Emissions of Criteria and Toxic Pollutants from Portland Cement Manufacturing Plants in SCAQMD

National Association of Clean Air Agencies Meeting

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Deputy Executive Officer
Cement Manufacturing
Emissions

- Existing and Proposed New Standards
  - EPA
  - SCAQMD
- SCAQMD’s Chromium Emission Study
Cement Handling and Production in SCAQMD

- **Riverside Cement Production**
  - **Gray Cement**
    - No existing cement kilns
    - Average of 670,894 tons/year (2004-2007)
  - **White Cement**
    - Two white cement kilns
    - Average of 104,551 tons/year (2004-2007)

- **California Portland Cement Production**
  - **Gray Cement**
    - Two gray cement kilns
    - Average of 807,831 tons/year (2004-2007)

- Numerous other batch plants and concrete recyclers in the area
Applicable Requirements

- **EPA Requirements**
  - NESHAP (40 CFR 63, Subpart LLL)
  - NSPS (40 CFR 60, Subpart F)
  - NSR/PSD (PM 2.5 & Others)

- **SCAQMD Requirements**
  - NSR for Criteria Pollutants (BACT, Offset, and Modeling)
  - NSR for Toxics (1-10 in-a-million, T-BACT, Hazard Index of 1)
  - Source Specific Rule
    - PM10 Reductions from Cement Manufacturing (Rule 1156)
  - Other Applicable Rules and Regulations
    - Opacity (Rule 401)
    - Fugitive Dust (Rule 403)
NESHAP Emission Standards

- Kilns @ Major Sources
  - PM $\leq 0.3$ lb/ton
  - Opacity $\leq 20$

- Kilns @ Major and Area Sources
  - Dioxin/Furan $\leq 0.2$ ng/dscm (0.4 if inlet $< 400$ °F)
  - THC $\leq 50$ ppmv
  - Mercury $\leq 41$ ug/dscm or use of a scrubber

- Clinker Coolers and All Others @ Major Sources
  - PM $\leq 0.1$ lb/ton (clinker coolers only)
  - Opacity $\leq 10$

Current NSPS Emission Standards

- Kilns
  - PM $\leq 0.3$ lb/ton
  - Opacity $\leq 20\%$
- Clinker Coolers
  - PM $\leq 0.1$ lb/ton
  - Opacity $\leq 10\%$
- All Others
  - Opacity $\leq 10\%$
Proposed NSPS Emission Standards

- EPA Proposed NSPS amendment on 5/30/08
- Applies to new Kilns and Clinker Coolers
- Proposed Emission Standards
  - PM ≤ 0.086 lb/ton
  - NOx ≤ 1.50 lb/ton (30-day rolling average)
  - SO2 ≤ 1.33 lb/ton (30-day rolling average) or 90% emission reduction
Visible Emissions
- Non-open piles - ≤ 10% opacity per EPA Method 9
- Open piles - ≤ 20% opacity per SCAQMD Method 9B
- Visible Dust Plum ≤ 100 ft

Air Pollution Control Device
- PM ≤ 0.01 gr/ft\(^3\) (installed prior to 11/4/05)
- PM ≤ 0.005 gr/ft\(^3\) (installed after 11/4/05)

Open clinker storage is allowed if area is ≤ 4 acres or loading/unloading rate is ≤ 80,000 tons/month

Open material storage is allowed if 90% of material is larger than ½ inch
Proposed Rule 1156
Amendments

- Eliminate enclosure threshold for clinker storage
  - Thereby requiring total enclosure of all clinker storage and handling
  - Enclosure required by March 1, 2009
- Modify exemption for non-clinker materials
  - 90% of materials mass is larger than ½ inch
- Clarifying changes
  - Opacity observations
  - Enclosed conveyors & transfer points vented to air pollution control device
- Proposed amendments up for adoption on September 5, 2008
### Reported Emissions of Criteria Pollutants from Cement Plants*

(Tons/Year)

<table>
<thead>
<tr>
<th></th>
<th>California Portland Cement</th>
<th>Riverside Cement</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOC</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>NOx</td>
<td>794</td>
<td>62</td>
</tr>
<tr>
<td>SOx</td>
<td>109</td>
<td>3</td>
</tr>
<tr>
<td>CO</td>
<td>73</td>
<td>2</td>
</tr>
<tr>
<td>TSP</td>
<td>117</td>
<td>107</td>
</tr>
</tbody>
</table>

