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Questions and answers on determining the product carbon footprint of masterbatches

What is a product carbon footprint?

A product's carbon footprint (PCF) shows its greenhouse gas emissions in CO_2 equivalents throughout its entire life cycle. This includes the extraction of raw materials, the manufacturing process, the usage phase and the recycling and disposal stages.

What are the various methods for calculating a carbon footprint?

There are three different approaches:

Gate to gate: The calculation is made within the factory boundaries.

Cradle to gate: The calculation is made from the extraction of raw materials to the factory gate.

Cradle to grave: The calculation is made from the cradle to the grave. For products intended for end consumers (B2C), additional aspects such as purchasing, usage and disposal must be taken into account.

Are there any standards or guidelines for calculating carbon footprints?

There are various standards and guidelines for carbon footprints, for example:

- PAS 2050
- Greenhouse Gas Protocol (GHG Protocol 2011)
- DIN Standards Committee Principles of Environmental Protection (NAGUS): DIN EN ISO 14067.2018
- Guideline from the *Together for sustainability* initiative TfS_PCF_guidelines_2022-interactif-pages.pdf (tfs-initiative.com)

What data is needed to calculate carbon footprints:

All emissions from the process under consideration must be accounted for:

The Greenhouse Gas Protocol (GHG) has proven to be a useful tool, assigning CO_2 emissions to different "scopes":

- Scope 1: Self-controlled emissions (direct), including gas
- Scope 2: Purchased energy (indirect), including electricity
- Scope 3: Supplied emissions (indirect), including **raw materials**

A precise delineation of emissions should help to ensure that emissions are not accounted for and listed multiple times by two or more companies in the same scope.

Where can you obtain the data needed to calculate your carbon footprint?

Suppliers are the best source of information on the raw materials, energy sources and activities (e.g. transport) under consideration.

However, greenhouse gas emission values are not available for all energies, raw materials or activities. Missing data can be found in life cycle assessment databases. However, the CO_2 equivalents available in the individual databases may differ.

Do the data always produce the same results?

Different calculation and exclusion criteria, as well as different CO_2 values in various life cycle assessment databases, mean that different results can be obtained when calculating the same product.

PCF values in the masterbatch industry

What raw materials are used to manufacture masterbatches?

A wide range of raw materials are used in the production of masterbatches. These can be divided into the following raw material groups:

- Polymers
- Pigments and fillers
- Additives (e. g. UV stabilisers, antistatic agents, flame retardants).

Depending on the application, there are three types of masterbatches: colour masterbatches, additive masterbatches and combination masterbatches (those containing both colourants and additives).

What data is required to determine the PCF of masterbatches?

To calculate the PCF values of masterbatches, the PCF values of the raw materials (Scope 3) must be known, as well as the parameters of the manufacturing processes.

Where can I obtain the values for the raw materials used in the manufacturing process?

PCF values for **precursors** (additives, other polymers, etc.) should be requested from suppliers. If no data is available, it can be obtained from the following sources:

- PCF values for certain **pigments and fillers** were determined by the pigment and filler manufacturers of Verband der Mineralfarbenindustrie e. V. The PCF values for the pigment groups and further information on the product carbon footprint are available on the Eurocolour homepage: eurocolour_flyer_carbon_footprint_05.2022.pdf

- PCF values for a range of **polymers** are publicly available (source: PlasticsEurope https://plasticseurope.org/sustainability/circularity/life-cycle-thinking/eco-profiles-set/).

- Databases, such as Ecoinvent, contain a large number of CF values from a wide range of areas, such as energy, packaging and chemicals. However, they often incur costs.

- Recipe components that are only very low concentrations in the masterbatch and have no significant influence on its PCF can be disregarded in the calculation. However, this must be justified and comprehensible.

What is the best approach for calculating the carbon footprint of masterbatches?

Due to the diversity of applications and processing chains, the cradle-to-gate approach is recommended for determining the PCF of masterbatches (B2B product).

Which processes need to be taken into account in the manufacturing process or the cradle-to-gate calculation?

To determine or estimate PCF values for typical masterbatches, companies must systematically calculate the greenhouse gas emissions (in CO_2 equivalents) generated during the entire manufacturing process of the masterbatch (up to the point of leaving the factory) in relation to the total quantity produced (per kg):

Scope 1 + Scope 2

- Mixing / grinding / dispersing
- Production of masterbatches (process, temperature / energy input)
- Storage – raw materials and possibly finished masterbatches
- Cleaning of machines / extruders
- Packaging of masterbatches
- Transport, if necessary (multiple locations within the premises)

Scope 3

- CF value of the formulation (raw materials known, read across if applicable)
- Any waste from production, cleaning, disposal

Must all process steps be accounted for individually, or can an average value be calculated?

As an alternative to considering the individual process steps, it is possible to take a broad view of the total operational energy consumption and distribute it across the volume of goods/products manufactured. This involves considering electrical energy as well as energy from fossil or renewable energy sources such as gas, oil, biogas and wood.

Which factors and boundary conditions must be precisely defined in order to determine the PCF?

- Energy mix
- Limits of consideration in formulations
- Worst-case and best-case scenarios

How is the PCF value specified?

In general, the PCF value is specified as kg CO_2 equivalents per unit considered, i.e. for a product as follows:
Greenhouse gas emissions (CO_2 equivalents) in relation to the total quantity produced (preferably per kg) with the unit kg Co_2 e / kg.

Are there any programmes available for PCF calculations?

Various programmes are available for this purpose, some of which have their own database, e.g.:

- CCalc-Tool www.ccalc.org.uk (including a database with many CF values)
- Pro Bas
- Fee-based calculation programmes

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Masterbatch Verband – German Masterbatch Association
The association represents the interests of German manufacturers of colour and additive masterbatches. It is a sector group of Verband der Mineralfarbenindustrie e. V. (VdMi).

The VdMi is listed in the Lobbying Register for the Representation of Special Interests vis-à vis the German Bundestag and the Federal Government (Lobbyregister des Deutschen Bundestags, number R000760) as well as in the Transparency Register of the EU Commission (number 388728111714-79).