Proposed Rule 1435 – Control of Toxic Air Contaminant Emissions from Metal Heating Operations

WORKING GROUP MEETING #3

September 28, 2023
2:00 PM
South Coast AQMD
Diamond Bar, CA

Join Zoom Webinar Meeting

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Agenda

- Summary of Working Group Meeting #2
- Responses to Comments
- Sources of Hexavalent Chromium and Control Strategies
- Site Visits Summary
- Next Steps

Summary of Working Group Meeting #2

- Provided brief overview of background and results from testing and sampling conducted at facilities
  - Hexavalent chromium emissions observed from furnaces and water quench tank
  - Metal dust buildup also contributed to hexavalent chromium emissions
- Reviewed results from industry survey conducted in 2021
  - 28 facilities responded
- Presented results from 2021 CE-CERT study and findings
  - Metal heating is a source of hexavalent chromium emissions
  - Higher temperatures correlate with higher emissions

Stakeholder Comments from Working Group Meeting #2

Comment #1 CE-CERT Study Details

a) Was testing only conducted from higher to lower temperatures?
b) Were metal samples cleaned before heating?
c) What coating was applied to the furnace refractory?
d) What is the makeup of the refractory samples?

Comment #2

What are the characteristics of metal heating furnaces in South Coast AQMD's jurisdiction?

Comment #3

Does the 700+ page study conducted for Rule 1407.1 show lower concentrations of hexavalent chromium emissions upon leaving a furnace?

Comment #4

Do we know if hexavalent chromium emissions from metal heating operations remain in the atmosphere?

