YEAR ROUND OPERATION – ARE YOU PREPARED?

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Workshop
Year Round Operation – Are You Prepared?

NOx Round Table

February 16, 2007

Cincinnati, OH

Year Round Operation

- Must Be Addressed ASAP
  - Regulations
    - Impact on gas/catalyst system
    - Impact on reagent system
    - Other
      - Additional SCRs
      - NOx credits
      - Transportation
      - Labor
  - Getting Ready
    - Inspections/maintenance
    - Consolidation/holistic plan
    - Designate consistent team

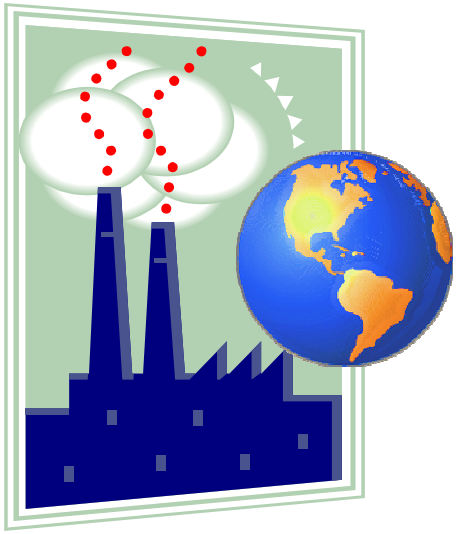
Catalyst
Engineer

- Informal - Sit Back and Relax
  - What I came up with
  - What you can add
  - Questions we can discuss

Learning Curve – People/Shifts

NOx Impact of CAIR Legislation

- 2003 NOx Baseline
  - Annual NOx cap = NOx 3.2 million tons.
  - Ozone season cap = 1.05 million Tons
- 2009 NOx Cap
  - Annual NOx
    - = NOx 1.52 million tons.
    - = 52% reduction (1.68 million tons)
  - Ozone Season
    - = 0.58 million tons
    - = 45% reduction (0.47 million tons)



- 2015 NOx Cap
  - Annual NOx
    - = NOx 1.27 million tons.
    - = 60% reduction
  - Ozone Season
    - = 0.48 million tons
    - = 54% reduction

Impact Upon Catalyst

- Current SCR Operation
  - Approximately 103 GW with SCR having approximately 120,000 m^3 catalyst
  - Estimated catalyst replacement 5% today and 20-25% by 2008
- 2009 Estimate SCR Operational Hours will about Double
  - Initial catalyst additions to meet new criteria – available?
    - Catalyst lead times increase
    - Impact of foreign market demand
  - Estimated catalyst annual replacement rate 20% - 30% beyond 2008
- Add About 10 GW of SCR/Year
  - Original needs 25,000 m^3/year more catalyst
  - New needs another 12,000 m^3/year
  - Add/Replace new another increase of 2,500 m^3/year - additive

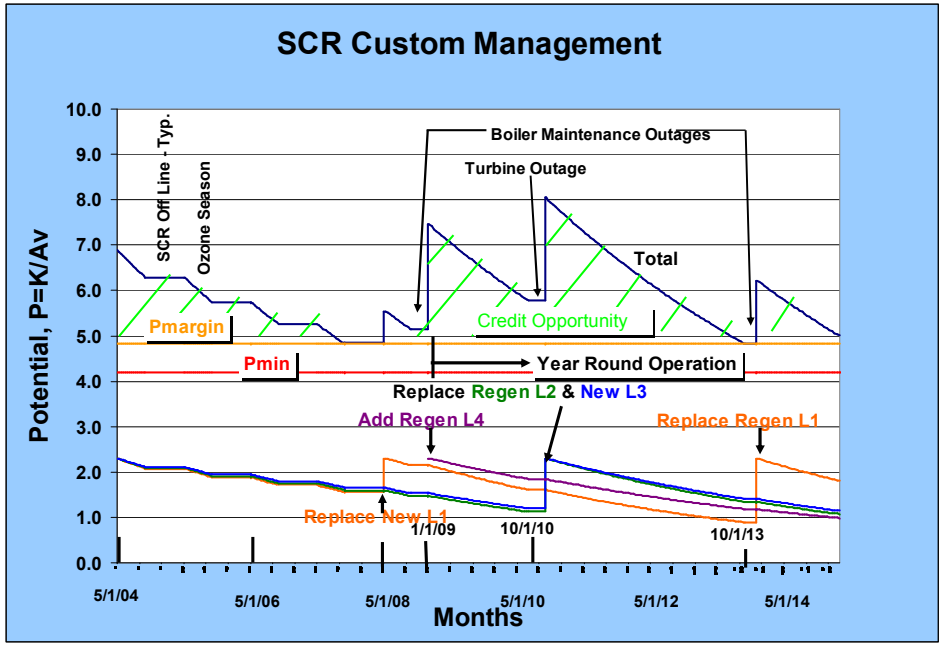
Catalyst Self Audit

- √ Actual/Design Conditions
- √ Ko for your catalyst
- √ Keof – End of Life
- √ Margin Estimated for Guarantees
  - Activity or
  - Life
- √ SO2 Oxidation with Margins
- √ Initial Catalyst Constituents
- √ Impact upon Mercury
- √ Arsenic/Calcium Guide

