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Updating Research Needs for Sampling and Analysis of Beryllium

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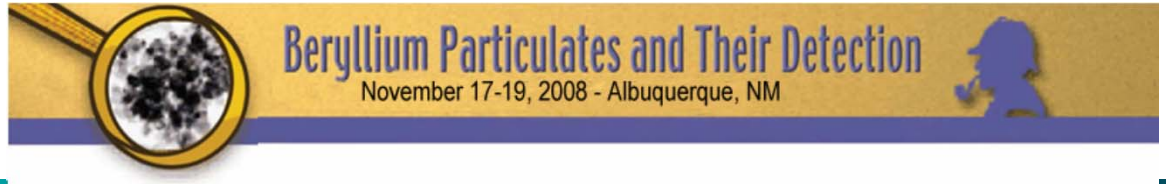
Way Back When …

- In 2006, NNSA provided funding for a Beryllium Health Research Agenda
- It was supposed to be multi-year, but in fact funding came through only in FY06
- BHRA goals included the following:
  - Developing criteria for real-time Be detection instrumentation and evaluation protocol
    - *Criteria were developed but there was no money to develop any instrumentation to be evaluated*
    - *Criteria would need to be re-visited but for real-time air monitoring are still largely the same*
  - Developing an aerosol laboratory like there once was at Lovelace Respiratory Research Institute in Albuquerque
    - *Would have been the test bed for the real-time instrumentation*
  - Development of a BeO reference material
    - *This got done, and we now have NIST SRM 1877*
  - Development of a Vacuum Sampling Method
    - *Note that ASTM has two vacuum sampling methods, D5438 and D7144*
  - Development of DSP Personal Sampling Method

Not Quite As Long Ago ...

- In November 2008, Mike McCawley presented overall beryllium research needs at the BHSC symposium in Albuquerque
- *Journal of Occupational and Environmental Hygiene,* December 2009, pp. D92-D96
- Based on a questionnaire sent to 135 BHSC members and interested parties – 27 responses
- Results categorized and prioritized
  - Basic Research (8 items, none related to sampling and analysis)
  - Health Effects (7 items)
  - Exposure Control (3 items)
  - Exposure Assessment (9 items)
  - New Issues (9 items)
- My goals are:
  - Review those that are related to sampling and analysis and assess which ones are still needed
    - *Include all those listed under Exposure Assessment*
  - Look for what is missing or new, that should be added



My Goals Are …

- Review those that are related to sampling and analysis and assess which ones are still needed
  - Include all those listed under Exposure Assessment
- Look for what is missing or new, that should be added
- Then let's discuss a framework for …
  - How many of these things really matter
    - *If we can agree on criteria for what really matters*
  - How the proposed regulatory changes impact what really matters
  - How to get funding for those that DO really matter

Exposure Assessment

- Priority #1 – Develop a sampling method that characterizes Be particle exposure by mass, number, size fraction, chemical form, and surface area
  - McCawley et al. (2001) suggested that particle number may be a significant parameter
  - Tinkle (2003) suggested that particle size can be significant
  - But we still do measurements by total mass in air, or on surfaces – Are we OK with that?
- Priority #2 – Determine types and levels of Be exposure that are generated by different types of activities
  - Numerous studies have been done in this area
- Priority #3 – Develop different methods to better characterize risk of Be exposure (e.g., real-time analysis of Be)
  - Fluorescence method (ASTM D7202/NIOSH 7704/9110) is closest thing we have
  - For surfaces, point-and-shoot LIBS technology is getting closer to being suitable
  - But some feel that the need may be greater for a beryllium constant air monitor

Exposure Assessment (continued)

