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Recent Government Briefs

US FDA Considering Sunscreen Labels that would Identify Nanomaterials

The US Food and Drug Administration (US FDA) has requested comments on a draft warning it is considering that would alert consumers to the risks of sunscreen sprays. While the language in the US FDA Advanced Notice of Proposed Rulemaking (ANPRM) does not mention the term "nano" specifically, it has requested product information about "the typical particle size distributions for sunscreen spray products," suggesting that nano-sized particles are its focus. Nanomaterials are widely used in newer sunscreen formulations. For example, the opaque, milky white, high-SPF lotion sunscreens of the past have been replaced by clear, translucent products that are now applied via spray bottles. Nanomaterials are used for this purpose; the chemicals zinc oxide and titanium dioxide, widely used in sunscreens, are clear, easily aerosolized, and, when reduced to the nano scale, generally more desirable to many consumers than traditional sunscreens. The proposed new rule would require that all sunscreen spray products contain a label with directions and warnings such as: "When using this product keep away from face to avoid breathing it," "Hold container 4 to 6 inches from the skin to apply," "Do not spray directly into face. Spray on hands then apply to face," "Do not apply in windy conditions," and "Use in a well-ventilated area." It should be noted that the warnings do not specifically refer to nanomaterials; however, the requirement of a mandatory label is viewed by some as a first step in triggering a cascade of potential toxic tort litigation.

For more information, visit the Federal Register entry titled "Sunscreen Drug Products for Over-the-Counter Human Use; Request for Data and Information Regarding Dosage Forms," available here: <http://www.gpo.gov/fdsys/pkg/FR-2011-06-17/pdf/2011-14768.pdf>

Danish EPA Releases Report on the EH&S Risks for Seven Nanoparticles

The Danish Environmental Protection Agency (DEPA) has recently released a report titled "Survey on basic knowledge about exposure and potential environmental and health risks for selected nanomaterials." This study was conducted to characterize the uses of the most prevalent nanomaterials and to identify potential exposure scenarios most likely to represent an environmental or human health risk. Noting that there is no scientific consensus on the definition of nanomaterials, DEPA defines nanomaterials as "materials having one or more external dimensions in the nanoscale (1 nm to 100 nm) or materials which are nanostructured (possessing a structure comprising contiguous elements with one or more dimensions in the nanoscale but excluding any primary atomic or molecular structure)." Using this working definition, DEPA developed "profiles" for seven of the most common nanomaterials (*i.e.*, titanium dioxide, cerium dioxide, fullerenes, nanosilver, zero-valent iron, silicium dioxide, and nanoclay). Each nanomaterial is described in an autonomous section of the report that includes general physiochemical characteristics, manufacturing processes, and current uses (*e.g.*, consumer products, medical devices, *etc.*), as well as risk profiles describing both ecological and human health exposure and hazard assessments.

The full report citation is: Mikkelsen, SH; Hansen, E; Christensen, TB; Baun, A; Hansen, SF; Binderup, ML. 2011. "Survey on basic knowledge about exposure and potential environmental and health risks for selected nanomaterials." Danish Ministry of the Environment, Environmental Protection Agency. Environmental Project No. 1370 2011. The report is available here: <http://www2.mst.dk/udgiv/publications/2011/08/978-87-92779-09-0.pdf>

Hot-off-the-Presses Peer-Reviewed Research Articles of Note

MEASUREMENT AND EXPOSURE ASSESSMENT

Lewicka, ZA; Benedetto, AF; Benoit, DN; Yu, WW; Fortner, JD; Colvin, VL. 2011. "The structure, composition, and dimensions of TiO₂ and ZnO nanomaterials in commercial sunscreens." *J. Nanopart. Res.* 13(9):3607-3617. Abstract