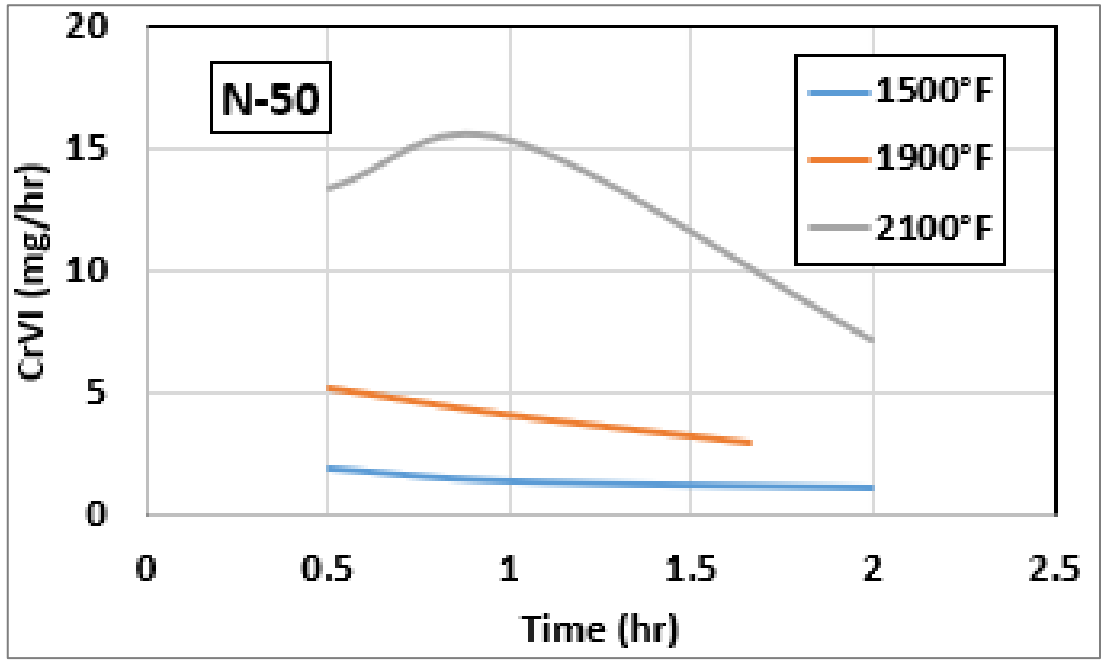
Response to Comment 1

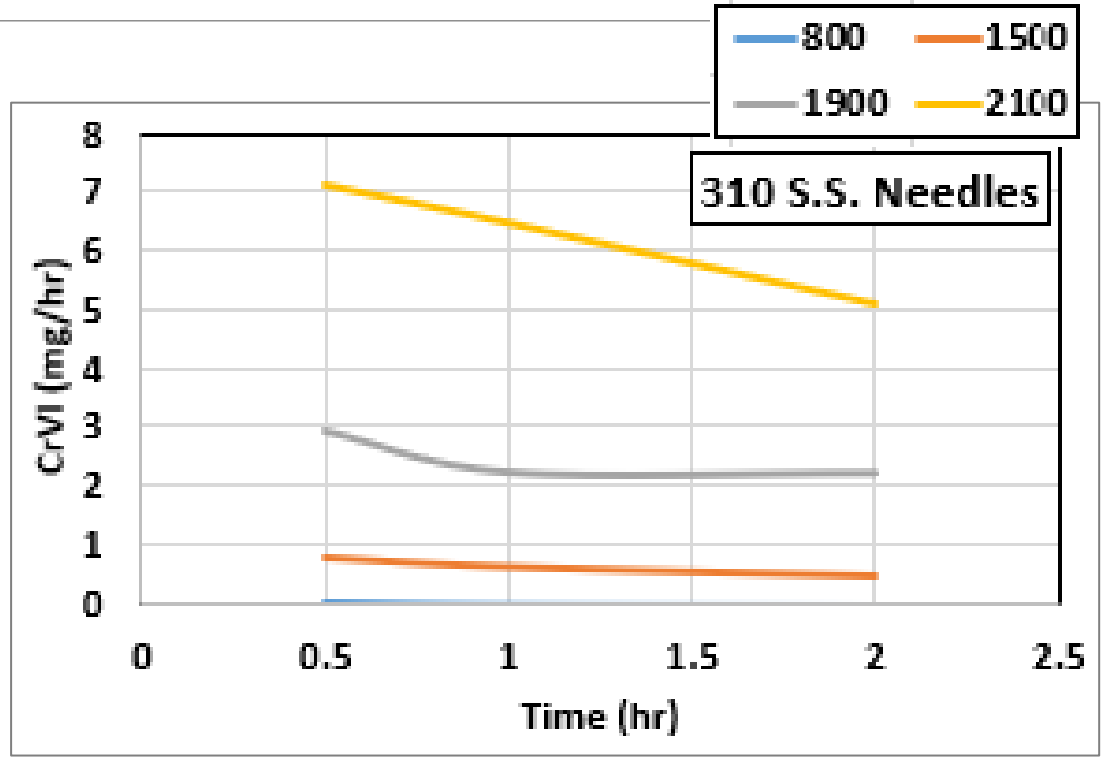
a) Was testing only conducted from higher to lower temperatures?

- After receiving comments from the California Metals Coalition in December 2019, CE-CERT tested from lower to higher temperatures
  - Conducted on stainless steel needles and racking material
- Regardless of the order of testing, higher emissions consistently correlated with higher temperatures

CE-CERT study is available at:
http://www.aqmd.gov/docs/default-source/rule-book/Proposed-Rules/1435/final-report-hexavalent-chromium-emissions-from-industrial-heat-treating-furnaces.pdf?sfvrsn=9

Comparison of Results





N-50 Alloy

Tested from **high to low** temperatures

310 Stainless Steel Needles

Tested from **low to high** temperatures

Response to Comment #1 *(continued)*

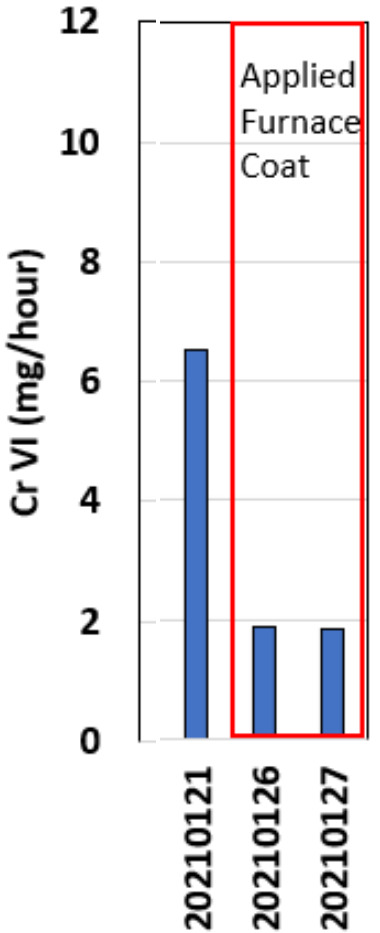
b) Were metal samples cleaned before heating?

- No, metal samples were not cleaned during the study

c) What coating was applied to the furnace refractory?

- T-Coat 692M, manufactured by Allied Mineral Products
  - Magnesia-based insulative refractory coating
- Applied prior to the second and third blank tests in a series of three consecutive blank tests
- Application of the coating reduced hexavalent chromium emissions by more than two-thirds when compared to the first blank test

Blank Tests Conducted After Furnace Coat Applied



Response to Comment #1 *(continued)*

d) Is there information available on the makeup of the refractory samples?

- There is no specific information available on the refractory samples used in the study
- Refractory samples were obtained from used refractory material provided by metal heating facilities
  - California Metals Coalition has confirmed the samples should not contain chromium, which is standard for current refractory materials

Comment 2: What are the characteristics of metal heating furnaces in South Coast AQMD's jurisdiction?

