Impacts of New SSI Standards on Mattabassett District's Operations

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THE MATTABASSETT DISTRICT
Preserving the environment for future generations to enjoy.

WRIGHT-PIERCE
Engineering a Better Environment

Presentation Overview

- Background
- Plant Upgrade
- New Regulations
- Impact Operations
- New SSI NOx Limits

Mattabassett District Background

- Located in Cromwell
- 4 constituent communities (Berlin, Cromwell, Middletown & New Britain)
- 15 Member Volunteer Board of Directors
- Staffed 24 hours per day – every day
- Cost to treat 1000 gals of waste water is only $1.10 one of the lowest in CT.

Nitrogen Upgrade Project

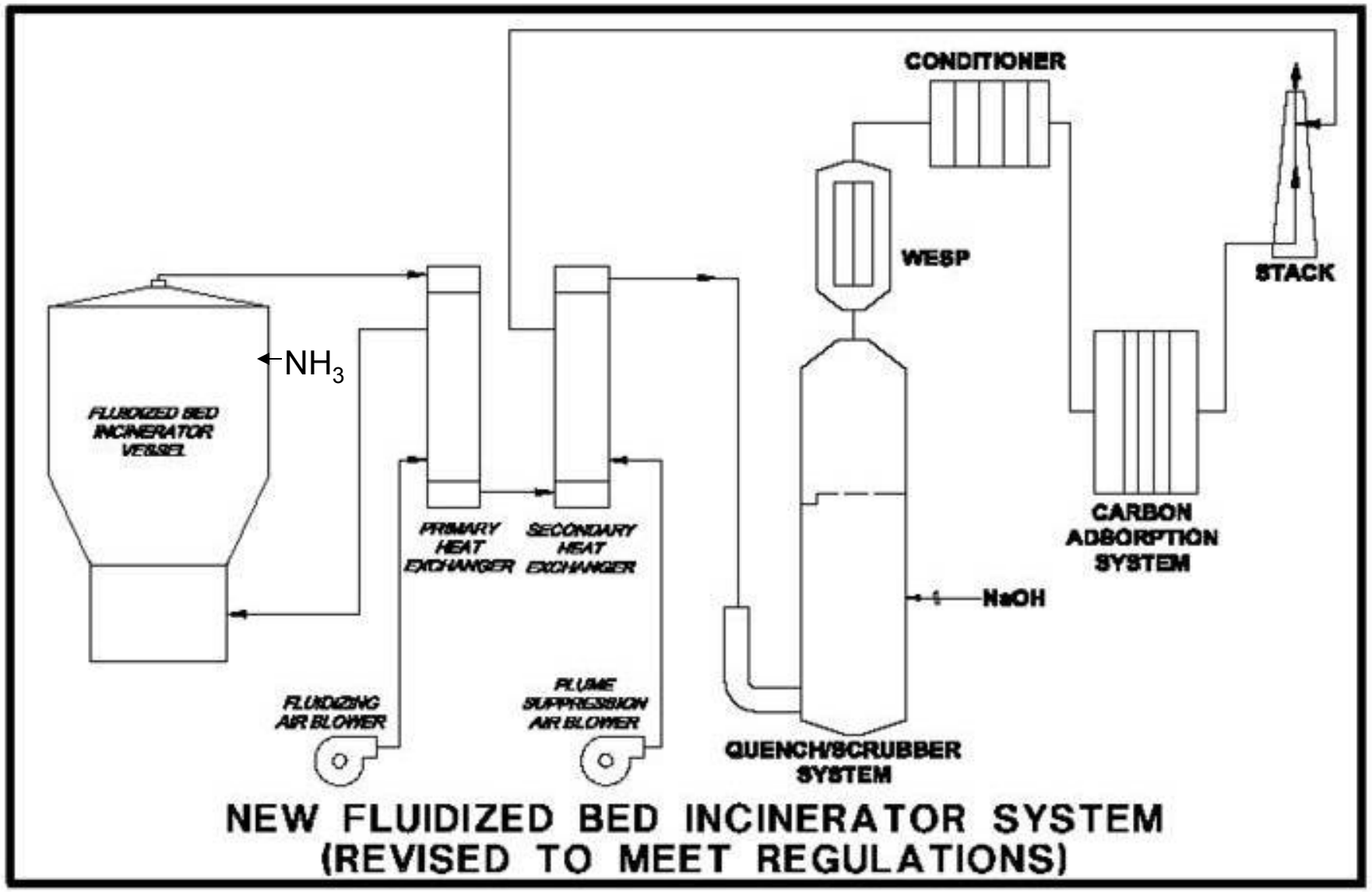
- Began May 2012 – Substantially complete July 15, 2015
- Projected Cost - $98,000,000
- Capacity - 20 - 35 million gals/day
- Expansion to receive Middletown flows.

