



October 2021

Environmental Product Declaration (EPD)

ARDEX EP 2000

Multi-Functional Epoxy Resin

FEICA (Association of European Adhesive & Sealant Industry) has developed Model Environmental Product Declarations (Model EPDs) independently verified by the Institute Construction and Environment (IBU). The compliance of our products to the Model EPDs is checked on the base of our formulations, by using an IBU approved guideline procedure verified to EN 15804 and ISO 14025.

We hereby declare that the product

ARDEX EP 2000 Multi-Functional Epoxy Resin

meets the criteria of the attached Model EPD

EPD-FEI-20150298-IBG1-EN for “reactive resins based on epoxy resin, unfilled/solvent free with low content of reactive diluent”

This means that the life cycle assessment data and other content of the Model EPD apply to these named products and may be used for sustainability assessment of the construction products and construction projects, in which they are used.

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ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

| | |
|--------------------------|---|
| Owner of the Declaration | FEICA - Association of the European Adhesive and Sealant Industry |
| Programme holder | Institut Bauen und Umwelt e.V. (IBU) |
| Publisher | Institut Bauen und Umwelt e.V. (IBU) |
| Declaration number | EPD-FEI-20150298-IBG1-EN |
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| Valid to | 13/06/2022 |

Reactive resins based on epoxy resin, unfilled/solvent-free with low content of reactive diluent
FEICA - Association of the European Adhesive and Sealant Industry



www.bau-umwelt.com / <https://epd-online.com>



1. General Information

FEICA - Association of the European Adhesive and Sealant Industry

Programme holder

IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Declaration number

EPD-FEI-20150298-IBG1-EN

This Declaration is based on the Product Category Rules:

Reaction resin products, 07.2014
(PCR tested and approved by the SVR)

Issue date

14/12/2015

Valid to

13/06/2022



Prof. Dr.-Ing. Horst J. Bossenmayer
(President of Institut Bauen und Umwelt e.V.)



Dr. Burkhard Lehmann
(Managing Director IBU)

Reactive resins based on epoxy resin, unfilled/solvent-free with low content of reactive diluent

Owner of the Declaration

FEICA - Association of the European Adhesive and Sealant Industry
Rue Belliard 40 box 10
1040 Brussels
Belgium

Declared product / Declared unit

1 kg reactive resin based on epoxy resin,
unfilled/solvent-free; density 1 - 1.25 g/cm³

Scope:

This validated Declaration entitles the holder to bear the symbol of the *Institut Bauen und Umwelt e.V.* It exclusively applies for products produced in Europe and for a period of five years from the date of issue. This EPD may be used by FEICA members and their members provided it has been proven that the respective product can be represented by this EPD. For this purpose a guideline is available at the FEICA secretariat. The members of FEICA are listed on its website. The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

Verification

The CEN Norm /EN 15804/ serves as the core PCR

Independent verification of the declaration
according to /ISO 14025/

internally externally



Mr Olivier Muller
(Independent verifier appointed by SVR)

2. Product

2.1 Product description

Reactive resins based on epoxy resin, unfilled/solvent-free

The reactive resins are manufactured in a two-component process using epoxy resins and hardening agents.

They comply with multiple, often specific tasks in the construction, fitting and repair of structures. By using reactive resins based on epoxy resin, unfilled/solvent-free, the fitness for use of structures is decisively improved and their life time extended.

The product displaying the highest environmental impacts was used as a representative product for calculating the Life Cycle Assessment results (worst case-approach).

2.2 Application

Reactive resins based on epoxy resins, unfilled/solvent-free, are used for the following applications:

Module 1: Reactive resins for protecting and repairing concrete structures

Products for **surface protection of concrete**, for increasing the durability of concrete and reinforced concrete structures as well as for new concrete and for maintenance and repair work; products for **structural bonding** for the structural bonding of strengthening materials to an existing concrete structure and **products for concrete injection for filling cracks, voids and interstices in concrete**

Module 2: Reactive resins for liquid-applied bridge deck waterproofing kits

Products for liquid-applied waterproofing for use on concrete bridge decks

Module 3: Reactive resins for watertight covering kits

Watertight covering kits for wet room floors and/or walls inside buildings

Module 4: Screed material and floor screeds

Products for screed / synthetic resin screed for use in floor constructions

Module 5: Reactive resins for waterproofing components made of concrete or brickwork and for pre-treating mineral sub-surfaces such as screed or concrete flooring prior to flooring, parquet and tiling work

Applications in accordance with the manufacturer's technical documentation / declaration of performance

Module 6: Reactive resins for optical design of concrete components

Products for usually coloured design of concrete accompanied by less-specified surface protection and improved durability of concrete and reinforced concrete surfaces. The same applies for other mineral sub-surfaces such as plaster, stone and brickwork.

