

Declaration of conformity

KÖSTER BAUCHEMIE AG
Dieselstraße 1 - 10
26607 Aurich / Germany

Conformity of the modified mineral mortar

KÖSTER 21

*with the classification rules of the
Environmental Product Declaration template*

EPD-DIV-2013311-EN

(Modified mineral mortars).

*The product complies with the classification rules
of the group 3 with a score of*

3230 Points

Johann J. Köster
(Director)

Aurich, 14th of May 2014

KÖSTER is an ISO 9001 certified company and member of



MODEL ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025 and EN 15804

Declaration holder	DBC / IVK / VdL
Publisher	Institut Bauen und Umwelt (IBU)
Programme holder	Institut Bauen und Umwelt (IBU)
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Modified mineral mortars

Deutsche Bauchemie e.V. (DBC);

Industrieverband Klebstoffe e.V. (IVK);

Verband der deutschen Lack- und Druckfarbenindustrie e.V. (VdL)

www.bau-umwelt.de



Institut Bauen
und Umwelt e.V.



Verband der deutschen
Lack- und Druckfarbenindustrie e.V.



Industrieverband
Klebstoffe e.V.



1 General information

Deutsche Bauchemie e.V.
Industrieverband Klebstoffe e.V.
**Verband der deutschen Lack- und
 Druckfarbenindustrie e.V.**

Programme holder

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

Declaration number

EPD-DIV-2013311-EN

This Declaration is based on the Product Category Rules:

PCR Mineral factory-made mortar, June 2011
 (PCR tested and approved by the independent Committee of
 Experts (SVA))

Issue date

24.07.2013

Valid until

23.07.2018



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



Dr.-Ing. Burkhardt Lehmann
 Managing Director at IBU

Modified mineral mortars

Holder of the Declaration

Deutsche Bauchemie e.V.
 Mainzer Landstr. 55, D-60329 Frankfurt
 Industrieverband Klebstoffe e.V.
 Völklinger Str. 4, D-40219 Düsseldorf
 Verband der deutschen Lack- und Druckfarbenindustrie e.V.
 Mainzer Landstr. 55, D-60329 Frankfurt

Declared product/unit

1 kg / 1 kg; density 800 - 1,700 kg/m³

Area of applicability:


This validated Declaration entitles the holder to use the
 symbol of Institut Bauen und Umwelt e.V. It exclusively
 covers the above-named product groups of manufacturing
 plants in Germany for a period of five years from the date
 of issue. The Declaration holder is liable for the details and
 documentation upon which the evaluation is based. It
 involves an association EPD based on the model Declaration
 [EPD-DIV-number-data base system], for which the product
 displaying the highest environmental impact in a group was
 selected for calculating the Life Cycle Assessment. The
 members of the Associations are indicated on the Associa-
 tion homepages.

Verification

The CEN DIN EN 15804 standard serves as the core PCR.

Verification of the EPD by an independent third party in accordance with ISO 14025

internal
 external



Matthias Schulz
 Independent auditor appointed by the SVA

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. They improve the
 fitness for use of buildings and significantly extend
 their life expectancy.

The products displaying the most environmental
 impacts were applied as representative products for
 calculating the Life Cycle Assessment results.

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 heat 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 suitable normal 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

Products for grouting on holes, recesses, concrete precast columns, foundations and for anchoring machine components indoors and outdoors

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 DIN EN 1504 "Products and systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity" must be observed. 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 (DIN EN 12190)
- Chloride ion content (DIN EN 1015-17)
- Adhesive bond (DIN EN 1542)
- Restrained shrinkage/expansion (DIN EN 12617-4)

1.2 Reinforcement corrosion protection products – Requirements on all intended uses in accordance with EN 1504-7, Table 1:

- Corrosion protection (DIN EN 15183)

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

Module 2: Adhesives based on modified mineral mortar

2.1 The minimum requirements in accordance with DIN EN 12004 "Adhesive for tiles – Requirements, evaluation of conformity, classification and designation" must be maintained. These are:

- Tensile adhesion strength after dry storage (DIN EN 1348)
- Tensile adhesion strength after water immersion (DIN EN 1348)
- Tensile adhesion strength after heat ageing (DIN EN 1348)
- Tensile adhesion strength after freeze/thaw cycles (DIN EN 1348)
- Open time: Tensile strength (EN 1346)

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

2.2 Performance characteristics in accordance with the manufacturer's technical documentation / Declaration of Performance / Declaration of Conformity; ETAG 004 "Guideline for the European technical approvals for external thermal insulation composite systems with rendering" must be considered..

