FEICA (Association of European Adhesive & Sealant Industry) has developed so-called Model Environmental Product Declarations (Model EPDs) and had them independently verified by the Institute Construction and Environment (IBU). These IBU verified Model EPDs have been made publicly available by FEICA and IBU. The Model EPDs represent the current production technology in Europe. ARDEX GmbH as a member of Deutsche Bauchemie e.V., which is a national association member of FEICA, has the right to declare that a specific FEICA Model EPD applies to the named product listed below. The compliance of our products to the Model EPDs is checked on the base of our formulations, by using an IBU-approved guideline procedure. We hereby declare that the product

**ARDEX G8S FLEX 1-6, Flexible grout 1-6 mm, rapid**

meets the criteria of the attached Model EPD

**EPD-FEI-20160042-IBG1-EN for “Modified mineral mortars, group 2”**

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.

**ARDEX GmbH**

ppa.  

Dr. Markus Stolper  
Head of Marketing and Sales

Dr. Julia Soldat  
Sustainability Manager

**Appendix:**

EPD with declaration number: **EPD-FEI-20160042-IBG1-EN**
## ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

<table>
<thead>
<tr>
<th>Owner of the Declaration</th>
<th>FEICA - Association of the European Adhesive and Sealant Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme holder</td>
<td>Institut Bauen und Umwelt e.V. (IBU)</td>
</tr>
<tr>
<td>Publisher</td>
<td>Institut Bauen und Umwelt e.V. (IBU)</td>
</tr>
<tr>
<td>Declaration number</td>
<td>EPD-FEI-20160042-IBG1-EN</td>
</tr>
<tr>
<td>ECO EPD Ref. No.</td>
<td>ECO-00000373</td>
</tr>
<tr>
<td>Issue date</td>
<td>23.05.2016</td>
</tr>
<tr>
<td>Valid to</td>
<td>22.05.2021</td>
</tr>
</tbody>
</table>

**Modified mineral mortars, group 2**

**FEICA - Association of the European Adhesive and Sealant Industry**
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

Modified mineral mortars, group 2

Owner of the Declaration
FEICA - Association of the European Adhesive and Sealant Industry
Avenue E. van Nieuwenhuyse 4
1160 Brussels
Belgium

Declaration number
EPD-FEI-20160042-IBG1-EN

This Declaration is based on the Product Category Rules:
Mineral factory-made mortar, 07.2014
(PCR tested and approved by the SVR)

Issue date
23.05.2016

Valid to
22.05.2021

Verfication
The CEN Norm /EN 15804/ serves as the core PCR
Independent verification of the declaration according to /ISO 14025/

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

Dr. Burkhard Lehmann
(Managing Director of IBU)

Dr. Burkhard Lehmann
(Independent verifier appointed by SVR)

2. Product

2.1 Product description
Modified mineral mortars are combinations of one or more inorganic binder, aggregates, water and if necessary additives. They comply with manifold, often specific, tasks in the construction, furnishing and refurbishment of buildings.
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
Modified mineral mortars are used for the following applications:

Module 1: Modified mineral mortars as repair mortar for the protection and repair of concrete structures
1.1 Products for structural and non-structural repair which are used to restore the original condition of concrete structures and/or to replace defective concrete
1.2 Products for reinforcement corrosion protection

Module 2: Adhesives based on modified mineral mortars

2.1 Products for bonding ceramic tiles as well as natural stone for internal and external installations on walls, floors and ceilings

2.2 Products for bonding thermal insulation composite panels

Module 3: Modified mineral mortars as joint fillers
Products for joint filling of wall and floor coverings made of ceramic tiles as well as natural stone for indoor and outdoor applications

Module 4: Modified mineral mortars as cementitious screed, floor levelling compounds, filler, flowing screed
Products for manufacturing bonded screed, screeds on separating or insulating layers, for levelling and repairing usual building substrates such as rough, uneven concrete floors, cement, anhydrite and mastic asphalt screed, heated screed and ceramic coverings for indoor and outdoor applications

