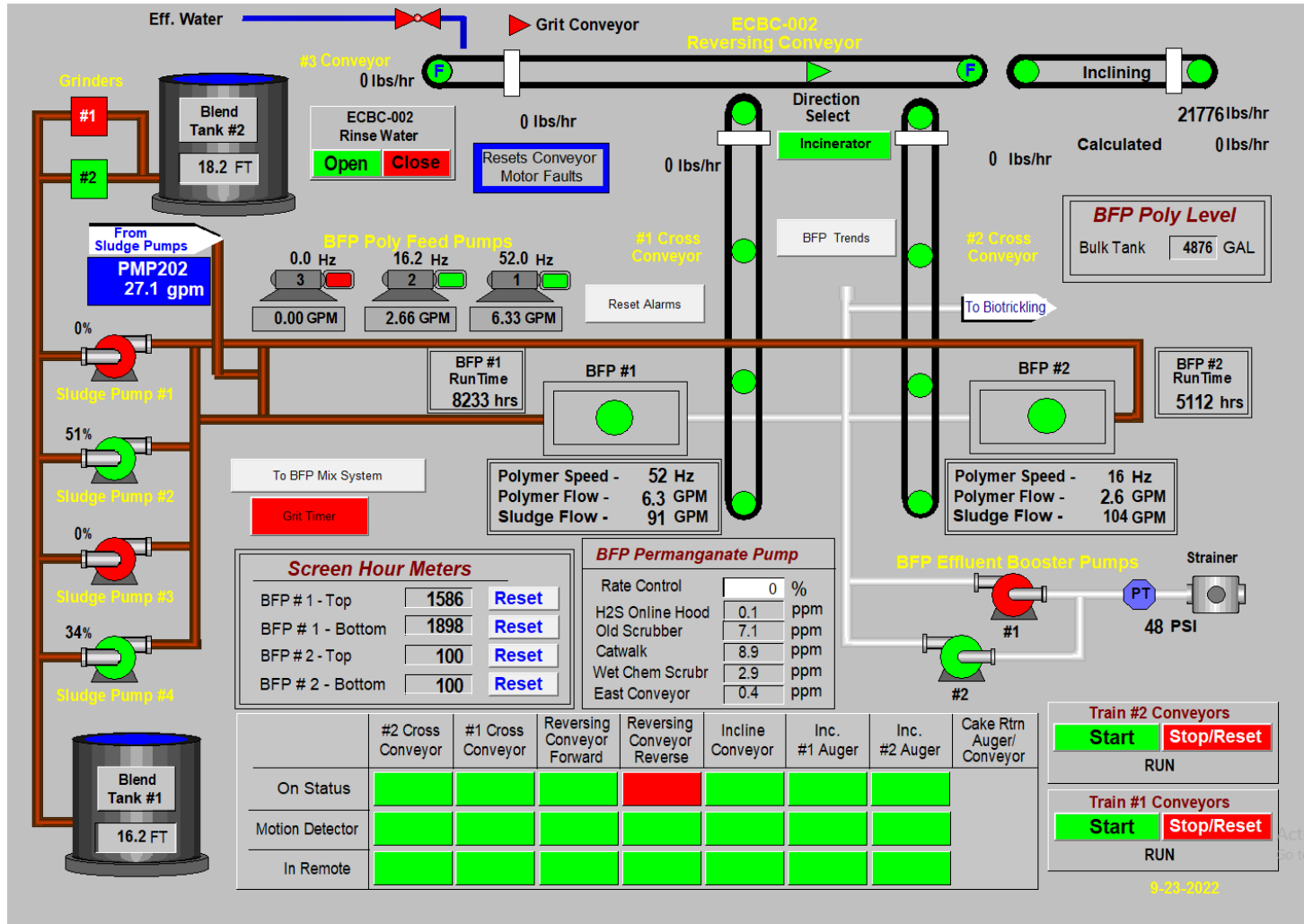
Drum Screen





Dissolved Air Flotation Thickener (DAFT)





Belt Filter Press



Solids Handling

- WAS comes from two different stages:
 - Carbonaceous activated sludge (CAS, pure O_2)
 - Nitrogenous activated sludge (NAS, air)
- Combine WAS from C and D clarifiers (>1% solids) at gravity belt thickeners (GBTs, exits 5-6%)
- Low pressure oxidation, LPO, Zimpro system
- Enters decant tank at 3-4% solids, leaves 10-12%