Estimated South Coast AQMD Furnace Count

Total

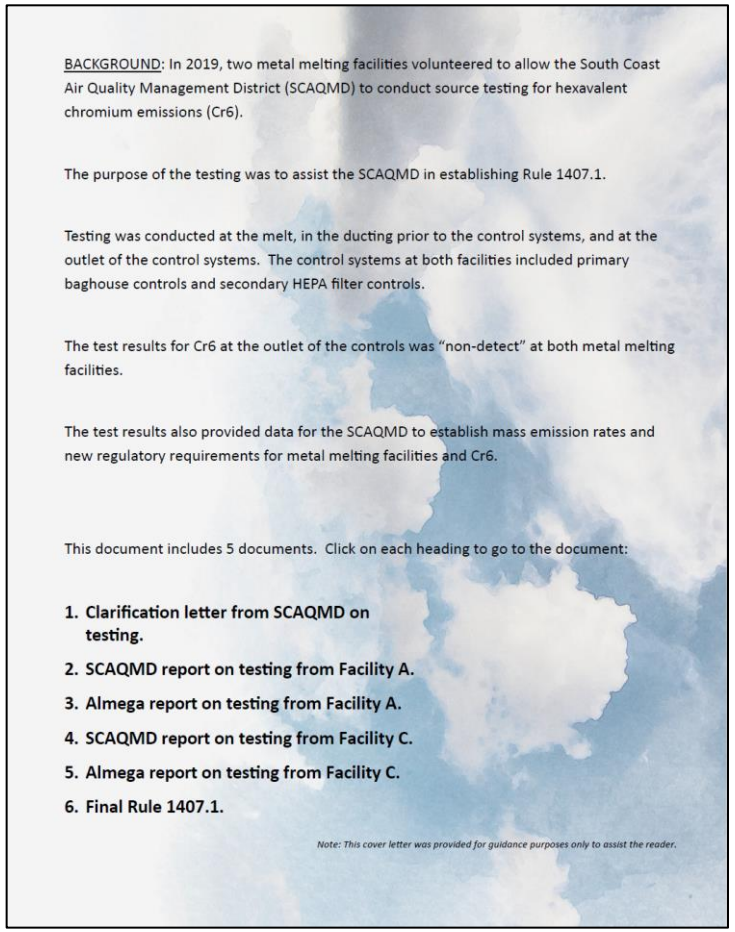
780 furnaces at
125 facilities

Heat Metal at Over 1200 °F

> 600 furnaces at
98 facilities

- Information based on permit database, survey responses and facility searches
- Includes electric furnaces and natural gas furnaces rated 2 million BTU/hr or less, which are exempted from being required to obtain permits

Comment 3: Does the 700+ page study conducted for Rule 1407.1 show lower concentrations of hexavalent chromium emissions upon leaving a furnace?



BACKGROUND: In 2019, two metal melting facilities volunteered to allow the South Coast Air Quality Management District (SCAQMD) to conduct source testing for hexavalent chromium emissions (Cr6).

The purpose of the testing was to assist the SCAQMD in establishing Rule 1407.1.

Testing was conducted at the melt, in the ducting prior to the control systems, and at the outlet of the control systems. The control systems at both facilities included primary baghouse controls and secondary HEPA filter controls.

The test results for Cr6 at the outlet of the controls was "non-detect" at both metal melting facilities.

The test results also provided data for the SCAQMD to establish mass emission rates and new regulatory requirements for metal melting facilities and Cr6.

This document includes 5 documents. Click on each heading to go to the document:

1. **Clarification letter from SCAQMD on testing.**
2. **SCAQMD report on testing from Facility A.**
3. **Almega report on testing from Facility A.**
4. **SCAQMD report on testing from Facility C.**
5. **Almega report on testing from Facility C.**
6. **Final Rule 1407.1.**

Note: This cover letter was provided for guidance purposes only to assist the reader.

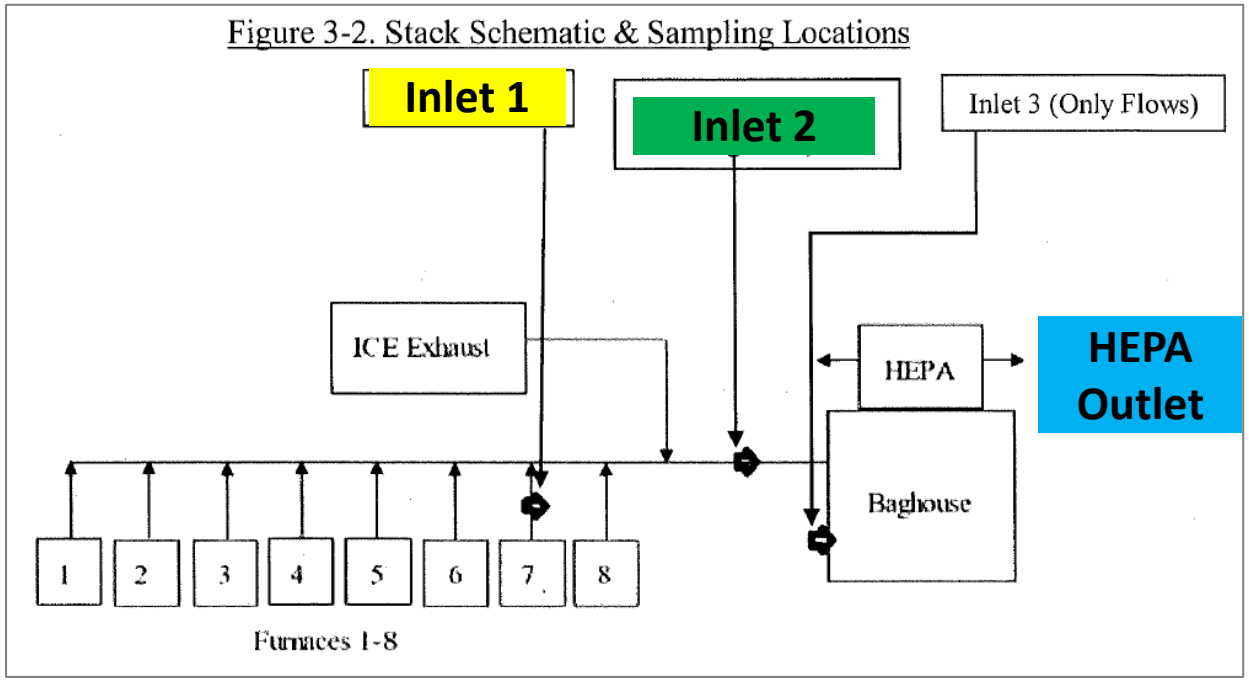
- 700+ page document compiled by California Metals Coalition for Rule 1407.1 – Control of Toxic Air Contaminant Emissions from Chromium Alloy Melting Operations (adopted 2021)
  - Primarily consists of two source test reports and the South Coast AQMD report evaluations from two metal melting facilities
- Purpose of the source tests was to gather emissions information from chromium alloy melting facilities:
  - Confirm formation of hexavalent chromium emissions
  - Quantify toxic air contaminant emissions
  - Assess effectiveness of associated pollution control devices