Module 5: Modified mineral mortars as levelling compounds for walls and ceilings
Products for levelling and repairing rough, uneven walls, for repairing grit spots, closing blowholes and modelling broken corners and edges

Module 6: Modified mineral mortar as grouts
Module 7: Modified mineral mortars for waterproofing slurries
Products for providing cement-based waterproofing surfaces in structural and civil engineering. For use in new and old buildings as well as beneath tiles (mineral or flexible waterproofing slurries)

Module 8: Modified mineral mortars as repair mortar
Products for carrying out repairs (e.g. for repairing minor voids and holes) on horizontal and vertical areas

2.3 Technical Data
Construction products with Declaration of Performance in accordance with /CPR/

Module 1: Modified mineral mortars as repair mortar for the protection and repair of concrete structures
The minimum requirements according to /EN 1504/ apply. These are:

1.1 Products for structural and non-structural repair - Requirements on performance characteristics for all intended uses in accordance with /EN 1504-3/, Table 1:
- Compressive strength (/EN 12190/)
- Chloride ion content (/EN 1015-17/)
- Adhesive strength by pull off test (/EN 1542/)
- Restrained shrinkage/expansion (/EN 12617-4/)

1.2 Reinforcement corrosion protection products – Requirements on all intended uses in accordance with /EN 1504-7/, Table 1:
- Corrosion protection (/EN 15183/)
Other performance characteristics in accordance with the manufacturer's technical documentation / declaration of performance

Module 2: Adhesives based on modified mineral mortar

2.1 The minimum requirements in accordance with /EN 12004/ apply. These are:
- Tensile adhesion strength after dry storage (/EN 1348/)
- Tensile adhesion strength after water immersion (/EN 1348/)
- Tensile adhesion strength after heat ageing (/EN 1348/)
- Tensile adhesion strength after freeze/thaw cycles (/EN 1348/)
- Open time: Tensile strength (/EN 1346/)
Other performance characteristics in accordance with the manufacturer's technical documentation / declaration of performance

2.2 Performance characteristics in accordance with the manufacturer's technical documentation / declaration of performance; /ETAG 004/ apply.

Module 3: Modified mineral mortars as joint fillers
The minimum requirements of /EN 13888/ must be maintained.

Module 4: Modified mineral mortars as cementitious screed, floor levelling compounds, filler, flowing screeds
The minimum requirements of /EN 13813/ must be maintained. These are:
- Reaction to fire (/EN 13501-1/)
- Release of corrosive substances
- Compressive strength (/EN 13892-2/)
- Flexural strength (/EN 13892-2/)
Other performance characteristics in accordance with the manufacturer's technical documentation / declaration of performance

Module 5: Modified mineral mortars as levelling compounds for walls and ceilings

Module 5.1: The minimum requirements of /EN 998-1/ apply. These are:
- Reaction to fire (/EN 13501-1/)
- Compressive strength
- Dry bulk density
- Capillary water absorption
- Water vapour permeability
Other performance characteristics in accordance with the manufacturer's technical documentation / declaration of performance

Module 5.2: The minimum requirements of /EN 13279/ apply.
Performance characteristics in accordance with the manufacturer's technical documentation / declaration of performance

Module 6: Modified mineral mortars as grouts

Module 7: Modified mineral mortar for waterproofing slurries
The minimum requirements in accordance with /EN 14891/ apply.

Module 8: Modified mineral mortars as repair mortar
Performance 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 as cited in chapter 2.3 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
Modified mineral mortars are generally manufactured and supplied as factory-made dry mortars. Factory-made dry mortar is a finished mixture of base materials which merely requires the addition of water on the building site. The products can be supplied in 1-5 kg bags, 15-25 kg sacks, Big Bags (1 t), minitainers (1.2 t) or as silo goods (5-15 t). Paper sacks with polyethylene lining were modelled as packaging (worst-case approach).

2.6 Base materials / Ancillary materials
On average, the products covered by this EPD contain the following ranges of base materials and auxiliaries referred to:
- Cement: ~ 15 - 98%
- Filler materials: ~ 0 - 80%
- Plaster: ~ 0 - 20%
- Additives: ~ 0 - 10%
- Dispersion powder: ~ 0 - 10%

These ranges are average values and the composition of products complying with the EPD can deviate from these concentration levels in individual cases. More detailed information is available in the respective manufacturer's documentation (e.g. product data sheets).

