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Chemical Risk Assessment of nanomaterials- Limitations and potential alternatives

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Various key pieces of regulation in the EU such as REACH, pharmaceutical regulation, and the water framework directive rely heavily on our ability to conduct and complete chemical risk assessments that provide meaningful results. Chemical risk assessment is consists of four parts – hazard identification, dose-response assessment, exposure assessment, and risk characterization.

In this presentation, a short review is provided of recent attempts to complete risk assessments for C60, carbon nanotubes, nano-TiO2 and nanoAg (Stone et al. 2009) and then the applicability of each of the four individual steps of risk assessment is discussed in the light of the current state of knowledge (Hansen 2009).

Each of the four steps of the risk assessment framework hold a number of limitations. Toxicity has been reported on for multiple nanoparticles, but for most nanoparticles these need further confirmation before one can say that a hazard has been identified. It is currently impossible to systematically link reported nanoparticle properties to the observed effects for effective hazard identification. Although some studies have reported observing a dose-response relationship, it was unclear whether a no effect threshold can be established and what the best hazard descriptor(s) of nanoparticles is and what the most relevant endpoints are. The current lack of characterization of the nanoparticles tested in various studies makes it impossible to identify causality between observed hazards and specific physical and chemical properties. Several studies have tried to assess current and future consumer and environmental exposure for nanomaterials, but these should be seen as ìproof of principleî rather than actual assessment of the exposure. Realistic exposure assessment is hampered by: paucity of knowledge, lack of access to information, by difficulties in monitoring nanomaterial exposure in the workplace and the environment, and by the fact that the biological and environmental pathways of nanomaterials are still largely unexplored. Risk characterization being at the end of the line, the sum or maybe even the power all of these limitations are conveyed to calculating risk quotients for nanomaterials (Hansen 2009).

It is concluded that risk assessment is found to be inadequate to timely inform policy-makers about the health and environmental risks of nanomaterials, if not in the short term, then most definitely, in the long term. Risk assessment is not feasible for the purpose of dealing with the complex emerging risks of nanomaterials and will not be adequate to ensure a decision-making process that enables us to make informed decisions within a reasonable period of time (Hansen 2009).

Alternative to risk assessment are discussed such as MultiCriteria Decision Analysis, Bayesian decision making and Adaptive management should be pursued to ensure and support transparent and informed decision-making processes (Grieger et al. 2011, Hansen 2009). Finally, some recommendations are provided on how these tools could be explored in a life-cycle perspective of a given nanomaterial or nanoproduct.

References

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Figures

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