On account of the susceptibility of epoxy resin layers to weathering factors (yellowing, whitening after extensive weathering), a final polyurethane-based coating is usually applied to epoxy layers in outdoor applications.

2.3 Technical Data

Module 1: Reactive resins for protecting and repairing concrete structures

The minimum requirements apply in accordance with /EN 1504/. These are:

1.1 **Surface protection** systems for concrete –

Requirements on performance characteristics for all intended uses in accordance with /EN 1504-2:2005-01/, Tables 1 and 5:

- Permeability to CO₂ (/EN 1062-6:2002-10/)
- Water vapour permeability (/EN ISO 7783-1-2:2012-02/)
- Capillary absorption and permeability to water (/EN 1062-3:2008-04/)
- Adhesive strength by pull off test (/EN 1542:1999-07/)

1.2 Products for **structural bonding** – Performance characteristics for all intended uses in accordance with Tables 3.1 and 3.2 (manufacturer's declaration of performance)-

1.3 Products for **concrete injection** for filling cracks, voids and interstices in concrete– Requirements on performance characteristics for all intended uses in accordance with /EN 1504-5:2005-03/, Table 3:

- Injectability (/EN 1771:2004-11/)
- Viscosity (/EN ISO 3219:1994-10/)

Other performance characteristics in accordance with the manufacturer's technical documentation / declaration of performance

Module 2: Reactive resins for liquid-applied bridge deck waterproofing kits

The minimum requirements of /ETAG 033/ apply.

The performance characteristics must be indicated in accordance with the European Technical Assessment.

Module 3: Reactive resins for watertight covering kits

The minimum requirements of the /ETAG 022/ apply. The performance characteristics must be indicated in accordance with the European Technical Assessment.

Module 4: Screed material and floor screeds

The minimum requirements of /EN 13813:2003-01/ apply. For synthetic resin screeds, these are:

- Bond strength (/EN 13892-8:2003-02/)
- Reaction to fire (/EN 13501-1:2010-01/)

Performance characteristics in accordance with the manufacturer's technical documentation / declaration of performance

Module 5: Reactive resins for waterproofing components made of concrete or brickwork and for pre-treating mineral sub-surfaces such as screed or concrete flooring prior to flooring, parquet and tiling work

The following minimum requirements must be fulfilled:

| Name | Value | Unit |
|----------------------------------|---------|--------------------|
| Shore hardness A /ISO 7619-1,2/ | > 15 | |
| Shore hardness D /ISO 7619-1,2/ | > 10 | |
| Density /EN ISO 2811: 2011-06/ | 0,8-1,5 | kg/dm ³ |
| Viscosity /EN ISO 3219: 1994-10/ | < 100 | Pa s |

Other performance characteristics are in accordance with the manufacturer's technical documentation / Declaration of Performance / Declaration of Conformity

Module 6: Reactive resins for optical design of concrete components

Physical data on the coating material and/or coating must be indicated in accordance with the respective product standards; these can include, for example:

- Viscosity (/EN ISO 3219:1994-10/)
- Density (/EN ISO 2811:2011-06/)
- Pendulum damping (/ISO 1522:2007-04/)
- Reaction to fire (/EN 13501-1:2010-01/)
- Tensile strength (/EN 13892-8:2003-02/)

Other performance are characteristics in accordance with the manufacturer's technical documentation / declaration of performance.

2.4 Placing on the market / Application rules

For the placing on the market in the EU/EFTA (with the exception of Switzerland) products falling under the Regulation (EU) No 305/2011 need a Declaration of Performance taking into consideration either the relevant harmonised European standard or the European Technical Assessment and the CE-marking. For the application and use of the products the respective national provisions apply.

