

The Real Issue with Wall Deposits in Closed Filter Cassettes – What's the Sample?

Michael J. Brisson
Savannah River Nuclear Solutions LLC
Aiken, SC 29808, USA

Third International Symposium on Beryllium Particulates and Their Detection
Albuquerque, NM
November 19, 2008

Disclaimers

Mention of commercial products in this presentation does not imply endorsement by the author, SRNS, SRS, or the U.S. Department of Energy (DOE).

The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of SRNS, SRS, or DOE.

The author will express some conclusions that have not necessarily been endorsed by the Beryllium Health and Safety Committee (BHSC).

The speaker is an employee of a Department of Energy (DOE) contractor, and is not a spokesperson for DOE.

Outline



(Source: Ashley, Brisson, and Jahn, *Standardization Issues in Beryllium Sampling and Analysis*, presented at Pittcon 2006)

- **The Issue with Wall Deposits**
 - Why it matters
 - History on samplers and sampling
- **Variations and causes**
 - Harper/Demange data
 - Limitations
- **What Is the Sample?**
 - Concerning the inhalable convention
 - Options with the CFC
 - Other options
 - Data comparability
 - BHSC and JOWOG 30-1-1 actions to date
- **Summary**

Wall Deposits – The Issue

- **This is not a new issue**
 - Has been discussed since 1990
- **This is not a beryllium-specific issue**
 - Affects all metal particulate sampling
 - Hexavalent chromium, lead, etc.
- **This is not a DOE-specific issue**
 - International issue
 - Affects everyone measuring metal particulate in the workplace

Wall Deposits – What and Why

- **What they are**

- Particulate that enters sampling cassette and deposits on interior walls rather than on sampling medium (i.e., filter)

- **Why it matters**

- Worker is exposed to whatever particulate is in the air
- If the filter doesn't catch all the particulate, is the catch representative of the risk to the worker?

Samplers

- **Samplers**

- Impingers
- Open face cassettes
- Closed face cassettes (CFC)
 - Popular in U.S. but not internationally
- IOM sampler
 - Intended to match up with ISO inhalable convention
 - Popular in Europe but not U.S.
 - Wall deposits noted in IOM development, considered important enough to be included, but no protocol to do this for chemical analysis
- Button sampler
 - Also intended for inhalable sampling
 - More costly, not disposable – requires cleaning and re-use
- Respicon sampler
 - Can sample multiple fractions at one time
 - Expensive

Sampling

- **Particulate mass is typically preferred metric for metals**
 - All OELs for Be are based on mass
- **For Be, particle size and number may also be important (McCawley et al., *Appl. Occup. Environ. Hyg.*, 2001, 16:631-638)**
- **So where is that direct-reading instrument???**



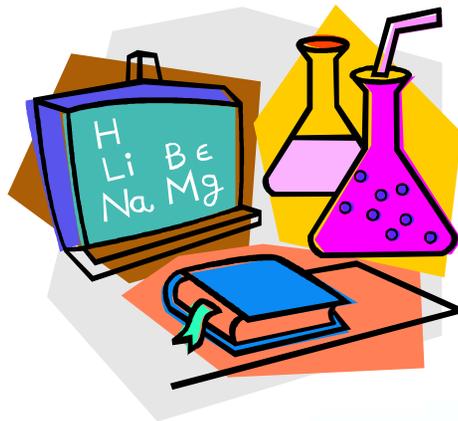
(Source:Fermilab
Web site,
www-esh.fnal.gov)

Wall Deposits – How Much?

- **Varies widely**
 - Up to 127% of filter catch based on studies from 1990-2002
 - Varies from metal to metal
 - Wind speed may add to variability
 - Due to high variability, cannot reliably use a “correction factor” to account for wall deposits
- **Possible causes**
 - Electrostatic charges
 - Inertia
 - Gravitational settling
 - Diffusion mechanisms
- **There are concerns that people can inhale these particles and we aren’t measuring them**

Recent Data

- **Harper and Demange, Concerning sampler wall deposits in the chemical analysis of airborne metals, *J Occup Environ Hyg* 4:D81-D86 (2007)**
 - Data shown on next two slides
- **Very limited beryllium data (only 4 data points)**



Recent Data (Harper/Demange) – 37 mm CFC

Environment	n	Agent	Median wall deposit as % of filter	Maximum wall deposit as % of filter
Cu smelter	18	Cu	21	55
Pb ore mill	9	Pb	19	35
Solder manufacture	30	Pb	29	74
Battery production	16	Pb	28	66
Welding	10	Cr(VI)	5	55
Plating	12	Cr(VI)	12	17
Paint spray	29	Cr(VI)	7	12
Zn Foundry	9	Zn	53	62
Zn Plating	18	Zn	27	91
Cast iron foundry	18	Fe	22	46
Grey iron foundry	18	Fe	24	77
Bronze Foundry	6	Cu, Pb, Sn, Zn	19, 13, 0, 15	45, 17, 0, 21
Cuproberyllium	4	Cu, Be	31, 12	40, 39