In individual cases, it is possible that substances on the list of materials of particularly high concern for inclusion in Annex XIV of the /REACH/ regulation are contained in concentrations exceeding 0.1%. If this is the case, this information can be found on the respective safety data sheet. Mortar for special use of products is recommended.

Environmental Product Declaration FEICA – Modified mineral mortars, group 2
applications can also contain fungicides, whereby the functional group of fungicides is dependent on the chemical specification.

2.7 Manufacture
The raw materials are stored in silos, big bags or sacks in the manufacturing plant and fed gravimetrically in accordance with the respective formula and mixed intensively. The mix is then packaged. 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
The state-of-the-art involves maximum recirculation of dry waste into production. Wherever dust is incurred during production in the plant, it is directed to a filter system taking consideration of the limit values applicable for the workplace and using the corresponding extraction plants. Sack discharge stations connected to the extraction plant offer employees additional protection from dust. Most of the dust collected in the filter system and any residue incurred during production is returned to the manufacturing process.

Powder residues: Residual product is returned to the production process wherever possible.

Air: Process air is dedusted autonomously, whereby the values are far below legal requirements.

Water: The production process does not involve water. Very low volumes of water are required for laboratory tests and for sanitary facilities.

Noise: Noise level measurements have indicated that all values established within the production facility fall below the hearing protection limit of 85dB(A).

Waste: The main types of waste are powder waste, paper (paper bags) and foil. Low volumes of metal scrap (metal containers), waste oil (maintenance) and commercial waste are incurred. All waste is separated, stored and redirected to the recycling circuit or disposed of.

2.9 Product processing/Installation
Modified mineral mortars can be processed both automatically and manually. The mortars are either automatically removed from a silo using a dry conveyor or manually taken from the container, mixed with water and installed.

The professional liability association's rules apply as well as the respective safety data sheets pertaining to the construction products.

On account of the various hydrate levels of cement, lime and calcium sulphate binding agents in the mineral mortar, the fresh mortar mixed with water is usually strongly alkaline. In the case of more extensive contact, this alkaline state can cause serious damage to eyes and skin. Therefore, any contact with eyes or skin must be avoided by taking personal protective measures and the information outlined on the safety data sheet must be observed.

Uncontrolled dust emissions should be avoided. Modified mineral mortars may not be discharged into the sewage system, surface water or groundwater. Waste incurred on the building site (packaging, pallets, residual mortar) must be collected separately. Suitable waste disposal companies dispose of packaging materials and mortar sacks and return them to the recycling circuit. Dry mortar residue is taken back by the manufacturing plants and used as a raw material. Dry mortar residue in mortar sacks is incurred. Hard mortar residue can be recycled or disposed of as building site rubble.

2.10 Packaging
A detailed description of packaging is provided in section 2.5. Empty, trickle-free paper containers and clean PE foils can be recycled.

2.11 Condition of use
Modified mineral mortar does not rot and is resistant to ageing when used in accordance with the designated purpose of the respective products. It is a durable product which, when used as adhesive, screed, waterproofing material or repair product, makes an essential contribution towards improving building function and value.

2.12 Environment and health during use
Owing to the stable crystalline bond and firm structure achieved after curing, emissions are extremely low and harmless to health when used in accordance with the designated purpose of the respective products. No risks are known for water, air and soil if the products are used as designated. Natural ionising radiation from mineral mortar is extremely low and negligible in terms of health hazards.

Options for applications in indoor areas with permanent stays by people:
Evidence of the emission performance of construction products in contact with indoor air and depending on the designated use must be submitted for applications in indoor areas with permanent stays by people, e.g. in accordance with the /AgBB/ test scheme or the /GEV/ (Gemeinschaft Emissionskontrollierte Verleigewerkstoffe, Klebstoffe und Bauprodukte e.V., Düsseldorf) /EMICODE/® marking system typically applied in Germany.