Gravity Belt Thickener



LPO-Zimpro

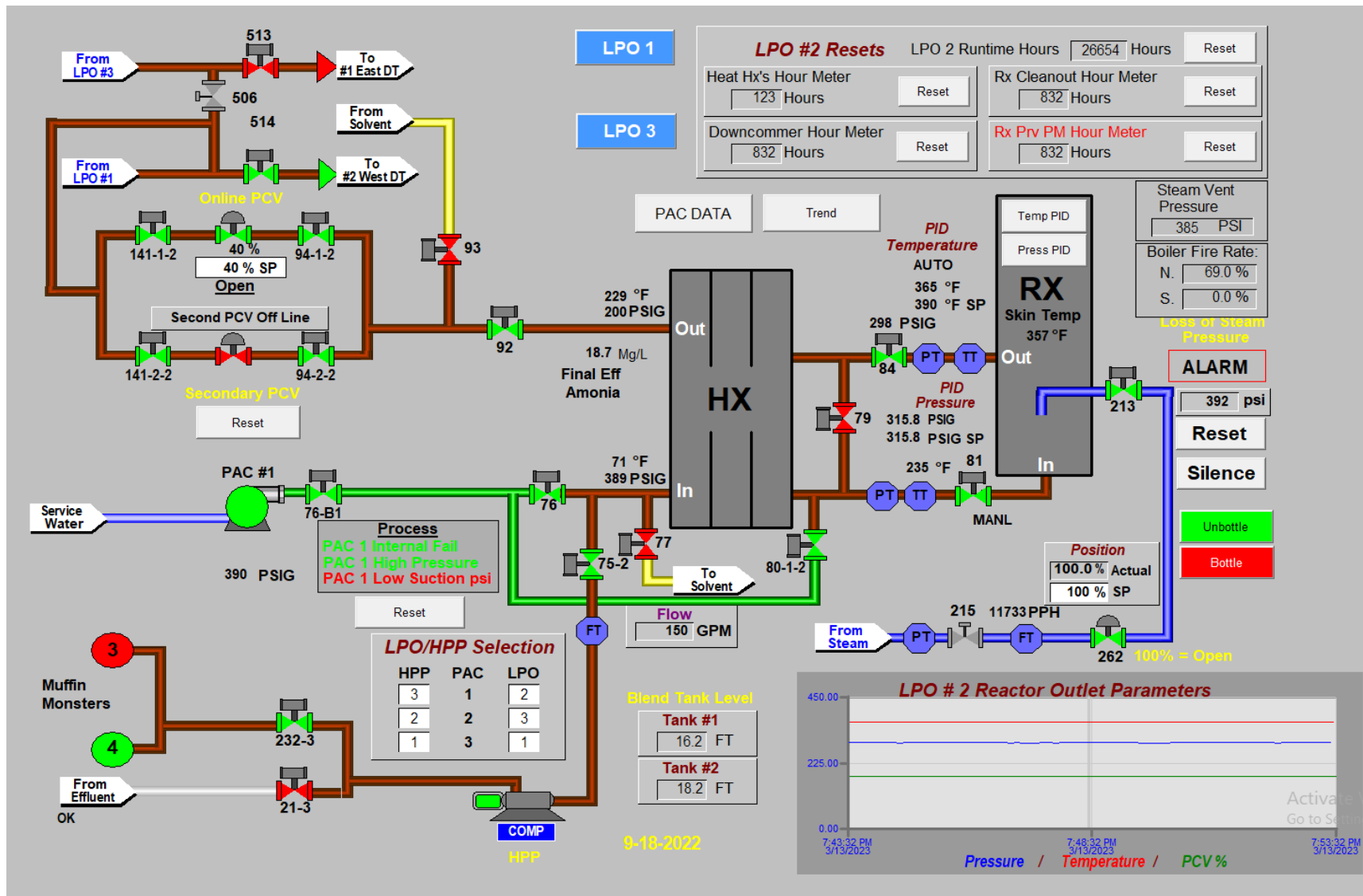
- Intended to improve dewatering and oxidize some volatile solids
- Complex, maintenance and energy intensive
- One of the last ones left in the US – spare parts hard to come





