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The Nano Flyer

Keeping the ESOH Acquisition Community Informed on Nanotechnology Developments

Supporting Nanotechnology for the Warfighter: Research at the U.S. Army Engineer Research and Development Center

The U.S. Army Engineer Research and Development Center (ERDC) is one of the Army's leading laboratories conducting research and development in support of the soldier, military installations, and the Corps of Engineers civil works mission. The Environmental Laboratory, located in Vicksburg, MS, is leading a strategic 8-year effort developing innovative classification schemes, environmental classification networks, and computational models to predict the environmental risk of engineered nanomaterials. This research group includes over 12 diverse scientists in the fields of chemistry, computational chemistry, soil science, geology, physics, and toxicology. The overall goal is to enable technology developers to integrate material design with environmental sustainability objectives. There are three areas of focus: (1) develop methods for measuring nanomaterials and their ecological impacts (2) develop a nanomaterial classification "periodic chart" to predict material attributes, and (3) develop computational approaches for predicting the environmental characteristics of nanomaterials in exploratory or full product development. Recent research has focused on several military relevant nanomaterials including nano-aluminum, carbon nanomaterials with and without surface modifications, and nano-silver.

Figure 1: Nanotubes in a water flea, *Ceriodaphnia dubia*

Nano-aluminum offers promise as an oxidizer in mixtures with other explosives and propellants. The ERDC research group investigated the fate and ecotoxicology of nano-aluminum oxide, a predicted byproduct of nano-aluminum formed by oxidation during detonation. The work, recently presented at the University of Massachusetts Nanotechnology Conference http://www.umass.edu/tei/conferences/nanoconference/ and the Joint Army Navy NASA Air Force (JANNAF) Interagency Propulsion meeting (http://www.jannaf.org/index.php), suggests minimal potential for transport and ecotoxicity in aquatic and terrestrial systems. These studies included a wide range of species and environmental systems and suggest levels of nano-aluminum would need to exceed 100 times that of background aluminum before observable effects will occur.

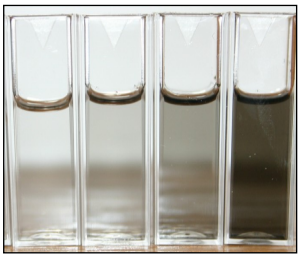

Figure 2: Multi-walled nanotubes stabilized in natural organic matter

In collaboration with private industry and academia, ERDC examined the potential environmental implications of waste streams in nano-carbon production. As part of ERDC's research on carbon nanotubes, a challenge in the life cycle of nanomaterials was identified in the inefficiency of manufacturing techniques which produce orders of magnitude more byproduct material relative to the final engineered nanomaterial. The composition of the carbon soot from fullerenes and metallofullerenes was examined and found to have a large amount of metals (copper and gadolinium) and organic solvents (Figures 3 and 4). This material would need to be stored or disposed of, raising concerns for potential entry into waste streams. The team determined the potential leachate to be toxic to a range of aquatic animals. The results of this study were published by Hull et al. http://dx.doi.org/10.1021/es802483p

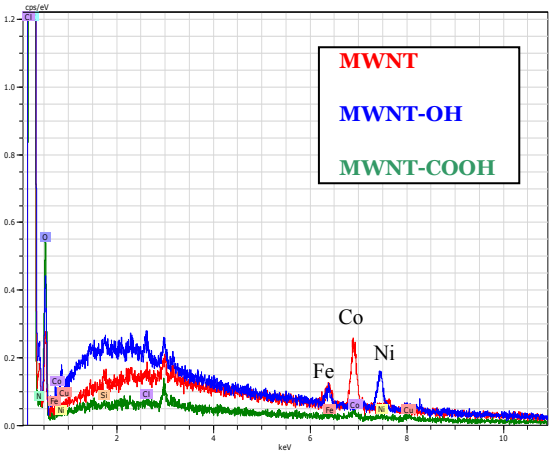

Figure 3: Metal impurities in nanotubes detected by energy dispersive x-ray spectroscopy.

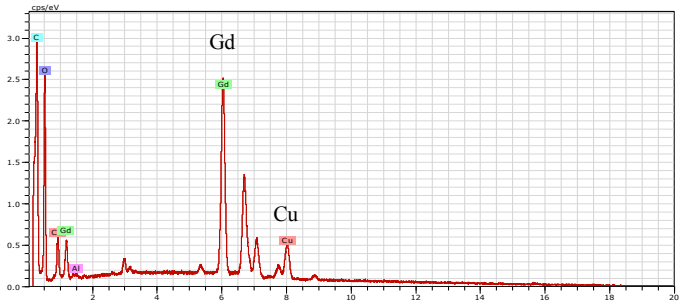

Figure 4: Metal impurities in a metallofullerene soot detected by energy dispersive x-ray spectroscopy.