This paper provides one of the more comprehensive assessments to date of the properties of two inorganic pigments, titanium dioxide (TiO₂) and zinc oxide (ZnO), that have gained extensive usage in nanoscale form in sunscreens due to their transparency and capacity to be easily aerosolized. For this study, Lewicka *et al.* isolated TiO₂ and ZnO particles from nine commercially available sunscreens purchased at drugstores, using a variety of sophisticated analytical techniques to characterize a suite of particle properties, including dimension, shape, crystal phase, surface area, and elemental composition. Eight of the sunscreens tested listed TiO₂ and/or ZnO as ingredients; the authors confirmed the presence of engineered nanomaterials in all eight of these products, despite a general lack of product labels specifying the content of nanomaterials. In addition, Lewicka *et al.* observed evidence of TiO₂ and ZnO particle agglomeration, which has implications for their potential to penetrate the skin. For some of the sunscreens, the authors detected the presence of aluminum and silicon in addition to titanium and zinc, likely due to the use of coating materials on the TiO₂ and ZnO nanomaterials. Lastly, Lewicka *et al.* identified two commercial nanoscale powders that closely matched the physical-chemical properties of the inorganic constituents in the sunscreens assessed in the study, proposing that these powders could serve as “effective surrogates” of the engineered nanomaterials in sunscreen products for studies of health and environmental impacts.

Nazarenko, Y; Han, TW; Lioy, PJ; Mainelis, G. 2011. “Potential for exposure to engineered nanoparticles from nanotechnology-based consumer spray products.” *J. Expo. Sci. Environ. Epidemiol.* 21(5):515-28. Abstract

This study investigated the human exposure potential of a variety of nanotechnology-based consumer sprays as well as analogous non-nano, or “regular,” products. Selected based on inclusion in the Woodrow Wilson Nanotechnology Consumer Products Inventory (<http://www.nanotechproject.org/inventories/consumer/>), the nanotechnology-based consumer sprays tested in this study included a personal care silver bactericidal spray, a facial nanospray for skin rejuvenation, a hair nanospray, a disinfectant nanospray, a skin hydrating nanomist, and a wheel nanocleaner. The investigators used sophisticated analytical techniques, including photon correlation spectroscopy and transmission electron microscopy (TEM), to characterize the particle size, shape, and agglomeration of particles in the liquid products, as well as those released in a realistic application scenario of the sprays. Nazarenko *et al.* reported evidence of both single nano-sized particles as well as nanoparticle agglomerates in all tested products, including those identified as nanotechnology-based products and the corresponding non-nano, or regular, products. Analyses of the aerosols released during spray application of the products also generally showed the presence of nano-sized particles for both nano and regular consumer spray products; wide particle size distributions, ranging from 14-nm to 20-µm, were also observed. Importantly, the investigators reported different particle size distributions for particles in the liquid products versus those released during spray application, as well as differences in concentrations and size distributions for spray application experiments with hand spraying and constant output atomizers. These results indicate the importance of characterizing potential exposures under actual use conditions – *i.e.*, for spray application, and using actual product packaging and supplied sprayers.

TOXICITY

Wohlleben, W; Brill, S; Meier, MW; Mertler, M; Cox, G; Hirth, S; von Vacano, B; Strauss, V; Treumann, S; Wiench, K; Ma-Hock, L; Landsiedel, R. “On the lifecycle of nanocomposites: Comparing released fragments and their *in-vivo* hazards from three release mechanisms and four nanocomposites.” *Small*. [Epub ahead of print]. Abstract