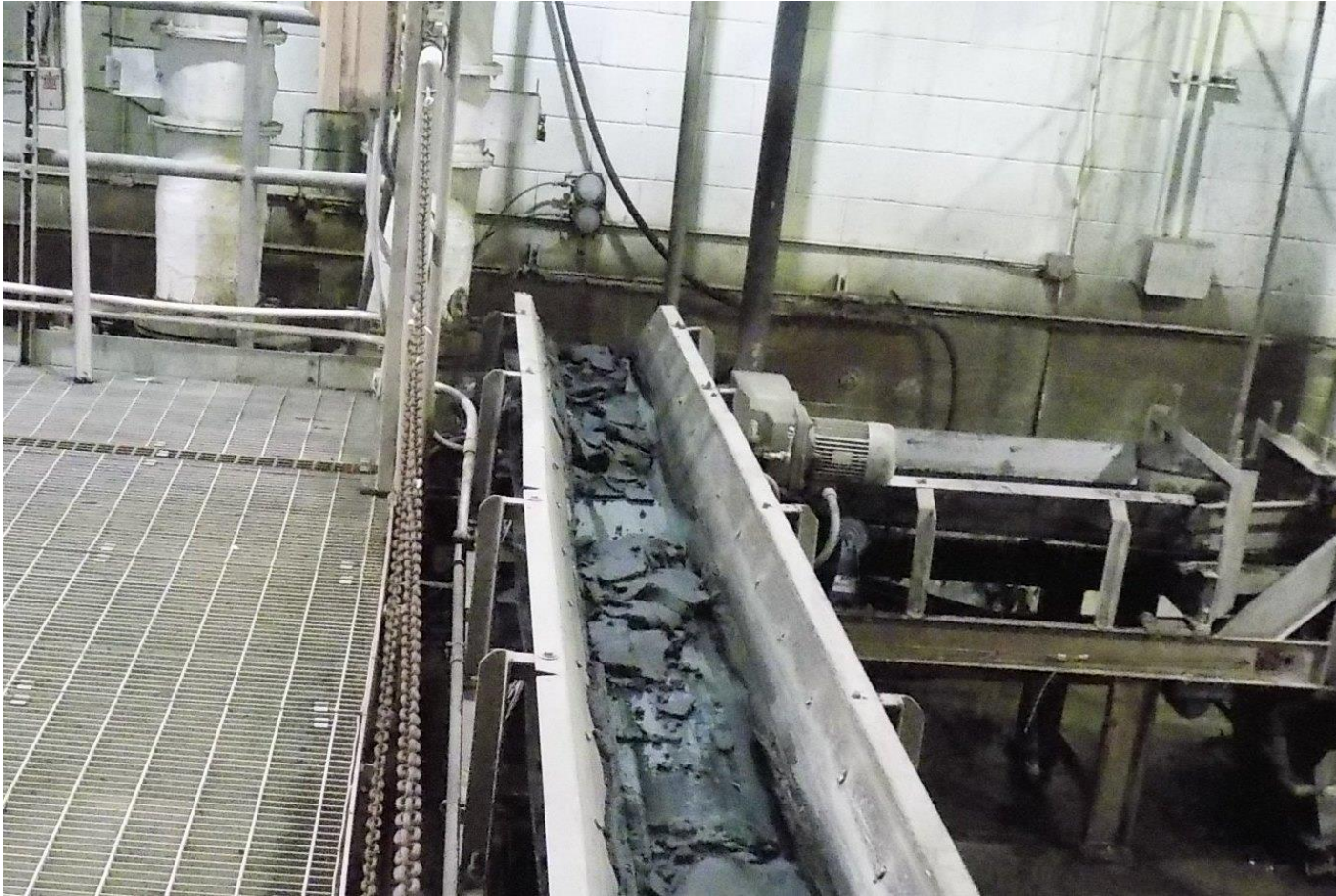
LPO - Zimpro





LPO - Zimpro





Incinerator Feed Cake

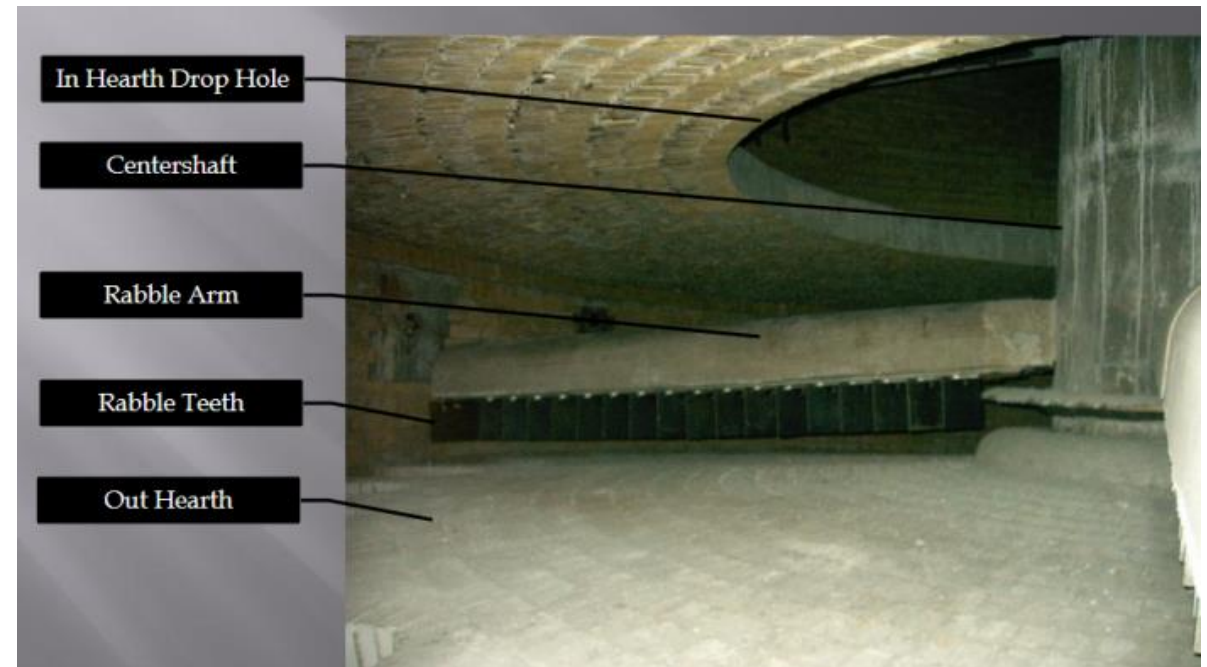
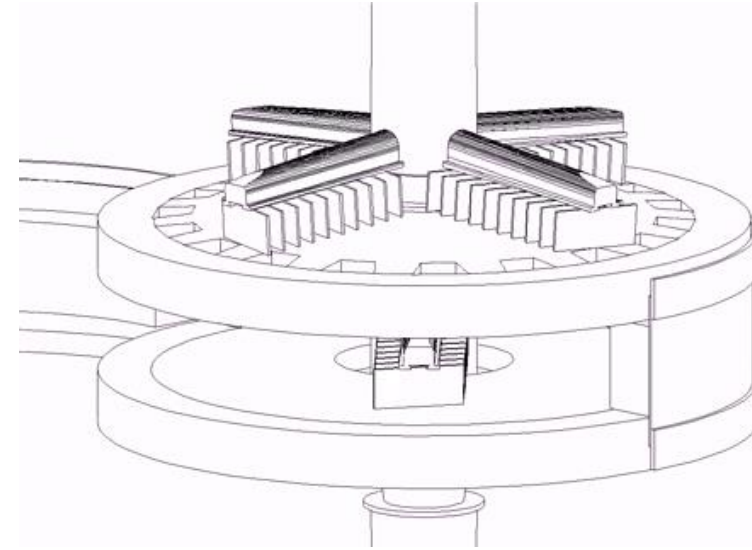