*Based on 2006-07 Annual Emission Report*
## Reported Emissions of Toxic Pollutants from Cement Plants* (Lbs./Year)

<table>
<thead>
<tr>
<th>Pollutant Description</th>
<th>Riverside Cement</th>
<th>California Portland</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,3-Butadiene</td>
<td>1.573</td>
<td>7.855</td>
</tr>
<tr>
<td>Ammonia</td>
<td>302.394</td>
<td>1962.888</td>
</tr>
<tr>
<td>Arsenic</td>
<td>1.748</td>
<td>0.371</td>
</tr>
<tr>
<td>Benzene</td>
<td>47.279</td>
<td>331.383</td>
</tr>
<tr>
<td>Beryllium</td>
<td>0.093</td>
<td>0.051</td>
</tr>
<tr>
<td>Cadmium</td>
<td>3.831</td>
<td>48.698</td>
</tr>
<tr>
<td>Chromium (VI)</td>
<td>1.281</td>
<td>0.159</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>95.249</td>
<td>16730.79</td>
</tr>
<tr>
<td>Lead (inorganic)</td>
<td>11.694</td>
<td>3.306</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>0.143</td>
<td>0.084</td>
</tr>
<tr>
<td>Nickel</td>
<td>8.554</td>
<td>17.152</td>
</tr>
<tr>
<td>PAHs, total, with components not reported</td>
<td>46.668</td>
<td>4.932</td>
</tr>
</tbody>
</table>

*Based on 2006-07 Annual Emission Report
SCAQMD’s Hexavalent Chromium Emission Study from Cement Plants
What Triggered the Investigation of Cr+6 Emissions from Cement Plants?

- Analysis of data completed in late 2007 as part of Multiple Air Toxics Exposure Study (MATES-III) showed high Cr+6 at one air monitoring station (Rubidoux in Riverside County)

- Investigation was conducted to identify the source(s) of Cr+6 emissions
Hexavalent Chromium
MATES-III

ng/m³

- MATES II
- MATES III Year 1
- MATES III Year 2

Locations:
- Anaheim
- Burbank
- Central LA
- Compton
- Fontana
- Huntington Park
- North Long Beach
- Pico Rivera
- Rubidoux
- Wilmington
- Average
- Rubidoux Filter Blank
2005 Hexavalent Chromium Emissions in the South Coast Air Basin

- On-Road Gasoline: 36%
- Paved Road Dust: 19%
- Metal Processes: 22%
- Heavy Duty Diesel Trucks: 3%
- Trains and Marine: 1%
- Off-Road Equipment: 19%

2005 Hexavalent Chromium Emissions in the South Coast Air Basin
Initial Investigation

- Permit Records Review
- Survey of Area
- Literature Review
- Wind Pattern Analysis
- Deposition Plates Deployment
Initial Actions

- Examined permit records and surveyed area for potential hexavalent chromium sources
- No major hexavalent chromium sources found
- Reports and literature did NOT indicate that emissions of hexavalent chromium from cement facilities were significant
Wind Pattern Analysis at Western Riverside Monitoring Station

• Most frequent wind direction is from the West

• However, higher levels of hexavalent chromium are measured when wind blows from the Northeast

• The cement production facilities are located over two miles to the Northeast
Location of Cement Plants and Monitoring Station

Western Riverside Air Monitoring Station

prevailing wind

California Portland Cement

TXI Riverside Cement
Deposition Plates Deployment

- Glass plates placed to collect falling particles
- A good survey tool for covering a wide area
- Not used for determining true atmospheric concentrations
- Three rounds of deployment in the area
  - Jan, Feb, Mar
- All three rounds showed higher hexavalent chromium content of deposited particles near Riverside Cement
Hexavalent Chromium Averages (ng/m³)
Feb. 12 – May 31, 2008

- MATES-III Basin: Average = 0.20
- MATES-III Rubidoux: Average = 0.39

PM samplers for Hexavalent Chromium

* Less than 10 samples collected to date
Extensive Area Sweep for Other Hexavalent Chromium Sources

- More than 50 square mile area around Riverside Cement
- Identified 444 regulated or potentially regulated sources
- None had hexavalent chromium emissions at levels that would lead to the observed monitored concentrations
Emission Testing

- White cement production facility at Riverside Cement
  - Kiln stack tested on March 19 - 21, 2008
  - Very low levels of hexavalent chromium emitted
  - Not enough to account for levels observed at offsite monitoring locations
Bulk Material Samples