Mattabassett is now the 3rd largest facility in the State.

Challenges:

- FBI meeting new incinerator Quad-L NOx limits

Incinerator



New FBI System Pollution Control

- FBI bed designed for CO and NOx control
  - 6.5 second freeboard residence time
- Quench followed by multi-venturi tray scrubber
  - Removal of particulate and associated metals
  - Acid gases
- Wet Electrostatic Precipitator
  - Further reduction particulates and metals
- Carbon bed system
  - Mercury and dioxin removal

New SSI Limits (Fluidized Bed)

Criteria Pollutants	NEW SSI Limits
PM , mg/dSCM	9.6
SO_x, ppmvd	5.3
NO_x, ppmvd	30
CO, ppmvd	27
Cd, mg/dSCM	0.0011
Pb, mg/dSCM	0.00062
Hg, mg/dSCM	0.001

All at 7% Oxygen

FLUIDIZED BED INCINERATOR Operational Issues

- NOx Emissions greatest challenge:
  - Regulatory –
    - 30 ppm limit, corrected to 7% oxygen
    - Higher O_2 equates to higher corrected NOx
    - Limits apply “at all times”
  - Process –
    - Ammonium injection provides approx. 70% reduction
    - More difficult at elevated bed temps (>1500^{o} F)
    - Fluidizing air is constant flow (not variable)

Operational Impacts

- Requires tighter control of Process & Reactor Operation
- Management of FOG
- Dewatering Process Flexibility
- Other Factors

Tighter Control of Reactor Operation

- Maintain low bed temps (<1450^{o} F)
- Minimize high O_2 Levels (< 10%)
- Minimize upstream equipment interruptions
- Decrease variability in sludge feed to control btu

Manage FOG Loads

- Maintain lower bed temps
  - Need lower volatile solids
- Receive FOG – Revenue Source
  - Scheduling deliveries
  - Reducing Number of deliveries

Sludge Dewatering Process

- Sludge variability
  - Feed rate
  - Dry solids concentration
  - Composition – volatiles
- “wetter” sludge burns cooler
  - Aim For 22-24% solids

Centrifuge Dewatering Process:

- Constant adjustments required
  - polymer
  - Bowl speed
    - Lower speed – wetter solids
- Operation not optimal:
  - Constant operator attention
  - Increased polymer usage
  - Decreased centrifuge recovery/capture rate

Operation Impact

- Other factors related to new SSI limits:
  - Carbon system periodic flushing requires significant downtime (1-2 weeks)
  - Ammonium Hydroxide used for NOx control
    - Chemical hazard

NOx – Can Limits be Met?