Module 3: Modified mineral mortars as joint fillers

The minimum requirements of DIN EN 13888 "Grout for tiles – Requirements, evaluation of conformity, classification and designation" must be maintained.

Module 4: Modified mineral mortars as cementitious screed, floor levelling compounds, filler, flowing screed:

The minimum requirements of DIN EN 13813 "Screed material and floor screeds – Screed materials – Properties and requirements" must be maintained. These are:

- Reaction to fire (DIN EN 13501-1)
- Release of corrosive substances
- Compressive strength (DIN EN 13892-2)
- Flexural strength (DIN EN 13892-2)

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

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

Module 5.1: The minimum requirements of DIN EN 998-1 "Specification for mortar for masonry – Part 1: Rendering and plastering mortar" must be maintained. These are:

- Reaction to fire (DIN 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 / Declaration of Conformity

Module 5.2: The minimum requirements of DIN EN 13279 "Gypsum binders and gypsum plasters – Part 1: Definitions and requirements" must be observed.

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

Module 6: Modified mineral mortars as grouts

The requirements of the DAfStb Guideline "Manufacturing and using cement-based casting concrete and grout" must be considered.

Module 7: Modified mineral mortar for waterproofing slurries

Module 7.1: The minimum requirements of the "Prüfgrundsätze für die Erteilung von allgemeinen bauaufsichtlichen Prüfzeugnissen für Bauwerksabdichtungen mit mineralischen Dichtungsschlämmen (PG-AIV-F)" (Testing principles for granting general building authority approved test certificates for waterproofing with mineral waterproofing slurries) must be considered

Module 7.2: The minimum requirements of the "Prüfgrundsätze für die Erteilung von allgemeinen bauaufsichtlichen Prüfzeugnissen für Abdichtungen im Verbund mit Fliesen- und Plattenbelägen" - Teil 1: Flüssig zu verarbeitende Abdichtungen (PG-AIV-F) (Testing principles for granting general building authority approved test certificates for waterproofing in conjunction with ceramic tiles – Part 1: Liquid-applied waterproofing materials" must be considered.

Module 7.3: In the future, the minimum requirements in accordance with DIN EN 14891 "Liquid-applied water-impermeable products for use beneath ceramic tiling bonded with adhesives – Requirements, test methods, evaluation of conformity, classification and designation" must be considered.

Module 8: Modified mineral mortars as repair mortar

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

2.4 Placing on the market / Application rules

Module 1: Modified mineral mortars as repair mortar for the protection and repair of concrete structures

A prerequisite for placing the product on the market and application in Germany is the CE marking of the products. The legal basis for CE marking is represented by Directive (EU) no. 305/2011 of the European Parliament and Council (ABl. I 88/5 dated 4.4.2011). CE marking confirms conformity with the declared performance of the product based on the harmonised DIN EN 1504 specification "Products and systems for the protection and repair of concrete structures". As for the rest, the provisions in Part II of the list of technical building regulations shall apply.

Module 2: Adhesives based on modified mineral mortar

2.1 A prerequisite for placing the product on the market and application in Germany is the CE marking of the products. The legal basis for CE marking is represented by Directive (EU) no. 305/2011 of the European Parliament and Council (ABl. I 88/5 dated 4.4.2011). CE marking confirms conformity with the declared performance of the product based on the harmonised DIN EN 12004 technical specification

"Adhesives for tiles". As for the rest, the provisions in Part II of the list of technical building regulations shall apply.

2.2 A prerequisite for placing the product on the market and application in Germany is the CE marking of the products. The legal basis for CE marking is represented by Directive (EU) no. 305/2011 of the European Parliament and Council (ABl. I 88/5 dated 4.4.2011). CE marking confirms conformity with the declared performance of the product based on the harmonised ETAG 004 technical specification "Guideline for European technical approvals for external thermal insulation composite systems with rendering". As for the rest, the provisions in Part II of the list of technical building regulations shall apply.

Module 3: Modified mineral mortars as joint fillers

The contents of the manufacturer's technical documentation must comply with DIN EN 13888 "Grout for tiles – Requirements, evaluation of conformity, classification and designation".