Think Ahead
Planning – Planning - Planning

Impact Upon Catalyst Management

- Catalyst Management Plan
  - New/regeneration lead times
    - Require earlier planning
    - Spare catalyst
  - Avoid unnecessary outages
    - Pluggage
    - Fuel
    - Deactivation
  - Test laboratory
    - Trusted
    - Certified
    - Independent
  - Increase number samples



Think Ahead
Planning – Planning - Planning

Impact Refurbishment Method

Activity Table

Layer	New	Depleted	Replace	Add
1	100%	70%	100%	70%
2	100%	70%	70%	70%
3	100%	70%	70%	70%
4	Spare	Spare	Spare	100%
Total	**300%**	**210%**	**240%**	**310%**
Time Left	**3 years**	**0**	**~ 1 year**	**> 3 years**

Cycling Operation Considerations

- Low Load forms Ammonium BiSulfate (ABS)
  - √ Minimum operating temperature – avoid ABS
  - √ Lower temps. vs operational times
  - √ Minimum NH_3 injection temperature – minimize catalyst pluggage
  - √ Recovery temperature – decompose ABS
- Economizer Bypass
  - √ More use
  - √ Upgrade?
- Off-Peak Operation
  - √ Reduced flow: mal-distribution?
  - √ Catalyst pluggage – ash deposition?
  - √ Upgrade flow distribution system?

Measurements - Anticipation

- NH_3 Consumption
- NH_3 Slip
  - √ Correlate wet with NH_3 in ash
    - Avoid bottom, eco. and hot ESP ash
  - √ Update for fuel switching/blending
- Catalyst Layers' ΔP
  - √ Track over time
    - Signals pluggage
- Air Preheater ΔP
  - √ Track over time
  - √ Upgrade air preheater?
    - ABS formation/pluggage
- √ Archive Fuel Samples
- √ Record AIG valve positions

-Build In Cautions –
- Avoid Stops -

Ammonia Consumption - Estimates

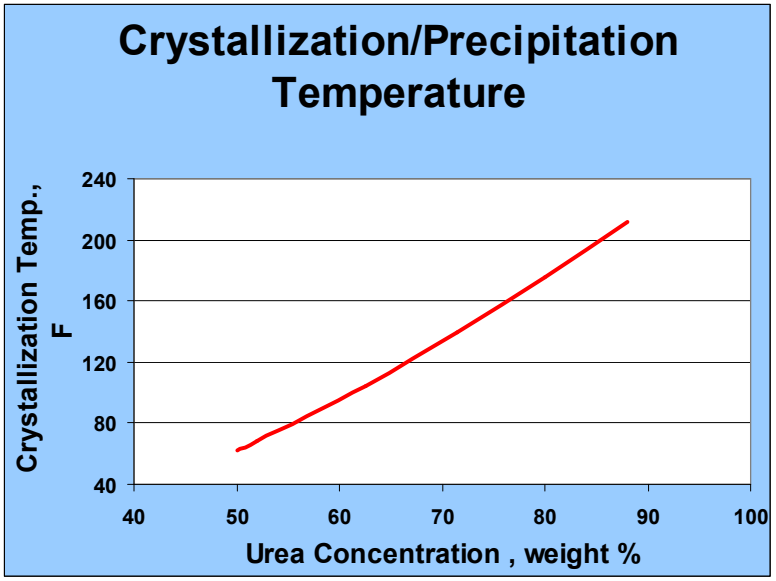
- 2003 NH_3 Usage
  - Basis: 0.35 lb/MMBTU ⟶ 0.15 lb/MMBTU:
  - Presents 7.5 – 4.3 = 3.2 million tons NOx [High]
  - 4.3 millions tons/year (17/46) = 1.6 NH_3 million tons/year
- 2009 Estimate NH_3 Increased Usage
  - About double – Say 1.6 to 2.4 millions tons/year
- Current U.S. NH_3 Consumption = 18.7 million tons/year total*
  - Will use ~8% – 12.8% more NH_3 in 2009
  - Supply probably not a problem

*The Fertilizer Institute, Wash. D.C.

