Declaration of Apeldoorn on LCIA of Non-Ferrous Metals

April 15th, 2004, a group of specialists in the areas of LCA (Life Cycle Assessment), LCIA (Life Cycle Impact Assessment) and Risk Assessment came together at TNO in Apeldoorn, The Netherlands, to discuss the current practices and complications of LCIA methodologies for non-ferrous metals (including essential metals such as zinc and copper). The workshop was commissioned by ICMM (International Council on Mining and Metals), ECI (European Copper Institute) and DBM (Dutch Duurzaam BouwMetaal Foundation), co-sponsored by the UNEP/SETAC (United Nations Environment Programme / Society of Environmental Toxicology and Chemistry) Life Cycle Initiative, and was organized by TNO (Netherlands Organisation for Applied Scientific Research) and CML (Institute of Environmental Sciences, Leiden University). The purpose of the workshop was to provide input to the UNEP/SETAC Life Cycle Initiative on issues surrounding the characterisation of metals by currently available ecotoxicity-based LCIA methods. The group, originating from industry, academia, government, research and consultancy, recognised that current ecotoxicity LCIA methods often produce a probably incorrect emphasis on the impact of metals.
Even though LCIA can use the models and the methodologies developed for Risk Assessment, *LCA is designed to compare different products and systems and not to predict the maximal risks associated with single substances.* However, LCIA models are still in development and do not yet take all important metal-specific properties and processes into account. They can be improved to provide a more meaningful result in ecotoxicity assessment by critically adopting and adapting advanced knowledge and models from risk assessment.

Agreement was reached that the following aspects are of major relevance for a correct understanding of the fate and toxicity of essential elements and need further elaboration:

- Speciation. This feature of metals, which determines their bioavailability and toxicity, was regarded as a highly desirable extension of LCIA, both in fate and effect modelling. The present focus on total metals concentrations in LCA and LCIA could be overly conservative.
- Persistence. Although metals may remain in a certain compartment of a model or ecosystem for a long time, they are usually not present in their bio-available form, but are rather converted to other species and/or adsorbed to particulate matter (e.g., soils, sediments, suspended matter). Infinite time horizons in steady state effect models could only be appropriate if bio-availability is properly considered..
- Essentiality. Within the essentiality window of essential metals, the possibility of adverse biological effects should be set at zero. Adverse effects may occur above or below that window. Below and within that window the LCA general principle of "less is better" does not apply.
- Bioavailability. As noted above, metals speciation determines bioavailability, which also needs to be included in LCIA. For this purpose the Biotic Ligand Model (BLM) should be used preferentially, with the Free-Ion Activity Model (FIAM) used in cases where the BLM has not been fully developed.
- Characterisation. Because LCA is used for comparative rather than predictive purposes or determinations of absolute risk, it is appropriate to use robust measures of toxicity rather than the lowest measures of toxicity, which are generally interpolated rather than directly measured. On this basis, the characterisation factor should be chosen at the HC_{50} (geometric mean of EC_{50}) level rather than the HC_5 or the NOEC level, based on the most representative, not the most sensitive species.
- Compartments in the multimedia model. A distinction should be made between compartments in the fate model (which should be as inclusive as possible) and in the effect model. If effects are negligible in a given effect compartment, there is no need to consider effects. This may well be the case for essential metals in the ocean.
- Spatial aspects. The consequences of regional differences in bioavailability, background concentrations, and therefore toxicity need to be further elaborated.

The UNEP/SETAC Life Cycle Initiative was asked to provide recommendations on the integration of the above factors into LCIA methodology. On some issues further research may be necessary beyond these recommendations. The Apeldoorn workshop participants recommend the following working procedures until final recommendations from the UNEP/SETAC Life Cycle Initiative are issued:

1. The fact that a number of critical issues regarding metals are imperfectly dealt with by present characterisation models for ecotoxicity, should be clearly communicated as part of LCIA reporting. Additionally, business or policy decisions should not without further discussion be made based on the results of the currently available (deficient) methods for assessing ecotoxicity in LCIA.

2. The chemical speciation of metals should be taken into account from the inventory phase onwards; emissions should be reported in terms of metal species, preferably in terms of dissolved metal instead of total metal.
3. If the contribution analysis of the LCIA shows that metals have a dominant influence on the results (and conclusions), a sensitivity analysis should be made with the time horizon for the toxicity impact categories set to 100 years when applicable or with excluding the metals from the impact assessment.
4. The oceans are deficient in essential metals. Therefore additional inputs to the ocean will probably not lead to toxic effects. The characterisation factor for toxicity in oceans of essential metals should be set at zero. For coastal seas, this may well be different.

A full report of the workshop, the underlying scientific report and presentations can soon be found at www.mep.tno.nl by using the search function for 'Apeldoorn Declaration'.

Apeldoorn, April 15th, 2004
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From left to right: Lionel Aboussouan, Robert Jan Saft, Marianne Schönnenbeck, Michael Hauschild, Katrien Delbeke, Jaap Struijs, Andrea Russell, Helias Udo de Haes, John Atherton, Wim van Tilborg, Chris Karman, René Korenromp, Gerda Sap, Achim Baukloh, Alain Dubreuil, William Adams, Reinout Heijungs, Olivier Jolliet, Arjan de Koning, Peter Chapman, Tom Ligthart.
Not in the picture: Dik van de Meent, Jan Kuyper, René van der Loos, Rein Eikelboom, Frederick Verdonck