Module 4: Modified mineral mortars as cementitious screed, floor levelling compounds, filler, flowing screed

A prerequisite for placing the product on the market and application in Germany is the CE marking of the products. The legal basis for CE marking is represented by Directive (EU) no. 305/2011 of the European Parliament and Council (ABl. I 88/5 dated 4.4.2011). CE marking confirms conformity with the declared performance of the product based on the harmonised DIN EN 13813 technical specification "Screed material and floor screeds – Screed materials – Properties and requirements". As for the rest, the provisions in Part II of the list of technical building regulations shall apply.

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

Module 5.1: A prerequisite for placing the product on the market and application in Germany is the CE marking of the products. The legal basis for CE marking is represented by Directive (EU) no. 305/2011 of the European Parliament and Council (ABl. I 88/5 dated 4.4.2011). CE marking confirms conformity with the declared performance of the product based on the harmonised DIN EN 998-1 technical specification "Specification for mortar for masonry – Part 1: Rendering and plastering mortar". As for the rest, the provisions in Part II of the list of technical building regulations shall apply.

Module 5.2: A prerequisite for placing the product on the market and application in Germany is the CE marking of the products. The legal basis for CE marking is represented by Directive (EU) no. 305/2011 of the European Parliament and Council (ABl. I 88/5 dated 4.4.2011). CE marking confirms conformity with the declared performance of the product based on the harmonised DIN EN 13279 technical specification "Gypsum binders and gypsum plasters – Part 1: Definitions and requirements". As for the rest, the provisions in Part II of the list of technical building regulations shall apply.


Module 6: Modified mineral mortars as grouts

A prerequisite for application in Germany is marking the products with the mark of conformity (Ü mark) based on the DAfStb Guideline on "Production and use of cement-bound force concrete and force mortar" (VeBMR) in accordance with Building Regulation List A, Part 1, consec. no. 1.5.16.

Module 7: Modified mineral mortars for waterproofing slurries

Module 7.1: A prerequisite for application in Germany is marking the products with the mark of conformity (Ü mark) based on a general building authority test certificate (abP) in accordance with Building Regulation List A, Part 2, consec. no. 2.49.

Module 7.2: A prerequisite for application in Germany is marking the products with the mark of conformity (Ü mark) based on a general building authority test certificate (abP) in accordance with Building Regulation List A, Part 2, consec. no. 2.50.

Module 7.3: A prerequisite for placing the product on the market and application in Germany is the CE marking of the products. The legal basis for CE marking is represented by Directive (EU) no. 305/2011 of the European Parliament and Council (ABl. I 88/5 dated 4.4.2011). CE marking confirms conformity by the manufacturer with the declared performance based on the harmonised DIN EN 14891 technical specification "Liquid-applied water-impermeable products for use beneath ceramic tiling bonded with adhesives – Requirements, test methods, evaluation of conformity, classification and designation". As for the rest, the provisions in Part II of the list of technical building regulations shall apply.

Module 8: Modified mineral mortars as repair mortar

Applications in accordance with the manufacturer's technical documentation / Declaration of Performance / Declaration of Conformity

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 / Auxiliaries

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

For group 1:

Cement: ~ 2 – 85%
 Filler materials: ~ 10 – 90%
 Plaster: ~ 0 – 45%
 Additives: ~ 0 – 6%
 Dispersion powder: ~ 0 – 5%

For group 2:

Cement: ~ 15 – 98%
 Filler materials: ~ 0 – 80%
 Plaster: ~ 0 – 20%
 Additives: ~ 0 – 10%
 Dispersion powder: ~ 0 – 10%

For group 3:

Cement: ~ 10 – 85%
 Filler materials: ~ 10 – 60%
 Plaster: ~ 0 – 1%
 Additives: ~ 0 – 5%
 Dispersion powder: ~ 0 – 30%

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 applications can also contain fungicides, whereby the functional group of fungicides is dependent on the chemical specification.

2.7 Production

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.

2.8 Environment and health during production

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), wood (pallets) 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. No dry mortar residue in mortar sacks is incurred. Hard mortar residue can be recycled or disposed of as building site rubble.

2.10 Packaging

Empty, trickle-free paper containers and clean PE foils can be recycled.

Wooden reusable pallets are taken back by the wholesalers (reusable pallets remunerated in the German deposit system) which returns them to the building product manufacturer who in turn redirects them into the production process.