2.5 Delivery status

Liquid or pasty in containers made of tinplate or plastic appropriately prepared in separate or combi-containers for the practical mixing ratio. One kg of product in individual containers. Sealants in plastic cartridges and poly-tube bags made of foil compound materials.

Typical container sizes contain 10 to 25 kg of material. For more extensive applications, vats containing approx. 200 kg or IBCs containing more than 1 tonne are also used.

A sheet steel container was modelled for the Life Cycle Assessment.

2.6 Base materials / Ancillary materials

The reactive resins based on epoxy, unfilled/solvent-free, comprise a resin and a crosslinking agent component. The resin component (A-component) contains Diglycidylether based on Bisphenol-A or Bisphenol-F resins (MW < 700). Hardening occurs when installed on site with the crosslinking agent component. For this purpose, polyamines, polyamides, polyamine adducts or mixtures of the same are used. The components can contain so-called reactive diluting agents (glycidether) and other auxiliaries such as accelerators, catalysts, wetting agents, foam regulators and viscosity regulators for fine adjustment of the product properties.

The mixing ratio for resin and crosslinker is adjusted in accordance with the stoichiometric requirements. Product crosslinking starts immediately after mixing the components.

On average, the products covered by this EPD contain the following range of base materials and auxiliaries:

- Resin component: ~ 60-90%
- Crosslinker component: ~ 5-20%
- Reactive diluting agent: ~ 0-30%

Other: ~ <1.5%

The ranges referred to above are average values and the composition of products complying with the EPD can deviate from the concentration volumes referred to in individual cases. More detailed information is provided by the respective manufacturer (e.g. on product data sheets).

In individual cases, it is possible that substances on the list of particularly harmful substances for inclusion in Annex XIV of the /REACH/ Ordinance are included in concentrations of more than 0.1%. If this is the case, this information can be found on the respective safety data sheet.

2.7 Manufacture

The formulated product components are usually mixed from the ingredients in batch mode and packaged for delivery, whereby quality and environmental standards in accordance with /ISO 9001:2008-12/ and the provisions outlined in the relevant regulations such as the Industrial Safety Regulation and Federal Pollution Control Act are adhered to.

2.8 Environment and health during manufacturing

As a general rule, no other environmental protection measures other than those specified by law are necessary.

2.9 Product processing/Installation

Reactive resins based on epoxy resin, unfilled/solvent-free, are processed by trowelling/knife-coating or rolling, pouring, spraying or injection, whereby health and safety measures (hand and eye protection, ventilation, respiratory equipment) are to be taken and consistently adhered to in accordance with the information on the safety data sheet and conditions on site. Reactive resins based on epoxy, unfilled/solvent-free, react after mixing resin and crosslinking agent under heat generation (exothermicity). The mixed components must therefore be processed swiftly within the pot life indicated. If larger volumes of the mixture remain in the container, this can lead to overheating and decomposition. In the case of reactively diluted products, exothermicity is particularly strong. VOC-emissions may occur.

2.10 Packaging

A detailed description of packaging is provided in section 2.5. Empty containers and clean foils can be recycled.

2.11 Condition of use

During the use phase, reactive resins based on epoxy, unfilled/solvent-free, are crosslinked and essentially comprise an inert, three-dimensional network. They are long-lasting products which protect our buildings in the form of primer, coatings or sealings and make a significant contribution towards retaining their function and long-term value.

2.12 Environment and health during use *Option 1 – Products for applications outside indoor areas with permanent stays by people*

During use, reactive resins based on epoxy, unfilled/solvent-free, lose their reactivity and are inert. No risks are known for water, air and soil if the products are used as designated.

Option 2 – Products for applications inside indoor areas with permanent stays by people

When used in indoor areas with permanent stays by people, evidence of the emission performance of construction products in contact with indoor air must be submitted according to national requirements. No further influences on the environment and health by emanating substances are known.

2.13 Reference service life

Reactive resins based on epoxy resin, unfilled/solvent-free, comply with various, often specific tasks associated with the construction or refurbishment of building structures. They decisively improve the usability of building structures and significantly extend their Reference Service Life. The anticipated Reference Service Life depends on the specific installation situation and associated product exposure. It can be influenced by weather factors as well as by mechanical or chemical loads.

