Improving Air Quality in Industrial Plants

Dialog on Sustainability
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Agenda

• Introduction
• Criteria pollutants and GHGs
• Attainment and non-attainment areas and what it means to industries
• Major and minor new source review permitting, and operating permits
• Technologies employed by industries to reduce air pollution
• Summary
REGULATIONS

- Clean Air Act (CAA) – 1963
- 1970 CAAA (Amendments) – Established NAAQS
  - From 1970 to 2015, aggregate national emissions of the six common pollutants alone dropped an average of 70 percent while gross domestic product grew by 246 percent
- 1990 CAAA - control of acid deposition (acid rain) and for the issuance of stationary source operating permits
- In January 2011, states and EPA initiated Clean Air Act permitting of greenhouse gas pollution from the largest new and modified stationary sources.
Reduction in national concentrations of air pollutants between 1990 and 2015

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>60</td>
</tr>
<tr>
<td>CO</td>
<td>84</td>
</tr>
<tr>
<td>Ozone</td>
<td>3</td>
</tr>
<tr>
<td>PM</td>
<td>69</td>
</tr>
<tr>
<td>SOx</td>
<td>67</td>
</tr>
<tr>
<td>Lead</td>
<td>85</td>
</tr>
</tbody>
</table>
REGULATIONS

• Other regulated pollutants: HAPs, GHGs
  – GHGs do not have a NAAQS

• Attainment vs Nonattainment areas
  – Prevention of Significant Deterioration (PSD) vs Nonattainment New Source Review (NNSR)
## NAAQS Table

<table>
<thead>
<tr>
<th>Pollutant [final rule cite]</th>
<th>Primary/Secondary</th>
<th>Averaging Time</th>
<th>Level</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Monoxide [76 FR 54294, Aug 31, 2011]</td>
<td>primary</td>
<td>8-hour</td>
<td>9 ppm</td>
<td>Not to be exceeded more than once per year</td>
</tr>
<tr>
<td></td>
<td>1-hour</td>
<td>35 ppm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead [73 FR 66964, Nov 12, 2008]</td>
<td>primary and secondary</td>
<td>Rolling 3 month average</td>
<td>0.15 μg/m³ (1)</td>
<td>Not to be exceeded</td>
</tr>
<tr>
<td>Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]</td>
<td>primary</td>
<td>1-hour</td>
<td>100 ppb (2)</td>
<td>98th percentile of 1-hour daily maximum concentrations, averaged over 3 years</td>
</tr>
<tr>
<td></td>
<td>primary and secondary</td>
<td>Annual</td>
<td>53 ppb (2)</td>
<td>Annual Mean</td>
</tr>
<tr>
<td>Ozone [73 FR 16436, Mar 27, 2008]</td>
<td>primary and secondary</td>
<td>8-hour</td>
<td>0.075 ppm (3)</td>
<td>Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years</td>
</tr>
<tr>
<td>Particle Pollution Dec 14, 2012</td>
<td>PM₂.₅</td>
<td>Annual</td>
<td>12 μg/m³</td>
<td>annual mean, averaged over 3 years</td>
</tr>
<tr>
<td></td>
<td>secondary</td>
<td>Annual</td>
<td>15 μg/m³</td>
<td>annual mean, averaged over 3 years</td>
</tr>
<tr>
<td></td>
<td>primary and secondary</td>
<td>24-hour</td>
<td>35 μg/m³</td>
<td>98th percentile, averaged over 3 years</td>
</tr>
<tr>
<td></td>
<td>secondary</td>
<td>24-hour</td>
<td>150 μg/m³</td>
<td>Not to be exceeded more than once per year on average over 3 years</td>
</tr>
<tr>
<td>Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]</td>
<td>primary</td>
<td>1-hour</td>
<td>75 ppb (4)</td>
<td>99th percentile of 1-hour daily maximum concentrations, averaged over 3 years</td>
</tr>
<tr>
<td></td>
<td>secondary</td>
<td>3-hour</td>
<td>0.5 ppm</td>
<td>Not to be exceeded more than once per year</td>
</tr>
</tbody>
</table>
Types of Permits-Construction

- Congress established the New Source Review (NSR) permitting program as part of the 1977 Federal Clean Air Act Amendments
  - ensures that air quality is not significantly degraded from the addition of new and modified facilities
  - assures the public that emissions from new and modified industrial sources will be reduced or eliminated through technically practicable and economically reasonable air pollution control method(s), and
  - verifies that advances in pollution control occur concurrently with industrial expansion.
Types of Permits-Construction

- An NSR permit is required before construction on a facility begins.
  - required for new and modified facilities

![Diagram showing Types of NSR Authorizations]

- De Minimis
- PBRs
- Standard Permits
- State Permits
- NNSR & PSD

Types of NSR Authorizations
Types of Permits-Construction

• de minimis facility or source
  – Emits less than 10 lbs/day of air pollutants
  – Less than 2000 lbs/ yr of hazardous air pollutants.
  – Boilers < 10 MMBtu/hr
  – Tanks < 20,000 gal

• PBR
  – Gas Stations, Emergency Generators

• Standard Permit

• Minor Permit

• Major Permit
Major Source Emission Thresholds

• Typically 100 or 250 tpy of criteria pollutants depending on the industry
• 0.6 tpy for lead
• 25 tpy of HAPs
• 100,000 tpy of GHGs (only if another pollutant is a PSD major)
• For modifications, the thresholds are much lower

\[ \text{tpy} = \text{tons per year} \]
Major for GHG Emissions-Rule

• On June 23, 2014, the Supreme Court of the United States issued an opinion in *Utility Air Regulatory Group v. EPA*. The court determined that a source cannot be considered a major facility for PSD permitting based solely on emissions of GHGs above major source thresholds.

