

Technical University of Denmark



Development of characterization factors for metals in coastal seawater

Hauschild, Michael Zwicky; Dong, Yan; Rosenbaum, Ralph K.

Publication date:
2014

[Link back to DTU Orbit](#)

Citation (APA):

Hauschild, M. Z., Dong, Y., & Rosenbaum, R. K. (2014). Development of characterization factors for metals in coastal seawater. Abstract from SETAC Europe 24th Annual Meeting, Basel, Switzerland.

DTU Library

Technical Information Center of Denmark

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Title: Development of characterization factors for metals in coastal seawater

Author: Michael Z. Hauschild¹, Yan Dong¹, Ralph K. Rosenbaum¹

Affiliation: ¹Quantitative Sustainability Assessment, Department of Management Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark

Email: mzha@dtu.dk

Session: Advancements in life cycle impact assessment and footprint method development

Track: Life cycle analysis and sustainability

Short Abstract: Metal ecotoxicity Characterization Factors (CFs) in coastal seawater were not developed in USEtox for Life Cycle Impact Assessment (LCIA), due to lack of appropriate ecotoxicity data and inadequate consideration of metal bioavailability in seawater. Taking into account the speciation behavior of metals in seawater and using effect data exclusively for marine organisms, two sets of spatially differentiated CFs were developed for the metals Cd, Co, Cu(II), Ni, Pb and Zn in coastal seawater. One set of CFs (CF_{sw-sw}) addresses the direct metal emission to coastal seawater while the other set (CF_{fw-sw}) represents the ecotoxicity potential of metals in coastal seawater caused by metal emission to freshwater followed by transport to the seawater compartment, taking into account the fate of metal in freshwater and in the estuary.

CF is the product of three factors: Fate Factor (FF), Bioavailability Factor (BF), and Effect Factor (EF). The multimedia fate model of USEtox was used to calculate the FF. WHAM 7.0 was used to model metal speciation underlying the BF. Free Ion Activity Model (FIAM) was used to model EF. The results showed that for a given metal, FF in seawater was higher than in freshwater, due to longer residence time of the water in the coastal seawater than in freshwater. The difference between FF in seawater and freshwater was smaller since the difference in water residence time was partially neutralized by metal removal in estuaries. Metal BFs in seawater were similar or slightly higher than in freshwater due to the lower DOC and SPM concentration in seawater. For most metals, EFs were lower in seawater than freshwater, due to lower sensitivity of seawater biota to metals. As a general observation, CF_{fw-sw} was lower than CF_{sw-sw} due to metal removal in freshwater and estuary, but the difference was modest for most metals. For Pb, seawater CF were up to 1-4 orders of magnitude higher than freshwater CF. But for the other metals, seawater CFs were similar to freshwater CFs, indicating that the higher FF and BF in seawater were largely counterweighed by the lower EF for these metals. The variation of CFs in different coastal seawaters were up to ca. 2-3 orders of magnitude for one metal, indicating the importance of using spatially differentiated CFs. Compared with USES-LCA default CF_{sw-sw} , the new CF_{sw-sw} were at least 3 orders of magnitude lower for all metals except Pb, of which USES-LCA CF_{sw-sw} fall within the range of this study. This implied that for some metals, ecotoxicity CFs in coastal seawater might be overestimated in previous LCIA methods.

Keywords: LCIA, ecotoxicity, marine, metal