- Workout with Engineer, Incinerator Manufacturer & EPA to find Solutions:

  -Assess Ammonia Injection Requirements

  -EPA to Review Operation AC & Regulation

  "At All Times"

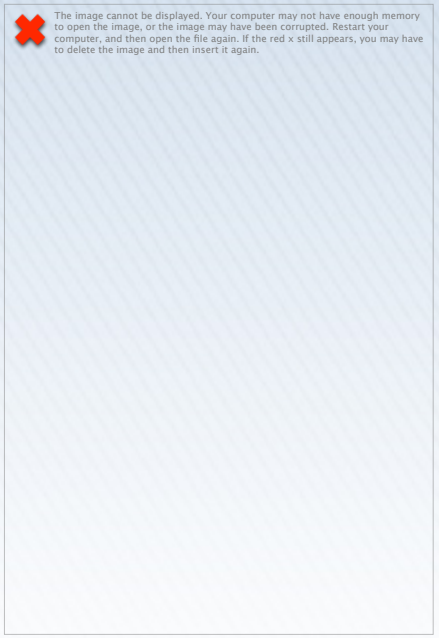
  -Stack Test for NOx instead of Continuous Monitoring

New SSI NOx Limits

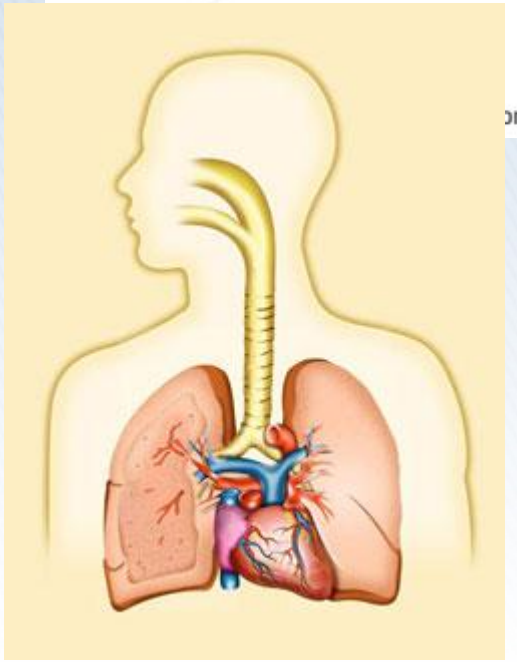
Is it Possible to Meet Them?

What is NOx?

- Nitrous Oxides
  - NO – nitric oxide MOST COMMON FORM
  - NO2 – nitrogen dioxide
  - N2O2 – dinitrogen dioxide
  - N2O5 – dinitrogen pentoxide
  - N2O – nitrous oxide
  - N2O4 - dinitrogen tetroxide
  - N2O5 – dinitrogen pentoxide



Why Control NOx ?



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How is NOx Created?

- Most NOx is from human sources
- Fuel NOx
- Thermal NOx
  - Occurs at high temperatures
  - More NOx forms at higher O2 levels

Emission Limits

FBIs:

New: 30 ppm NOx at 7% O2

Existing: 150 ppm NOx at 7% O2

MHIs:

New: 210 ppm NOx at 7% O2

Existing: 220 ppm NOx at 7% O2

Regulation Require…

- Emissions to be met “at all times”
  - Must meet on 24-hr avg
- CEMS: Report any time system is on
- Parameter Monitoring:

  Report when burning sludge

NOx Control

- Ammonia Injection
  - Inject NH3 in bed

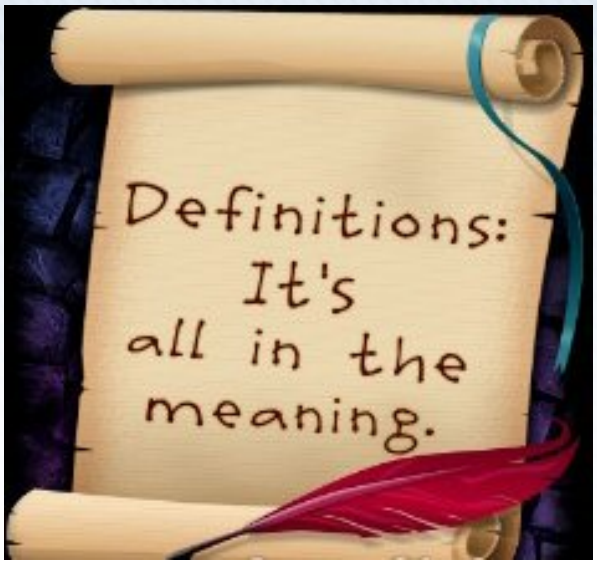
$$4NO + 4\ NH_3 + O_2 \rightarrow 4\ N_2 + 6\ H_2O$$