One of the goals of the ERDC research team has been to establish the foundation for a "periodic chart" classification approach to predict nanomaterial environmental attributes for application with minimal life cycle impacts. One of the team's leading computational chemists, Dr. Frances Hill, is developing an atomic scale model of nano-silver. This model can be used to predict interactions of the particle with other chemicals and particles; providing an alternative approach to gain an understanding of their environmental characteristics. To further integrate the environmental characteristics within a decision-making framework, the team developed a risk ranking approach using stochastic mechanistic acceptability analysis (SMAA) for guiding technology development that offers the foundation for decision making within the EPA and industry and in developing nanotechnologies to support Army scientists and engineers. This approach was published in J. of Nanoparticle Research (http://springerlink.com/content/y63556p0h5p08lj1/).

For more information contact Jeffery A. Steevens, Nanomaterials Risk Team Leader at Jeffery.A.Steevens@us.army.mil. Additional information about the ERDC research program, team, and products can be found online at: http://el.erdc.usace.army.mil/nano/

Article written by Dr. Jeffery A. Steevens, Environmental Laboratory U.S. Army Engineer Research and Development Center

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Advancing Alternative Energy

On 27 April 2009 the White House announced that the U.S. Department of Energy Office of Science will invest $777 million over the next five years to develop forty-six Energy Frontier Research Centers (EFRCs) focusing on enhancing solar energy, electricity storage, biofuels, nuclear and carbon capture/sequestration research . Out of the forty-six EFRCs centers, Los Alamos National Laboratory (LANL) will develop two new centers. One of the two centers being created at LANL is being led by Victor Klimor. This center will use nanoparticles like quantum dots to enhance traditional silicon photovoltaic cells used in producing solar panels. In the end, nanotechnology will potentially enhance current alternative energy products to increase energy efficiency in an effort to make solar energy widely available.

Tackling Our Energy Challenges in a New Era of Science: http://www.sc.doe.gov/bes/EFRC.html

Solar and Nuclear Energy Expertise to be Enhanced by Research Centers: http://www.lanl.gov/news/index.php/fuseaction/home.story/story_id/16531

Research Highlights Potential for Improved Solar Cells: http://www.lanl.gov/news/index.php/fuseaction/home.story/story_id/15709

How will REACH impact the production of nanoscaled materials?

Regulatory frameworks for handling engineered nanomaterials in Europe fall under a new regulation called **R**egistration, **E**valuation, **A**uthorization and Restriction of **Ch**emical substances (REACH 1907/2006) that went into effect on 1 July 2007 and explicitly mentions the precautionary principle. Manufacturers, importers and downstream users have to make sure that the substances they utilize and put on the market do not adversely affect human health or the environment. This should guarantee that risks from dangerous substances are under control. Substances of concern are to be gradually replaced by alternative substances or technologies where suitable economically and technically viable alternatives are available. According to the requirements this regulation will check for health and environmentally relevant properties of engineered nanomaterials when annual production or import exceeds the threshold value of 1 ton (http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm).

REACH replaces many prior regulations. One of its main objectives is determining dangerous properties of substances and their uses, especially in the case of existing substances (phase-in-substances). The registration of existing substances follows a set of priorities, whereas the criteria are the annual production tonnage and potential hazards.

Another important aspect is the definition of duties and obligations for manufacturers, importers and downstream users of the substances used in preparations and manufactured items. Recommendations for risk management measures shall be passed along the supply chain in a systematic way. This implies the adequate and transparent documentation and communication of risks adherent to specific substances. The aim of these provisions is to avoid impairments of human health and the environment under usage conditions.

The European Commission developed a report titled "Nanomaterials in REACH" in December 2008 which details how REACH applies to nanomaterials.

Nanomaterials in REACH:
http://ec.europa.eu/environment/chemicals/reach/pdf/nanomaterials.pdf

Recently, the European Parliament released a report on the "Regulatory Aspects of Nanomaterials" on 8 April 2009 regarding the potential environmental, safety and occupational health aspects associated with the developments in the field of nanotechnology.