2.13 Reference service life
Modified mineral mortars decisively improve the usability of building structures and significantly extend their original service lives. The anticipated reference service life depends on the specific installation situation and the exposure associated with the product. It can be influenced by weathering as well as mechanical or chemical loads.

2.14 Extraordinary effects

Fire
In accordance with Commission Decision 94/611EC, modified mineral binding agents comprising finely-distributed organic components must always be classified in reaction-to-fire class A1 "No contribution to fire" in accordance with /EN 13501-1/.
Where higher percentages of organic components are involved, it can also be assumed that at least the requirements of /EN 13501-1/ are maintained for fire class E and EfI.

Water
No relevant volumes of water-soluble substances hazardous to water are washed out when exposed to water (e.g. flooding). Cement-based mortar is stable in terms of structure and is not subject to any changes in form when exposed to water and drying.
Mechanical destruction
The mechanical destruction of modified mineral mortars does not lead to any decomposition products which are harmful for the environment or health. Dust incurred during de-construction should be avoided by taking the appropriate measures (e.g. humidification).

2.15 Re-use phase
Components manufactured using modified mineral mortars can usually be easily demolished. When removing a building, the materials do not need to be treated as special waste; care should, however, be taken to ensure unmixed residual materials wherever possible. Mineral mortars can usually be redirected to normal building material recycling circuits. Re-use is generally in the form of recycled aggregate in building construction and civil engineering.

No practical experience is currently available for re-using components comprising modified mineral mortar after decommissioning.

2.16 Disposal
The portion of a modified mineral mortar-based product applied at an other construction product is rather low. These low amounts do not play a role when the construction product is disposed. They do not interfere with the disposal/recycling of other components / building materials.

The following European Waste Codes waste (EWC) codes can apply:
- Mineral filler and levelling compound: /EWC 2000/532/EC 170107/
- Calcium sulphate-based filler and levelling compound: /EWC 2000/532/EC 170802/

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 modified mineral mortar with a density of 800 - 1,700 kg/m³. 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).

With the information about the consumption per surface area the results can be calculated into a declared unit of kg/m².

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declared unit</td>
<td>1</td>
<td>kg</td>
</tr>
<tr>
<td>Conversion factor to 1 kg</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

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

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/ ts 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 multiinput allocation with a credit for electricity and thermal energy was used for incineration of 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 modified mineral mortar was selected as the declared unit. Depending on the application, a corresponding conversion factor such as the specific use per surface area must be taken into consideration.
4. LCA: Scenarios and additional technical information

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transport to the building site (A4)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Litres of fuel</td>
<td>0.0016</td>
<td>l/100km</td>
</tr>
<tr>
<td>Transport distance</td>
<td>1000</td>
<td>km</td>
</tr>
<tr>
<td>Capacity utilisation (including empty runs)</td>
<td>85</td>
<td>%</td>
</tr>
<tr>
<td>Gross density of products transported</td>
<td>800 - 1700</td>
<td>kg/m$^3$</td>
</tr>
<tr>
<td>Capacity utilisation volume factor</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Installation into the building (A5)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water consumption</td>
<td>0.0003</td>
<td>m$^3$</td>
</tr>
<tr>
<td>Material loss</td>
<td>0.013</td>
<td>kg</td>
</tr>
</tbody>
</table>
5. LCA: Results

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

<table>
<thead>
<tr>
<th>PRODUCT STAGE</th>
<th>CONSTRUCTION PROCESS STAGE</th>
<th>USE STAGE</th>
<th>END OF LIFE STAGE</th>
<th>BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material supply</td>
<td>Transport</td>
<td>Manufacturing</td>
<td>Assembly</td>
<td>Use</td>
</tr>
<tr>
<td>A1</td>
<td>X</td>
<td>X</td>
<td>A2</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>MND</td>
</tr>
</tbody>
</table>

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 kg modified mineral mortar, group 2

