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Experts need ... experts' judgments

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N.T. de Oude, the editor of this newsletter, wrote a call for contributions on the topic of life-cycle impact assessment under the title `Experts need ... experts' [1]. A number of people have by now responded to this. Among them were Heijungs & Guinée on the one hand and Assies on the other who started a polemic on the assessment of toxic substances, and in particular on the modeling of the fate of chemicals in the environment [2, 3, 4]. Mr. de Oude has asked us to jointly summarize points of agreement and points of disagreement.

In current practice the inventory table very often lacks information on the time during which emissions take place. The amounts of emissions are given per functional unit and not per unit of time. This has to do with the fact that the functional unit is mostly defined in terms of a certain function, and not as a function per unit of time.

At the same time, one promising class of models to predict the fate of chemicals in the environment is the steady-state multicompartment model, e.g. the model described as level III by Mackay [5]. This type of model takes continuous emissions of constant rate as input and predicts steady-state concentrations in various environmental compartments as output.

The problem is therefore, that the inventory table gives numbers which are not suitable for use in steady-state models because the time-dimension is lacking. One conclusion could be that steady-state models are not appropriate for use in LCA. A more constructive attitude would be to try to resolve the misfit.

Heijungs & Guinée argue that this can be achieved by regarding the emissions as given in the inventory table as emission pulses and adapting the steady-state model by the introduction of a reference substance in order to suit emission pulses [2, 6]. It can be proven that the ratio of the concentrations which are predicted with the steady-state model is equivalent to the ratio of the integrated exposure as a result of pulsed emissions. Heijungs & Guinée make use of this equivalency to apply the steady-state model to emission pulses. The predicted exposure (dimensions unit mass unit time per unit volume) is combined with some no-effect concentration to reflect the potential risk or hazard of an emission. According to Heijungs & Guinée the actual hazard or risk can unfortunately not be calculated with LCA.

Assies argues that it is reasonable to make the (modeling) assumption that the product system is a steady-state system [3]. The functional unit can be defined as the delivery of a certain amount of a service or function per unit of time. Extractions from and emissions to the environment which are given in the inventory table can be related to the same unit of time and can be regarded as inflows and outflows to maintain the product system in steady state. The emission data of the inventory table, which now are given in the dimensions unit of mass per unit of time, can directly be applied in the steady-state environmental model to predict increases of environmental concentrations due to the product system. The ratio of the incremental concentration and some no-effect concentration can be regarded as the contribution of the product system to an environmental hazard or risk. Because the actual risk of the incremental concentration is largely dependent on the ambient concentration, Assies has a proposal to combine the incremental concentration due to the product system with the ambient concentration [7].

According to Assies the adaptation of the steady-state model using the concept of a reference substance is not correct. The measure of exposure represents the integrated exposure resulting from a pulsed emission. The time dimension which is incorporated in the measure of exposure reflects the environmental lifetime of a pollutant. As environmental lifetimes of pollutants may differ a great deal, exposure is compared over different time horizons.

Furthermore the calculated exposure is not a concentration and therefore not compatible with the no-effect concentration which is also used in the expressions. Heijungs & Guinée hold that it is allowed to determine the ratio of a quantity that is not a concentration to a quantity that is a concentration. The result is not dimensionless, but that poses no problem to them.

Heijungs & Guinée agree with Assies on the fact that it is possible to incorporate a time dimension in the functional unit. All of us acknowledge that the

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environmental model is merely used to synthesize a variety of information on environmental processes which influence the environmental fate of a chemical pollutant. In the context of LCA these simple evaluative models are generally not adequate to predict actual concentrations.

The incremental concentration is insufficient to predict any actual hazard or risk. To overcome this, Assies proposes to incorporate the ambient concentration. Heijungs & Guinée hold that the ambient concentration is not to be incorporated in an LCA, but is the subject of substance policy, which supplements product policy. In their opinion LCA is about potential risks, and not about actual risks.

This is more or less the situation to the authors. Needless to say that the views of other experts in the field of life-cycle impact assessment on this matter is highly appreciated. Do you agree on our common points of view? And if you do not agree, can you settle the question? Or do you still have another point? Please consider these points carefully, read our more detailed proposals [6, 7], and write, either directly to us, or if you think your reaction is worth reading for more experts, to the editor of this newsletter.

[1] De Oude, N.T., 1993. *Experts need ... experts.* SETAC-Europe LCA-news 3, no.2: 1-2.

[2] Heijungs, R. & J.B. Guinée, 1993. *CML on actual versus potential risks.* SETAC-Europe LCA-news 3, no.4: 4.

[3] Assies, J.A., 1994. *Experts need ... experts (II).* SETAC-Europe LCA-news 4, no.1: 5-6.

[4] Heijungs, R. & J.B. Guinée, 1993. *The flux-pulse problem in LCA.* SETAC-Europe LCA-news 4, no.3: 6-7.

[5] Mackay, D., 1991. *Multimedia environmental models, the fugacity approach.* Lewis Publishers Inc., Chelsea.

[6] Guinée, J.B., and R. Heijungs. *A proposal for the classification of toxic substances within the framework of life cycle assessment of products.* Chemosphere 26, 1925-1944.

[7] Assies, J.A., 1994. *On the assessment of toxic emissions in life cycle impact assessment.* Accepted for publication in the proceedings of the fourth SETAC-Europe congress, 10-14 April 1994, Brussels.

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"Ecobalances for Companies" - A new field of LCA-applicati

In many of today's companies there is a need and will to have an "environmental balance sheet", not only for individual products (on the basis of product-LCAs), but also for the company itself. It makes sense to optimise both over the whole life cycle of products - as is being done in product-LCAs - as well as over a company. The latter may be considered a single "unit of responsibility". Within a company one has of course not full, but still a large degree of autonomy to how to gear the processes. In addition, there are clear links between today's structure of an LCA and a company-based assessment. For both applications, the LCA-structure of "goal definition - inventory - assessment - improvement" is useful. Also for a company, rules about "How to define the company as a functional unit" are needed, an inventory of environmental interventions (inputs and emissions) has to be taken and these interventions have to be assessed on ecological grounds.

But how to call that "baby"? During the recent Workshop of the SETAC Working Group on Impact Assessment in Zürich, the terms "company-LCA", "company Ecobalance" (similar to the German word "Unternehmungs-Ökobilanz") and "company environmental statement" (as an element of an environmental management system) were proposed, but no decision has been taken yet.

In a recently published book [1], a method for such company ecobalances is presented. The method was developed during 1990-1992 by the

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