Defining Research Needs & Crop Protection Products

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Bridging Nano EHS Research Efforts:
A Joint US-EU Workshop
March 10, 2011

Overview of Presentation

- Overview of nanotechnology
- How is nanotechnology being used by the crop protection industry?
- What are the research needs for nanotechnology relating to EHS?
- What are the key issues with the technology for the crop protection industry?

Why discuss nanotechnology?

- Nanomaterials have the same chemical composition as their larger (non-nano) counterparts
  - § exhibit a larger surface area for any given mass
- Nanomaterials
  - § May be more chemically reactive
  - § May have different biological reactivity
- Materials may be inert in larger form but may be reactive at the nanoscale
- Thus, nanomaterials may have the ability to affect the target organism and the non-target organism (and ecosystems) differently than do products made up of larger particles of the same material
- Not necessarily a safety or health issue

Nanotechnology is Global

- Nanotechnology products are currently on the market in 24 different countries.
- Currently, the US, East Asia and Europe have the most products.

- Increase from less than $12 billion in 2006 to $18 billion in 2008.
- Predicted impact of $2.5 trillion by 2015

(Lux Research, 2009)

Where is nanotechnology today?

- After more than twenty years of basic and applied research, nanotechnologies are increasing in commercial use.
- The rapidly growing field of nanotechnology and its products pose interesting challenges to policy-makers and regulators.
  - § limitations in data and uncertainty about health and environmental effects
- Current status with nanotechnology policy and research is not surprising as it reflects the same questions posed with earlier generations of chemical/technology management.

Nanomaterials

The most common materials are:

- Silver
- Carbon (including fullerenes)
- Zinc (including zinc oxide)
- Silica
- Titanium (including titanium dioxide)
- Gold

Crop protection product pipelines

Using nanotechnology

- Pesticides
- Fungicides
- Herbicides

Nanotechnology uses by the crop protection industry

- Greater precision in pesticide usage
  - Reduced spray drift and surface runoff
  - Controlled release
  - Reduced amounts
- Efficient emulsification and encapsulation of active ingredients
  - Greater stability
  - Precision in release
- Modern Agricultural Revolution
  - Promising uses of nanotechnology

Research needs – Characteristics

Size distribution

Aerodynamic diameter

Impact of ‘size characteristics’ versus ‘chemical composition’

Commonality versus Differences

- Resources considerations
- Experimental animal use

Research needs – solubility/formulation

One early application of nanotechnology across industries is to tackle the problem of poor water solubility of hydrophobic chemicals

- bioavailability of chemicals are altered by changes in solubility

Testing the active ingredient versus testing the final product formulation?

Research needs - Toxicity

Nanomaterials may behave differently and these unique properties may influence toxicity

- Inhalation (do nanomaterials go to the deep lung?)
- Blood brain barrier (do nanomaterials translocate to the brain?)

Definition of dose

- Traditional mass-based dose metrics may need to evolve for nanotoxicity studies

What about aggregation so that nanoproperties are lost?

Research needs - Exposure

- Inhalation ?
- Blood brain barrier ?

As biological toxicity needs to be examined, exposure should inform the evaluation

Prior exposure to non-intentionally produced nanomaterials?

Research answers

Are these new questions?

Collaboration between industry & government & academia

Methods development

- Delivery of nanomaterials
- Detection of nanomaterials

- Scientific discussions about environmental health and safety questions for nanomaterials should bridge geographies and governments
  - Programs of work that leverage resources and establish communities of research practice
  - Both near-term and future collaborations

What are the concerns with the technology?

Regulatory uncertainty

- Adequacy of FIFRA
- Proposed ‘adverse event’ approach

Learning from biotechnology

- Do the existing laws provide for protection of human health and the environment?

Science-centric future!

- Science-based policy supported by research solutions is an essential foundation to our future
- Drives policy and legislation
- Get involved in advocating for research priorities and funding
- Research funding is essential to policy and regulatory decision making
  - Scientific information
  - Training future scientists
  - Public – private partnerships
- Science can and should be the regulatory “check-and-balance”

More information

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