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 Verlegewerkstoffe, Klebstoffe und Bauprodukte e.V., Düsseldorf) EMICODE® marking system typically applied in Germany.

2.13 Reference service life

Modified mineral mortars fulfil manifold, often specific, tasks in the construction or repair of building structures. They 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 DIN EN 13501-1.

Where higher percentages of organic components are involved, it can also be assumed that at least the requirements of DIN EN 13501-1 are maintained for fire class E and E_{fl}.

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

Only a minor percentage of modified mineral mortar is incurred when disposing of components on/in which they were used.

Low levels of adherence do not play any role in terms of disposal. They do not interfere with disposal/recycling of other components / building materials.

The suitability of hardened mineral mortar for depositing in a class I landfill in accordance with the Landfill Ordinance is guaranteed (DepRVV).

The EWC waste code for mineral mortar is 170101 and 101314; 170107 for mineral filler and levelling compound and 170802 for calcium sulphate-based filler and levelling compound.

2.17 Further information

More information is available on the manufacturers' product or safety data sheets and is also available

on the manufacturers' Web sites or on request. Valuable technical information is also available on the associations' Web sites.

TKB instructions, for example, are available at www.klebstoffe.com or information on Deutsche Bauchemie is available at www.deutsche-bauchemie.de.

3 LCA: Calculation rules

3.1 Declared unit

The association EPD refers to the declared unit of 1 kg of modified mineral mortar. The analyses are based on the representative (worst-case) products for each group whereby the data for the manufacturing process represents average data supplied by various manufacturers and plants.

No details were provided concerning consumption per unit of area on account of the extremely different areas of application and recipe formulations in this EPD. Exact details are available on the manufacturers' product-specific data sheets.

3.2 System boundary

Modules A1/A2/A3, A4, A5 and D are taken into consideration in the LCA:

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

This EPD therefore involves a Declaration from "cradle to plant gate, with options".

3.3 Estimates and assumptions

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

3.4 Cut-off criteria

No cut-off criteria were applied for calculating the LCA. All raw materials submitted by the associations for the formulations 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.

3.5 Background data

Data from the GaBi 5 data base was used as background data. Where no background data was available, it was supplemented by manufacturer information and literary research.

3.6 Data quality

Representative products were applied for this model EPD and the product in a group with the highest environmental impact was applied for calculating the LCA results. The data sets are no more than 4 years old.

3.7 Period under review

The review period concerns annual production for the year 2011.

3.8 Allocation

No allocations were used for production. A multi-input allocation with a credit for electricity and thermal energy was used for incineration of packaging in accordance with the simple credit method. The credits achieved through packaging disposal are offset in Module D.

3.9 Comparability

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 unit area must be taken into consideration.

As a general rule, a comparison or evaluation of EPD data is only possible when all of the data records to be compared have been drawn up in accordance with EN 15804 and the building context and/or product-specific performance characteristics are 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)

Litres of fuel	0.00161 l/100 km
Transport distance	500 km
Capacity utilisation (including empty runs)	85%

Volume capacity utilisation factor	100%
Product bulk density	700 – 2.500 kg/m ³

Construction installation process (A5)

Auxiliaries	0 kg
Water consumption	0.0003 m ³
Other resources	0 kg
Electricity consumption	0 kWh

Other energy carriers	0 MJ
Material loss	0,013 kg
Output materials following waste treatment on the building site	0 kg
Dust emissions	0 kg
NM VOC emissions	0 kg

5 LCA: Results

SYSTEM LIMITS (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)																	
Production stage			Building construction stage		Use stage							End-of-life stage				Benefits and loads beyond the system boundaries	
Provision of raw materials	Transport	Production	Transport to building site	Construction-installation process	Use / Application	Maintenance	Repairs	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction	Transport	Waste treatment	Disposal	Re-use, recovery or 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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X

