PROSCALE:

Human Toxicity Assessment in LCA

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GOAL

Although regulatory requirements are in place to ensure the safe use of chemicals in their application, the ambition to reduce the environmental impacts of products along their life cycle is often combined with an ambition to identify and reduce hazards and exposures. As there is currently no methodology available to compare hazard and exposure performance along the lifecycle and identify priorities for improvement, requirements are often based on purely hazard-based lists for priority substances without evaluating their risk in specific applications.

LCA is widely used to quantify the overall environmental impact of products along the life cycle but the models for toxicity impacts are focusing on the indirect impact of chemicals emitted into the environment. As a performance-based indicator for the application in LCA, ProScale assesses hazard and direct exposure potentials from chemicals along their life cycle. It can be integrated in LCA to compare human toxicity potentials of alternatives. Furthermore, Environmental Product Declarations ("EPDs") and Product Environmental Footprints ("PEFs") in life cycle thinking, a risk-based approach for product assessments can be applied.

Several companies from the Industrial Sustainability practitioner network (ISPN) were involved in the method development and applying the method in LCA.

METHODS

The ProScale methodology is a function of the four parameters (Figure 1):

– **Hazard Factor (HF)** – Describes the hazard of a substance, reflecting health effect, severity and potency based on hazard statements (also called H-phrases) and acceptable concentration levels (e.g. OEL, DNEL).

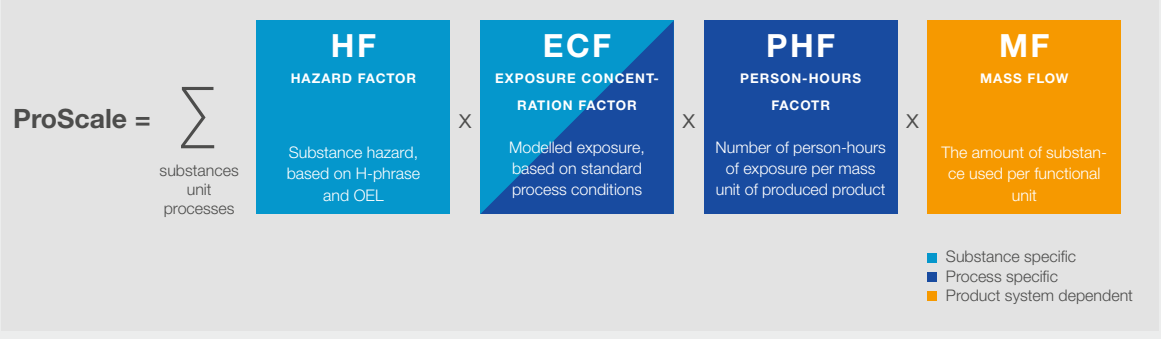
– **Exposure Concentration Factor (ECF)** – Describes the exposure concentration of a substance based on exposure modelling using the ECETOC TRA Tier 1 exposure model.

– **Person-Hours Factor (PHF)** – Number of person-hours of exposure per mass unit of produced product or service.

– **Mass Flow (MF)** – Describes the amount of a substance needed per functional unit of a product.

The Hazard Factor, the Exposure Concentration Factor, the Persons-Hours Factor and the Mass Flows are calculated for each substance and each unit process and then combined to establish the ProScale score.

FIGURE 1:
Illustration of the ProScale methodology.



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RESULTS

Insulation boards aggregates were assessed in a cradle-to-gate approach together when the final insulation boards are produced.

The results can be shown in different ways. One option is to show all the product contributions linked with the pre-chain, another option is to list the results product by product. Table 1 shows all summarized ProScale factors including the pre-chain. Polystyrene is the most significant material due to the high input to the boards. It is followed by the pentane impact and the flame retardant.

	POLY-STYRENE	PENTANE	GRAPHITE	FLAME RETARDANT	NEOPOR BEAD	PENTANE (BOARD PROD)
INHALATION	1,56E-01	9,16E-03	0	1,61E-03	0	9,59E-03
DERMAL	1,54E-03	7,91E-05	0	6,37E-06	0	7,91E-05
ORAL	0	0	0	0	0	0

TABLE 1:
ProScale PSP in toxicity points of the insulation materials test case

Table 1 shows, which materials along the life cycle have the highest impact. That is oil production, followed by the naphtha input and the benzene. Polystyrene as material has no direct impact, because it does not have an H-phrase as a material.

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