Regulatory Aspects of Nanomaterials:
http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A6-2009-0255+0+DOC+XML+V0//EN#title2

Key recommendations regarding regulations within REACH:

- Develop a registration procedure for nanomaterials manufactured and imported to the European Union (EU)
- Prepare a chemical safety report for all registered nanomaterials that identify their hazards and perform a exposure assessment
- Notification of all nanomaterals placed on the market on their own, in preparations or in articles

REACHing for nano:
http://blogs.edf.org/nanotechnology/2009/04/02/

GoodNanoGuide

Do you use Wikipedia on a daily basis? If you answered yes, you may be interested in a recently launched nano-wiki, overseen by an Implementation Committee that includes, among others, Bruce Stockmeier (Argonne National Lab), Michael Riediker (Institute for Work and Health (Switzerland)), Kristen Kulinowski (Director of International Council on Nanotechnology (ICON)), Chuck Geraci and Mark Hoover (NIOSH) and Mathew Jaffe (Crowell & Moring). The GoodNanoGuide was designed to exchange ideas on occupational safety and how to properly handle nanomaterials. The site will be available to the general public for view; however, only individuals who are registered as GoodNanoGuide providers will be able to contribute to the website. All in all, this interactive wiki will provide "users" with up-to-date information on ESOH issues occurring in nanotechnology.

The GoodNanoGuide (beta) site: http://goodnanoguide.org/

Additional information on the GoodNanoGuide: http://icon.rice.edu/projects.cfm?doc_id=12207

Department of Toxic Substance Control (DTSC)

The DTSC is requesting manufactures or imports of carbon nanotubes in California, to provide information on the fate and transport of carbon nanotubes in the environment and their analytical test methods. The DTSC has authority to request for this information under the Health and Safety Code, Chapter 699, sections 57018-57020. The information provided by manufactures and imports will be a proactive step in identifying information gaps which will hopefully led to the protection of human health and the environment.

Recipients of the formal request letter have 365 days to provide their response to DTSC. A copy of the letter can be viewed at:
http://www.dtsc.ca.gov/TechnologyDevelopment/Nanotechnology/upload/Formal_AB289_Call_In_Letter_CNTs.pdf

The mailing list can be viewed at:
http://www.dtsc.ca.gov/TechnologyDevelopment/Nanotechnology/upload/AB289_CNT_Contact_List.pdf

The website that addresses nanotechnology under the Department of Toxic Substance Control can be found at: http://www.dtsc.ca.gov/TechnologyDevelopment/Nanotechnology/

SOCMA Nanotechnology Expands Membership

The Society of Chemical Manufactures & Affiliates (SOCMA) Nanotechnology Small and Medium Enterprise (SME) Coalition expanded its membership to address issues which are looming over the heads of nanotech start-up companies. Recent concerns on the environmental safety and occupational health (ESOH) impacts of engineered nanomaterials have led organizations to question the EPA's Toxic Substance Control Act (TSCA) for engineered nanomaterials and possibly reforming TSCA. Currently nanotech start-up companies and other industrial leaders feel that nanomaterials have the potential to enhance current products on the market; however, there are many questions on the potential ESOH impacts of engineered nanomaterials. To promote public acceptance and create products that are safe for the environment and human health, the SOCMA Nanotechnology SME Coalition has created an associate membership for those who are not producing nanomaterials but have an interest in the successful development of the industry. This membership is for consultants, law firms, and research organizations to participate in meetings, conference calls and other SOCMA Nanotechnology SME Coalition events focusing on the potential environmental safety and health issues and standards for the nanotech industry.

Society of Chemical Manufactures & Affiliates website: http://www.socma.com/

For additional information please contact Christine Sanchez, Manager of Public Relegations & Communications at 202-721-4182 or sanchezc@socma.com

Nano Websites:

C&EN Chemical & Engineering News
NanoFocus
http://pubs.acs.org/cen/nanofocus/

National Nanotechnology Initiative (NNI)
Supplement to the President's FY 2010 Budget
http://www.nano.gov/index.html

Environmental Defense Fund
Chemicals & Nanomaterials
http://blogs.edf.org/nanotechnology/

Upcoming Conferences:

6-7 October 2009
Nanomaterials and the Environment & Instrumentation, Metrology and Analytical Methods
Arlington, VA
www.nano.gov/html/meetings/environment/

3 November 2009
Nanotechnology for Environmental Cleanup Pollution Control
Northern California
http://grac.org/nanotech.asp

17-18 November 2009
Nanomaterials and Human Health & Instrumentation, Metrology and Analytical Methods
Arlington, VA
www.nano.gov/html/meetings/humanhealth/

Call for Articles and Information:

Submit articles or suggested topics for inclusion in future bimonthly editions to Megan Hawk, SAIC at Megan.Hawk@wpafb.af.mil or 937-255-3373.

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