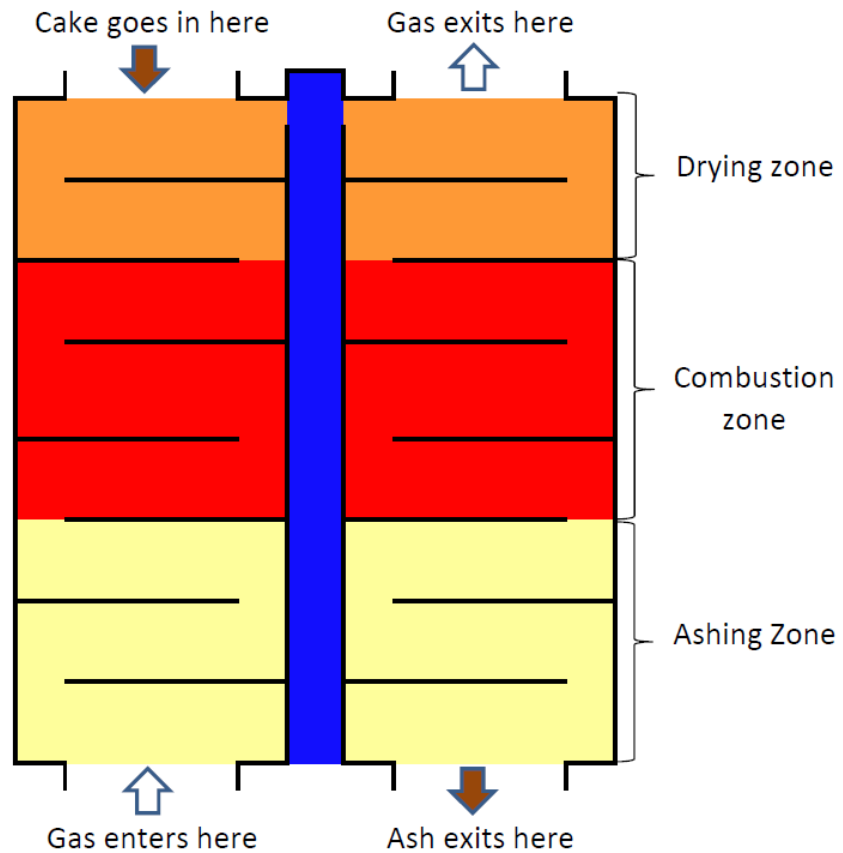


Biosolids Disposal Options

- 80-100 tons or more of biosolids each day
 - Incineration
 - Land application
 - Landfill