Nanocomposites, which consist of materials such as plastics and cement that are enhanced with nanoparticles, are gaining use in consumer products due to their ability to confer desirable properties such as strength, scratch resistance, elasticity, conductivity and transparency. For example, nano-enhanced thermoplastics are used as lightweight alternatives to metal components in automobiles, and concrete enhanced with nano-sized calcium silicate hydrates (CSH) accelerates hardening and reduces energy consumption by eliminating the need for heat-induced hardening. This study by Wohlleben *et al.* evaluated potential consumer exposure to nanoparticles from four commercially used nanocomposites: polyamide (PA) enhanced with nano silica, polyoxymethylene (POM) enhanced with carbon nanotubes (CNT), and cement enhanced with either CNT or CSH. Particles generated from sanding the nanocomposites were comparable in size, shape, and number to particles generated from the same material without the nanoparticles, although addition of nanoparticles tended to increase the size of particles generated from POM and cement. Normal mechanical use of the nanocomposites, simulated with a Taber Abraser, also generated particles comparable in number and size to those generated from material without nanoparticles. Although long-term weathering, simulated with UV irradiation, resulted in exposure of naked CNTs from the PA material, those CNTs were not readily liberated from the PA matrix, even with use of ultrasound. Surfaces of the POM and cement were comparable, either with or without nanoparticles. Wohlleben *et al.* also assessed toxicity of the materials, either with or without nanoparticles, at three days and again at three weeks following intratracheal instillation in rats. Addition of nanoparticles to the materials did not significantly alter their toxicity, as assessed by clinical signs, bronchoalveolar lavage, hematology, lung and lymph node histology, and genotoxicity. Overall, this study indicates that consumers are unlikely to be exposed to nanoparticles from use of a range of nanocomposites.

Monteiro-Riviere, NA; Wiench, K; Landsiedel, R; Schulte, S; Inman, AO; Riviere, JE. “Safety evaluation of sunscreen formulations containing titanium dioxide and zinc oxide nanoparticles in UVB sunburned skin: An *in vitro* and *in vivo* study.” *Toxicol. Sci.* 123(1):264-280. Abstract

Absorption of titanium dioxide (TiO₂) and zinc oxide (ZnO) nanoparticles has been evaluated previously in healthy skin, but prior studies have not evaluated absorption of TiO₂ and ZnO nanoparticles through sunburned skin, which is of interest considering the widespread use of these nanoparticles in sunscreens. Hence, the objective of this study by Monteiro-Riviere *et al.* was to compare absorption of commercially available TiO₂ and ZnO nanoparticles in sunscreen formulations through both healthy and sunburned skin. Nanoparticles

were evaluated *in vitro*, using skin isolated from Yorkshire pigs, and *in vivo*, also using Yorkshire pigs. Overall, the *in vitro* results were comparable to the *in vivo* results. Using transmission electron microscopy, the authors observed evidence of enhanced penetration of both TiO₂ and ZnO nanoparticles for skin exposed to ultraviolet B (UVB) radiation, with greater penetration of TiO₂ than ZnO; penetration was limited to the stratum corneum for both, and nanoparticles were not found in the Langerhans cells (*i.e.*, skin macrophages). Using a highly sensitive analytical method for detecting titanium and zinc (time-of-flight secondary ion mass spectrometry), Monteiro-Riviere *et al.* observed evidence of TiO₂ penetration into the epidermis, with some penetration into the dermis layer, for both non-exposed and UVB-exposed skin. ZnO was localized primarily in the upper epidermis. For both the TiO₂ and ZnO nanoparticles, study findings thus indicated that UVB exposure tended to enhance penetration. Although both TiO₂ and ZnO were able to penetrate into the skin, they were not absorbed through UVB-exposed skin, as assessed *in vitro*.

Reports, Reviews, White Papers, and Books

New Report Describes the Public Risk Perception of Nanotechnology

A social research agency for the United Kingdom (UK) and international policymakers (known as TNS-BMRB) recently released a report commissioned by the Food Standards Agency (FSA) that describes the public's perception of nanotechnology. The data for this report were collected during six workshops, each comprising two groups of approximately ten participants held in six locations across the UK between November 2010 and February 2011. While views varied over the course of these workshops, participants repeatedly returned to three central questions, namely: why are we using nanotechnology, who will benefit, and is it worth it? The report describes how regulators should be prepared to anticipate and respond to these core questions by having a transparent nanotechnology regulatory process as part of the wider system of existing regulations. The report also suggests that while the public interest constitutes safety and environmental impacts, it also includes initial transparency of rulemaking to ensure the values of consumers help to shape the direction and consequences of proposed regulations.

