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Getting the chemicals right: addressing inorganics in sustainability assessments of technologies

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A main goal of sustainability research is to enable a technological development in industry and elsewhere that ensures that what is produced and how it is produced today does not harm the quality of human or environmental health for present and future generations. As part of current environmental sustainability assessments, the toxicity potential of several thousand organic chemicals is included in characterization models within life cycle impact assessment (LCIA). However, many economic production processes involve the use of inorganic chemicals to a large extent, while the related pressure on human and environmental health of environmental emissions of these substances is not yet fully understood and not included in any existing LCIA method. In this presentation, we provide an overview of the relevance of inorganic chemicals and outline possible ways towards incorporating inorganic chemicals in LCIA toxicity characterization.

Substances such as sodium sulfate decahydrate, sodium hydroxide, sodium carbonate, titanium(IV)oxide, and sodium hydrosulfite are used in large quantities e.g. in the textile industry [1], in the personal care sector [2] and/or in the building and construction industry. However, these inorganic substances are considered neither in current life cycle inventory databases nor in state-of-the-art LCIA characterization models. While some specific inorganic substances are included in impact assessment models for climate change (e.g. sulphur hexafluoride or carbon dioxide) or eutrophication (e.g. phosphorus pentoxide or nitrogen dioxide), human and eco-toxicity assessment models do currently not consider any inorganic substances except some cationic metals. Without the integration of inorganic substances such as salts, acids, bases and elements, however, no conclusions regarding the environmental sustainability of any technology containing any of these substances can be drawn.

The modelling approaches for different substance groups will be contrasted, for which a simple approach based on Kow is not suitable to characterize toxicity-related impacts, such as cationic metals, nanoparticles, and perfluorinated alkylated substances (PFAS). Differences in physicochemical properties and environmental fate of these specific substance groups compared to inorganic substance groups like acids, bases, and salts will be discussed. Furthermore, an approach to address environmental impacts like increased salinity as well as possible relevant chemical reaction pathways as a first step towards an adapted fate modelling toward a broader set of inorganic substances will be outlined as a necessary step toward improving the assessment of environmental sustainability of technologies containing inorganic substances in their life cycle.

[1] Chemicals Agency 2014, Report No. 6/14, Chemicals in textiles – Risks to human health and the environment.
[2] National Library of Medicine. Household Products Database. Last modified: September, 2016. Available from URL: http://householdproducts.nlm.nih.gov/index.htm. Accessed on November 10, 2016.