Towards the development of a salinity impact category for South African environmental life-cycle assessments: Part 1 – A new impact category

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Abstract

Environmental life-cycle assessments conducted in South Africa to date have made use of published equivalency (or characterisation) factors for characterising ecotoxicity effects. These factors are calculated using environmental fate and effect models, and generate equivalency factors that are not necessarily valid for South African conditions. Furthermore, current models do not adequately characterise the effects of common ions associated with salinity impacts. Salinisation of South African water resources is of strategic concern, and the need for life-cycle assessments to be able to incorporate salinity effects is apparent. There are sufficiently clear cause-effect relationships between the sources and impacts of salinity, and impacts are sufficiently different in nature from existing categories to warrant a separate salinity impact category. A conceptual method is proposed for creating a new salinity impact category for life-cycle assessment and for calculating salinity equivalency factors. The proposed method meets the international requirements for creating new impact categories and it is recommended that the method be developed further.

Keywords: environmental life-cycle assessment, salination

Introduction

The environmental life-cycle assessment (LCA) technique for evaluating the environmental impact of products from cradle to grave is not new. Environmental assessments of products were carried out as far back as the 1960s. From the end of the 1980s, however, interest in LCA has grown strongly, and the methodological development has reached the point where standardisation has occurred through organisations such as the International Organisation for Standardisation and SETAC (Wenzel et al., 1997).

Details of the LCA method are described elsewhere (Wenzel et al., 1997). Briefly; releases of all environmentally significant compounds to the environment from all stages of a product's life-cycle are inventoried (for example, in units of kg substance released per kg of product produced). During the next stage (classification /characterisation), each impact parameter of the inventory table is converted into a contribution to one or more environmental themes, or impact categories. This is done by multiplying the mass of compound released due to the life-cycle activity by equivalency factors (or characterisation factors) for the compound. Equivalency factors are calculated using characterisation models. In terms of the requirements of ISO 14042, the following impact categories and sub-categories are obligatory:

- Depletion of abiotic resources
- Effects of land use
  - Increase in land competition
- Climate change
- Stratospheric ozone depletion
- Human toxicity
- Eco-toxicity
  - Fresh-water aquatic
  - Marine
  - Terrestrial
- Photo-oxidant formation
- Acidification
- Nutrification.

The following additional optional categories have been defined, and are not obligatory at this stage.

- Effects of land use
  - Loss of life support
  - Loss of biodiversity
- Toxicity
  - Fresh-water sediment
  - Marine sediment
- Radiation
- Depletion of biotic resources
- Desiccation
- Noise
- Waste heat
- Casualties.

Characterisation

Several characterisation models are available for estimating equivalency factors for each compound contributing to a specific impact category (See Table 1 for the models generally in use). Equivalency factors are generally estimated using environmental fate and exposure models, and are indicators of the probability of exposure and probability that the exposure leads to an effect (i.e. risk). The impact parameters (or release) for each compound and each compartment are multiplied by the respective equivalency factors and the results are added to give a total score for each impact category.

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