Challenges and limitations associated with aquatic effects and bioaccumulation studies for sparingly soluble and particulate substances

Summary of ECETOC Task Force Report
28 January, 2019
Motivations

- Increasing pressure on assessing the environmental risks, associated with particulates, such as NMs and microplastic
  - Scientific
  - Regulatory

- Challenges towards effective and efficient governance and regulation.
  - **Technical/scientific “problems”:**
    - (standard) test methods are missing or not applicable;
    - test methods are not always relevant
  - **Infrastructure for data management not adequate**
    - doubts about quality of data; no facilities for checking or curation
  - **Regulation (REACH) and underlying principles**
    - Chemical identity as entry point, generic information requirements and hazard oriented approach of REACH not suitable.
Motivations - Scientific

- **SCOPE OF TASK FORCE REPORT**
  - Summarize key SCIENTIFIC challenges in testing and interpreting aquatic effects studies of poorly soluble substances
  - Provide basis to foster discussion leading towards improved hazard characterization

- **OUT OF SCOPE**
  - Terrestrial and sediment toxicity testing
  - Particulates as vectors
  - Degradation products
“Poison is in everything, and nothing is without poison. The dosage makes it either a poison or a remedy.”

*Paracelsus, 16th century Founder of toxicology*

Risk = (Exposure)(Hazard)

“...the dose (i.e. exposure) makes the poison...”
Exposure

[Diagram showing processes of exposure, such as air-water exchange, sorption to vessel walls, colloid-bound substances, particle-bound substances, and degradation.]
Exposure
Physicochemical properties
Linking Exposure to Observed Adverse Effect

\[ \text{OAE} = \sum E_{iT} + \sum E_{Pint} \]
Intrinsic and Extrinsic properties

- Intrinsic:
  - Material
  - Size
  - Shape

- Extrinsic:
  - Surface
  - Functional group
  - Surface charge
  - Solubility

- Nanoparticles: 100 nm
- Microparticles: 5 mm
- Sparingly soluble liquids
System-dependent Extrinsic properties
Standardized Testing - Challenges and Limitations

Characterisation of INTRINSIC properties of Exposure Stressor
- Poorly soluble liquids (i.e. UVCB)
- Solid (i.e. NMs, microplastic)

Characterisation of EXTRINSIC properties of Exposure Event
- Aquatic toxicity test
  - pH
  - Ionic strength
  - Concentration of organic matter
  - Volume of test system
  - Stressor concentration
  - Test duration

Characterisation of particle fate in test system
- Dissolution/degradation kinetics
- Zeta potential
- Equilibrium partitioning

Application of appropriate method for establishing stable dispersion in test system
- Preparation of stock solution
- Mechanical mixing into media
- Chemically controlled dispersion
- Mechanical controlled dispersion
- Controls
Aquatic Effects Testing – Interpretation of OAEs

- Need for standardization testing protocols
  - Simultaneous exposure to particle and dissolved fractions
  - Physical effects relative to intrinsic toxicity
  - Lab exposures generally higher than field
  - Differences in species sensitivity
Key messages

- Standardized approaches related to exposure within test systems is fundamental element towards strengthening quality of data.
- Application of fundamental eco-toxicological principles advocated - from dose to response.
- Current state-of-the-art insufficient to enable mechanistic understanding to inform the risk assessment.
- Task Force report attempts to highlight key challenges and limitations…
Recommendations and Next Steps

Stakeholder Workshop to discuss, agree, and prioritize activities to fill existing data gaps