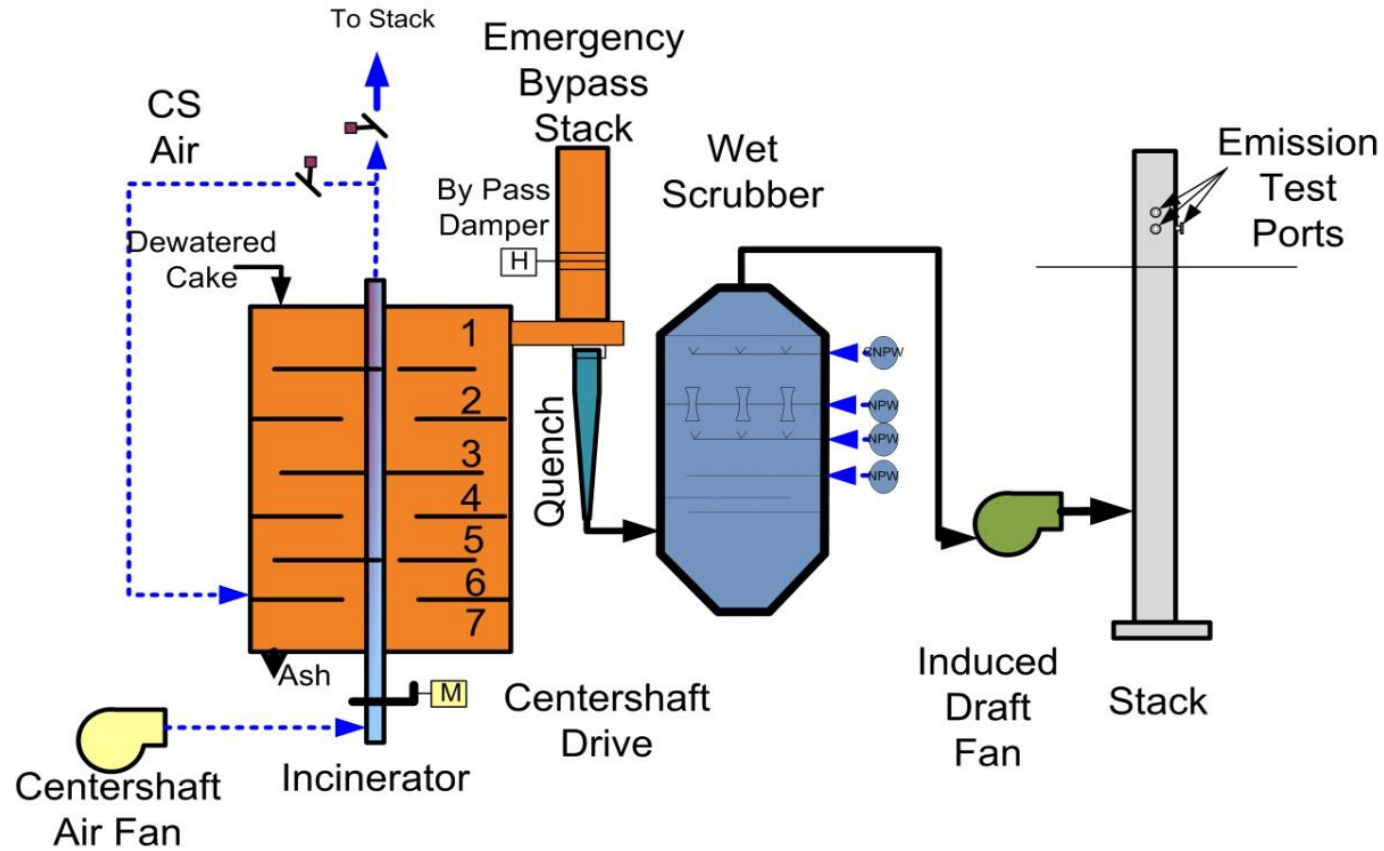


Multiple Hearth Incinerator Cutaway





Air Handling



Sludge Flow - 91 GPM

#1 Cross Conveyor

#2 Cross Conveyor

PMP202
27.0 gpm

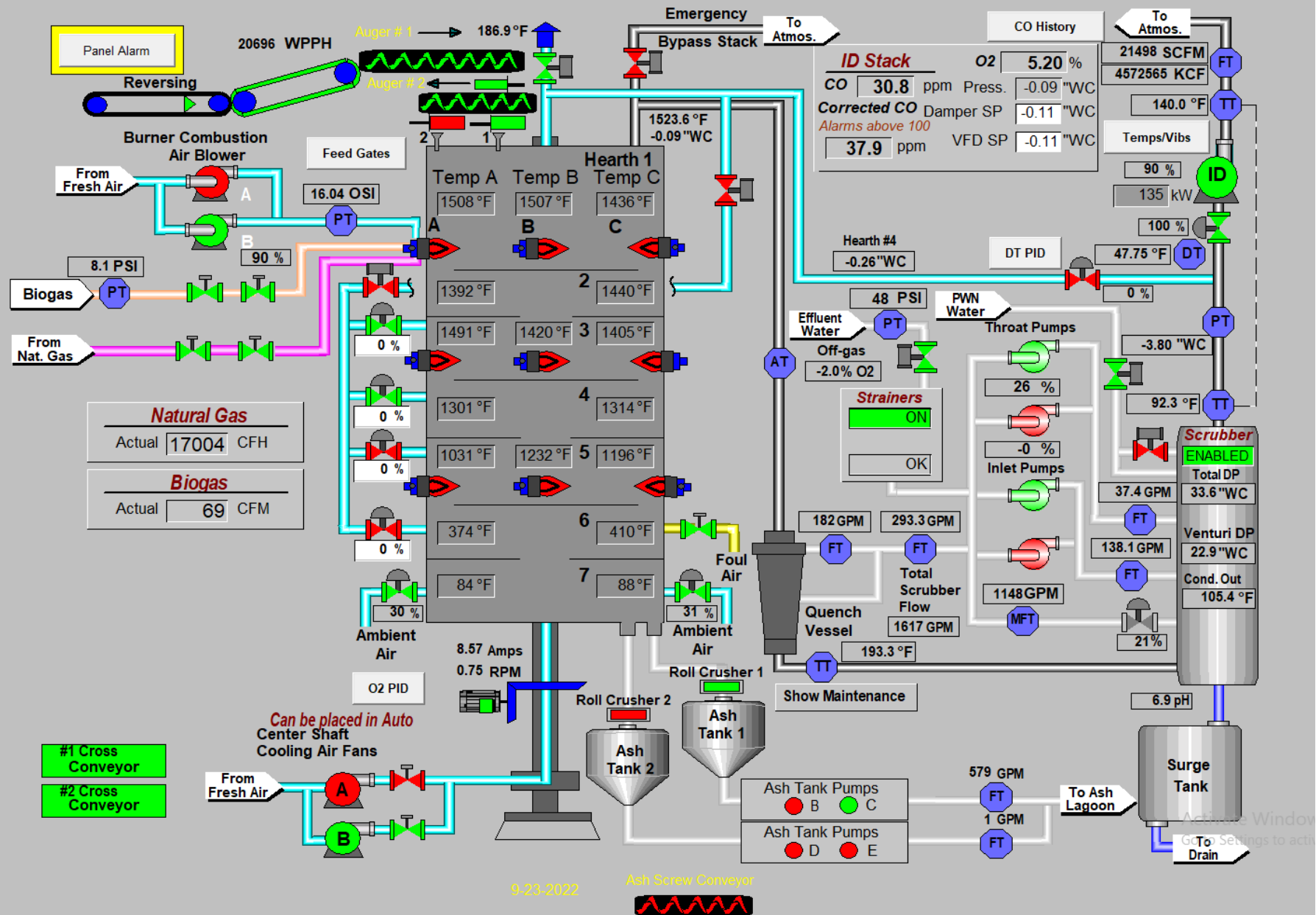
Sludge Flow - 104 GPM

☐ Misc. Pre-Start
☐ Scrubber
☐ Center Shaft Air
☐ Induced Draft Fan
☐ Center Shaft Drive
☐ Burner Comb. Air
☐ Sludge Comb. Air
☐ ID Fan Air Flow 21434
(>17,000 SCFM for Purge)

Burn Mode
CAKE BURNING 30.0
NO GRIT Burning

Incinerator Mode 8
Ok To Burn 100°F

Incinerator Start





SSI MACT Rule

- MACT: Maximum Achievable Control Technology
- MACT rules set a baseline of emissions levels currently achieved by best-performing similar sources through control methods
- Rule published in 2011, and finalized in 2016
- Requires annual HAP (hazardous air pollutant) stack testing within 11-13 months of previous compliance test
 - If emissions for a specific pollutant are at or below 75% of the emission guidelines for two consecutive tests, compliance testing is only required every three years.
 - Results of stack testing establish operating limits for emissions control equipment



Sewage Sludge Incinerators: Final Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources Final Rule Fact Sheets

This page contains a February 2016 and a February 2011 fact sheet with information regarding the final New Source Performance Standards (NSPS) and Emission Guidelines for Existing Sources for Sewage Sludge Incinerators (SSI). This document provides a summary of the information for these regulations.

- The plan includes:
 - Emissions limits for all regulated pollutants
 - Visible emissions limit for ash handling operations
 - Requirements for annual inspections of emissions control devices