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>A4</th>
<th>A5</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global warming potential</td>
<td>kg CO₂-Eq.</td>
<td>6.39E-1</td>
<td>4.82E-3</td>
<td>9.97E-2</td>
<td>-3.69E-2</td>
</tr>
<tr>
<td>Depletion potential of the stratospheric ozone layer</td>
<td>kg CFC11-Eq.</td>
<td>5.14E-9</td>
<td>2.21E-14</td>
<td>3.60E-13</td>
<td>-1.21E-11</td>
</tr>
<tr>
<td>Acidification potential of land and water</td>
<td>kg SO₂-Eq.</td>
<td>2.03E-5</td>
<td>1.10E-5</td>
<td>1.24E-5</td>
<td>-5.84E-5</td>
</tr>
<tr>
<td>Eutrophication potential</td>
<td>kg POC₁₄-Eq.</td>
<td>1.92E-8</td>
<td>2.75E-6</td>
<td>2.44E-6</td>
<td>-5.97E-6</td>
</tr>
<tr>
<td>Formation potential of tropospheric ozone photochemical oxidants</td>
<td>kg ethene-Eq.</td>
<td>1.90E-8</td>
<td>-3.33E-6</td>
<td>1.13E-6</td>
<td>-6.20E-6</td>
</tr>
<tr>
<td>Abiotic depletion potential for non-fossil resources</td>
<td>kg Sb-Eq.</td>
<td>1.00E-6</td>
<td>3.21E-10</td>
<td>1.09E-9</td>
<td>-4.27E-9</td>
</tr>
<tr>
<td>Abiotic depletion potential for fossil resources</td>
<td>[MJ]</td>
<td>7.09E+0</td>
<td>6.64E-2</td>
<td>2.20E-2</td>
<td>-5.06E-1</td>
</tr>
</tbody>
</table>

RESULTS OF THE LCA - RESOURCE USE: 1 kg modified mineral mortar, group 2

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>A4</th>
<th>A5</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable primary energy as energy carrier</td>
<td>[MJ]</td>
<td>2.05E+0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Renewable primary energy resources as material utilization</td>
<td>[MJ]</td>
<td>9.00E+0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total use of renewable primary energy resources</td>
<td>[MJ]</td>
<td>2.03E+0</td>
<td>3.77E-3</td>
<td>3.16E-3</td>
<td>-3.34E-2</td>
</tr>
<tr>
<td>Non-renewable primary energy as energy carrier</td>
<td>[MJ]</td>
<td>6.80E+0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Non-renewable primary energy as material utilization</td>
<td>[MJ]</td>
<td>1.20E+0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total use of non-renewable primary energy resources</td>
<td>[MJ]</td>
<td>8.00E+0</td>
<td>6.60E-2</td>
<td>2.95E-2</td>
<td>-6.19E-1</td>
</tr>
<tr>
<td>Use of secondary material</td>
<td>[kg]</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
</tr>
<tr>
<td>Use of renewable secondary fuels</td>
<td>[MJ]</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
</tr>
<tr>
<td>Use of non-renewable secondary fuels</td>
<td>[MJ]</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
</tr>
<tr>
<td>Use of net fresh water</td>
<td>[m³]</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 kg modified mineral mortar, group 2

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>A1-A3</th>
<th>A4</th>
<th>A5</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous waste disposed</td>
<td>[kg]</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Non-hazardous waste disposed</td>
<td>[kg]</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Radioactive waste disposed</td>
<td>[kg]</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Components for re-use</td>
<td>[kg]</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
</tr>
<tr>
<td>Materials for recycling</td>
<td>[kg]</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
</tr>
<tr>
<td>Materials for energy recovery</td>
<td>[kg]</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
</tr>
<tr>
<td>Exported electrical energy</td>
<td>[MJ]</td>
<td>0.00E+0</td>
<td>0.00E+0</td>
<td>1.25E-1</td>
<td>0.00E+0</td>
</tr>
<tr>
<td>Exported thermal energy</td>
<td>[MJ]</td>
<td>0.00E+0</td>
<td>2.98E-1</td>
<td>-8.34E-2</td>
<td>0.00E+0</td>
</tr>
</tbody>
</table>

Not all of the used inventories for the calculation of the LCA support the methodological approach for the declaration of water and waste indicators. The material amounts, displayed with these inventories, contribute significantly to the production. The indicators Use of fresh water, Hazardous waste disposed, Non-hazardous waste disposed and Radioactive waste disposed are therefore not declared (decision of IBU advisory board 2013-01-07).