2.14 Extraordinary effects

Fire

Even without any special fire safety fittings, the reactive resins based on epoxy, unfilled/solvent-free, comply with the minimum requirements of /EN 13501-1/ for fire class E and Efl. In terms of the volumes used, they only have a subordinate effect on the fire characteristics of a building (e.g. smoke gas development) in which they are installed. As cross-linked epoxy resins involve a duroplastic material, it does not melt or drip with the result that the resins do not contribute to fire spread, whereas the combustibility of cross-linked epoxy resins is greater than that of other duroplastics. Among other substances, formaldehyde and phenol can be formed in the event of a fire.

Water

The reactive resins based on epoxy, unfilled/solvent-free, are chemically inert and water-insoluble. They are often used for protecting building structures from harmful water ingress / the effects of flooding.

Mechanical destruction

Mechanical destruction of reactive resins based on epoxy resin does not lead to any decomposition products which are harmful to the environment or health.

2.15 Re-use phase

According to present knowledge, no environmentally-harmful effects are generally anticipated in landfilling, for example, as a result of de-construction and recycling of building materials to which crosslinked epoxy resin products are adherent.

If epoxy systems can be removed from construction products without any noticeable effort, thermal utilisation is a practical recycling variant on account of their energy content.

Minor adhesion is not taken into consideration during disposal. It does not interfere with disposal/recycling of the remaining components / building materials.

2.16 Disposal

Individual components which can no longer be recycled must be combined at a specified ratio and hardened.

Hardened product residue is not special waste.

Non-hardened product residue is special waste. Empty, dried containers (free of drops and scraped clean) are directed to the recycling process. Residue must be directed to proper waste disposal taking consideration of local guidelines.

The following European Waste Codes waste (EWC) codes can apply:

Hardened product residue:

/EWC 2000/532/EC 080112/ with the exception of those covered by /EWC 2000/532/EC08 01 11/

/EWC 2000/532/EC 080410/ with the exception of those covered by /EWC 2000/532/EC 08 04 09/

2.17 Further information

More information is available in the manufacturer's product or safety data sheets and is available on the manufacturer's Web sites or on request. Valuable technical information is also available on the associations' Web sites.

3. LCA: Calculation rules

3.1 Declared Unit

This EPD refers to the declared unit of 1 kg reactive resin based on epoxy resin, unfilled/solvent-free of density 1 - 1.25 g/cm³ in the mixing ratio required for processing both components in accordance with the PCR Part B for Reactive resin products.

Consumption per unit area of the products to be applied extensively can range between only a few hundred grams and more than 1 kg per square metre. In the case of products, which are injected, the application volume depends on the component to be injected.

The results of the Life Cycle Assessment provided in this declaration have been calculated from the product with the highest environmental impact (worst-case scenario).

Declared unit

| Name | Value | Unit |
|---------------------------|-------|------|
| Declared unit | 1 | kg |
| Conversion factor to 1 kg | 1 | - |

3.2 System boundary

Modules A1-A3, A4, A5 and D are taken into consideration in the LCA:

- A1 Production of preliminary products
- A2 Transport to plant
- A3 Production incl. provision of energy, production of packaging as well as auxiliaries and consumables, waste treatment)
- A4 Transport to site
- A5 Installation (disposal of packaging & installation losses and emissions during installation)
- D Credits from incineration of packaging materials & installation losses and recycling of the metal container

The declaration is therefore from "cradle to gate - with options".

3.3 Estimates and assumptions

Where no specific /GaBi/ processes were available, the individual recipe ingredients of formulation were estimated on the basis of information provided by the manufacturer or literary sources.

3.4 Cut-off criteria

All raw materials submitted for the formulations and production data were taken into consideration.

The manufacture of machinery, plants and other infrastructure required for production of the products under review was not taken into consideration in the LCA.

Transport of packaging materials is also excluded.

3.5 Background data

Data from the /GaBi 6/ database was used as background data. Where no background data was available, it was complemented by manufacturer information and literary research.

