

Occupational Exposure Science What Have We Learned Since QEEN I?

QEEN II: 2nd Quantifying Exposure to Engineered Nanomaterials from Manufactured Products Workshop

October 9, 2018

Charles L. Geraci, Ph.D., CIH

Associate Director for Emerging Technologies National Institute for Occupational Safety and Health



The findings and conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy

State of the Science in 2015?

"This literature review (2000-2015) provides evidence that for ENMs, as found for other materials, the likelihood of the exposure depends largely on the physical form of the substance as well as the applied process and operational conditions. These results can be used to provide first indications of the likelihood of exposure and guidance for exposure controls in workplaces. However, there is a clear lack of high-quality exposure data, in particular for downstream use and end-of-life scenarios and in low- and medium-income countries."

Basinas et al. Anals of Work Exposure and Health. 2018



At QEEN I in 2015 we said the state of ENM exposure science was:



Occupational Exposure Science for Nanomaterials Current State, Challenges, and Future Research



- Complex
- Focused on 'pristine' materials
- Lacked realism
- Needed consistency
- Needed more life cycle
- Mass still a primary metric
- Exploring other metrics needed
- Confirmatory analyses needed
- Challenging to define 'nano..."



Remember this from 2015?

Simple View of a Complex Life Cycle Reality



aggregation, etc.

Basic Questions and Research Challenges

- Detection
- Measurement
- Relevant measurement
- Consistency
- Reproducibility
- Real-world encounters (Value Chain)

Good information on all of these topics will be shared in our breakout sessions.





Progress

- Consistency in approach examples
 - OECD Tiered Approach
 - NIOSH NEAT 2.0
 - OECD Strategy
 - ISO TC 229 Technical Guidance
- Improved sampling and analytical techniques
- Advanced or improved field instruments



JANOTECHNOLOGY



OECD Environment, Health and Safety Publications Series on the Safety of Manufactured Nanomaterials No. 82 DRI STRATEGIES, TECHNIQUES AND SAMPLING PROTOCOLS FOR DETERMINING THE CONCENTRATIONS OF MANUFACTURED NANOMATERIALS IN AIR AT THE WORKPLACE ٠ Environment Directorate ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT Paris 201 DURNAL OF OCCUPATIONAL AND ENVIRONMENTAL HYGIENE Taylor & Francis (🛥) 16, VOL. 13, NO. 9, 708-717 tp://dx.doi.org/10.1080/15459624.2016.1167278 Refinement of the Nanoparticle Emission Assessment Technique into the Nanomaterial Exposure Assessment Technique (NEAT 2.0) Adrienne C. Eastlake^a, Catherine Beaucham^a, Kenneth F. Martinez^b, Matthew M. Dahm^a, Christopher Sparks^c, Laura L. Hodson^a, and Charles L. Geraci^a National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Cincinnati, Ohio; bHWC, Washington, DC (formerly of NIOSH); 'Bureau Veritas North America, Inc., Houston, Texas (formerly of NIOSH) ABSTRACT **KEYWORDS** Emission; nanomaterial; Engineered nanomaterial emission and exposure characterization studies have been completed at NEAT; occupational exposure more than 60 different facilities by the National Institute for Occupational Safety and Health (NIOSH). assessment: sampling These experiences have provided NIOSH the opportunity to refine an earlier published technique, the Nanoparticle Emission Assessment Technique (NEAT 1.0), into a more comprehensive technique for assessing worker and workplace exposures to engineered nanomaterials. This change is reflected in the new name Nanomaterial Exposure Assessment Technique (NEAT 2.0) which distinguishes it from NEAT 1.0. NEAT 2.0 places a stronger emphasis on time-integrated, filter-based sampling (i.e., elemental mass analysis and particle morphology) in the worker's breathing zone (full shift and task specific) and area samples to develop job exposure matrices. NEAT 2.0 includes a comprehensive assessment of emissions at processes and job tasks, using direct-reading instruments (i.e., particle counters) in datalogging mode to better understand peak emission periods. Evaluation of worker practices, ventilation efficacy, and other engineering exposure control systems and risk management strategies serve to

Recommended Reading All show a similar, tiered approach

- Microscopy
- **Elemental analysis**
 - Direct analysis for metals
 - 'Indicator' analysis for CNT/CNF
- Guidance for CNT 'counting'
- Updating the initial approach



A Life-Cycle Approach (Go to Session 1C)





Ultra-Fine Particulate An opportunity to go....



Ambient air particulate matter (PM), including ultrafine (Nano sized) particulate matter (UFP) provided a foundation to study Engineered Nanomaterials (ENM). Extensive ENM knowledge can now be applied to better inform PM and UFP health risk research and vice versa.

Paraphrased from Stone et al. Environmental Health Perspectives. 2017



New Knowledge?

- More ENMs are making it into commerce
- Lines between Nano and Advanced Materials are blurred
- Measurement and characterization methods are improving
- Life cycle/value chain approach
- Introduction into Advanced Manufacturing
- Renewed focus on Ultrafine Particulate (in addition to Engineered Nano Particulate)



Take Home Message?

- Progress is being made on several fronts to detect and measure ENM.
- We accept that ENMs are one of many components in a complex industrial environment
- Basic measurements can identify opportunities for exposure mitigation
- Control procedures work
- Joining our experience with UFP and ENM will be important