Occurs at temps of 1400 deg F to 2000 deg F

Regulation State #1:

"*Periods of Startup, Normal Operations and shutdown are predictable and routine*"

- Implies sludge is consistent
- Implies these 3 have same emissions
- Does not address other situations
  - Hot Standby
  - Sand addition
  - Introduction of sludge/Loss of sludge



Startup Sequence

- Aeration blower and Sludge Pump on
- Centrifuges ramped up to speed
- Introduce sludge
- Typically hours before steady state

- NOx rates are erratic
  - > 500 ppm corrected

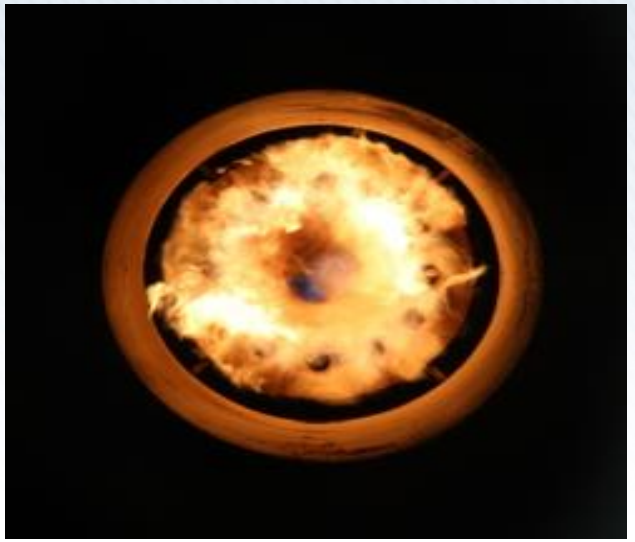
Regulation State #2:

Use of NG or Fuel Oil during startup -

Emissions are expected to be low

But – these fuels result in higher NOx

- Final heat-up of Vessel
- Sand addition
- Hot standby



Sand Addition

- Sand addition can take 3-4 hours
- Add fuel to keep temp up
- NOx values typically cycle to >500 ppm
  - Brings daily avg to > 69 ppm corrected
  - May achieve limit for uncorrected

Regulation State #3:

Method of Calculating Daily Average

- Impact NOx more than other parameters
  - NOx is highest when O2 is high
- Calculation Uses 1- 15 min value for an hour

Example Calculation

- Shutdown in first ¼ of hour
- This hour value is 250 ppm NOx
- Rest of Day must be <20 ppm NOx

- If only use ¼ of an hour – rest of day
  - Rest of day must be less than 28.6 ppm NOx