 - Annual testing, monitoring, recordkeeping, and reporting requirements
 - Procedures for test data submitted to EPA
 - Schedule for compliance with federal plan
 - Title V permit provisions



Emissions Limits

EPA SSI MACT Limits

TABLE 5—SUMMARY OF EG EMISSIONS LIMITS PROMULGATED FOR EXISTING SSI

Pollutant	Units	Emission limit for MH incinerators	Emission limit for FB incinerators
Cd	milligrams per dry standard cubic meter @7-percent oxygen.	0.095	0.0016.
CO	parts per million of dry volume @ 7-percent oxygen.	3,800	64.
HCl	parts per million of dry volume @ 7-percent oxygen.	1.2	0.51.
Hg	mg/dscm @7-percent oxygen	0.28	0.037.
NO _x	parts per million of dry volume @ 7-percent oxygen.	220	150.
Pb	milligrams per dry standard cubic meter @7-percent oxygen.	0.30	0.0074.
PCDD/PCDF, Toxicity Equivalence (TEQ).	nanograms per dry standard cubic meter @7-percent oxygen.	0.32	0.10.
PCDD/PCDF, Total Mass Basis (TMB).	nanograms per dry standard cubic meter @7-percent oxygen.	5.0	1.2.
PM	milligrams per dry standard cubic meter @7-percent oxygen.	80	18.
SO ₂	parts per million of dry volume @ 7-percent oxygen.	26	15.
Fugitive emissions from ash handling.	Percent of the hourly observation period.	Visible emissions of combustion ash from an ash conveying system (including conveyor transfer points) for no more than 5 percent of any compliance test hourly observation period.	Visible emissions of combustion ash from an ash conveying system (including conveyor transfer points) for no more than 5 percent of any compliance test hourly observation period.

Cedar Rapids Title V Limits

Applicable Requirements

Emission Limits (lb./hr, gr./dscf, lb./MMBtu, % opacity, etc.)

The emissions from this emission point shall not exceed the levels specified below.