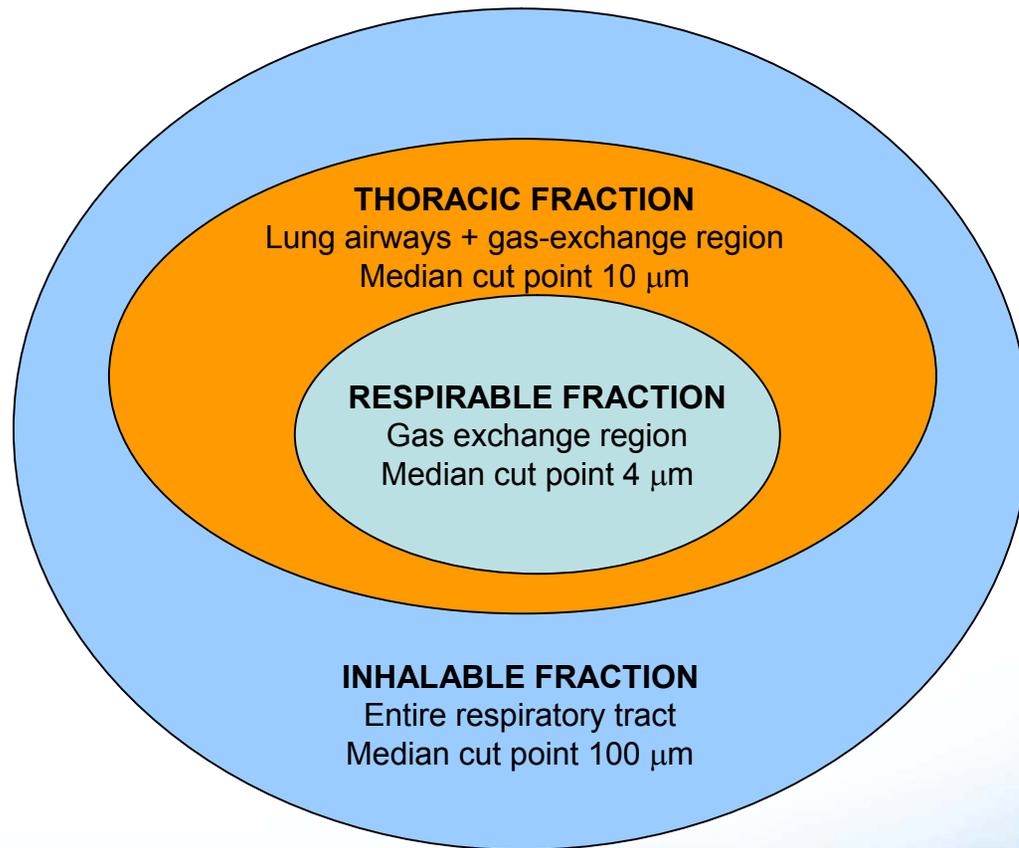
Recent Data (Harper/Demange) – IOM

Environment	n	Agent	Median wall deposit as % of filter	Maximum wall deposit as % of filter
Cu smelter	17	Cu	16	38
Pb ore mill	8	Pb	19	30
Battery production	11	Pb	8	33
Welding	18	Al	3	13
Cast iron foundry	18	Fe	8	69
Grey iron foundry	18	Fe	5	16
Bronze foundry	6	Cu, Pb, Sn, Zn	0, 0, 0, 3	10, 3, 23, 6

(These numbers almost entirely lower than for CFC.
No beryllium data in this table)

You've Seen This Before ...

... but keep it in mind for the next few slides



Inhalable Convention (ISO 7708)

- **ACGIH NIC for beryllium proposes inhalable fraction**
 - Part of a general move by ACGIH to adopt a sampling convention
- **Particles between 10-100 μm not efficiently sampled by CFC**
- **When CFC wall deposits included, performance more closely matches inhalable convention**
 - This simply stands to reason
 - However, definitive data to support this premise are lacking (M. Harper)

More About Inhalable Convention

- It is stipulated for wind speeds ≥ 1 m/sec
- Many workplaces have much slower air movement
- Some have proposed a modified inhalable convention for slow-moving air (or “calm air”)
 - Revision to ISO 7708
 - Cognizant working group not yet comfortable with moving forward; more data required

So the Question Is ...

WHAT IS THE SAMPLE???

- Filter catch only, or include wall deposits?
- Does the CFC collect the sample we need?
- If not, are there options to “get there” with the CFC?
- Does the health end point (protection against CBD only or BeS and CBD) make a difference?
- How do the answers impact sampling and analysis methods and costs?
- How do the answers impact data comparability?

Is the Sample the Filter Catch Only?