5.1 Parameters for outlining environmental impact

Group 1

LCA RESULTS – ENVIRONMENTAL IMPACT: 1 kg modified mineral mortar					
		Production	Transport to building site	Installation	Benefit
Parameter	Unit	A1-A3	A4	A5	D
GWP	[kg CO ₂ equiv..]	4.65E-01	2.44E-02	1.00E-01	-4.20E-02
ODP	[kg CFC11 equiv.]	5.16E-09	5.09E-13	8.34E-13	-1.27E-11
AP	[kg SO ₂ equiv.]	1.72E-03	1.60E-04	1.21E-05	-5.81E-05
EP	[kg PO ₄ ³⁻ equiv.]	1.75E-04	3.98E-05	2.42E-06	-6.53E-06
POCP	[kg ethene equiv.]	1.46E-04	-6.73E-05	1,28E-06	-5.34E-06
ADPE	[kg Sb equiv.]	1.63E-06	1.12E-09	1.29E-09	-4.34E-09
ADPF	[MJ]	6.85E+00	3.33E-01	2.32E-02	-5.53E-01
Legend	GWP = Global Warming Potential; ODP = Ozone Depletion Potential; AP = Acidification Potential; EP = Eutrophication Potential; POCP Ozone Creation Potential; ADPE = Abiotic Depletion Potential for Non-fossil Resources; ADPF = Abiotic Depletion Potential for Fossil Resources				

Group 2

LCA RESULTS – ENVIRONMENTAL IMPACT: 1 kg modified mineral mortar					
		Production	Transport to building site	Installation	Benefit
Parameter	Unit	A1-A3	A4	A5	D
GWP	[kg CO ₂ equiv..]	9.30E-01	2.44E-02	1.00E-01	-4.20E-02
ODP	[kg CFC11 equiv.]	2.04E-10	5.09E-13	8.34E-13	-1.27E-11
AP	[kg SO ₂ equiv.]	2.73E-03	1.60E-04	1.21E-05	-5.81E-05
EP	[kg PO ₄ ³⁻ equiv.]	3.53E-04	3.98E-05	2.42E-06	-6.53E-06
POCP	[kg ethene equiv.]	1.77E-04	-6.73E-05	1,28E-06	-5.34E-06
ADPE	[kg Sb equiv.]	1.23E-06	1.12E-09	1.29E-09	-4.34E-09
ADPF	[MJ]	8.29E+00	3.33E-01	2.32E-02	-5.53E-01
Legend	GWP = Global Warming Potential; ODP = Ozone Depletion Potential; AP = Acidification Potential; EP = Eutrophication Potential; POCP Ozone Creation Potential; ADPE = Abiotic Depletion Potential for Non-fossil Resources; ADPF = Abiotic Depletion Potential for Fossil Resources				

Group 3
LCA RESULTS – ENVIRONMENTAL IMPACT: 1 kg modified mineral mortar

		Production	Transport to building site	Installation	Benefit
Parameter	Unit	A1-A3	A4	A5	D
GWP	[kg CO ₂ equiv..]	1.11E+00	2.44E-02	1.00E-01	-4.20E-02
ODP	[kg CFC11 equiv.]	2.85E-08	5.09E-13	8.34E-13	-1.27E-11
AP	[kg SO ₂ equiv.]	2.87E-03	1.60E-04	1.21E-05	-5.81E-05
EP	[kg PO ₄ ³⁻ equiv.]	3.14E-04	3.98E-05	2.42E-06	-6.53E-06
POCP	[kg ethene equiv.]	4.51E-04	-6.73E-05	1,28E-06	-5.34E-06
ADPE	[kg Sb equiv.]	1.72E-06	1.12E-09	1.29E-09	-4.34E-09
ADPF	[MJ]	2.27E+01	3.33E-01	2.32E-02	-5.53E-01
Legend	GWP = Global Warming Potential; ODP = Ozone Depletion Potential; AP = Acidification Potential; EP = Eutrophication Potential; POCP Ozone Creation Potential; ADPE = Abiotic Depletion Potential for Non-fossil Resources; ADPF = Abiotic Depletion Potential for Fossil Resources				

