THERMYLIS HIGH TEMPERATURE FLUIDIZED BED INCINERATOR

Mattabassett District
Unit 2 Fluidized Bed Incinerator
Cromwell, CT

Presented by:
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WRIGHT-PIERCE
Engineering a Better Environment

Presentation Overview

- Background / Design Requirements
- Process Flow Diagrams
- Theory
  - Combustion Principles
  - Fluidization Principles
  - Stack Emissions
- Pictures of our Equipment

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Mattabassett District FBI Background

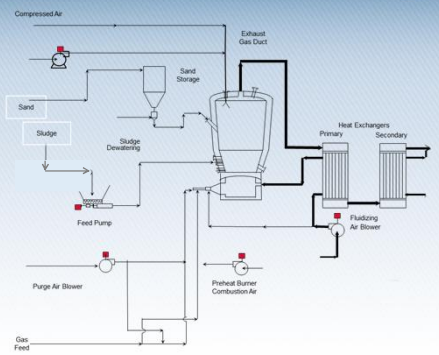
- Currently operates a FBI
- Takes in Merchant Sludge/FOG
- FBI Design: 1.5 dry Ton/hr
- New Regulations Came out Mid-Design

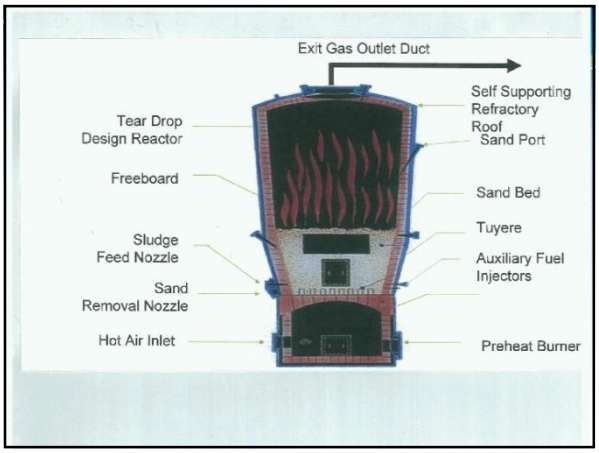
Compare BACT to New SSI Limits

Criteria Pollutants	BACT	NEW SSI Limits
PM , mg/dSCM	24	9.6
SO_x, ppmvd	26	5.3
NO_x, ppmvd	155	30
CO, ppmvd	100	27
Cd, mg/dSCM	0.106	0.0011
Pb, mg/dSCM	0.46	0.00062
Hg, mg/dSCM	0.142	0.001

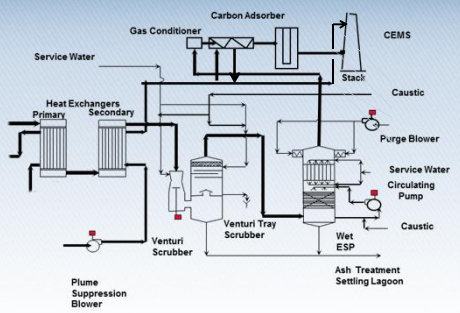
All at 7% Oxygen

Mattabassett Process Flow Diagram





Mattabassett Process Flow Diagram



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Combustion Requirements

1. Temperature – Must be above ignition temperature
   - Fuel oil 1150 °F
   - Natural Gas and biosolids 1250°F
2. Residence Time – > 6 sec in freeboard
3. Turbulence – Sand bed must be well mixed
   - homogenous bed temperatures
4. Excess Air – Oxygen left in Exhaust
   - > 3% based on wet gas is recommended.

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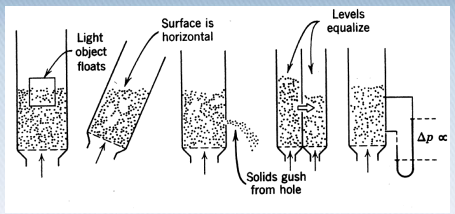
Fluidization Principles



Gas-Solid mixture

Takes on "FLUID" Properties

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Stack Emissions – Carbon Monoxide (CO)

- Limit: 27 ppmv
- CO is a poison and attaches to red blood cells like oxygen does.
- Carbon in the sludge feed is oxidized in the furnace when there is a deficit of Oxygen to form CO.
- CO is oxidized to CO2 in the furnace with sufficient oxygen.

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Stack Emissions – Nitrogen Oxides NOx

- Limit: 30 ppmvd
- NOx is a contributor to acid rain and ozone production.
- Nitrogen from Air is oxidized in the furnace and the preheat burner to form NO2, NO3, N2O5
- Control: NOx + NH_3 forms N2 above 1600ºF
- NOx is partially adsorbed in the scrubber
  - Need high pH (NaOH injection).

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Stack Emissions – Mercury (Hg)

- Hg 0.0010 mg/dscm
- Hg comes in with the sludge.
- Hg reacts with sulfur sites on the activated carbon.

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Stack Emissions – Dioxins and Furans

- Dioxins and Furan (PCDD and PCDF)
- Limit TMB 0.013 ng/dscm total mass basis
- Limit TEQ 0.0044 ng/dscm toxic equivalency basis
- Dioxins and Furans are:
  - formed when the flue Gas is cooled.
  - adsorbed on the surface of the carbon.