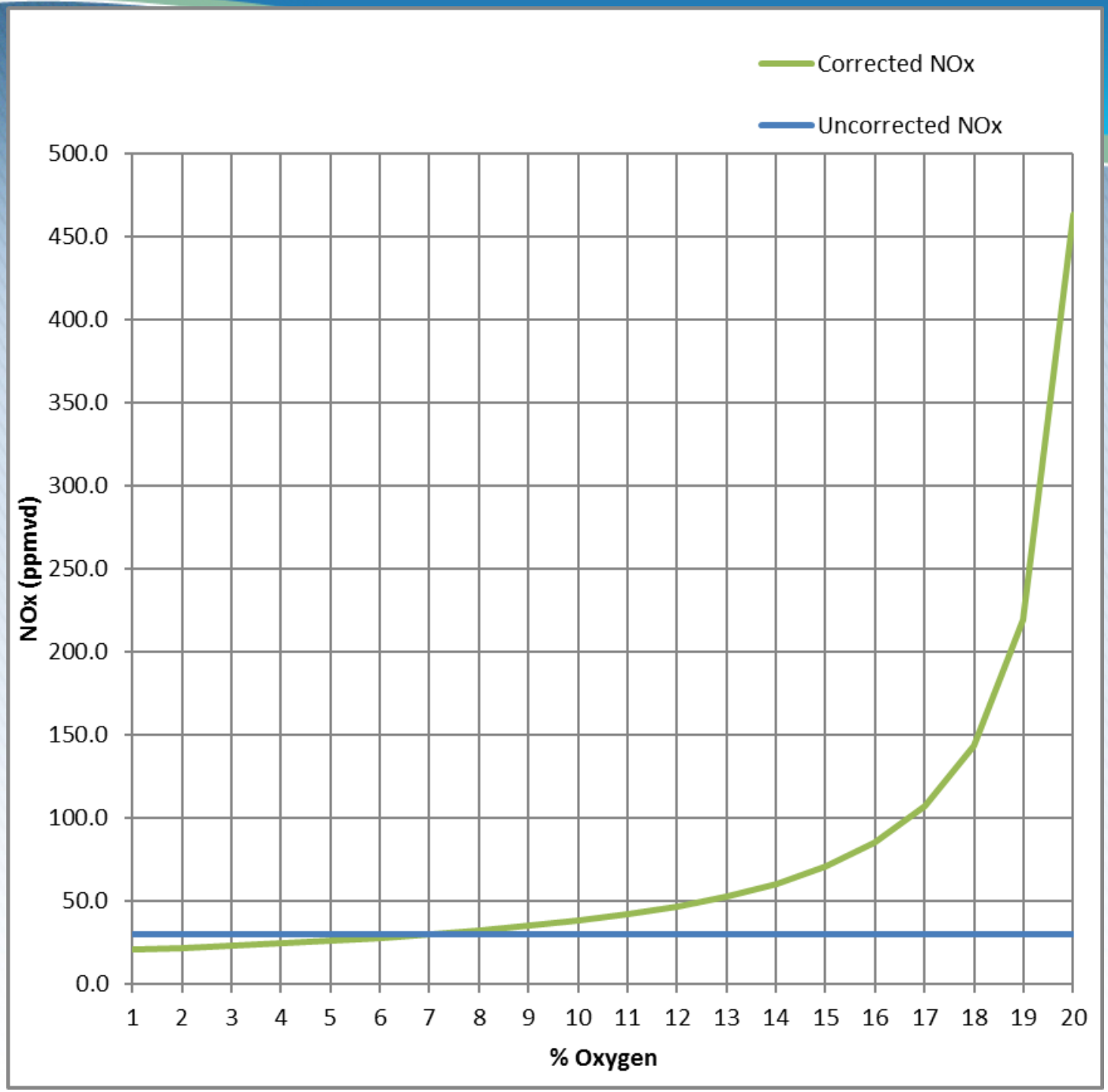
Regulations Don't State:

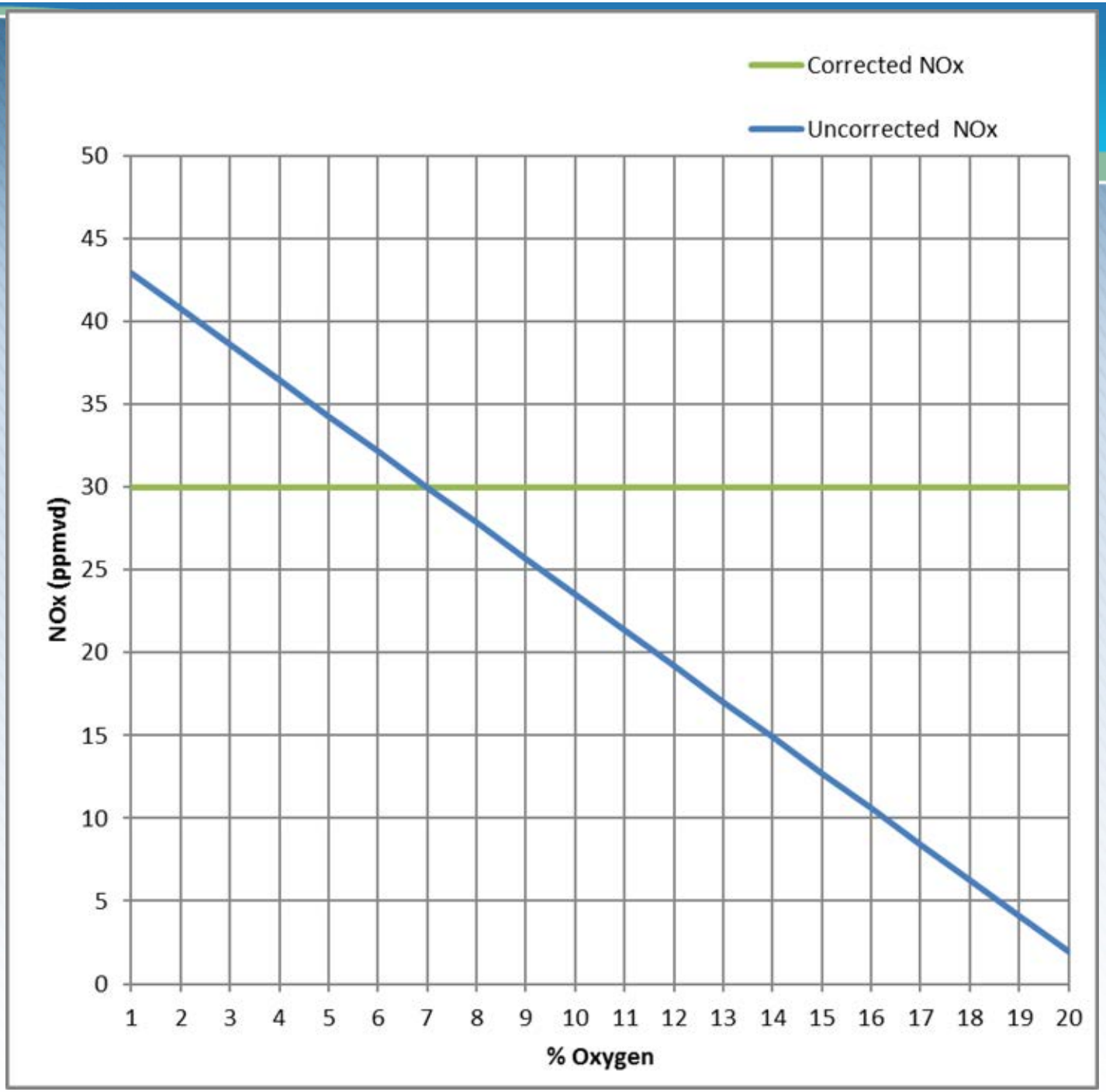
- Correct to 7% O_2 only when burning sludge

$$NOx\ @7\%\ O_2 = NOx\ actual\ (20.9 - 7)\ /(20.9 - \%\ O_2)$$

Typical air has 50 ppb NOx

– corrected value is 139 ppm NOx


Corrected NOx
Uncorrected NOx
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
NOx (ppmvd)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
% Oxygen


Corrected NOx
Uncorrected NOx
NOx (ppmvd)
50
45
40
35
30
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
% Oxygen

To summarize

- Emission limits cannot be consistently met during
  - Hot standby
  - Loss of sludge
  - Loss of one centrifuge
  - Sand addition
  - Startup/Shutdown of System
- Correction to 7% O2 during startup/shutdown is unreasonable.

Questions?