5.2 Parameters for outlining use of resources
Group 1
LCA RESULTS – USE OF RESOURCES: 1 kg modified mineral mortar

		Production	Transport to building site	Installation	Benefit
Parameter	Unit	A1-A3	A4	A5	D
PERE	[MJ]	1.20E+00	-	-	-
PERM	[MJ]	0.00E+00	-	-	-
PERT	[MJ]	1.20E+00	1.98E-02	2.26E-03	-6.09E-02
PENRE	[MJ]	7.02E+00	-	-	-
PENRM	[MJ]	6.00E-01	-	-	-
PENRT	[MJ]	7.62E+00	3.34E-01	2.63E-02	-6.41E-01
SM	[kg]	0	-	-	-
RSF	[MJ]	1.11E-02	2.49E-06	6.29E-06	-9.25E-06
NRSF	[MJ]	1.17E-01	2.60E-05	2.98E-05	-9.69E-05
FW*	[m ³]	-	-	-	-
Legend	PERE = Primary Energy, Renewable; PERM = Primary energy, non-renewable; PERT = Primary energy, renewable, total; PENRE = Primary energy, non-renewable; PENRM = Primary energy, non-renewable, for material usage; PENRT = Primary energy, non-renewable, total; SM = Use of secondary materials; RSF = Renewable secondary fuels; NRSF = Non-renewable secondary fuels; FW = Use of fresh water resources				

* Not all of the data inventories used for calculating the LCA support the methodical approach for declaring the water and waste indicators. The material volumes depicted by these data inventories contribute approx. 5% to product manufacturing. This is significant as it accounts for > 3% (in relation to the mass of the declared unit). The indicators can not therefore be accounted for (decision by the Expert Committee (SVA) on 07.01.2013).

Group 2
LCA RESULTS – USE OF RESOURCES: 1 kg modified mineral mortar

		Production	Transport to building site	Installation	Benefit
Parameter	Unit	A1-A3	A4	A5	D
PERE	[MJ]	3.32E+00	-	-	-
PERM	[MJ]	0.00E+00	-	-	-
PERT	[MJ]	3.32E+00	1.98E-02	2.26E-03	-6.09E-02
PENRE	[MJ]	9.65E+00	-	-	-
PENRM	[MJ]	0.00E+00	-	-	-
PENRT	[MJ]	9.65E+00	3.34E-01	2.63E-02	-6.41E-01
SM	[kg]	0	-	-	-
RSF	[MJ]	1.58E-01	2.49E-06	6.29E-06	-9.25E-06
NRSF	[MJ]	1.67E+00	2.60E-05	2.98E-05	-9.69E-05
FW	[m ³]	1.10E-02	1.91E-05	5.41E-04	-9.49E-05

Legend	PERE = Primary Energy, Renewable; PERM = Primary energy, non-renewable; PERT = Primary energy, renewable, total; PENRE = Primary energy, non-renewable; PENRM = Primary energy, non-renewable, for material usage; PENRT = Primary energy, non-renewable, total; SM = Use of secondary materials; RSF = Renewable secondary fuels; NRSF = Non-renewable secondary fuels; FW = Use of fresh water resources
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Group 3

LCA RESULTS – USE OF RESOURCES: 1 kg modified mineral mortar

		Production	Transport to building site	Installation	Benefit
Parameter	Unit	A1-A3	A4	A5	D
PERE	[MJ]	1.25E+00	-	-	-
PERM	[MJ]	0.00E+00	-	-	-
PERT	[MJ]	1.25E+00	1.98E-02	2.26E-03	-6.09E-02
PENRE	[MJ]	2.10E+01	-	-	-
PENRM	[MJ]	3.60E+00	-	-	-
PENRT	[MJ]	2.46E+01	3.34E-01	2.63E-02	-6.41E-01
SM	[kg]	0	-	-	-
RSF	[MJ]	4.86E-05	2.49E-06	6.29E-06	-9.25E-06
NRSF	[MJ]	4.36E-04	2.60E-05	2.98E-05	-9.69E-05
FW*	[m³]	-	-	-	-
Legend	PERE = Primary Energy, Renewable; PERM = Primary energy, non-renewable; PERT = Primary energy, renewable, total; PENRE = Primary energy, non-renewable; PENRM = Primary energy, non-renewable, for material usage; PENRT = Primary energy, non-renewable, total; SM = Use of secondary materials; RSF = Renewable secondary fuels; NRSF = Non-renewable secondary fuels; FW = Use of fresh water resources				

* Not all of the data inventories used for calculating the LCA support the methodical approach for declaring the water and waste indicators. The material volumes depicted by these data inventories contribute approx. 28% to product manufacturing. This is significant as it accounts for > 3% (in relation to the mass of the declared unit). The indicators can not therefore be accounted for (decision by the Expert Committee (SVA) on 07.01.2013).