• In other words, a source is subject to PSD permitting (i.e., BACT) for its GHG emissions only when emissions of non-GHG emissions are above major source thresholds as well.
Why Industries Avoid Major Permitting

• 12-18 months review by regulatory agency
• Intensive dispersion modeling
• Increased testing & monitoring
  – Entails costly equipment such as CEMS
• BACT/LAER requirements
  – Best Available Control Technology
  – Lowest Achievable Emission Rate (no cost considerations)
Emission Controls

• PSD requires
  – Best Available Control Technology (BACT) review
  – An air quality analysis (AQA), and
  – public notice

• LAER
  – Lowest Achievable Emission Rate technology evaluation
  – emissions offsets, and
  – public notice
# Nonattainment Major Source Emission Rates

<table>
<thead>
<tr>
<th>Criteria Pollutant</th>
<th>Nonattainment Area Classification</th>
<th>County or Area</th>
<th>Nonattainment Major Source (tpy)</th>
<th>Nonattainment Major Source Modification (tpy)</th>
<th>Offset Ratio Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozone as VOC or NOx</td>
<td>Moderate</td>
<td>DFW (10 counties) (2008 standard)</td>
<td>100</td>
<td>40</td>
<td>1.15 to 1</td>
</tr>
<tr>
<td>Ozone as VOC or NOx</td>
<td>Moderate</td>
<td>HGB (8 counties) (2008 standard)</td>
<td>100</td>
<td>40</td>
<td>1.15 to 1</td>
</tr>
<tr>
<td>PM10</td>
<td>Moderate</td>
<td>City of El Paso</td>
<td>100</td>
<td>15</td>
<td>1.00 to 1</td>
</tr>
<tr>
<td>Pb</td>
<td>Nonattainment</td>
<td>Portion of Collin County</td>
<td>100</td>
<td>0.6</td>
<td>1.00 to 1</td>
</tr>
<tr>
<td>SO2</td>
<td>Nonattainment</td>
<td>Portions of Freestone, Anderson, Rusk, Panola, and Titus Counties (2010 standard)</td>
<td>100</td>
<td>40</td>
<td>1.00 to 1</td>
</tr>
</tbody>
</table>

Recently changed from 25 to 40
Types of Permits-Operation

- Minor
- Major or Title V
  - Congress passed the Federal Clean Air Act Amendments of 1990, which included new provisions in Title V, creating an operating permit program to ensure better compliance and to allow for more thorough air pollution control.
  - A Title V permit is required for operation of major sources and certain non-major sources.
Common Emission Sources in Industries

• Fugitives
  – Almost 50% in refineries and 30% in chemical plants out of total emissions
  – Count all the valves, flanges, pumps, compressors etc!

• Combustion Sources
  – Boilers, Heaters, Oxidizers, Incinerators, Flares

• Tanks
  – Atmospheric venting, floating roofs

• Cooling Towers

• Loading/Unloading operations

• Dust Collectors, Cyclone Separators

• MSS-Maintenance, Start-up and Shut-down
Permitting Process

- Estimate emissions
- Very conservative figures in Permit Application
- Can operate less than capacity, but not even 1% more than capacity
Refinery Expansion Options

- Brazoria vs Matagorda County
- Different thresholds for different siting options
Refinery Expansion
Polyethylene Plant

• Existing plant A with 2 bays
• Plant B installing 3rd bay
• To avoid major permitting, look into options to reduce emissions from existing bays
• Route flare vents to a new thermal oxidizer
• Boiler Operation Conundrum
  – Design vs turndown
  – Normal need is 50% of Design
  – Cannot meet CO limits during turndown
  – Plants have made more steam and let it out just to meet emission requirements
• Dispersion modeling failed
  – Fenceline to include a neighbor chemical facility
  – Move the emission sources and increase stack height
  – Reduce emissions

Improving Air Quality in Industrial Plants
Technologies Employed by Industries

• NOx - LNB, ULNB, SCR, SNCR, Scrubber, Two stage combustion
• SOx - Scrubber
• VOC – Flares, Thermal Oxidizers, Activated Carbon, Heaters/Boilers,
• PM – Bag Filters, ESPs, Scrubbers
Technologies Employed by Industries

• Catalysts, scrubbers, and low-VOC paints and coatings, are part of a long list of technologies that were not known in 1970, but are proven and widely deployed today.

• Sophisticated new valve seals and leak detection equipment, including cameras that can see leaks, for refineries and chemical plans

• Low or zero VOC paints, consumer products and cleaning processes
Smokeless Design

Air or Steam Assist

Air Assist

a. No blower air
b. Blower is started
c. Air flow increasing
d. Smokeless burning
Enclosed Flares
Important Parameters in Emissions

• Stack Height-helps in dispersion
• Temperature-high temp increases velocity
• Velocity-increased dispersion
Common Air Quality Violations

• Installing and operating equipment without obtaining proper permits.
• Not maintaining records required by permits.
• Exceeding permit limits.
• Not maintaining air pollution control equipment.
Summary

• CAA has made significant impact in reducing emissions and improving industrial air quality
• Stringent requirements in Nonattainment area
• Major permits require more time and resources
• Industries dependent on advancements in emission control technologies
QUESTIONS?