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. The majority of life cycle energy consumption takes place during the production phase (A1-A3). Besides the cement also the dispersion powder influences the results significantly, although this is only used up to 5%. 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 and paper 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. CO₂ is the most important contributor to Global Warming Potential (GWP). For the Acidification Potential (AP), NOₓ and SO₂ contribute to the largest share.
Transportation to the construction site (A4) and the installation process (A5) make a negligible contribution to almost all impacts. The only exception is a relevant influence of carbon dioxide emissions in module A5 to Global Warming Potential (GWP) due to the incineration of the packaging materials paper and pallets.

In module A4, transport to construction site, values for Photochemical Ozone Creation Potential (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. Transportation processes are responsible for the emission of NOx in the ground layer atmosphere. NO in particular can have an ozone depleting effect that is reflected in CML 2001 by assigning a negative characterisation factor to this substance. However, although these negative values may appear unusual, it should be considered that POCP is only one of the analysed environmental impact categories. All other potential impacts would increase with greater transportation distances, showing that transportation is a process leading to net environmental burdens. Furthermore, even for POCP, transportation processes needed for supply of materials and product distribution only have limited counterbalance effects on the overall LCA results. Energy credit from incineration of packaging material reported in module D show a negligible influence on the overall results.

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 labelling 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 labelling 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 of 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):

Table 1 shows an overview of the most relevant regulations and specifications as of April 2015, as regards requirements after 3 days of storage in a ventilated test chamber.

Table 2 provides an overview of the most relevant regulations and specifications as of April 2015, as regards requirements after 28 days of 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.

<table>
<thead>
<tr>
<th></th>
<th>TVOC [µg/m³]</th>
<th>Sum of carcinogens, C1A, CA2 [µg/m³]</th>
<th>Formaldehyde [µg/m³]</th>
<th>Acetaldehyde [µg/m³]</th>
<th>Sum of Form- and Acet-aldehyde</th>
</tr>
</thead>
<tbody>
<tr>
<td>German DIBt/AgBB regulation</td>
<td>10 000</td>
<td>10</td>
<td>-/-</td>
<td>-/-</td>
<td>-/-</td>
</tr>
<tr>
<td>draft Lithuanian regulation</td>
<td>10 000</td>
<td>10</td>
<td>-/-</td>
<td>-/-</td>
<td>-/-</td>
</tr>
<tr>
<td>EMICODE EC1</td>
<td>1 000</td>
<td>10</td>
<td>50</td>
<td>50</td>
<td>50 ppb</td>
</tr>
<tr>
<td>EMICODE EC1 PLUS</td>
<td>750</td>
<td>10</td>
<td>50</td>
<td>50</td>
<td>50 ppb</td>
</tr>
</tbody>
</table>
LeachingMeasurement of leaching performance (eluate analysis) indicating the measurement process.

Leaching is only relevant for specific applications. In this case, information can be provided by the manufacturer.

### 8. References

**PCR 2013, Part A: 2013-04**
Institut Bauen und Umwelt e.V., Berlin (pub.); Product Category Rules for construction products from the range of Environmental Product Declarations from Institut Bauen und Umwelt e.V. (IBU) Part A: Calculation rules for the Life Cycle Assessment and requirements on the Background Report
[www.bau-umwelt.de](http://www.bau-umwelt.de)

**PCR 2011, Part B: 2011-06**
Product Category Rules for Construction Products, Part B: Requirements on the EPD for mineral trade mortar
[www.bau-umwelt.de](http://www.bau-umwelt.de)


**GaBi ts software**
Software and database for comprehensive analysis. LBP, University of Stuttgart and thinkstep AG, 2015

**GaBi ts documentation**
Documentation of GaBi 6 data sets from the database for comprehensive analysis LBP, University of Stuttgart and thinkstep AG, 2015
[http://documentation.gabi-software](http://documentation.gabi-software)