3.6 Data quality

Representative products were applied for this EPD and the product in a group displaying the highest environmental impact was selected for calculating the LCA results. The datasets are less than 5 years old. Production data and packaging are based on details provided by the manufacturer. The formulation used for evaluation refers to a specific product.

3.7 Period under review

Representative formulations were accepted by FEICA Ltd and collected in 2011.

3.8 Allocation

No allocations were applied for production. A multi-input allocation with a credit for electricity and thermal energy was used for incineration of production residues and packaging materials. The credits achieved through packaging disposal are declared in Module D.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account. In this case, 1 kg reactive resin was selected as the declared unit. Depending on the application, a corresponding conversion factor such as the specific unit area must be taken into consideration.

4. LCA: Scenarios and additional technical information

The following technical information forms the basis for the declared modules or can be used for developing specific scenarios in the context of a building evaluation if modules are not declared (MND).

Transport to the building site (A4)

| Name | Value | Unit |
|---------------------------------|--------|---------|
| Litres of fuel | 0.0016 | l/100km |
| Transport distance | 1000 | km |
| Capacity utilisation (including | 85 | % |

| | | |
|---------------------------------------|-------------|-------------------|
| empty runs) | | |
| Gross density of products transported | 1000 - 1250 | kg/m ³ |
| Capacity utilisation volume factor | 1 | - |

Installation into the building (A5)

| Name | Value | Unit |
|------------------------|-------|------|
| Material loss | 0.01 | kg |
| VOC in the air (NMVOC) | 0.02 | kg |

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

| PRODUCT STAGE | | | CONSTRUCTION PROCESS STAGE | | USE STAGE | | | | | | | END OF LIFE STAGE | | | | BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES |
|---------------------|-----------|---------------|-------------------------------------|----------|-----------|-------------|--------|-------------|---------------|------------------------|-----------------------|----------------------------|-----------|------------------|----------|---|
| Raw material supply | Transport | Manufacturing | Transport from the gate to the site | Assembly | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | De-construction demolition | Transport | Waste processing | Disposal | Reuse-Recovery-Recycling-potential |
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| X | X | X | X | X | MND | MND | MNR | MNR | MNR | MND | MND | MND | MND | MND | MND | X |

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 kg reactive resin based on epoxy resin, unfilled/solvent-free

| Parameter | Unit | A1-A3 | A4 | A5 | D |
|--|--|----------|----------|----------|-----------|
| Global warming potential | [kg CO ₂ -Eq.] | 5.81E+0 | 4.91E-2 | 9.15E-2 | -1.50E-1 |
| Depletion potential of the stratospheric ozone layer | [kg CFC11-Eq.] | 5.96E-10 | 2.02E-13 | 3.84E-13 | -1.01E-11 |
| Acidification potential of land and water | [kg SO ₂ -Eq.] | 1.19E-2 | 1.26E-4 | 1.39E-5 | -5.43E-4 |
| Eutrophication potential | [kg (PO ₄) ³⁻ -Eq.] | 1.51E-3 | 3.11E-5 | 2.58E-6 | -4.40E-5 |
| Formation potential of tropospheric ozone photochemical oxidants | [kg ethene-Eq.] | 2.28E-3 | -3.41E-5 | 7.22E-3 | -7.46E-5 |
| Abiotic depletion potential for non-fossil resources | [kg Sb-Eq.] | 2.47E-5 | 1.93E-9 | 1.10E-9 | -4.53E-9 |
| Abiotic depletion potential for fossil resources | [MJ] | 1.17E+2 | 6.76E-1 | 2.01E-2 | -1.55E+0 |

RESULTS OF THE LCA - RESOURCE USE: 1 kg reactive resin based on epoxy resin, unfilled/solvent-free

| Parameter | Unit | A1-A3 | A4 | A5 | D |
|--|-------------------|---------|---------|---------|----------|
| Renewable primary energy as energy carrier | [MJ] | 4.38E+0 | IND | IND | IND |
| Renewable primary energy resources as material utilization | [MJ] | 0.00E+0 | IND | IND | IND |
| Total use of renewable primary energy resources | [MJ] | 4.38E+0 | 3.79E-2 | 2.25E-3 | -2.27E-2 |
| Non-renewable primary energy as energy carrier | [MJ] | 1.23E+2 | IND | IND | IND |
| Non-renewable primary energy as material utilization | [MJ] | 0.00E+0 | IND | IND | IND |
| Total use of non-renewable primary energy resources | [MJ] | 1.23E+2 | 6.79E-1 | 2.38E-2 | -1.60E+0 |
| Use of secondary material | [kg] | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 |
| Use of renewable secondary fuels | [MJ] | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 |
| Use of non-renewable secondary fuels | [MJ] | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 |
| Use of net fresh water | [m ³] | 3.41E-2 | 6.65E-5 | 2.35E-4 | -1.91E-4 |