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Stack Emissions – Heavy Metals

- Limit: Cd 0.0011 mg/dscm
- Limit: Pb 0.00062 mg/dscm
- Metals come in with the sludge feed.
- Heavy metals are removed in the Wet Electrostatic Precipitator and are attracted to ground electrodes.

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Stack Emissions – Sulfur Dioxide (SO)

- Limit: 5.3 ppmvd
- SOx is a contributor to acid rain.
- Sulfur from the sludge is oxidized in the furnace to form SO2, SO3, SO4
- SOx dissolves in water to form sulfuric acid in the scrubber.
- Caustic soda (Sodium Hydroxide) helps to dissolve additional SOx in the water.

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Stack Emissions – Particulate Matter (PM) & Opacity

- Limit: PM: 9.6 mg/dscm
  Opacity: 0%
- Particulates is ash and fine sand.
  - Breakdown of sand
  - They are removed in the scrubber and the WESP.
- Opacity comes from particulates and also from condensed water vapor (like fog). This is eliminated with plume suppression air.

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EQUIPMENT

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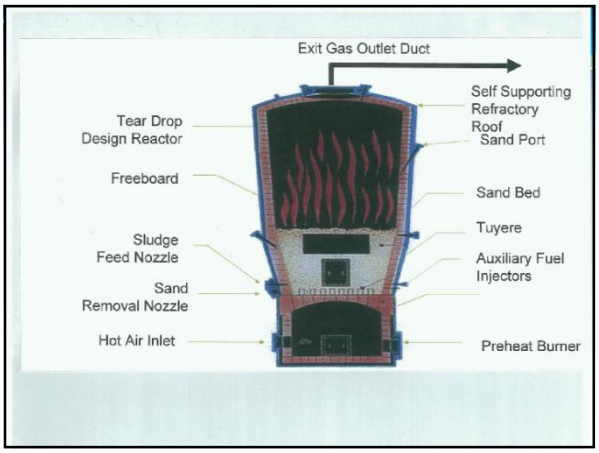
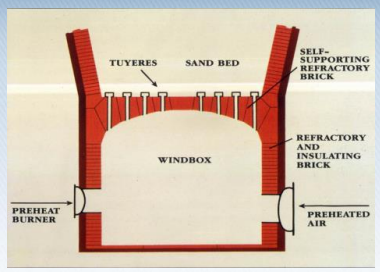


WINDBOX



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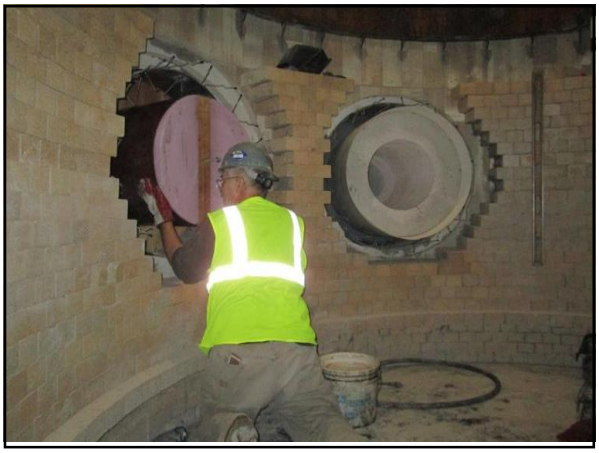
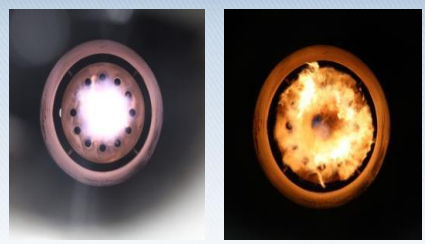


PREHEAT BURNER



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PREHEAT BURNER

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WINDBOX

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REFRACTORY ARCH DOME TOP/BOTTOM

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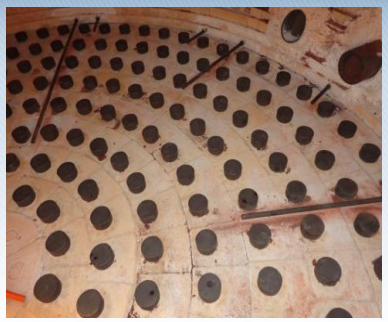
TUYERE

29/06/2015 25

DOME and TUYERES



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Bustles

- Even Distribution
- Injection points
  - Cooling air
  - Injection port
  - Atomizing air

Sludge Injection

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AMMONIA INJECTION SYSTEM

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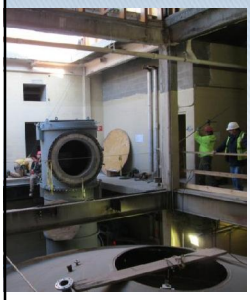
Vessel Exhaust To heat Exchanger



Heat Exchangers

Heat Exchanger Tubes

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Quench and Multi-Venturi Scrubber

ASH SLURRY PUMPS

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WESP


Questions / Discussions