Responses to Comments

Comment #3

- Multiple furnaces share ducting that is vented to baghouse and HEPA
- Furnaces 2, 3, and 7 were operating during testing
  - Furnace 7 was processing stainless steel
  - Report did not document materials processed in Furnaces 2 and 3
- Emissions sampling conducted at three points
  - **Inlet 1** - Exhaust duct venting Furnace 7 (140 °F)
  - **Inlet 2** - Exhaust duct venting multiple furnace, upstream of baghouse and HEPA (86 °F)
  - **Outlet of HEPA filters**

Facility 1 Sampling Schematic and Source Test Results



Toxic Air Contaminant	Inlet 1	Inlet 2	HEPA Outlet
Emissions Concentrations (ug/dscm)			
Total Chromium	78.24	4.65	< 0.78
Hexavalent Chromium	9.91	0.91	< 0.02
Mass Emissions (mg/hr)			
Total Chromium	350.19	291.43	< 64.74
Hexavalent Chromium	44.13	56.55	< 1.73

* Emissions at HEPA outlet were below limit of detection

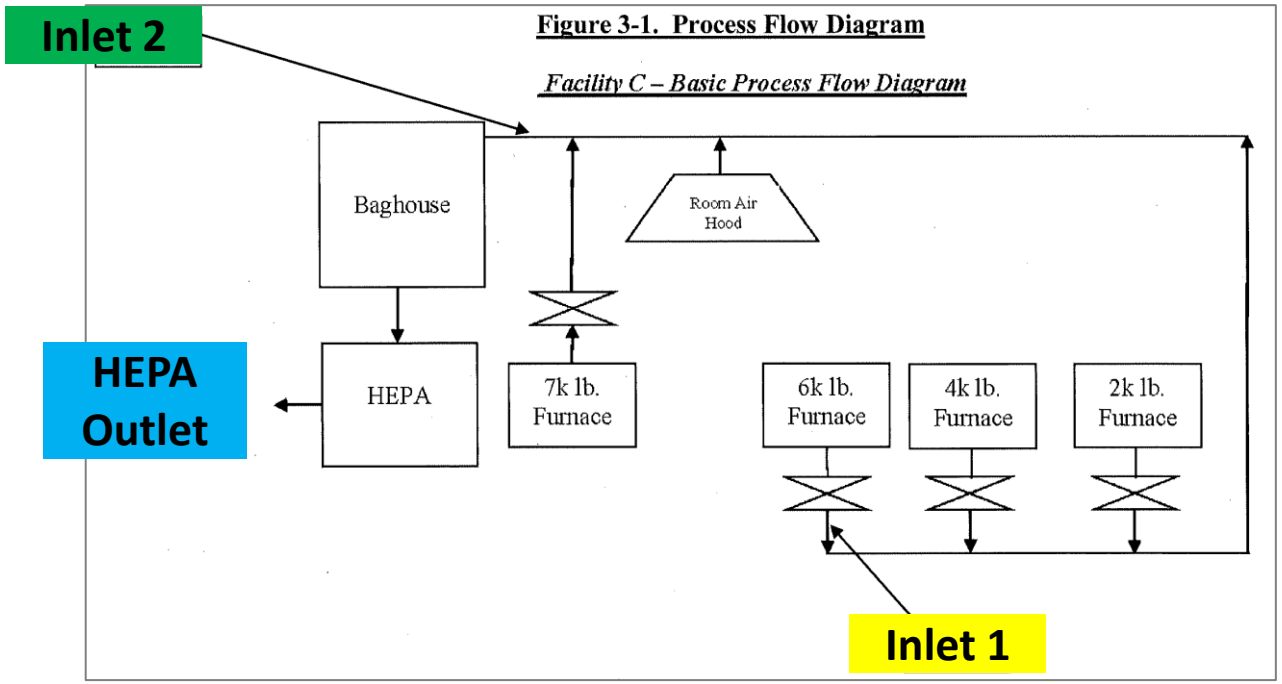
** *Nickel emissions were also detected, and followed the same pattern as hexavalent chromium emissions*