- **Historically, the sample has only been the filter catch**
 - In 1950s and 1960s, larger particles not considered important
- **But we have known for at least 15 years that some particulate collects on walls of CFC's**
- **Since CFC is efficient for particles up to 10 μm , it is reasonable to conclude that wall deposits are in the range of 10-100 μm**
 - These would be included within inhalable fraction

What Should We Be Collecting?

- **“Total dust”?**
 - The original description of what is collected with the CFC, but clearly a misnomer
- **Inhalable fraction?**
 - ACGIH NIC
 - Common in Europe
 - More appropriate if we are protecting against BeS as well as CBD
- **Respirable fraction?**
 - Some believe this is best indicator for CBD itself
- **Should we collect multiple fractions (such as with the Respicon sampler)?**

10CFR851 and ACGIH TLV's

- **DOE worker health and safety rule (10CFR851) invokes 2005 ACGIH TLV's, but not necessarily changes after that**
- **Some DOE sites are contractually obligated to the “latest” TLV's regardless of 10CFR850 and 851**
- **Those sites “bound” to ACGIH TLV's will not have time for studies to collect additional data that may support some other position, and will either ...**
 - Implement some new and potentially more costly sampling/analytical option, or
 - Seek permission not to follow the ACGIH NIC (if it is adopted)

OSHA Regulation

- **Beryllium PEL**
 - Product of the Standards Directorate
 - Rulemaking in progress; SBREFA report complete
 - Wall deposits and/or specific methods appear not to be discussed
 - Specifics of proposed rulemaking will not be available until NOPR is issued in Federal Register
- **Analytical position will be discussed in Hendricks presentation**

Who Will Decide the Fraction?

This is my opinion:

- **ACGIH appears poised to include “inhalable” as part of its TLV**
- **Provisions of 10CFR851 notwithstanding, it may be difficult for DOE (and perhaps DoD also) to ignore the change if adopted**
- **I make no attempt to speculate beyond DOE/DoD**
 - Please remember, I don’t speak for DOE or DoD
 - This also is not the official position of the BHSC

Does CFC Collect What We Need?

- **From a historical perspective, some would say “yes”**
 - It’s been done that way since the late 1950s
 - It can be argued that for Be, particles $\leq 10\mu\text{m}$ are more important and are efficiently sampled by CFC
- **From perspective of ACGIH and international community, perhaps “no”**
 - Without inclusion of wall deposits, available evidence indicates that CFC filter catch does not track inhalable convention
 - So if that convention is appropriate, we need to be doing something differently
 - Arguments have been made for and against inhalable convention for beryllium, but in the final analysis, other bodies will make a decision and members of the beryllium community will have to react in some way to those decisions

Can CFC Filter Catch Only Still Be Used?

Continuing “filter catch only” could be viable if:

- Beryllium wall deposits are found to be low enough (reminder: for the four data points available, median was 12% of filter catch and maximum was 39%)
- A correlation can be established such that the filter catch can be deemed representative (current data do not suggest this to be likely)
- Again, some sites may not be able to wait for data to support either of these possibilities

CFC Could Also Be Viable if ...

... as described in Archuleta presentation:

- Wall deposits are included using one of the analytical options in that presentation
- Conductive polypropylene cassettes prove viable to minimize wall deposits

Otherwise, a different sampler may have to be selected

- Any other sampler would be more expensive than the CFC
- Most other samplers have additional drawbacks (e.g., decontamination between uses)
- Developing something better would take time and money, but may be best long-term answer

Issues with Data Comparability

- **Adding wall deposits would increase the mass of particulate being analyzed**
 - Does that invalidate the current PELs and TLVs that were based on filter catch only?
 - How do we compare “old” and “new” data after making such a change?
- **Should we avoid change or recognize we may need to change and take steps to manage it?**
 - After all, we aren’t still using impingers or flame AA

BHSC and JOWOG Actions to Date

- **BHSC has issued a white paper on this issue**
 - Described issue and overall status
 - Identified additional information needed
 - Did not offer specific guidance
- **US/UK Joint Working Group (JOWOG) 30-1-1, Beryllium Facility Safety**
 - Met earlier this week

Summary

- **The wall deposits issue cannot be ignored**
- **It is bigger than beryllium and will largely be addressed by others outside of the beryllium community**
 - However, individuals can have a say by participating in standards bodies such as ASTM International
- **There is a clear need for additional research, but because ACGIH may not wait for that research, the beryllium community may have to take action(s) without it**
- **Whatever is decided upon, should be applied consistently**

Acknowledgements

Apologies for inadvertent omissions!

Melecita Archuleta (Sandia National Lab)

Martin Harper (NIOSH)

Martine Demange (INRS-France)

Warren Hendricks (OSHA)

Members of the BHSC, particularly the Sampling and Analysis Subcommittee

Members of JOWOG 30-1-1