

The need for OEL values for nanomaterials – what we need from the workshop

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- The workplace has been a clear focal point since the first workshops/meetings in 2004.
 - The effectiveness of PPE was the first order of business; yet the results of studies begun years ago are only just being published.
 - Traditional methods for setting OEL values rely on long-term animal studies or human experience – we have neither (at least not that we know of because exposures were not defined).
 - Control banding and hazard classes are good ideas, but IH needs a number and an instrument that can reliably measure it.
- It is not practical to wait for ACGIH, NIOSH, or any other national body to develop OEL values – and may not be applicable for a broad range of nanomaterials. Each company needs to press forward with a system on its own.

Effectiveness of PPE – state of the science

- Initial concerns were raised about the effectiveness of respirator cartridges to capture particles <100 nm. Now we know they work.
 - Rengasamy et al., J Int Soc Res Prot 24: 49-59, 2007
 - Rengasamy et al., J Occup Environ Hyg. 2008 Sep;5(9):556-64.
 - Rengasamy et al., Ann Occup Hyg. 2009 Mar;53(2):117-28.
 - Rengasamy et al., Ann Occup Hyg. 2010 Oct;54(7):789-98.
 - Rengasamy et al., J Occup Environ Hyg. 2011 Jan;8(1):23-30.
 - Rengasamy et al., Ann Occup Hyg. 2011 Apr;55(3):253-63.
 - Rengasamy et al., J Occup Environ Hyg. 2012;9(2):99-109.
 - Rengasamy et al., Ann Occup Hyg. 2012 Jul;56(5):568-80.
 - Rengasamy et al., J Occup Environ Hyg. 2012;9(7):417-26.
- Initial concerns were raised about the effectiveness of latex or neoprene gloves. Now we know that penetration through skin is very limited (Gopee et al, 2009; Monteiro-Riviere et al, 2011; Sadrieh et al, 2010).

Animal and human data – state of the science

- Traditional methods for setting OEL values rely on long-term animal studies or human experience
 - To date, few long-term studies have been published on nanomaterials. There are some 90-day studies for CNTs -- 2 studies using different materials that reported different results. As a result, 2 different internal OEL values are used, and the methodology used was different.
 - It is not feasible to conduct 90-day studies on all nanomaterials if the study design proposed by EPA for CNTs is followed (Andre Nel suspects that those studies would cost \$800,000 - \$1,000,000 each).
 - How can we incorporate data from short-term studies into an OEL process?
- Human data may already exist, since some small particles have been in use for many years – we just didn't capture the exposure correctly.

Control Banding does not yield a number

- Control banding by itself dictates procedures and processes, but not acceptable exposure. we can't send everyone onto the manufacturing floor dressed like moon men.
- Attempts from Pharma to assign OEL values to bands are not practical.
 - Low hazard potential - $> 1 \text{ mg/m}^3$
 - Moderate hazard potential - $0.1 - 1 \text{ mg/m}^3$
 - Elevated hazard potential - $0.001 - 0.1 \text{ mg/m}^3$
 - High hazard potential - $< 0.001 \text{ mg/m}^3$

What is the expected outcome of this workshop

- Guidance. Consensus. A process that can incorporate the information that we generate in short-term studies and use them to establish reasonable OEL values.
- We need to recognize that an OEL for one molecular entity may not apply to all molecular entities, i.e., one CNT is not all CNTs.
- We need consensus on the appropriate safety factors – 100? 1000?
- We need to understand how to measure and control a manufacturing environment that may contain a population of particle sizes – from nano to micro.
- We need to understand how to measure OELs in a manufacturing environment that may contain nano-objects and agglomerates.