Responses to Comments

Comment #3

- Multiple furnaces share ducting that is vented to baghouse and HEPA
- 6,000 lb. furnace and one other furnace were operating during testing
  - 6,000 lb. furnace was processing chrome iron
  - Report did not document materials processed in other furnace
- Emissions sampling conducted at three points
  - **Inlet 1** - Exhaust duct venting 6,000 lb. furnace (129 °F)
  - **Inlet 2** - Exhaust duct venting multiple furnaces, upstream of baghouse and HEPA (98 °F)
  - **Outlet of HEPA filters**

Facility 2 Sampling Schematic and Source Test Results



Toxic Air Contaminant	Inlet 1	Inlet 2	HEPA Outlet
Emissions Concentrations (ug/dscm)			
Total Chromium	538.07	107.34	< 0.28
Hexavalent Chromium	5.88	1.54	< 0.07
Mass Emissions (mg/hr)			
Total Chromium	922.8	1016.5	< 3.4
Hexavalent Chromium	10.2	14.9	< 0.78

* Emissions at HEPA outlet were below limit of detection

*** Nickel emissions were also detected, and followed the same pattern as hexavalent chromium emissions*

Test Results and Takeaways

Rule 1407.1 Source Testing Takeaways

- Hexavalent chromium emissions are diluted from exhaust to inlet of control (i.e., lower concentration)
- Hexavalent chromium *mass* emissions from samples collected directly downstream of a source are similar to samples collected further away from the source
- Control devices effectively reduced hexavalent chromium emissions below detection limits

Comment #4: Do we know if hexavalent chromium emissions from metal heating operations remain in the atmosphere?

Predominant wind directions from the West and the South

- Screening source test conducted at outlet of a forging furnace found high concentrations of hexavalent chromium emissions: 24,500 ng/m^3 *
  - The furnace was not vented to pollution controls
- Emissions are vented through roof vents that were upwind from several South Coast AQMD ambient monitoring stations

* South Coast AQMD MATES IV background levels of hexavalent chromium are about 0.06 ng/m3.

Summary of Ambient Monitoring

- Results from a special monitoring effort showed elevated levels of hexavalent chromium immediately downwind of a forging facility

Predominant wind directions from the West and the South

Ambient Monitor Results on Days Prior to Source Tests

Date	Monitor No.						
	19	21	23	24	27	31+	32+
5/22/2017	1.31	0.28	1.44	Invalid	1.23	-	-
5/25/2017	0.90	0.68	1.09	1.76	0.78	-	-
5/28/2017	0.08	0.32	0.10	0.10	2.31	-	-
5/31/2017	0.3	0.7	1.43	0.67	1.09	-	-
7/3/2017	0.14	0.14	2.90	0.43	0.23	2.07	0.21
7/6/2017	0.94	0.36	0.84	1.54	0.25	0.41	0.88
7/9/2017	1.25	1.87	0.22	1.75	0.62	3.44	3.21
7/12/2017	2.87	1.26	0.86	2.90	7.66	1.41	2.99

* South Coast AQMD MATES IV background levels of hexavalent chromium are about 0.06 ng/m3.
\+ Monitor was not operational until June 2017.

Hexavalent Chromium Presence in Atmosphere

- The average half-life of hexavalent chromium in Los Angeles ambient air is approximately 14 hours[1]
  - Cited in a Health Risk Assessment submitted by a heat treating facility
  - Emissions may travel more than 40 miles (~downtown LA to Ontario airport) within span of its half-life using an average windspeed of 3 miles per hour
- Hexavalent chromium emissions could pose a risk to receptors near the source and beyond

[1] Grohse, P M, Gutknecht, W F, Hodson, L, & Wilson, B M. *Fate of hexavalent chromium in the atmosphere. Final report, January 1987-June 1988*. United States.

Sources of Hexavalent Chromium and Emission Control Strategies

Sources of Hexavalent Chromium at Metal Heating Operations

Point Sources

- Furnaces
- Water quench tanks and direct contact cooling towers

Fugitive Sources

- Scale from oxidized metal surfaces
- Dust buildup at facilities

Furnaces

- Due to oxidation, hexavalent chromium forms as loose scale on the surface of heated alloys
  - CE-CERT study estimates temperature of formation at around 1500 °F
  - Source tests measured elevated emissions from furnaces operating as low as 1250 °F
- Hexavalent chromium formed in furnaces also contaminates the refractory, leading to ongoing emissions regardless of material being processed in a furnace