The complete report is available here:

<http://www.food.gov.uk/multimedia/pdfs/publication/fsacfnanotechnologyfood.pdf>

First REACH Workshop on Nano

On June 23, 2011, the first Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) workshop on nanomaterials was conducted in Brussels, Belgium. The stated objectives of this workshop were to provide European officials with an update on the European Chemical Industry Council (Cefic) activities on nanomaterials and update all participants and stakeholders with a state of affairs on European Union (EU) policy developments. The workshop was attended by more than 150 representatives from corporations, industry associations, regulators, and prominent experts in the field.

The meeting was focused on approaches that would leverage the societal benefits of these emerging technologies and materials (e.g., in energy and healthcare) while safely regulating, assessing and managing their use. The meeting also included updates on the latest developments from the Organisation for Economic Co-operation and Development (OECD). Significant presentations were also made by the European Commission, providing an update on the regulatory activities around nanomaterials and a description of the preparation process for the upcoming REACH review. For example, during the initial regulatory review (published in 2009), the Commission found that there was no "regulatory void" in terms of the management of nanomaterials. However, the Commission is currently revising this conclusion in a second regulatory review scheduled for release at the end of 2011. This second REACH review is expected to include a number of scientific studies addressing some of the key uncertainty issues surrounding nanomaterial hazard assessment.

The presentations for this workshop are available here:

<http://www.cefic.org/Industry-support/Implementing-reach/Workshops1/Nano-and-REACH-Workshop-23-June---Presentations/>

Upcoming Meetings and Conferences

Third Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies (S.NET)

November 7-10, 2011
Tempe, Arizona

<http://www.cns.ucsb.edu/SNet2011/>

Scientists and engineers are invited to share their knowledge and experiences in the development of nanotechnology with those in the social sciences and humanities at the Third Annual Conference of the Society for the Study of Nanoscience and Emerging Technologies. This event has been co-organized by the Centers for Nanotechnology in Society at Arizona State University and the University of California, Santa Barbara. Through more than 50 panel sessions, the conference aims to exchange ideas and encourage critical reflection on the newest developments in nanotechnology. The topics that will be covered include risk analysis frameworks for nanomaterials, nanotechnology and the public, regulation and legal trends in the US and around the world, nanotechnology and food, nanomedicine, nanoremediation, and nanotechnology in the context of sociology, politics, and ethics.

6th BioNanoTox and Applications Research Conference

November 17-18, 2011
Little Rock, Arkansas

<http://sites.google.com/site/bntconference/>

Scientists from a variety of disciplines, including biology, chemistry, toxicology, engineering, and biotechnology, will attend

tutorials and paper and poster presentations in a multidisciplinary approach to discussing recent research on nanotechnology. The focus of the conference will be on the potential impact of nanotechnology on healthcare, agriculture, environmental protection and remediation, and the construction of biocompatible nanomaterials.

New Product Highlight

Nanomaterials as Asphalt Coatings

A new colloidal nano silica product is being used to cool blacktop asphalt surfaces in hot urban environments. This product, called Cool Pavement Nano-UHPC technology, is manufactured by Emerald Cities™ and is now being used in cities like Phoenix, Arizona, where air temperatures can reach 118 degrees Fahrenheit and blacktop temperatures can reach 200 degrees Fahrenheit. The Cool Pavement coating consists of colloidal nano silica as well as “superplasticizers, polymers, and solar reflective pigments,” and it is reported to reduce the surface temperature of asphalt by up to 50 degrees Fahrenheit.

For more information on Cool Pavement Nano-UHPC technology, visit: <http://www.emeraldcoolpavements.com/>

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