Update on Secondary PM2.5 Formation in the San Joaquin Valley and Research on Potential Controls

November 16, 2017
Presentation Outline

• Role of ammonia in forming PM2.5
• Required SIP precursors analysis
• District controls reducing ammonia
• Connection of ammonia and methane
Sources of Ammonia in the Valley

- **Dairy**: 125 tons, 38%
- **Fertilizer**: 118 tons, 36%
- **Non-Dairy Livestock**: 61 tons, 19%
- **Waste Disposal**: 10 tons, 3%
- **On-Road Motor Vehicles**: 4 tons, 1%
- **Fuel Combustion**: 2 tons, 1%
- **Other**: 8 tons, 2%

Total: 329 tons per day, 2013
Role of Ammonia in PM2.5 Formation

Limiting precursor: Target the gas in least supply to provide the most effective improvement in air quality
US EPA ‘Significant’ Precursor Guidance

PM SIP must determine significance of four precursors:

SO₂   NOx   ROG   Ammonia

Step 1:
Determine the air quality impact of emission reductions in the base year

Step 2:
Further assess significance in impact of existing and new controls on the relative abundance of in atmospheric reactions
Ammonia Precursor Analysis
in the Valley

**Step 1:**
Determine the air quality impact of emission reductions in the base year

- PM2.5 impact at Bakersfield above threshold with 30% reduction of ammonia emissions

<table>
<thead>
<tr>
<th>Modeled Impact</th>
<th>EPA Recommended Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>24-hour</strong></td>
<td></td>
</tr>
<tr>
<td>3.3 µg/m³</td>
<td>1.3 µg/m³</td>
</tr>
<tr>
<td><strong>Annual</strong></td>
<td></td>
</tr>
<tr>
<td>0.41 µg/m³</td>
<td>0.2 µg/m³</td>
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</tbody>
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**Step 2:**
Further assess significance in impact of existing and new controls on the relative abundance of in atmospheric reactions

- CARB mobile controls provide about 58% reduction in NOx emissions in future

- PM2.5 impact at Bakersfield below threshold with 30% reduction of ammonia emissions in future

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<tr>
<td><strong>24-hour</strong></td>
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</tr>
<tr>
<td>0.9 µg/m³</td>
<td>1.3 µg/m³</td>
</tr>
<tr>
<td><strong>Annual</strong></td>
<td></td>
</tr>
<tr>
<td>0.11 µg/m³</td>
<td>0.2 µg/m³</td>
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- 30% reduction of ammonia emissions is about 100 tons per day
Significance Analysis Supported by Empirical Data

- Field study measurements indicate ammonia is in excess in the Valley
- Ammonia concentrations in SJV and SoCAB have increased
- NOx reductions are the most effective path to reduce PM concentration
  - Can provide some PM reductions
  - Ammonia is eye and respiratory irritant at low concentrations
- Continue to look for opportunities to reduce ammonia

Excess NH₃ in the SJV on Jan 18 (Top) and Jan 20 (Bottom) based on NASA aircraft measurements in 2013
# District Controls on Ammonia from Dairies

<table>
<thead>
<tr>
<th>District Rule</th>
<th>Measures to Select From Include…</th>
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</table>
| Conservation Management Practices *(Rule 4550)* | • Frequent manure removal  
• Scraping and harrowing |
| Biosolids, Animal Manure, and Poultry Litter Operations *(Rule 4565)* | • Timely incorporation or injection of manure into soil  
• Rapid covering of biosolid piles  
• Installation of aerated static piles |
| Confined Animal Facilities *(Rule 4570)* | • Nutritional management to reduce nitrogen intake  
• Timely incorporation or injection of manure into soil  
• Increased frequency and effectiveness of manure removal from animal housing area  
• Covering of manure piles |
Methane and Ammonia often Emitted by Same Sources

• Effective methane mitigation strategies may also deliver reductions in local air pollutants

Sources of Methane Emissions Statewide

- Dairy Manure: 25%
- Dairy Enteric: 20%
- Landfills: 20%
- Non-Dairy Livestock: 10%
- Oil & Gas Extraction: 4%
- Wastewater: 4%
- Rice: 3%
- Industrial & Other: 5%
- Pipelines: 9%

2013
New Research

- Characterize source attribution of local and regional ammonia emissions using mobile surveyors
- Investigate dynamics of ammonia in complex urban environments
- Assess ammonia measurement capabilities at ambient monitoring stations
- Identify methane and ammonia sources using remote sensing technology
Research Spotlight

• Evaluate real-world impact of various dairy manure management practices (e.g., digesters) on methane and ammonia emissions

• Expected deliverables:
  • Guidelines for alternative manure management practices with ammonia advantages
  • Understanding of how changes in dairy manure management practices affect emissions of methane and ammonia
Integrated Methane and Ammonia Approach

- Dairy and Livestock Working Group evaluations of methane and ammonia issues
- CARB research on effect of dairy manure management practices on methane and ammonia emissions
- $99 million from Greenhouse Gas Reduction Fund
- SLCP Reduction Strategy implementation with greenhouse gas and air pollutant co-benefits