Exposure through the Life Cycle COR – Work Group 1

Developing a Resource Tool for Concepts and Methods to Analyze Engineered Nano Materials in Environmental Media Throughout their Life Cycle

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Disclaimer: This is not a presentation from the California Department of Public Health or the Agency for Toxic Substances and Disease Registry
Exposures Through the Life Cycle

Product: Nano-composite/Dispersion in matrix...

Occupational exposure industrial sources

Environmental & consumer exposure

Accidental release
Release during use (aging...)

Recycling / End of life (incineration, waste water treatment, disposal...)

Formulation/production of nanocomposites (coating...)

Nanoparticle Production

Intermediate

Extraction from by-products

Pristine nanoparticles

Usage

Environment

Workers

Occupational exposure

Industrial sources

Exposures Through the Life Cycle

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Releases and Exposures during the Life Cycle
Late stages: diffuse sources, exposure of general population
nano-TiO₂ in Sunscreen

Nanoproduct use

Release during swimming

Nanoproduct end of life

Release during swimming

Release during shower

Sewage treatment plant
# Releases and Exposures during the Life Cycle

**Early stages:** point sources, occupational exposure; incidental releases

## National Registries

<table>
<thead>
<tr>
<th>Country</th>
<th>Actions</th>
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<tbody>
<tr>
<td><strong>US</strong></td>
<td>ENM not covered under Right-To-Know or Toxic Release Inventory. TSCA: some ENM covered under Significant New Use Rules; FIFRA</td>
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<tr>
<td><strong>France</strong></td>
<td>Mandatory reporting of ENM in 2013 (manufacturing, import, distribution, research)</td>
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<td><strong>Netherlands</strong></td>
<td>Planned exposure registry and health monitoring for workers</td>
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<td><strong>Denmark</strong></td>
<td>Database under construction for safety evaluation. Registration of manufacturers and importers</td>
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<tr>
<td><strong>UK</strong></td>
<td>Voluntary Reporting Scheme 2006 -2008: 13 submissions to VRS</td>
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Example:
Location of Potential Industrial Sources in France

Manufacturing ENM in France: Voluntary declaration by French companies (ANSES 2004/2005)
www.nanomateriaux.org/VisiteurFrancais
Example from California: no RtK, no TRI, but CA Assembly Bill 289 (2006)

- Department of Toxic Substances Control, requested information from manufacturers: 7 research institutions responded

- Silicon Valley Toxics Coalition (NGO): 2008 survey of 129 Bay Area companies

- City of Berkeley: community “right-to-know” law for manufacturers/users of ENM (2006)
How to measure ENM in different media/compartments?

Challenges
• Identification and quantification in air, water, soil, food, biological samples
• Multitude of diverse ENM
• Changes throughout their lifecycle
• Distinction between natural and engineered NM

Goals
• Provide a current and relevant resource tool for ENM community
• Proposal for a wiki-based / crowd-sourced relational database
• Database includes analytical concepts and methods
• Many different users
Proposed Relational Database

Mission
Relational Database for Analytical Concepts and Methods for ENM in environmental media

Requirements
• Easy query for analytical procedures in various media, ENM, instrumentation
• Easy data-entry; crowd-sourced/wiki-based
• Development of new analytical concepts
• Connected to other nano-databases
• …
Proposal for Database Structure

Examples of tables/files:

1. Analytical methods
2. Analytical concepts
3. Lookup Table (definitions)
4. ...

How are tables related?

One to many: One definition in the lookup table will be connected to many rows in the analytical methods table

Many to many: one analytical method may be used in many analytical concepts; one analytical concept may use many analytical methods (resolve with linking table)
Columns/Fields to include in Table “Analytical Methods”

- **a)** “Primary key” – unique ID for each record
- **b)** Environmental Medium/compartment
- **c)** ENM analyzed
- **d)** Physical-chemical characteristics:
  1) Size Distribution
  2) Surface area/g
  3) Chemical composition
  4) Aggregation states
  5) Shape
  6) ….
- **e)** Instrumentation used
- **f)** Sample preparation method
- **g)** Images at various magnifications
- **h)** Citation/source
- **i)** Date published
- **j)** Type of publication:
  1) Regulation (Country, State; Organization)
  2) Bibliography
  3) Research article
  4) Industry/Commercial (using, manufacturing ENM)
  5) Industry/Commercial selling analytical method/technique
  6) Industry/Commercial selling analytical services
- **k)** …
Challenges

• Designing a flow chart for analyzing an unknown ENM in any given compartment

• Use multiple analytical techniques to identify and quantify ENM during their life cycle

• Use the unique and specific characteristics to develop new analytical concepts

• Find data gaps

• Define Standard Operating Procedures

• Connect to other existing nano-databases (NHECD, Nanomaterial Registry)
Next Steps/Questions

• How to handle impurities

• How to handle mixtures

• Who would develop/maintain this database?

• Cooperation with other CORs and existing databases will be critical

Your questions and input are greatly appreciated!
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LifeCycleCOR members:

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