

Metals Industry Air Metals Emissions and Hazard Rankings

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Abstract:

- Total releases of metal air emissions (18 metals) from the metals manufacturing industry (SIC33XX) were over 3400 tons in 2005 (latest US EPA Toxic Release Inventory data).
 - These emissions represent the largest source of metal air emissions of any industry sector in the US.
- Metal air emissions can be prioritized not only by the amount of metal compounds released, but also by their hazard properties.
- This "toxicity weighting" is based on well recognized human health and environmental hazard properties of metals.
- For example, the five most toxic metals according to EPA's Toxicity Characteristic Leaching Procedure (TCLP) for hazardous waste metal compounds are **mercury**, followed by **cadmium** and **selenium** and then **arsenic**, **chromium** and **lead**.
- The Indiana Relative Chemical hazard Score (IRCHS) and other methods of hazard ranking are evaluated and compared as methods for prioritizing hazard impacts and environmental management practices in metals manufacturing.

Introduction:

- In February 2007, the United Nations Environment Program called for further research and international regulatory activities on **mercury**, **cadmium** and **lead**.

This poster provides:

- A comparison of the environmental and human hazard properties of metals
- An analysis of metal emissions from the US Toxic Release Inventory (TRI)
- Recommendations on data needs

Is the international focus on mercury, lead and cadmium too narrow?

Metals Environmental Hazard Ranking

(EPA Hazardous Waste Toxicity Characteristic Leaching Procedure, TCLP)

Mercury = 0.2 mg/L
Selenium = 1.0 mg/L
 Cadmium = 1.0 mg/L
 Lead = 5.0 mg/L
Chromium = 5.0 mg/L
Arsenic = 5.0 mg/L



Metals Hazard Rankings

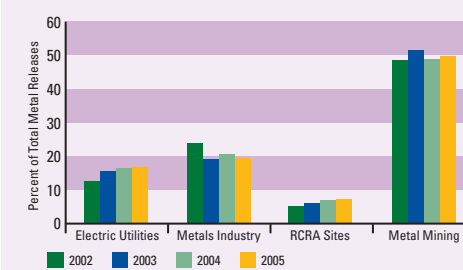
METALS	Arsenic	Cadmium	Chromium (+3)	Lead	Mercury	Selenium
OSHA PEL RANK (mg/m ³)	2	1	6	3	4	5
CANCER	0.01	0.005	0.50	0.05	0.10	0.20
EPA Ambient Air Risk-Based Conc. (mg/m ³)		X				
Relative Rank (mg/m ³)	2	1	5	6	3	4
Dose Response value (µg/m ³)	4.1E-7	9.9E-7	5.5		3.1E-4	1.8E-2
EPA Hazardous Air Pollutant RANK	17	13	5	42	4	126
Total = 189 HAPS						
Prioritized Chronic Inhalation Dose Response value (µg/m ³)	0.03	0.02	0.1 (+6)	1.5	0.3	2.0
IFC Metal Mining Standards (mg/m ³)	0.002			0.05	0.05	0.20
EPA Drinking Water MCL (mg/L)	0.05	0.005	0.1	0.015	0.002	0.05
Biological Exposure Indices	35 ug/L	5 ug/g	25 ug/L	30 ug/creat.	35 ug/g	25 ug/g
Steel Worker Overexposures	Urine	creat. Urine	Urine	100 ml Blood	creat. Urine	creat. Urine
Total Chemical Hazard Score (1-100 IRCHS)	40.4	32.9	32.7	33.3	28.7	21.6
Ecosystem Bioaccumulation Lichen Studies (120)	X		X	X	X	X

Metal Hazards Conclusion

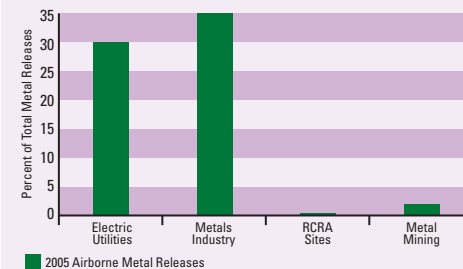
- Combined environmental and health data suggest international efforts should focus on **arsenic**, **chromium** and **selenium** as well as **mercury**, **cadmium**, and **lead**
- For measuring metal exposures, international data, such as from OECD, on metals emissions is limited – US EPA Toxic Release Inventory (TRI) is best available data source



