Improving substance coverage for more accurate ecotoxicity normalisation factors

A Consortium-based approach

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Context

The product footprinting method developed by the EBS Consortium for **cosmetic products is** based on the **Product Environmental Footprint (PEF)** of the European Commission (EC). It covers the **entire life cycle of products**, from raw material extraction to end-of-life, including the fate of the formula after usage.

The life cycle impact assessment method used is **EF 3.1**, and the impact category **Freshwater ecotoxicity (adapted from USEtox) is driving the normalised and weighted single score of most products** (accounting on average for **15-30% of the aggregated score** for Face Care, Hair Wash and Hair Treat products), and in general is the **main differentiator** between products.

After a deep dive into that impact category, **several limitations** were identified:

1. High **uncertainty** in the ingredient characterisation factors (CFs)
2. Low **coverage** for cosmetic ingredients
3. **The Normalisation factor (NF) for Freshwater ecotoxicity** is **too low** because of incomplete inventories (Crenna et al., 2019)[1]

The Consortium decided to focus on two elements: **review of existing CFs and calculation of new CFs** (see Poster 5.04.P-Tu497) and **improve the NF** (the focus of this work).

What is the EBS Consortium?

The EcoBeautyScore (EBS) Consortium aims at developing a common environmental impact scoring system for cosmetic products. Its main purpose is to enable consumers to make more informed purchasing decisions based on a harmonised environmental impact assessment of products. Its main objectives include creating a common method for environmental impact assessment and establishing methodological principles for scoring products based on a rating scale, e.g. A-E. The scope of the Consortium covers all cosmetic products and has 70+ members, aiming for inclusivity regardless of size or resources.

Purpose of this work

Evaluate the cosmetics industry's contribution to the Normalisation Factor for Freshwater ecotoxicity (NF_{FE}) and therefore improve its quality through collection of company data, which is the strength of a Consortium-like initiative.

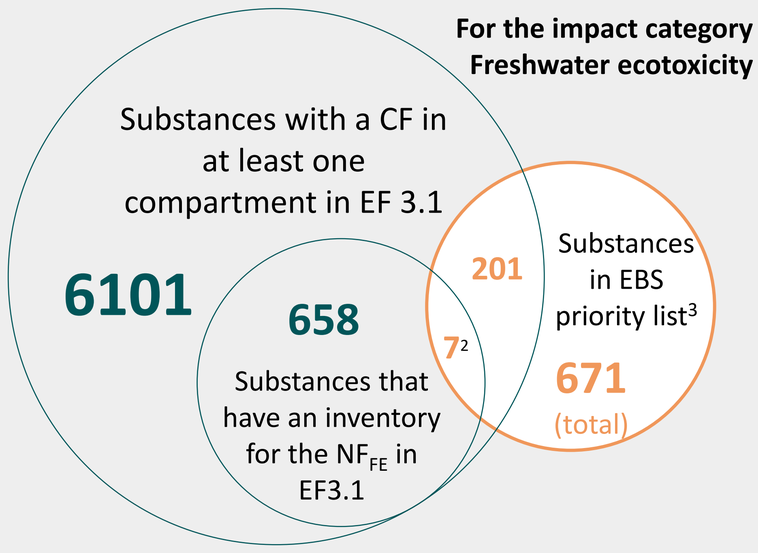
Underestimated NF for Freshwater ecotoxicity – a well-known issue

- The three USEtox impact categories are the only ones of the EF 3.1 method package to be given the **lowest grade of III for both "Inventory coverage completeness" and "Inventory robustness"**.
- Because the NF_{FE} is too low, the ecotoxicity impact contribution is **overweighted in the normalised single score.**

$$\sum_{\text{All chemicals}} \left[\text{Total emissions into the environment (based mainly on national inventories)}\right] \times \left[\text{Characterisation factors in EF3.1}\right] = \text{Normalisation factor for Freshwater ecotoxicity } (NF_{FE})$$

Incomplete because:
- Gaps in reported chemical emissions
- Global emissions are based on EU inventories which are scaled up (Saouter et al., 2018), which might not be representative for many chemicals due to the specific EU regulations

Incomplete because many chemicals do not have a CF in EF3.1 *(see the work of the EBS Consortium on the CFs in Poster 5.04.P-Tu497)*



[2] All 'emissions to air' from propellants or alcohols. [3] List of substances determined as part of the Consortium work reflecting the most used ingredients in Body Wash, Hair Wash, Hair Treat, and Face Moisturizing products.

