SIEGWERK'S PARTIAL PRODUCT ENVIRONMENTAL FOOTPRINT

(P-PEF)

PRODUCT SAFETY TRANSPARENCY by SIEGWERK

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1. GENERAL INFORMATION

One of Siegwerk´s core objectives is to become a circular and digital packaging solutions company, to contribute positively and responsibly to society and the environment. In this respect, Siegwerk has set key priorities for its business strategy, including: capture opportunities from circular economy and digitalization; increase efficiency and effectiveness in the core business; bring the best out of people; and make sustainability a driving force. Further, this strategy upholds a commitment to preserve the long term independence and future success of the privately owned enterprise.

To translate Siegwerk's sustainable business strategy into tangible action, Siegwerk pursues continuous improvement, compliance, and ambitious targets. The continuous improvement activities are driven by the local organizations and are the back-bone of our sustainable business practices. The ambitious targets are managed through Siegwerk's sustainable business program HorizonNOW. HorizonNOW is organized along 4 platforms and is monitored along 7 targets. All targets are to be fulfilled by 2025. New targets will be set in due time for the years to come. With these actions Siegwerk has direct impact on six carefully chosen UN Sustainable Development Goals (SDG).[1]

Siegwerk, a leading manufacturer of printing inks, extends its efforts in sustainability and continues on the path of giving clear information of the environmental impact of its products. Therefore, after being able to give detailed information on the Partial Product Carbon Footprint (P-PCF) of its products, Siegwerk extends now this set of information to Partial Product Environmental Footprint data (P-PEF) which can be given for every sold product.

2. PRODUCT ENVIRONMENTAL FOOTPRINT

2.1 What is to be understood by Product Environmental Footprint?

The PEF aims to transparently communicate essential environmental parameters. This approach enables comparability, standardization, and harmonization of product environmental performance. The PEF impact categories relate to specific environmental effects, such as resource use and emissions of harmful substances.

PEF relies on Life Cycle Assessment (LCA) principles, considering material flows, energy consumption, emissions, and waste streams associated with a product or organization. By analyzing the entire life cycle, a comprehensive picture of environmental impacts emerges. The benefits of PEF include consistency (providing a standardized approach), supply chain consideration (promoting sustainable practices), and the ability to reduce environmental impact through informed decision-making.

2.2 Different Impact Categories of PEF

As a complete picture, Siegwerk will share clear and detailed information on the following environmental impact categories on single product level:

- Product Carbon Footprint
- Biorenewable Content
- Acidification Potential
- Land Use
- Eutrophication Potential
- Water Footprint
- Ozone Depletion Potential
- Circular Material Use Rate

2.2.1 Product Carbon Footprint (PCF)

The Product Carbon Footprint (PCF) quantifies all greenhouse gas emissions associated with a product throughout its life cycle. From raw material extraction to production, use, and disposal, it

[1] United Nations Department of Economic and Social Affairs, Sustainable Development – THE 17 GOALS, https://sdgs.un.org/goals (12.06.2024).

captures emissions. The PCF helps identify, analyze, and reduce these impacts. Calculations follow the Greenhouse Gas Protocol (GHG), a widely used standard. It includes direct (Scope 1) and indirect (Scope 2 and 3) emissions. Scope 1 covers direct emissions from owned sources, while Scope 2 includes purchased electricity-related emissions. Scope 3 accounts for the entire value chain.

All Partial Product Carbon Footprint (P-PCF) relevant values are given in the unit $kgCO_{2eq}$)/kg with 2 decimal numbers.

For more detailed information about this most prominent impact category of the PEF, please ask your Siegwerk representative about the Product Carbon Footprint Whitepaper.[2]

2.2.2 Product Biorenewable Content (PBRC)

Biorenewable chemicals can serve as feedstock in the chemical industry. They offer a sustainable alternative to petroleum-based carbon feedstocks. These chemicals are derived from sources like agricultural feedstock, biomass, organic waste, and other renewable materials. Examples include fermentation products like ethanol, the cellulose part of nitrocellulose, glycerol, and fatty acids. Their use can contributes, focusing on the complete life cycle of a product, to a lower carbon footprint.

All PBRC values are given in % of the liquid and of the dried ink film without decimal numbers.

For more detailed information on the PBRC, including Siegwerk´s Biorenewable definition, please ask your Siegwerk representative about the Biorenewable Content Whitepaper.[3]

2.2.3 Product Acidification Potential (PAP)

The Product Acidification Potential is an environmental indicator that assesses soil and water acidification. Acidic precipitation occurs when air pollutants are converted into acids, lowering the pH of rainwater and mist to 5.6 or below. This indicator is used within the framework of the PEF to evaluate the environmental impacts of products. PAP is considering the release of protons from acid-forming substances.