- Collected Samples from Both Cement Facilities and Batch Plants
  - Soil
  - Finished product
  - Clinker storage piles
  - Bag-house fall-out
  - Raw materials

- Higher levels of hexavalent chromium found in gray cement materials

- Initially, not enough hexavalent chromium content to produce observed concentrations at sampling sites
Gray Clinker Outdoor Storage Piles

Monitoring Location
Upon Further Analysis…

- Separated larger pieces of gray clinker from fine dust material using a sieve
- Fine dust showed much higher hexavalent chromium content
- Fine dust is more likely to become airborne and blow offsite
- Observed concentrations at sampling sites now within the range of model predictions

<table>
<thead>
<tr>
<th>TXI Riverside</th>
<th>Bulk samples Cr+6 (ppb)</th>
<th>Sieved Samples Cr+6 (&lt;44 µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bay A surface</td>
<td>500</td>
<td>3980</td>
</tr>
<tr>
<td>Bay A sub-surface</td>
<td>750</td>
<td>3350</td>
</tr>
<tr>
<td>Bay B surface</td>
<td>800</td>
<td>3350</td>
</tr>
<tr>
<td>Bay B sub-surface</td>
<td>870</td>
<td></td>
</tr>
<tr>
<td>Bay H surface</td>
<td>1320</td>
<td>6830</td>
</tr>
<tr>
<td>Bay H sub-surface</td>
<td>2030</td>
<td></td>
</tr>
<tr>
<td>Bay I surface</td>
<td>1140</td>
<td>2070</td>
</tr>
<tr>
<td>Bay I sub-surface</td>
<td>1120</td>
<td></td>
</tr>
<tr>
<td>Bay J surface</td>
<td>1670</td>
<td>15000</td>
</tr>
<tr>
<td>Bay J sub-surface</td>
<td>1740</td>
<td></td>
</tr>
</tbody>
</table>
Fingerprinting

- Microscopically examined gray clinker fine dust and particles on the deposition plates
More Fingerprinting

- X-Ray Diffraction (XRD) to measure chemical composition and crystal structure
- Calcium hydroxide a marker for fine clinker dust
- Found on deposition plates nearer...
Conclusions

- Fine clinker dust from TXI Riverside Cement is a source of airborne hexavalent chromium
- Cal Portland Cement emissions appear to be less than TXI Riverside Cement
  - Better dust control
  - Indoor storage of clinker
  - Longer distance between potential emission points and the fenceline
  - Additional monitoring will be conducted
Cancer Risk

- Lifetime cancer risk based on 70 years of continuous exposure
- Basin-wide average is ~1200 in one million
- Only 16 weeks of data collected to date
- Immediately adjacent to the site
  - 250 to 500 in one million
- Similar to risk next to a busy freeway, a rail yard or a chrome plating facility
- Cancer risk calculations method under review
Children may be more susceptible from exposures to cancer causing substances

Cal/EPA reviewing cancer risk potencies

- Proposal to apply additional weighting factors for childhood exposures
- Next steps: review by public and by State Scientific Review Panel
- If adopted estimated cancer risk would increase by 1.7 times from lifetime exposure to cancer causing substances
<table>
<thead>
<tr>
<th>Reference</th>
<th>Exposure Level</th>
<th>Riverside Cement*</th>
<th>Cal Portland*</th>
<th>West Riverside MATES III</th>
<th>Basin Avg. MATES III</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSHA</td>
<td>5000</td>
<td>200</td>
<td>1.46</td>
<td>0.35</td>
<td>0.39</td>
</tr>
<tr>
<td>NIOSH</td>
<td>1000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cal EPA</td>
<td></td>
<td></td>
<td>0.35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Samples taken adjacent and downwind of cement facilities
Immediate Control Measures

- Aggressive action to reduce the hexavalent chromium emissions from cement handling and production, and to lower the risk levels in the community
  - Notices of Violation issued for visible dust emissions
  - Continued and additional sampling in the community for hexavalent chromium and dust (PM10)
  - Ongoing field surveillance and inspections
  - Elimination of outdoor storage of clinker
Further Control Measures

- Modify TXI permit requirements
- Amend SCAQMD Rule 1156 to further reduce particulate emissions from cement plants
- Adopt new SCAQMD rule to reduce Cr+6 emissions from cement plants
- Suggest inclusion of Cr+6 standards in NESHAP Subpart LLL