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES:

1 kg reactive resin based on epoxy resin, unfilled/solvent-free

| Parameter | Unit | A1-A3 | A4 | A5 | D |
|-------------------------------|------|---------|---------|---------|----------|
| Hazardous waste disposed | [kg] | 1.11E-3 | 3.22E-7 | 6.99E-9 | -6.38E-9 |
| Non-hazardous waste disposed | [kg] | 3.90E-2 | 9.66E-5 | 1.38E-3 | 1.76E-3 |
| Radioactive waste disposed | [kg] | 2.51E-3 | 9.27E-7 | 1.47E-6 | -1.80E-5 |
| Components for re-use | [kg] | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 |
| Materials for recycling | [kg] | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 |
| Materials for energy recovery | [kg] | 0.00E+0 | 0.00E+0 | 0.00E+0 | 0.00E+0 |
| Exported electrical energy | [MJ] | 0.00E+0 | 0.00E+0 | 1.14E-1 | 0.00E+0 |
| Exported thermal energy | [MJ] | 0.00E+0 | 0.00E+0 | 2.67E-1 | 0.00E+0 |

6. LCA: Interpretation

All impacts are associated with the production phase (A1-A3). The most significant contribution to the production phase impacts is the upstream production of raw materials as main driver. Another relevant contributor in the production phase, in the category of Abiotic Depletion Potential Elements (**ADPE**), is the steel sheet used as a packaging material. The majority of life cycle energy consumption takes place during the production phase (A1-A3). Significant contributions to Primary Energy Demand – Non-renewable (**PENRT**) derive from the energy resources used in the production of raw materials. The largest contributor to Primary Energy Demand – Renewable (**PERT**) is the consumption of renewable energy resources required for the generation and supply of electricity. During manufacturing (A1-A3) some

influence also arises due to the wooden pallets used as packaging that need solar energy for photosynthesis. It should be noted that Primary Energy Demand – Renewable (**PERT**) generally represents a small percentage of the production phase primary energy demand with the bulk of the demand coming from non-renewable energy resources. Transportation to the construction site (A4) and the installation process (A5) make a negligible contribution to almost all impacts. The only exception is the photochemical ozone creation potential (**POCP**) that is significantly influenced by the installation of the product due to emissions of benzyl alcohol of maximum 2%. This leads to a contribution of the installation phase of up to 80% on the overall life cycle of the product.

Emissions associated with the manufacturing of products (A3) only have a minor influence on POCP. In module A4, transport to construction site, values for POCP are negative due to emission profile modelled for the selected transportation process and of the characterisation method used in CML 2001 for the calculation of the POCP.

Scrap burdens and energy credit from incineration of packaging material reported in module D are not important (contribution <2.5% for most results). CO₂ is the most important contributor to Global Warming Potential (GWP). For the Acidification Potential (AP), NO_x and SO₂ contribute to the largest share.

7. Requisite evidence

VOC

Special tests and evidence have not been carried out or provided within the framework of drawing up this Model EPD. Some member states require special documentation on VOC emissions into indoor air for specific areas of application. This documentation, as well as documentation for voluntary VOC labelling, has to be provided separately and is specific for products in question.

Evidence pertaining to VOC emissions shall show

- either an attestation of compliance with,
- or documentation of test data that are required in, any of the existing regulations or in any of the existing voluntary labeling programs for low-emitting products, as far as these

(1) include limits for the parameters TVOC, TSVOC, carcinogens, formaldehyde, acetaldehyde, LCI limits for individual substances (including but not limited to the European list of harmonized LCIs), and the R value;

(2) base their test methods on /CEN/TS 16516/ (or /EN 16516/, after the on-going revision of /CEN/TS 16516/);

(3) perform testing and apply the limits after 28 days storage in a ventilated test chamber, under the conditions specified in /CEN/TS 16516/; some regulations and programs also have limits after 3 days, on top of the 28 days limits;

(4) express the test results as air concentrations in the European Reference Room, as specified in CEN/TS 16516.