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<table>
<thead>
<tr>
<th></th>
<th>TVOC [μg/m²]</th>
<th>TSVOC [μg/m²]</th>
<th>Ethylen glycol</th>
<th>Formaldehyde</th>
<th>Acetaldehyde</th>
<th>LCI</th>
<th>R value</th>
<th>Specials</th>
<th>Sum non-Cl &amp; non-identified [μg/m²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgian regulation</td>
<td>1000</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td>200</td>
<td>Belgian list</td>
<td>1</td>
<td>Toluen</td>
<td>300 μg/m³</td>
</tr>
<tr>
<td>French regulations class A+</td>
<td>1000</td>
<td>-/-</td>
<td>-/-</td>
<td>10</td>
<td>200</td>
<td>-/-</td>
<td>-/-</td>
<td>List of 8 VOCs, 4 CMR</td>
<td>-/-</td>
</tr>
<tr>
<td>French regulations class A</td>
<td>1500</td>
<td>-/-</td>
<td>-/-</td>
<td>60</td>
<td>300</td>
<td>-/-</td>
<td>-/-</td>
<td>List of 8 VOCs, 4 CMR</td>
<td>-/-</td>
</tr>
<tr>
<td>French regulations class B</td>
<td>2000</td>
<td>-/-</td>
<td>-/-</td>
<td>120</td>
<td>400</td>
<td>-/-</td>
<td>-/-</td>
<td>List of 8 VOCs, 4 CMR</td>
<td>-/-</td>
</tr>
<tr>
<td>French regulations class C</td>
<td>&gt;2000</td>
<td>-/-</td>
<td>-/-</td>
<td>&gt;120</td>
<td>&gt;400</td>
<td>-/-</td>
<td>-/-</td>
<td>List of 8 VOCs, 4 CMR</td>
<td>-/-</td>
</tr>
<tr>
<td>German DIB/AgBB regulation</td>
<td>1000</td>
<td>100</td>
<td>1</td>
<td>100</td>
<td>1200</td>
<td>German AgBB list</td>
<td>1</td>
<td>-/-</td>
<td>100</td>
</tr>
</tbody>
</table>

**draft Lithuanian regulation**
1000 100 1 (after 3 days) (after 3 days) -/- Lithuanian list 1 -/- -/- -/- -/-

**EM/ CODE EC1**
100 50 1 (after 3 days) -/- -/- -/- -/- -/- -/- -/- -/-

**EM/ CODE EC1 PLUS**
60 40 1 (after 3 days) (after 3 days) -/- German AgBB list 1 -/- -/- Ammonia, odour -/-

**Finnish M1, sealants**
20 -/- 1 10 -/- -/- -/- -/- Ammonia, odour -/-

**Finnish M1, adhesives**
200 μg/m² h -/- 5 μg/m² h 50 μg/m² h -/- -/- -/- -/- -/- -/- -/- -/-
Commission decision of 4 October 1996 for specifying a directory of products to be classified as category A “No contribution to fire” in accordance with decision 94/611/EC on construction products for implementing Article 20 of Directive 89/106/EEC

EN 1504-3:2006-03
Products and systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity – Part 3: Structural and non-structural repair

EN 1504-2:2015-03
Products and systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity – Part 2: Surface protection systems for concrete

EN 12190:1998-12
Products and systems for the protection and repair of concrete structures – Test methods – Determination of compressive strength of repair mortar

EN 1015-17:2005-01
Methods of test for mortar for masonry – Part 17: Determination of water-soluble chloride content of fresh mortars

EN 1542:1999-07
Products and systems for the protection and repair of concrete structures – Test methods – Measurement of bond strength by pull-off

EN 12617-4:2002-08
Products and systems for the protection and repair of concrete structures – Test methods – Part 4: Determination of shrinkage and expansion

EN 1504-7:2015-09
Products and systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity – Part 7: Reinforcement corrosion protection

EN 15183:2006-11
Products and systems for the protection and repair of concrete structures – Test methods – Corrosion protection test; German version EN 15183