- Priority #4 – Develop sampling methods to characterize fine and ultrafine particulate exposure
  - McCawley et al. (2002) developed a filter assembly for this purpose
  - Goes back to the question of how important particle size is versus total mass
- Priority #5 – Develop methods for quantifying skin and mucous membrane exposure
  - Dermal sampling via ASTM D7822 and lab analysis can quantify what is ON the skin (not what might be imbedded below skin surface)
  - Also see Day et al. (2006)
- Priority #6 – Determine which exposure parameters correlate with each other at different times and workplaces
- Priority #7 – Identify or develop a high-flow personal sampling pump
  - Pumps up to 10 L/min are now out there, but technical issues have kept them from broad use
- Priority #8 – Develop standardized sampling methods for surface sampling of uncommon, rough, or porous surfaces
  - ASTM D7659 provides guidance and list of sampling standards
- Priority #9 – Develop real-time beryllium particle counter
  - Goes back to the question about the importance of particle number

Things Identified in 2008 as "New Issues"

- Speciation of Be found in diseased persons
  - Compare with what is found in workplaces
  - As presented, this is a Med-Epi issue; however, the entire issue of "speciation" has been discussed, and set aside, many times within the SAS
- Sensitization versus disease and correlated particle sizes with respect to airborne fractions
  - Not yet in the realm of "sampling and analysis"; still in the Med-Epi realm
- Develop realistic criteria for sampling and analysis personnel and labs
  - Person who submitted this felt that accreditation did not necessarily equate to quality results
  - In part this is more of a policy issue than a research needs issue
  - In part this relates to sample preparation requirements as established by Oatts et al. (2012)

Things That Were Missing or Need to be Added

- Missing: Disposable sampler to collect inhalable fraction
  - A prototype is being tested now
- What needs to be added?
  - Consider impacts from OSHA rulemaking proposal
  - Consider impacts from proposed revisions to 10 CFR 850 (once promulgated)
  - Consider what it would take, if it were deemed necessary, to adhere to the ACGIH® TLV® of 0.05 $\mu g/m^3$ in air

Once the List is Updated …

- Re-Prioritize the List
  - Involve Research Needs and Sampling/Analysis Subcommittees
- For the top priorities, is there any way to get funding?
  - Where do we go for funding?
    - *Or maybe, where <u>don't</u> we go?*
  - Can we show sufficient benefit for the projected cost?
  - Benefits <u>must</u> be tangible to get consideration
  - Benefits could be:
    - *Cost savings (e.g., reduced analytical costs)*
    - *Cost avoidance (e.g., reduced production down time)*
- Of course, this whole discussion has been about sampling and analysis needs, but it could also be applied to other research needs (e.g., Med/Epi, Risk Communication)

Any Ideas?

In Case There Is Time and Interest – Basic Research Items

In order of priority:

1. Develop and validate improved screening and diagnostic tests
2. Identify opportunities for therapeutic interventions (pre-CBD or for CBD)
3. Characterize and determine health significance of physiochemical properties of beryllium (e.g., bioavailability, health impacts)
4. Establish standard clinical definitions and protocols for establishing BeS and CBD *(Middleton et al., 2008 and 2011)*
5. Define natural history of Be disease
6. Develop *in vivo* and *in vitro* technologies for detecting Be in tissue
7. Develop and test an animal that models human CBD by contracting disease after exposure to Be
8. Develop a human cell line that responds to Be

In Case There Is Time and Interest – Health Effects

In order of priority:

1. Determine dose-response relationship *(see Schuler et al., Scand J Work Environ Health 38(3):270-281, 2012)*
2. Determine natural history of Be disease (also under basic research)
3. Develop sampling methods to characterize and identify biomarkers of exposure
4. Determine effective means for communicating Be risk *(BHSC Risk Communication Subcommittee)*
5. Develop a nationwide Be registry
6. Determine prevalence of BeS and CBD in public
7. Develop nationwide tissue repository of samples from BeS and CBD patients *(Beryllium BioBank)*

In Case There Is Time and Interest – Exposure Control

In order of priority:

1. Develop improved engineering and administrative controls for maintenance, construction, or demolition activities
2. Develop a coating technology to mitigate Be particulate release
3. Establish a standard reference material for Be alloy particulate