EP	Pollutant	Emission Limit(s)	Authority for Requirement	Authority for Requirement
013	Opacity	20%	LCO Sec.10-60(a) 40 CFR §60.152(a)(2) LCO Sec. 10-62(b)(11) 567 IAC 23.1(2)"k"	LCPH ATI 6532 / PTO 6411-R1
	PM-Federal	1.30 lb/ton dry sludge input	40 CFR §60.152(a)(1) LCO Sec. 10-62(b)(11) 567 IAC 23.1(2)"k"	
	PM ₁₀	3.04 lb/hr		
	SO ₂	9.0 lb/hr; 39.4 tpy ⁽¹⁾		
	NO _x	7.4 lb/hr		
	THC	100 ppm, ⁽²⁾	40 CFR §503.44(c)	
	CO	100 ppm, ⁽²⁾	40 CFR §503.40(c)(2)	
	Hg	3.2 kg (7.1 lb) / 24-hour period	40 CFR §61.52(b) LCO Sec. 10-62(c)(4) 567 IAC 23.1(3)"d"	
	Be	10 gm (0.022 lb) / 24-hour period	40 CFR §503.43(a)	
	Pb	Calculated ⁽³⁾	40 CFR §503.43(c)	
	As	Calculated ⁽⁴⁾	40 CFR §503.43(d)	
	Cd	Calculated ⁽⁴⁾	40 CFR §503.43(d)	
	Cr	Calculated ⁽⁴⁾	40 CFR §503.43(d)	
	Ni	Calculated ⁽⁴⁾	40 CFR §503.43(d)	

⁽¹⁾ The emission limit applies to the combined emissions of EP013, EP053, EP054, and EP056 when burning biogas.

⁽²⁾ The THC and CO emission limits are based on the monthly average concentration corrected for 0% moisture and 7% oxygen. The owner or operator must only comply with either the THC or CO emission limit pursuant to 40 CFR 503.40(c).

⁽³⁾ (1) The average daily concentration for lead in sewage sludge fed to a sewage sludge incinerator shall not exceed the concentration calculated using Equation (4).

$$C = \frac{0.1 \times NAAQS \times 86,400}{DF \times (1 - CE) \times EF} \quad \text{Eq. (4)}$$

Where:

C = Average daily concentration of lead in sewage sludge.

NAAQS = National Ambient Air Quality Standard for lead in micrograms per cubic meter.

DF = Dispersion factor in micrograms per cubic meter per gram per second.

CE = Sewage sludge incinerator control efficiency for lead in hundredths.



Relationship between Operating Parameters and SSI MACT Standards

- Combustion and Afterburner Chamber Temperatures
 - Cadmium, dioxin/furans, carbon monoxide, hydrochloric acid, mercury, nitrogen oxide species, lead, particulate matter, and sulfur dioxide
- Pressure Drop Across Scrubber
 - Particulate matter, cadmium, lead
- Scrubber Water Flow Rate
 - Cadmium, dioxin/furans, carbon monoxide, hydrochloric acid, mercury, nitrogen oxide species, lead, particulate matter, and sulfur dioxide
- Scrubber Water pH
 - Hydrochloric acid and sulfur dioxide



Reporting Requirements

- SSI MACT requires semi-annual deviation reporting
- Reports include:
 - Start and end time
 - Average recorded values for each parameter during deviation period
 - Duration of deviation
 - Cause
 - Corrective Action



SSI MACT Reporting

City of Cedar Rapids WPCF
40 CFR 62.16030(d) Semiannual Report
July through December 2022