Water Quench Tanks

- Oxidized scale from heated workpieces may be cooled in water quench tanks
  - Water can become ladened with hexavalent chromium
- Open circuit cooling towers that directly cool the quench water circulate the hexavalent chromium-laden water and release airborne droplets
  - Rule 1404 limits hexavalent chromium concentration in cooling towers to 0.15 mg/L

Scale from Oxidized Metal Surfaces

- Scale from oxidized surfaces of workpieces and supporting racks/stands that contains hexavalent chromium can be distributed throughout a facility
- Using forced air to cool workpieces can create airborne dust
- Material can be re-suspended from various activities

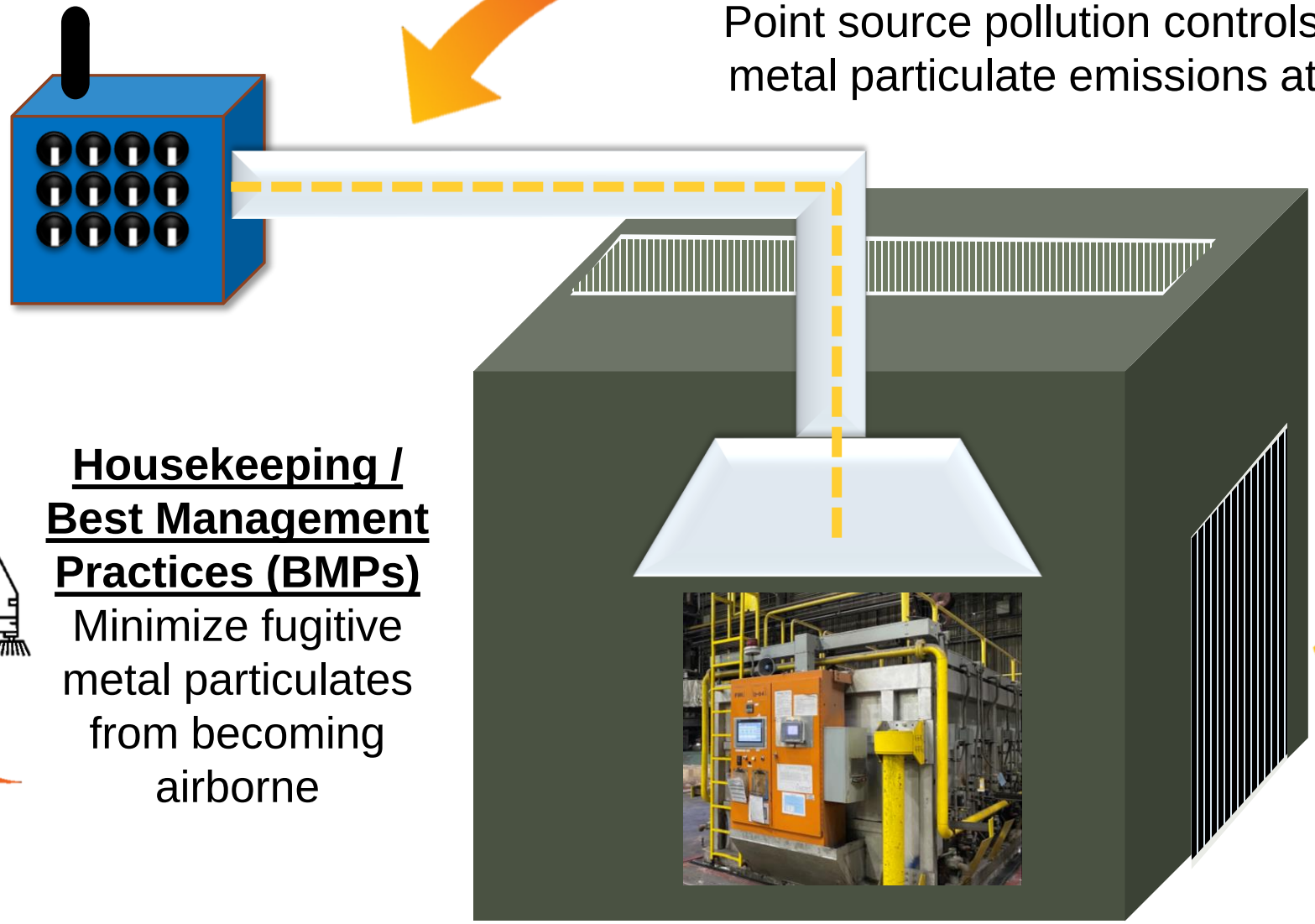
Dust Buildup at Facilities

- The scale that originated from oxidized metal surfaces can collect at facilities, appearing as metal dust
- Insufficient or improper housekeeping can result in dust buildup
- Subsequent disturbances, such as vehicular traffic, may crush material into smaller particles, making the material easier to become airborne

Emission Control Strategies

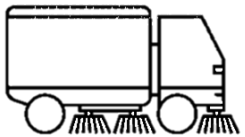
Point Source Controls

Point source pollution controls reduce metal particulate emissions at source



Enclosures

Buildings with minimal openings for ingress and egress contain fugitive metal particulate emissions



Housekeeping / Best Management Practices (BMPs)

