Advances and New Direction in Ammonia Slip Monitoring

Cemtek KVB-Enertec CEMS Conference
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South Coast Air Quality Management District
Ammonia Slip from Stationary Sources

- **Ammonia Slip from Ammonia/Urea Use in SCRs to Control NO\textsubscript{x} Emissions**

- **SCAQMD NH\textsubscript{3} Slip Limits in Existing and Proposed Rules**
  - BACT NH\textsubscript{3} Slip Limits
    - 5 ppm @ 15% O\textsubscript{2} for Gas Turbines (Simple Cycle and Combined Cycle)
    - 5 ppm @ 3% O\textsubscript{2} for Boilers and Heaters

- **Compliance Determination by SCAQMD Method 207.1**
  - Initially Quarterly Testing, then Annual Schedule after Consistent Compliance Demonstration

- **Many SCAQMD Permits Require NH\textsubscript{3} Slip Determination**
  - Differential NO\textsubscript{x} Measurement
  - Equations Calculate NH\textsubscript{3} Slip
  - Information but not for Compliance
Ammonia Slip Calculation Procedure

- Inlet and Outlet SCR NOx Measurements
- Ammonia Injection Rate
- Dry Exhaust Gas Flow Rate
- Determine NH$_3$ Slip by Calculation Procedure
Gas Turbine Ammonia Slip

- Large Difference Between Measured NH$_3$ vs. Calculated NH$_3$ Slip
- Currently Not Used by SCAQMD for Compliance Purposes

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<thead>
<tr>
<th>Parameters</th>
<th>Values  ***</th>
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<tbody>
<tr>
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<tr>
<td>Gaseous Emissions (Inlet):</td>
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<tr>
<td>NO$_x$ inlet, ppm volume dry</td>
<td>N/A</td>
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<tr>
<td>Gaseous Emissions (Outlet):</td>
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<tr>
<td>NO$_x$ outlet, ppm volume dry</td>
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<tr>
<td>Measured NH$_3$ slip, ppm volume dry @ 15% O$_2$*</td>
<td>2.70</td>
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<tr>
<td>Calculated NH$_3$ slip, ppm volume dry @ 15% O$_2$**</td>
<td>2.01</td>
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<tr>
<td>Difference between measured and calculated NH$_3$ slip</td>
<td>26%</td>
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* Using SCAQMD Method 207.1
** NH$_3$ slip calculated from NO$_x$ CEMS measurement difference of (1) stack gas NO$_x$ and (2) stack gas NO$_x$ and NH$_3$ slip converted to NO$_x$
*** Average of 2 runs
Gas Turbine Ammonia Slip

- Large Difference Between Measured NH₃ vs. Calculated NH₃ Slip
- Currently Not Used by SCAQMD for Compliance Purposes

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<th>Values ***</th>
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<tr>
<td>Gaseous Emissions (Inlet):</td>
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<td>NOₓ inlet, ppm volume dry</td>
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<tr>
<td>Gaseous Emissions (Outlet):</td>
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<td>NOₓ outlet, ppm volume dry</td>
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<tr>
<td>Measured NH₃ slip, ppm volume dry @ 15% O₂ *</td>
<td>2.73</td>
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<tr>
<td>Calculated NH₃ slip, ppm volume dry @ 15% O₂ **</td>
<td>3.59</td>
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<td>Difference between measured and calculated NH₃ slip</td>
<td>32%</td>
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* Using BAAQMD Method ST1B
** NH₃ slip calculated from NOₓ CEMS measurement difference of (1) SCR inlet NOₓ and (2) stack gas NOₓ
*** Average of 3 runs
Ammonia Slip Measurement

- **NH₃ is a PM₂.₅ Pre-cursor**
  - Reducing NH₃ Slip Reduces PM₂.₅
  - SCAQMD Non-attainment for PM₂.₅

- **SCAQMD Rule 1325**
  - PM₂.₅ NSR May be Triggered for NH₃ Emissions >40 tpy

- **Continuous and Accurate Measurement of NH₃ Slip = Better Control of NOₓ Emissions and NH₃/Urea Injection Rate**

- **Optimization of NH₃ Injection Rate**
  - Potential Reduction in NH₃/Urea Usage and Cost Savings
  - Monitor SCR Catalyst Performance
Ammonia CEMS

• Calculation Method not Accurate to Determine Compliance with NH₃ Slip Limits
  ▪ Quarterly/Annual Source Testing not Adequate to Determine Ongoing Compliance

• Continuous and Real Time Monitoring is Desirable
  ▪ NH₃ CEMS Provides Accurate Ongoing Compliance Determination with NH₃ Slip Limits
Ammonia CEMS Technologies

• **Tunable Diode Laser (TDL)**
  - Some Facilities in South Coast Air Basin are Currently Using TDL NH₃ CEMS

• **Fourier Transform Infrared (FTIR)**

• **Most In-Situ Systems**
Ammonia CEMS Certification Procedure

- Use CEMS for Compliance/Enforcement
  - Discussed with CARB, CEC, BAAQMD, TCEQ, EPA
  - TCEQ is using EPA PPS-001

- SCAQMD Proposed Plan for CEMS Certification
  - Use EPA PPS-001
    - Certification
    - Ongoing CEMS QA/QC
  - SCAQMD Method 207.1 as Reference Method for CEMS Certification
Ammonia CEMS Certification Procedure (continued)

• Conduct Demonstration Project
  - Certification and Ongoing CEMS QA/QC per EPA PPS-001
    - RATA, Daily Calibration Tests
    - CEMS Performance Stability Tests
  - SCAQMD Method 207.1 as Reference Method
  - Working with CEC, BAAQMD, CARB
Conclusion

• Benefits to Air Quality
  ▪ Monitor Ongoing NH₃ Slip Compliance
    ✓ Specially with Lower NOₓ Limits in Proposed Rules
  ▪ Reduce PM₂.₅ Emissions
  ▪ Better Estimate of PM₂.₅ Emissions for SCAQMD Planning and Emissions Inventory Purposes
  ▪ Helps Towards Clean Air Goals for South Coast Air Basin

• Benefits to Industry
  ▪ Better Control of NOₓ Emissions During Startup and Normal Operation
  ▪ Controlled/Reduced NH₃/Urea Injection Rate
  ▪ Monitor SCR Catalyst Performance and Predict SCR Useful Life
  ▪ Excess NH₃ Slip May Reduce Potential Corrosion Problems Downstream of SCR
  ▪ Monitor Combustion Equipment Performance
Lastly….

Looking for Host Site to Conduct
Ammonia CEMS Demonstration Project

Questions & Comments?

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