All PAP values are given in mol(H^+_{eq}) with 5 decimal numbers.

2.2.4 Product Land Use (PLU)

Product Land use quantifies the land area required for raw material extraction, production, and disposal. By considering factors like deforestation, habitat loss, and soil degradation, the impact on ecosystems is given. Product Land use is crucial because it affects biodiversity, carbon sequestration, and overall sustainability. Understanding land use helps design more sustainable products and minimize ecological harm.

All Product Land Use values are given in Eco-Point Pt with 1 decimal number.

2.2.5 Product Eutrophication Potential (PEP)

Product Eutrophication Potential assesses the impact of nutrient enrichment (e.g., nitrogen and phosphorus) on ecosystems. It leads to excessive algae growth, oxygen depletion, and harm to aquatic life. Reducing nutrient emissions helps mitigate eutrophication and promotes environmental sustainability.

In order to give the full picture for the Product Eutrophication Potential Siegwerk is splitting this one environmental impact category into 3 different values. With this more detailed information Siegwerk will demonstrate the impact of its products within the eutrophication of the freshwater (Product Eutrophication Potential – Freshwater (PEP-F)), the eutrophication of the sea (Product Eutrophication Potential – Marine (PEP-M)) and the eutrophication of the land (Product Eutrophication Potential – Terrestrial (PEP-T))

All three different Product Eutrophication Potential values are given in kg(PO_{4eq})/kg (PEP-F), kg(N_{eq})/kg (PEP-M) and mol(N_{eq})/kg (PEP-T) with 5 decimal numbers.

2.2.6 Product Water Footprint (PWF)

The PWF assesses the water-related impact of a product throughout its life cycle. It considers water consumption, pollution, and scarcity. Key aspects include blue water (surface and groundwater), green water (rainwater), and grey water (polluted water). By quantifying water use and its environmental consequences, we promote sustainable practices.

All PWF values are given in $m^3_{deprived}$/kg with 2 decimal numbers.

2.2.7 Product Ozone Depletion Potential (PODP)

The Product Ozone Depletion Potential measures a chemical compound's impact on the stratospheric ozone layer. It quantifies the relative degradation caused by the substance compared to trichlorofluoromethane (R-11 or CFC-11), which has an PODP fixed at 1.01. Brominated compounds typically have higher PODP values (5 to 15), while pure fluorocarbons have an PODP of 0.

[2] https://www.siegwerk.com/fileadmin/Data/Documents/Circular_Economy_Publications/EN/CO2_Whitepaper.pdf
[3] Biorenewable Content Whitepaper available on request

PODP informs environmental policies and promotes ozone layer protection.

All PODP values are given in kg($CFC11_{eq}$)/kg with 5 decimal numbers.

2.2.8 Product Circular Material Use Rate (PCMUR)
The Product Circular Material Use Rate assesses how efficiently materials are used in a circular economy. It quantifies the proportion of recycled or reused materials compared to total material consumption.

All PCMUR values are given in % without decimal numbers.

3. SIEGWERK´S PARTIAL PRODUCT ENVIRONMENTAL FOOTPRINT (P-PEF)

3.1 Siegwerk´s approach
For the P-PEF data generation and calculation all relevant environmental impacts from the cradle to the customers gate will be taken into consideration. This approach is already well known from Siegwerk´s P-PCF data submission. It is the only reliable scope under the consideration of Siegwerk's position in the supply chain. A direct influence is given only on this part of the product cycle. Most downstream stages of the product life cycle are outside of Siegwerk's direct influence and are in the responsibility of Siegwerk's customers and their customers, up to the end of life scenario. As a consequence all relevant impact categories are given as partial value – they are part of the environmental impact of the complete packaging or product.

For the realistic P-PEF determination all the relevant sources with significant environmental impact need to be considered. All other potential but negligible sources are not included in Siegwerk´s P-PEF calculation. The packaging of Siegwerk´s product for example is customer specific and can't be generalized in order to be included in the Siegwerk P-PEF product value. Furthermore the portion of the packaging to the P-PCF is <1%.

By providing these information to customers Siegwerk will enable the respective companies to precisely and easily determine **their own complete P-PEF**.

The **P-PEF which is specified individually for each product sold by Siegwerk, is to be understood as a "cradle to customer gate"** P-PEF. A detailed explanation of the approach is given in the upcoming chapter. The approach for **all indicators of the PEF follows the TÜV validated approach for PCF in line with ISO 14067:2019**.[4]

3.2 Siegwerk´s Database generation
In order to be able to share detailed product specific Scope 3 information, an ISO 14067:2019 compliant data collection was initiated for the whole purchased raw material portfolio.