Minimize fugitive metal particulates from becoming airborne

These control strategies would be effective in controlling hexavalent chromium emissions, as well as other toxic metal emissions

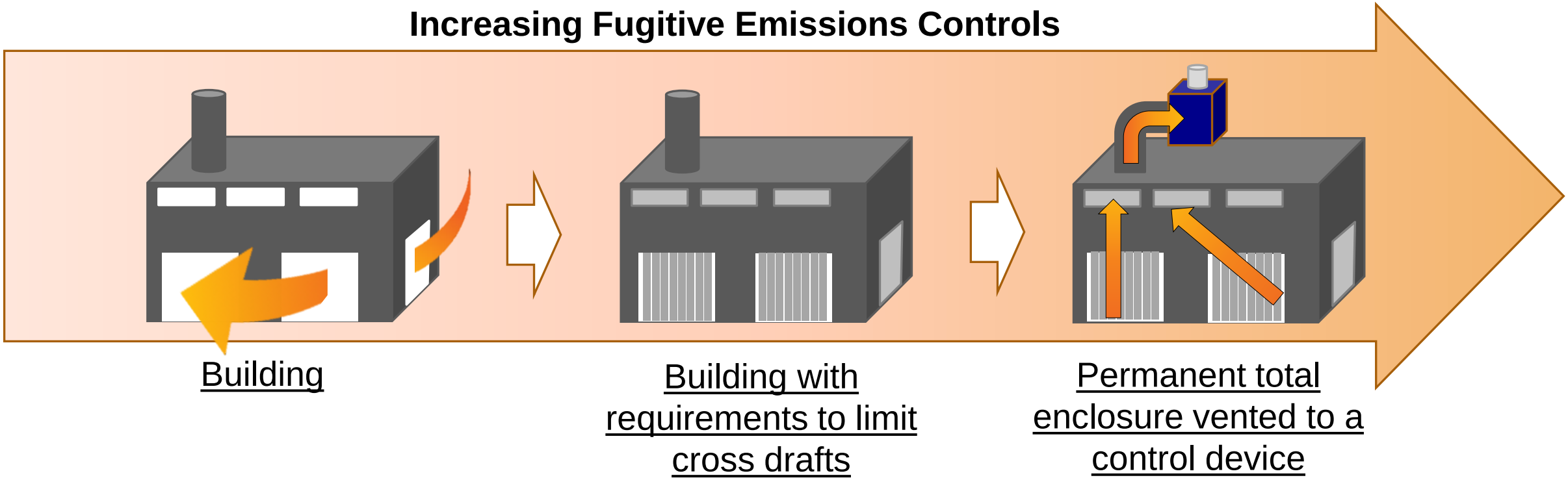
Point Source Controls

- Air pollution control devices reduce metal particulate emissions at the source
  - HEPA filters typically required to control hexavalent chromium emissions
- Source tests and other parameter tests would be required to ensure:
  - Pollutants are directed to control device
  - Control device is sufficiently capturing pollutants

High Efficiency Particulate Air (HEPA) filters are certified to achieve a minimum filtration of 99.97 percent for particles sized 0.3 microns or larger

Enclosures

- Enclosures minimize openings for ingress and egress, which reduces fugitive emissions



Housekeeping / BMPs

- Measures reduce the accumulation of metal particulates that can be re-entrained
- Examples include:
  - Routine cleaning of specified areas where metal particulates are likely to accumulate
  - Using cleaning methods that do not re-suspend material (e.g., wet cleaning, HEPA vacuum, etc.)
  - Disposal of metal particulates into closed containers

Emission Control Strategies Required in South Coast AQMD Rules

Rule	Title	Date*	Point Source Controls	Enclosures	Housekeeping / BMPs
1407	Control of Emissions of Arsenic, Cadmium, and Nickel from Non-Chromium Metal Melting Operations	2019	Yes	Yes	Yes
1407.1	Control of Toxic Air Contaminant Emissions from Chromium Alloy Melting Operations	2021	Yes	Yes	Yes
1420	Emissions Standard for Lead	2017	Yes	Yes	Yes
1420.1	Emission Standards for Lead and Other Toxic Air Contaminants from Large Lead-Acid Battery Recycling Facilities	2015	Yes	Yes	Yes
1420.2	Emission Standards for Lead from Metal Melting Facilities	2015	Yes	Yes	Yes
1426	Emissions from Metal Finishing Operations	2021	No	Yes	Yes
1430	Control of Emissions from Metal Grinding Operations at Metal Forging Facilities	2017	Yes	Yes	Yes
1460	Control of Particulate Emissions from Metal Recycling and Shredding Operations	2022	No	Yes	Yes
1469	Hexavalent Chromium Emissions from Chromium Electroplating and Chromic Acid Anodizing Operations	2021	Yes	Yes	Yes
1469.1	Spraying Operations Using Coatings Containing Chromium	2021	Yes	Yes	Yes

** Adoption or last amendment date*

Site Visit Summary

- Conducted site visits at 15 metal heating facilities
  - 11 site visits in 2019
  - 4 site visits in 2023
- Visited 10 heat treating facilities and 5 forging facilities