Examples of such regulations are the Belgian /Royal Decree C-2014/24239/, or the German /AgBB/. Examples of such voluntary labeling programs are EMICODE, Blue Angel or Indoor Air Comfort.

Relevant test results shall be produced either by an /ISO 17025/ accredited commercial test lab, or by a qualified internal test lab of the manufacturer.

Examples for the applied limits after 28 days storage in a ventilated test chamber are:

- TVOC: 1000 µg/m³
- TSVOC: 100 µg/m³
- Each carcinogen: 1 µg/m³
- Formaldehyde: 100 µg/m³
- LCI: different per substance involved
- R value: 1 (meaning that, in total, 100% of the combined LCI values must not be exceeded).

Informative Annexes (2 tables):

The table shown below is an overview of the most relevant regulations and specifications as of April 2015, as regards requirements after 3 days storage in a ventilated test chamber.

| | TVOC [µg/m ³] | Sum of carcinogens. C1A,CA2 [µg/m ³] | Formal- dehyde [µg/m ³] | Acet- aldehyde [µg/m ³] | Sum of Form- and Acet- aldehyde |
|-----------------------------|------------------------------|---|---|---|--|
| German DIBt/AgBB regulation | 10 000 | 10 | -/- | -/- | -/- |
| draft Lithuanian regulation | 10 000 | 10 | -/- | -/- | -/- |
| EMICODE EC1 | 1 000 | 10 | 50 | 50 | 50 ppb |
| EMICODE EC1 ^{PLUS} | 750 | 10 | 50 | 50 | 50 ppb |

The table above provides an overview of the most relevant regulations and specifications as of April 2015, as regards requirements after 28 days storage in a ventilated test chamber. Some details may be

missing in the table due to lack of space. Values given represent maximum values/limits.

| | TVOC [µg/m³] | TSVOC [µg/m³] | Each carcinogen C1A,CA2 [µg/m³] | Formaldehyde [µg/m³] | Acetaldehyde [µg/m³] | LCI | R value | Specials | Sum non-LCI & non- identified [µg/m³] |
|-----------------------------|-----------------|------------------|--|-------------------------|-------------------------|------------------|---------|-----------------------------|--|
| Belgian regulation | 1000 | 100 | 1 | 100 | 200 | Belgian list | 1 | Toluene 300 µg/m³ | -/- |
| French regulations class A+ | 1000 | -/- | -/- | 10 | 200 | -/- | -/- | List of 8 VOCs, 4 CMR | -/- |
| French regulations class A | 1500 | -/- | -/- | 60 | 300 | -/- | -/- | List of 8 VOCs, 4 CMR | -/- |
| French regulations class B | 2000 | -/- | -/- | 120 | 400 | -/- | -/- | List of 8 VOCs, 4 CMR | -/- |
| French regulations class C | >2000 | -/- | -/- | >120 | >400 | -/- | -/- | List of 8 VOCs, 4 CMR | -/- |
| German DIBt/AgBB regulation | 1000 | 100 | 1 | 100 | 1200 | German AgBB list | 1 | -/- | 100 |
| draft Lithuanian regulation | 1000 | 100 | 1 | product type specific | -/- | Lithuanian list | 1 | -/- | -/- |
| | | | | | | | | | |
| EMICODE EC1 | 100 | 50 | 1 | (after 3 days) | (after 3 days) | -/- | -/- | -/- | -/- |
| EMICODE EC1 ^{PLUS} | 60 | 40 | 1 | (after 3 days) | (after 3 days) | German AgBB list | 1 | -/- | 40 |
| Finnish M1, sealants | 20 | -/- | 1 | 10 | -/- | -/- | -/- | Ammonia, odour | -/- |
| Finnish M1, adhesives | 200 µg/m²h | -/- | 5 µg/m²h | 50 µg/m²h | -/- | -/- | -/- | Ammonia, odour | -/- |

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