NH_3 Supply Should Be Adequate

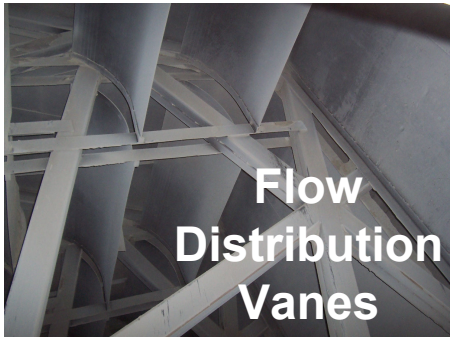
Ammonia On Site

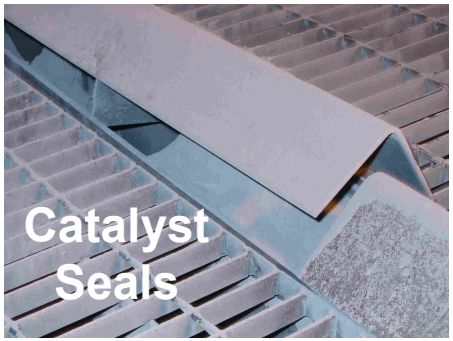
- Added Consumption Requires Increased
  - Delivery to site
  - Site storage
  - Vaporization
  - Increased maintenance
- Winter Operation Impacts
  - Anhydrous - low
  - Aqueous - condensation
  - Urea – crystallization
    - Insulate piping
    - Trace heating
- Supply Reliability



Auxiliaries

- Bypass Systems
  - √ Economizer
  - √ SCR – secure for safety
- Inspect Duct Work
  - √ Insulation/expansion joints
  - √ Ammonia system/AIG
  - √ Catalyst seals
  - √ Flow distribution devices
- LPA Screens and LPA Removal



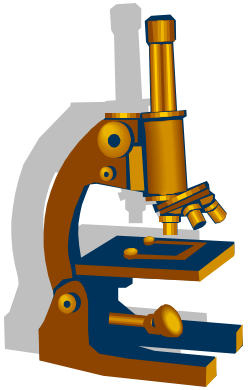


- √ SCR Cleaning Devices
  - Sootblowers
  - Acoustic horns
- √ Instrument service/maintenance

Auxiliaries Now Operate Year-Round

Fuels

- Seasonal Variations?
- Impact on Quality
  - Ash
    - Quantity
    - LPA
  - Arsenic: As/Ca
  - Calcium: CaO
  - Silica: SiO_2
  - Phosphorous
  - Alkali metals: Na and K
  - Iron: Fe
  - SO_3
- Pluggage
- Catalyst Reuse



Other Impacts

- Adding FGD?
  - Switch to higher sulfur fuels
  - Higher SO_3
  - Air Preheater
- Year Round Mercury Oxidation
- Coal Blending
  - Ash fusion temperature
  - Pet Coke
    - Increased SO_2
    - Vanadium
  - PRB
    - Decreased As/Ca ratio
    - Reduced chloride level
  - Biomass/Waste
  - Other

Manage Impacts on SCRs

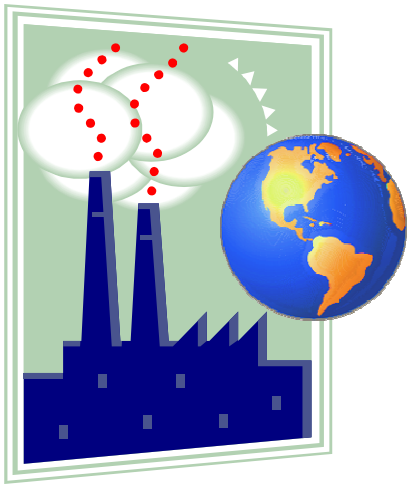
Change in Management Strategy

- Catalyst Availability/Cost
- Labor Availability/Cost
  - Most upgrades
    - Fall 2008 outage, or
    - Spring 2009 outage
  - Labor costs –replace/add
    - Higher contractor prices
    - Lower productivity
  - Plan early
    - Earlier or later outages
    - Spare catalyst
- Third Party Availability/Cost
  - Inspections
  - Testing
  - Tuning
  - Flow distribution
- Truck Availability/Cost
  - Thousands of modules
    - Drivers
    - Proper trucks

Think Ahead

Change in Management Strategy

- Constant Operation
  - Can not ride out problems
  - More maintenance/compressed
- What if SCR Goes Off-Line?
  - NOx credit strategy
    - Seller
    - Buyer
    - Neutral



Anticipation/Closer Tracking

- Proactive Planning
  - More catalyst Sampling/rapid testing
  - Activity
  - Poison accumulation
  - Longer lead times
- Have more SCR spare parts
  - Catalyst
  - Meters
  - Valves
  - Others
  - Consistency

Risks

- 12 from 5 Month Operation
  - More usage – higher risk of unavailability
  - Higher reliability required
  - Compressed off-line time
- Outage Duration
  - New?
  - Regenerate?
  - Rejuvenate?
  - Back-up catalyst?
- Labor Availability/Specialized Contractors
- Long Term Agreements?
  - Guaranteed response/certainty
  - Firm pricing in an escalating market

The Clock is Ticking

Discussion

http://www.scr-tech.com/tech_papers.htm