EN 12004:2014-02
Adhesive for tiles – Requirements, evaluation of conformity, classification and designation

EN 1346:2007-11
Adhesives for tiles – Determining the open time

EN 1348:2007-11
Adhesive for tiles – Determination of tensile adhesion strength for cementitious adhesives

ETAG 004:2001-02-20
Guideline for European technical approval of external thermal insulation composite systems with rendering (ETAG 004)

EN 13888:2009-08
Grout for tiles – Requirements, evaluation of conformity, classification and designation

EN 13813:2003-01
Screed material and floor screeds – Screed materials – Properties and requirements

EN 13501-1:2010-01
Fire classification of construction products and building products – Part 1: Classification using data from reaction to fire tests

EN 13892-2:2003-02
Methods of test for screed materials – Part 2: Determination of flexural and compressive strength

EN 13501-1:2010-01
Fire classification of construction products building elements – Part 1: Classification using data from reaction to fire tests

EN 998-1:2015-11
Specification for mortar for masonry – Part 1: Rendering and plastering mortar

EN 13279-1:2008-11
Gypsum binders and gypsum plasters – Part 1: Definitions and requirements

EN 14891:2015-02
Liquid-applied water impermeable products for use beneath ceramic tiling bonded with adhesives – Requirements, test methods, evaluation of conformity, classification and designation

EWC 170101: 2000/532/EC
European Waste Catalogue / Ordinance on European List of Wastes Concrete

EWC 101314: 2000/532/EC
European Waste Catalogue / Ordinance on European List of Wastes Waste concrete and concrete sludge

EWC 170107: 2000/532/EC
European Waste Catalogue / Ordinance on European List of Wastes Mixtures of concrete, bricks, tiles and ceramics

EWC 170802: 2000/532/EC
European Waste Catalogue / Ordinance on European List of Wastes Gypsum based construction metals e.g. for plasterboard

CPR

REACH

EN ISO 9001:2008-12
Quality management systems – Requirements
ISO 16000-3:2013-01
Indoor air – Part 3: Determination of formaldehyde and other carbonyl compounds by sampling using a pump

ISO 16000-6:2012-11
Indoor air – Part 6: Determination of volatile organic compounds indoors and in test chambers by sampling on TENAX TA®, thermal desorption and gas chromatography using MS or FID

EN ISO 16000-9:2008-04
Indoor air – Part 9: Determination of the emission of volatile organic compounds from building products and furnishings – Emission test chamber method

EN ISO 16000-11:2006-06
Indoor air – Part 11: Determination of the emission of volatile organic compounds from building products and furnishings – Sampling, storage of samples and preparation of test specimens

CEN/TS 16516:2015-07
Construction products - Assessment of release of dangerous substances - Determination of emissions into indoor air

Royal Decree C-2014/24239
Belgisch Staatsblad 8 MEI 2014, p. 60603. — Koninklijk besluit tot vaststelling van de drempelniveaus voor de emissies naar het binnenmilieu van bouwproducten voor bepaalde geooogde gebruiken

EN 17025: 2007-05
General requirements for the competence of testing and calibration laboratories

EMICODE
GEV – Gemeinschaft Emissionskontrollierte Verlegewerkstoffe, Klebstoffe und Bauprodukte e. V. (pub.). www.emicode.de

Blue Angel
Environmental label organised by the federal government of Germany
www.blauer-engel.de

Indoor Air Comfort
Product certification by Eurofins, Hamburg, Germany
www.eurofins.com

Institut Bauen und Umwelt
Institut Bauen und Umwelt e.V., Berlin(pub.): Generation of Environmental Product Declarations (EPDs);

General principles
for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2013/04
www.bau-umwelt.de

ISO 14025
DIN EN ISO 14025:2011-10: Environmental labels and declarations — Type III environmental declarations — Principles and procedures

EN 15804
EN 15804:2012-04+A1 2013: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

emissions of volatile organic compounds (VOC and SVOC) from building products
www.umweltbundesamt.de/produkte/bauprodukte/agb.htm