Point Source Controls

- One heat treating facility vented all heat treating operations to baghouses and Ultra Low Penetration Air (ULPA) filters
  - ULPA filters have a minimum efficiency rating of 99.9995% for the removal of particulates sized 0.12 um diameter or larger
- Staff did not observe point source controls installed at other facility metal heating operations

Enclosures

- Not all furnaces are indoors
- Building structures that house metal heating operations may not have walls that totally enclose the building
- Some buildings have very high ceilings and/or large footprints
- Some roofs have vents and openings
- One heat treating facility enclosed all heat treating operations within permanent total enclosures

Housekeeping

- Most facilities instituted a routine cleaning schedule around the metal heating areas
  - Cleaning frequency varied
- Observed dry sweeping kicking up dust at a facility

Best Management Practices

- Heat treating facility:
  - Monitors hexavalent chromium levels in water quench tank and periodically doses quench tank water with ferrous sulfate to reduce hexavalent chromium to trivalent chromium
  - Uses fans to cool workpieces only within PTEs vented to controls
- Furnace refractories are typically replaced as needed if damaged

WGM #3 Recap

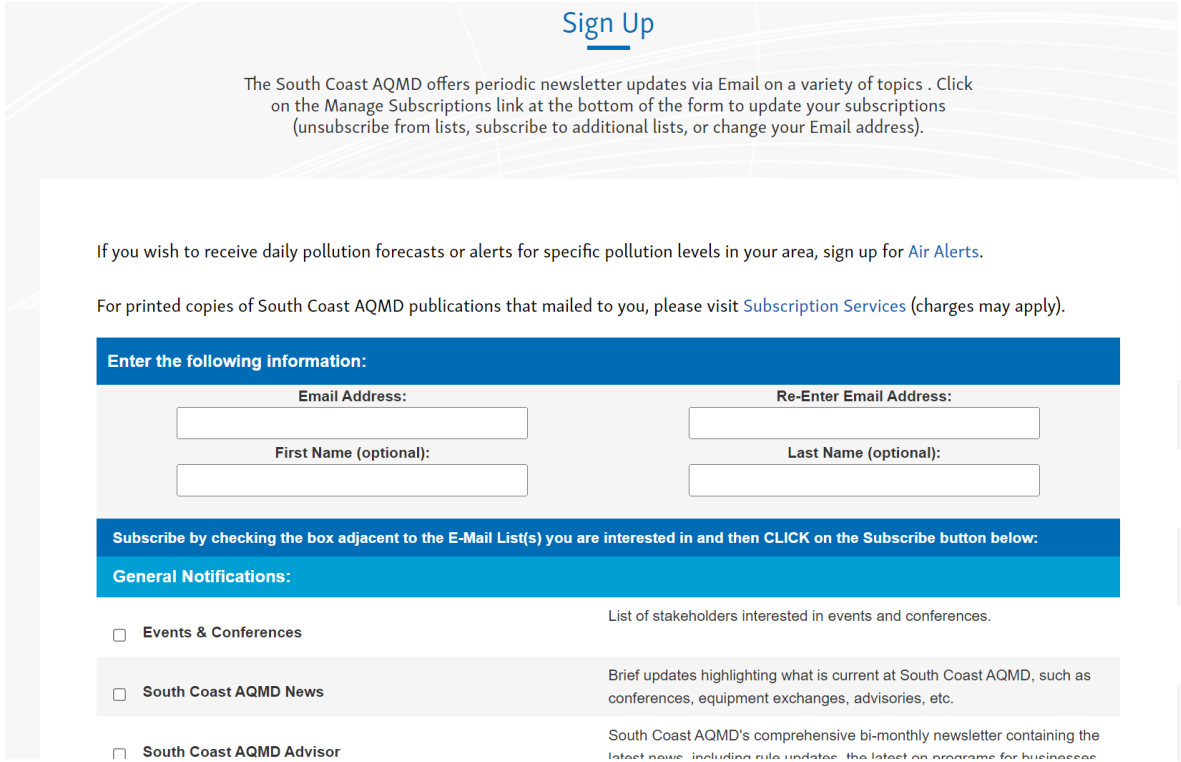
- Hexavalent chromium emissions remain present after leaving furnaces and may pose a health risk to nearby receptors and beyond
- Emission control strategies exist and are common in other toxic metal rules
  - Configuration of metal heating facilities may pose implementation challenges for point source controls and enclosure requirements

Next Steps

- Continue conducting site visits
- Working Group Meeting #4
  - Preliminary Rule Concepts

Staying Updated

- Sign up to receive e-mail updates via http://www.aqmd.gov/sign-up



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☐ Rule 1426	Emissions from Metal Finishing Operations
☐ Rule 1426.1	Point Source Emissions from Hexavalent Chromium Metal Finishing Operations
☑ Rule 1435	Control of Emissions from Metal Heat Treating Processes
☐ Rule 1460	Control of Particulate Emissions from Metal Recycling and Shredding Operations
☐ Rule 1466	Toxic Air Contaminant Emissions from Decontamination of Soil

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