

Global Human Toxicity Potential assessed with the ProScale method for use in Normalisation in LCA

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Life Cycle Assessment (LCA) is widely used to quantify the overall environmental impact of products, and methods are increasingly harmonised through e.g. the Product environmental Footprint (PEF) initiative of the European Commission [1].

So far, methods to assess human toxicity impacts cover the indirect impact of chemicals emitted into the environment. ProScale was developed as a method to fill this gap for a hazard and exposure-based quantitative scoring system for comparing direct chemical risks (corresponding to near-field human toxicity) to workers, professionals and consumers associated with products in a life cycle perspective [2].

Examples of applying ProScale are emerging [3,4], showing that the method works and can be integrated into LCA. But in order to align with other impact assessment approaches for the benefit of LCA and PEF practitioners, there is also a need for a global normalisation score [5] for ProScale. The study described here presents the results of the first calculation of two such Normalisation scores for ProScale, inhalation and dermal.

Method: ProScale scores are calculated (as detailed in [1]) as $PSS = HF \times ECF \times PHF \times MF$, where: PSS denotes the ProScale Score (separate for inhalative, oral and dermal exposure routes); HF is the Hazard Factor for a substance, derived based on H-phrase hazard bands and OEL/DNEL; ECF is the Exposure Concentration Factor, and is based on rescaled ECETOC TRA [6] exposure estimates; PHF is a Person-Hour Factor describing the person-hours of work needed per unit output or input of a process (product or service); and MF is the Mass Flow, describing the amount of a substance needed to produce a product (kg per functional unit).

For the global Normalisation score, we focused on petrochemistry and plastics. For about 60 individual processes, ProScale scores for inhalation and dermal exposure were calculated. Then, the global annual production, or in some cases production capacity, was identified through a range of literature sources, normally covering a year in the period 2015-2018.

Result: The resulting Normalisation scores are: ProScale(inhalation): 1.2E+14 ProScale points, and ProScale(dermal): 1.2E+13 ProScale points. Among the assessed and included processes, the three dominating processes are crude oil extraction (43% and 69% for inhalation and dermal, respectively), crude oil refining (27/7) and steam cracking (20/18).

Discussion: As a first version of normalisation scores, the numbers calculated here could be used, but cover a limited part of the global economy. Possibly important other processes are for example metal production processes. The domain of residential exposure from building material is also not included at this point. This may mean that when using these scores in regular LCA projects, direct human toxicity potential as calculated with ProScale will potentially be slightly overestimated. Further work is planned to elaborate the issue further.

References

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