What are the Critical Parameters/ Data Needs to Understanding NP Exposure to Consumers and the General Population ?

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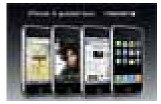
IHCP - Institute for Health and Consumer Protection

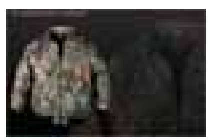

Nanomaterials in consumer products

















Consumer products – Which?

- **Several 'inventories' exist, e.g. the Woodrow Wilson inventory: "While not comprehensive, this inventory gives the public the best available look at the 1,000+ manufacturer-identified nanotechnology-based consumer products currently on the market" (http://www.nanotechproject.org/inventories/consumer/)**

- **Do we need a comprehensive inventory?**
- **Criteria for inclusion?**
- **Voluntary or backed with legal requirements?**

Consumer exposure potential

- **Liquid, powder or solid?**
- **Content/concentration?**
- **Frequency and duration of use?**
- **Application, e.g.**
  - Spraying; e.g. sunscreen (Boxall et al. 2007)
  - Dermal applications, e.g. cosmetics (Fullerenes – TiO2)
  - Articles/solid products, exposure due to wear and tear, e.g. Hsu and Chein, 2007; Göhler et al. 2010
  - Accidents?
- **…..**

Consumer exp. "characterisation"

- **What is released?**
  - 'Original' nanomaterial?
  - 'Modified' / decomposed nanomaterial?
  - Ions (e.g. from nano-ZnO or nano-silver)?
  - Aggregates/Agglomerates?
  - Nanomaterial as part of something else (e.g. as part of spray droplet or nano-Ag as part of a textile fibre)?
  - ……

  - See e.g. Kulthong K. et al., 2010 and Geranio et al., 2009, in relation to what is released when nano-silver containing textiles are exposed to artificial sweat and when washed

Consumer exp. estimation

- **Measurements**
  - Metric (mass-, surface-, number-, or?)
  - Size distribution
  - Costs vs. quality of information
  - Background & artefact(s)
  - ….
- **Modelling**
  - Current models:
    - § use mainly mass-metric
    - § not validated for NMs
    - § do underlying algorithms take account of nano-specific properties?
  - Validation/development of new models
    - § need measurement data
    - § how to deal with nano-specific properties like e.g. agglomeration?

General population (Exposure via the environment)

Release/emissions from sources
->Fate/transport/pathways
->Distribution in environmental media as e.g.

- **Drinking water**
- **Ambient air**
- **Crops and other food**

Quantification of exposure

- **Analytical detection / Measurements**

- **Modelling (Regional - local)**

Analytical quantification

1. **Sampling and analytical protocols**
2. **Background levels (Natural & other sources)**
3. **Interaction with biotic and abiotic elements (detection, sample extraction, ….)**

Very few studies available:

Example (Farré et al, 2010) Detection of C_{60} and C_{70} in wastewater suspended matter; **C_{60} max concentration: mg/L range**

C60 background levels from natural sources?

Modelling: Source and release

1. **Production**
   1. Wide range of values, e.g. nano-TiO_2 between 600 to 60000 t/y (Gottschalk et al. 2009)
2. **Quantification of emissions: point (production facilities) and diffuse (e.g. consumer products)**
   1. Metrics: amount released (kg/day) vs. concentration (mass, number)
3. **MNM characterization in emissions/effluents**
   1. Free/embedded particles
   2. Agglomeration and aggregation state
   3. Ions released (amount and rate)

Modelling: Fate/pathways

1. **Partitioning kinetics**
   - Aggregation, agglomeration and de-agglomeration
   - Sedimentation/re-suspension
   - Solubilisation (ion leaching)
   - Absorption
2. **Transformation**
   - Physical/Chemical/Biological degradation
3. **Bioaccumulation/Biomagnification**
   - Particles and/or ions

Environmental conditions (e.g. pH, NOM, ion strength)

→ **Need to understand and model processes (use colloids and remediation experience?)**

→ **Quantitative data about bioaccumulation/biomagnification needed**

1. **Boxall et al. (2007). Simple algorithms estimation, NM in cosmetics and personal care products and paints usage.**
   1. Silver: 10 ng/L (surface water)
   2. Titanium dioxide: 24.5 mg/L (surface water); 7 mg/m^3 (air outdoor)
2. **Gottschalk et al. (2010). Probabilistic mass flow analysis model, based on fractions of NM mass allocated to each compartment**
   1. TiO_2: 21 ng/L (surface water); 0.001 mg/m^3 (air)
   2. CNT: 3.3 pg/L (surface water); 0.008 ng/m^3 (air)

Conclusions

- **Knowledge gaps !**
  - Sources/uses – Where? How much?
  - Release – What? How much?
  - "Fate"
  - Exposure concentrations
- **Measurements**
  - Metric(s), size distribution……
  - Background and artefacts
  - …
- **Modelling**
  - Current models? Validation? "Scaling" possible?
  - New models?
  - Measurement data needed
  - Potential of simulation testing?