- Specific supplier information regarding the P-PEF values of their products were used whenever the supplier was able to offer valuable data in accordance to ISO 14067:2019.
- Different Life Cycle Assessment (LCA) databases were used which nearly cover Siegwerk's entire raw material portfolio.
- Raw material data not directly covered by these LCA databases are determined by using the principle of highest chemical similarity for LCA data allocation.

3.2.1 Supplier Information
As a best case, the most accurate information for a purchased raw materials should be directly received from the supplier of Siegwerk (as the producer of the raw materials used in Siegwerk´s products). Therefore if applicable, on case by case basis, particular supplier data on individual raw materials are considered. The collection of suppliers data is following the strict ISO standard 14067:2019 requirements.

3.2.2 Databases
The choice of the right database for the establishment of LCA data is one of the most critical steps in the baseline setting. Therefore a thorough analysis of available tools was done and a verification with an external consultant on applicability was conducted.

In light of Siegwerk´s raw material portfolio it was concluded that the use of different databases is necessary.

[4] *Validation statement No. 3846898-2-PCF*

The current procedure can be described as follows:

- Data for nearly all raw materials (90%) are covered by the **LCA database Ecoinvent 3.8**.[5]
- In order to cover special classes of raw materials, like pigments · which for the time being are not yet available in Ecoinvent 3.8, alternative Databases (**Environmental Footprint Database**[6] and the **Evah Pigment Database**[7]) are being used.
- All databases are used with the **OpenLCA 2.0.2**[8] Life Cycle and Sustainability Assessment software for finally calculating the PCF.
- The used impact assessment method **EF 3.1 Climate Change**[9] is the best available approximation to be **ISO 14067:2019 compliant.** This is used to calculate the emissions of the raw material production as well as the emissions generated by transportation in a 100 year time period.
- The information retrieved is updated on regular basis.

4. SIEGWERK´S PARTIAL PRODUCT ENVIRONMENTAL FOOTPRINT – VALUES SHARED

The P-PEF information that Siegwerk shares for its products represents an comprehensive overview of all environmental impact categories shown under 2.2. This overview is made available for selected customers in the form of a PEF Pass, which contains all relevant data and additional background information.

The P-PEF data is given as follows:

DISPLAYED INFORMATION	UNIT
Partial Product Carbon Footprint (P-PCF)	
Fossil GHG emissions of P-PCF	kg (CO_{2eq})/kg (product)
Biogenic GHG emissions of P-PCF	kg (CO_{2eq})/kg (product)
Land use & change GHG emissions of P-PCF	kg (CO_{2eq})/kg (product)
Partial Biogenic Carbon	kg (CO_{2eq})/kg (product)
Partial Biogenic Carbon	kg C/kg (product)
Partial-Product Biorenewable Content (P-PBRC)	
Partial-Product Biorenewable Content (dry film)	%
Partial-Product Biorenewable Content (wet ink)	%
Partial Product Acidification Potential (P-PAP)	
Partial-Product Acidification Potential	mol (H^+_{eq})
Partial-Product Land Use (P-PLU)	
Partial-Product Land Use	Pt
Partial-Product Eutrophication Potential (P-PEP)	
Partial-Product Eutrophication Potential - Freshwater (P-PEP-F)	kg (PO_{4eq})/kg
Partial-Product Eutrophication Potential - Marine (P-PEP-M)	kg (N_{eq})/kg
Partial-Product Eutrophication Potential - Terrestrial (P-PEP-T)	mol (N_{eq})/kg
Partial-Product Water Footprint (P-PWF)	
Partial-Product Water Footprint	$m^3_{deprived}$/kg
Partial-Product Ozone Depletion Potential (P-PODP)	
Partial-Product Ozone Depletion Potential	kg $(CFC11_{eq})$/kg
Partial-Product Circular Material Use Rate (P-PCMUR)	
Partial-Product Circular Material Use Rate	%

[5] *Ecoinvent v3.8 (https://ecoinvent.org/the-ecoinvent-database/data-releases/ecoinvent-3-8/)*
[6] *Environmental Footprint Database (https://eplca.jrc.ec.europa.eu/EnvironmentalFootprint.html)*
[7] *Evah Pigment Database (http://www.evah.com.au/our-services.html)*
[8] *Open LCA 2.0.2 (https://www.openlca.org/download/)*
[9] *EF 3.1 Climate Change (https://eplca.jrc.ec.europa.eu/LCDN/developerEF.html)*

5. CONFIRMATION OF THE APPROACH

The approach presented is based on Siegwerk´s P-PCF approach developed and reviewed in cooperation with the external consultant Ramboll and validated by the external auditing body TÜV SÜD (**Validation statement No. 3846898-2-PCF**).

It is confirmed that Siegwerk´s approach is in line with the requirements of ISO 14067:2019 which enables Siegwerk's customers to precisely determine their own GHG emissions on the basis of the data provided by Siegwerk.