US Total Metal Releases Increasing EPA TRI Data



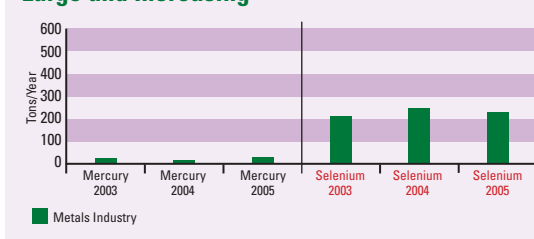
For Airborne Releases, Metals Industry is Largest Source



Point Sources Large – Controllable 2004 EPA TRI Data

METALS & METAL COMPOUNDS (POUNDS)	TOTAL ON/OFF SITE	TOTAL AIR FUGITIVE + POINT SOURCES	AIR PERCENT POINT SOURCES
Arsenic	167,620	329	85 %
Cadmium	1,170,000	3,813	77 %
Lead	31,600,000	440,000	72 %
Mercury	26,824	9,917	96 %
Selenium	501,087	35,679	97 %

Mercury Releases Low But Selenium Releases Large and Increasing



Increase Likely Due to Increased Use of Selenium-Contaminated Metals

- Manganese metal widely used as hardening alloy in **aluminum** and **steel industries**
- Manganese metal made using selenium contains 400 to 1500 ppm selenium
- Selenium use as catalyst in manganese metal production increasing – 75% of the global manganese market

Emissions Control Data Limited

- No air emissions factors (EPA AP-42) for **arsenic**, **cadmium** and **selenium**
- Little available metals industry data on:
 - Site specific stack emission monitoring
 - Air pollution control efficiencies
- Particulate metals pollution control data from coal-powered utilities industry
 - Different for metals industry?

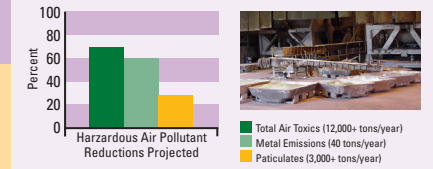
Controlling Particulate Metals Coal Power Utilities Data

- Effects of control technologies additive:
- Cyclone/Scrubber
 - Electrostatic Precipitation
 - Fabric Filters
 - Wet Flue Gas Desulfurization



Large Reductions Projected in Air Emissions from Aluminum Recycling Plants – Verification?

(EPA Area Source Regulations, 40 CFR Part 63, 2000)



Conclusions

- International efforts should focus on **arsenic**, **chromium** and **selenium** as well as **mercury**, **cadmium**, and **lead**.
- US metals emissions increasing and the metals industry is the major source of airborne metal emissions, which are predominately from controllable point sources. **Mercury** emissions low but **selenium** emissions increasing.
- For metals industry, especially **aluminum**, **steel** and **aluminum recycling**, recommend:
 - Metals monitoring of all wastes
 - Occupational & biological metals monitoring
 - Environmental audits

Data Sources:

- United Nations Environmental Program www.un.org
 - US EPA Toxicity Characteristic Leaching Procedure (TCLP) regulations
 - International Labor Union www.ilo.org/public/english/protection/safework
 - US EPA Technology Transfer Network Air Toxics website (www.epa.gov/ttn/atw/toxsource/summary.html)
 - Indiana Relative Chemical Hazard Scores/Purdue University Clean Manufacturing Technology Institute <http://cobweb.ecn.purdue.edu/CMTI/IRCHS/>
 - Organization for Economic Cooperation and Development (OECD) reports www.oecd.org
 - US EPA Toxic Release Inventory (TRI) www.epa.gov
- Other websites:
- www.SeleniumWatch.org
 - www.agls.uidaho.edu/envirosci/resources.html
 - www.who.int/pes
 - www.hazard.com/msds/index.html
 - www.europe.osha.eu.int/good_practices_risks/ds/oel.en