62.16030(d)(3)(iii)				62.16030(d)(3)(iv)	62.16030(d)(3)(v)(A)				62.16030(d)(3)(v)(B)			
Calendar Date and Times for Deviations				Average Recorded Values During Deviation Period	Duration and cause of deviation from emission limits, emission standards, operating limits and corrective actions.				Duration and cause of deviation from bypass events and corrective actions.			
Deviation Start Date	Deviation Start Time	Deviation End Date	Deviation End Time	OPERATING LIMITS: Afterburner temp (deg F): 1294 Scrubber dP (in H2O): 38.96 Scrubber water flow (gpm): 1758 Scrubber Water Effluent pH (SU): 6.8	Duration of Deviation (hours)	Deviation Description	Cause of deviation	Corrective Action	Duration of Deviation (hours)	Deviation Description	Cause of deviation	Corrective Action
10/13/2022	12:52	10/13/2022	13:25						0.53	Incinerator bypass event	The ID fan went down on high vibration.	Restarted the ID fan and regained purge.
10/17/2022	9:44	10/17/2022	12:19						2.58	Incinerator bypass event	The ID fan went down on high vibration.	Instrumentation looked into the vibration sensors are set them. Restarted the ID fan and restarted the incinerator.
10/20/2022				New Operating Limits: Afterburner temp (deg F): 1305 Scrubber dP (in H2O): 27.99 Scrubber water flow (gpm): 1575 Scrubber Water Effluent pH (SU): 6.6								
10/21/2022	18:48	10/21/2022	19:09						0.35	Incinerator bypass event	The ID fan went down on high temp alarms.	Reset alarms and restarted the incinerator.
10/26/2022	13:00	10/26/2022	17:59	Afterburner temp (deg F): 1258 Scrubber dP (in H2O): 32.58 Scrubber water flow (gpm): 1643.7 Scrubber Water Effluent pH (SU): 6.7	5	Hearth temp out of range	The hearth temperature dropped below the new operating limit that was established on 10/20/2022.	New operating limits were discussed with staff.				
11/3/2022	12:00	11/3/2022	0:00	Afterburner temp (deg F): 1401.6 Scrubber dP (in H2O): 27.1 Scrubber water flow (gpm): 1639.1 Scrubber Water Effluent pH (SU): 6.9	8	Scrubber dP out of range	Cause undetermined. Recorded average scrubber dP is 27.1, 96.8% of the operating limit of 27.99. Average incinerator feed is 1.55 dry tons/hour, 52% of permitted capacity.	No action taken. System returned to within operating limits.				
11/5/2022	0:00	11/6/2022	0:00	Afterburner temp (deg F): 1442.5 Scrubber dP (in H2O): 27.6 Scrubber water flow (gpm): 1641.2 Scrubber Water Effluent pH (SU): 6.7	15 (Not continuous)	Scrubber dP out of range	Cause undetermined. Recorded average scrubber dP is 27.6, 98.6% of the operating limit 27.99. Average incinerator feed is 1.65 dry tons/hour, 55% of permitted capacity.	No action taken. System returned to within operating limits.				
11/6/2022	0:00	11/7/2022	10:59	Afterburner temp (deg F): 1405.9 Scrubber dP (in H2O): 27.3 Scrubber water flow (gpm): 1636.9 Scrubber Water Effluent pH (SU): 6.7	22 (Not Continuous)	Scrubber dP out of range	Cause undetermined. Recorded average scrubber dP is 27.3, 97.5% of the operating limit 27.99. Average incinerator feed is 1.9 dry tons/hour, 64% of permitted capacity.	No action taken. System returned to within operating limits.				
11/27/2022	3:00	11/27/2022	14:59	Afterburner temp (deg F): 1441.2 Scrubber dP (in H2O): 29.17 Scrubber water flow (gpm): 1637.7 Scrubber Water Effluent pH (SU): 6.5	9 (Not Continuous)	pH out of range	Scrubber make-up water (Final Effluent) had a pH of 7.1 for this period.	No action taken. System returned to normal.				
11/28/2022	3:00	11/29/2022	4:00	Afterburner temp (deg F): 1437 Scrubber dP (in H2O): 29.5 Scrubber water flow (gpm): 1620.3 Scrubber Water Effluent pH (SU): 6.5	22 (Not Continuous)	pH out of range	Scrubber make-up water (Final Effluent) had a pH of 7.1 for this period.	No action taken. System returned to normal.				
12/1/2022	21:00	12/2/2022	23:59	Afterburner temp (deg F): 1441.2 Scrubber dP (in H2O): 29.17 Scrubber water flow (gpm): 1637.7 Scrubber Water Effluent pH (SU): 6.5	3	pH out of range	Scrubber make-up water (Final Effluent) had a pH of 7.1 for this period.	No action taken. System returned to normal.				
12/7/2022	12:00	12/8/2022	19:59	Afterburner temp (deg F): 1272 Scrubber dP (in H2O): 37.00 Scrubber water flow (gpm): 1647 Scrubber Water Effluent pH (SU): 7.3	8	Hearth temp out of range	Cause undetermined. The 12 hour average during this time period was 1293 degrees F, 99.1% of the operating limit of 1305.0	No action taken. System returned to normal.				
12/29/2022	0:00	12/31/2022	23:59	Afterburner temp (deg F): 1393 Scrubber dP (in H2O): 26.60 Scrubber water flow (gpm): 1636 Scrubber Water Effluent pH (SU): 7.6	44 (Not Continuous)	Scrubber dP out of range	Process went from feeding two belt filter presses to just feeding one belt filter press. During this timeframe the belt filter press had a torn belt causing sludge production to swing from high to low production affecting the DP on the scrubber.	Replaced the top belt on Belt Filter Press #1 MAR C133702.				



Biosolids: Sludge vs Ash

- Sludge:
 - ~25% total solids, ~80% volatile
 - ~80 tons / day produced
 - Subject to biosolids 503 regulations for use / disposal
- Ash:
 - ~100% total solids, ~0% volatile
 - ~6-7 tons / day produced
 - Primarily calcium, iron, aluminum, magnesium, sodium, potassium, and zinc.
 - BUD determination for use / disposal



BUD: Beneficial Use Determination

Chapter 108, Iowa Code

- Solid by-product considered a “resource” and no longer considered “waste”
- Cannot adversely affect human health and environment
- Requires:
 - Location of reuse
 - Description of the product
 - Chemical and physical characteristics of the product
 - Health and environmental affects – typically though TCLP, SCLP, and total metals analysis
 - Product management plan



Biosolids pad:
Fills after ~ 2 weeks of use





North Ash Lagoon:
4,500 dry ton capacity
Concrete-lined

South Ash Lagoon:
14,600 dry ton capacity
Clay soil over rubber liner



Thank you for your time!

Questions?

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