Method

Step 1 Calculate company specific contributions to the normalisation factor

The Consortium constructed a **tool** in the form of an excel spreadsheet that was circulated to companies so they can calculate and report their **"company specific" contribution to the NF** to the Consortium.

Step 2 Sum across all companies for which data were collected

Step 3 Extrapolation to the entire industry

$$\text{Extrapolation factor} = \frac{\text{Estimated turnover of the entire cosmetic industry (inc. personal care)}}{\text{Turnover of the companies that participated in the study}}$$

Sources: WWD and Statista

$$\underset{\text{Companies}}{\sum_{(2)}} \left[\underset{\text{Chemicals}}{\sum} \left[\underset{(1)}{\text{Cosmetic ingredients total volumes (annual tonnage)}} \times \text{1- Removal rate} \times \text{Characterization factors (or proxy values)} \right] \right] \times \underset{(3)}{\text{Extrapolation factor based on covered market share}} = \text{Normalisation factor for the Cosmetic industry}$$

Company total usage of chemicals in all their products for the year of reference, in tons, with chemicals identified via INCI names + CAS numbers from the company's internal systems.

Assumption 1: All cosmetic products are washed-off and discharged to wastewater.
Assumption 2: Substance-specific fraction is removed during wastewater treatment.
Source of the Removal Rates: Multiple sources combined by experts, including HAD tables, ECHA, ChemSpider, EPIsuite…
NB: Same assumptions as for the pharmaceutical industry contribution to the NF in EF 3.1 (Leclerc et al., 2019)

Source of the Characterisation Factors:
- EF 3.1
- Re-calculated and new CFs as per Consortium work (see Poster 5.04.P-Tu497)
- When no CFs were found, a proxy was used to avoid 'No Data No Impact'

Match by INCI name and CAS# to allow more matches, including when several CAS# are associated to the chemical from the company's internal system
NB: this resulted in several CFs found for some chemicals, hence a MIN and a MAX NF calculated

Results

Current Normalisation Factor in EF3.1 = 3.91E+14 CTUe

Unit = CTUe	MINIMUM NF FOR COSMETIC INDUSTRY (based on MIN CF & without proxy values)	MAXIMUM NF FOR COSMETIC INDUSTRY (based on MAX CF & with proxy values)	% of current EF3.1 NF
Before extrapolation	1.18E+13	2.61E+13	3.0 – 6.7 %
After extrapolation	7.07E+13	1.56E+14	18 – 40 %

New Normalisation Factor based on EBS work (MAX with proxy) = 5.47E+14 CTUe

Main limitations

- MIN/MAX issue – **data** require more **cleaning** on the companies' side
- Potential remaining **errors in the CFs**
- Limitations of the **USEtox method**, such as exposure routes coverage
- **Representativeness** of the companies that participated might need to be assessed more thoroughly
- The **extrapolation method** only gives a ballpark figure and this could be improved
- Applies only to emissions from the cosmetic industry – need to revise emissions from **other sectors**

Conclusions and recommendations

Proof of concept is a success

Company-specific data were collected while ensuring confidentiality. The exercise was faster and less resource-intensive than expected.

Influence on the Normalisation Factor is significant.

6-7% of current EF3.1 NF, 18-40% if extrapolated, which gives an indication of the current underestimation for the cosmetic sector only.

Improving the NF will require a more coordinated activity

Improving the global Freshwater ecotoxicity NF will require improved emission estimate for other sectors.

References: Crenna et al. (2019) - *Global environmental impacts: data sources and methodological choices for calculating normalization factors for LCA;* Saouter et al (2018) - *Environmental Footprint: Update of Life Cycle Impact Assessment Methods – Ecotoxicity freshwater, human toxicity cancer, and non-cancer; Leclerc et al. (2019) - Building national emission inventories of toxic pollutants in Europe; WWD = https://wwd.com/beauty-industry-news/beauty-features/2022-top-100-global-beauty-manufacturers-1235621361/ [Accessed on 15-04-2024]; Statista = https://www.statista.com/outlook/cmo/beauty-personal-care/worldwide [Accessed on 15-04-2024].*