5.3 Other environmental information outlining various waste categories and output flows

Group 1

LCA RESULTS – OUTPUT FLOWS AND WASTE CATEGORIES: 1 kg modified mineral mortar

		Production	Transport to building site	Installation	Benefit
Parameter	Unit	A1-A3	A4	A5	D
HWD	[kg]	-*	-*	-*	-*
NHWD	[kg]	-*	-*	-*	-*
RWD	[kg]	-*	-*	-*	-*
CRU	[kg]	-	-	-	-
MFR	[kg]	-	-	-	-
MER	[kg]	-	-	-	-
EE [type]	[MJ]	-	-	1.28E-01	-
EE [type]	[MJ]	-	-	3.09E-01	-
Legend	HWD = Hazardous waste for landfilling; NHWD = Non-hazardous waste disposed of; RWD = Radioactive waste disposed of; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EE = Exported energy per type				

* * Not all of the data inventories used for calculating the LCA support the methodical approach for declaring the water and waste indicators. The material volumes depicted by these data inventories contribute approx. 5% to product manufacturing. This is significant as it accounts for > 3% (in relation to the mass of the declared unit). The indicators can not therefore be accounted for (decision by the Expert Committee (SVA) on 07.01.2013).

Group 2

LCA RESULTS – OUTPUT FLOWS AND WASTE CATEGORIES: 1 kg modified mineral mortar

		Production	Transport to building site	Installation	Benefit
Parameter	Unit	A1-A3	A4	A5	D
HWD	[kg]	8.93E-05	0.00E+00	3.37E-04	0.00E+00
NHWD	[kg]	1.12E+00	6.61E-05	1.29E-02	-2.40E-04
RWD	[kg]	2.51E-04	4.79E-07	1,28E-06	-3.63E-05

CRU	[kg]	-	-	-	-
MFR	[kg]	-	-	-	-
MER	[kg]	-	-	-	-
EE [type]	[MJ]	-	-	1.28E-01	-
EE [type]	[MJ]	-	-	3.09E-01	-
Legend	HWD = Hazardous waste for landfilling; NHWD = Non-hazardous waste disposed of; RWD = Radioactive waste disposed of; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EE = Exported energy per type				

Group 3

LCA RESULTS – OUTPUT FLOWS AND WASTE CATEGORIES: 1 kg modified mineral mortar

		Production	Transport to building site	Installation	Benefit
Parameter	Unit	A1-A3	A4	A5	D
HWD	[kg]	-*	-*	-*	-*
NHWD	[kg]	-*	-*	-*	-*
RWD	[kg]	-*	-*	-*	-*
CRU	[kg]	-	-	-	-
MFR	[kg]	-	-	-	-
MER	[kg]	-	-	-	-
EE [type]	[MJ]	-	-	1.28E-01	-
EE [type]	[MJ]	-	-	3.09E-01	-
Legend	HWD = Hazardous waste for landfilling; NHWD = Non-hazardous waste disposed of; RWD = Radioactive waste disposed of; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EE = Exported energy per type				

* * Not all of the data inventories used for calculating the LCA support the methodical approach for declaring the water and waste indicators. The material volumes depicted by these data inventories contribute approx. 28% to product manufacturing. This is significant as it accounts for > 3% (in relation to the mass of the declared unit). The indicators can not therefore be accounted for (decision by the Expert Committee (SVA) on 07.01.2013).

6 LCA: Interpretation

Non-renewable primary energy requirements (PENRT) are primarily dominated by manufacturing of the preliminary products (~70 - ~90%). This is explained by the fact that they almost exclusively involve preliminary products from mineral or fossil raw materials which are energy-intensive during production. The primary energy carriers used are therefore natural gas, crude oil and coal.

During the manufacturing process, electricity consumption (up to approx. 20%) and production of packaging materials have a particular effect on non-renewable primary energy requirements.

Fillers generally only have a minimum effect on primary energy requirements, unlike dispersion powder, additives and pigments.

Incineration of the packaging material (A5) and the energy recovery associated with this process result in credits to a sum of approx. 7% being awarded.

The share of **renewable primary energy (PERT)** in overall primary energy can account for up to 27%. Among preliminary products, this is particularly attributable to the renewable percentage of the power mix and the citric acid content used as an accelerator which is manufactured from corn starch. The use of wooden pallets is particularly ascertainable during manufacturing. Solar energy is required for photosynthesis during corn and wood growth which is therefore noted here as a renewable source of primary energy.

At up to more than 80%, the **Global Warming Potential (GWP)** is dominated by production of preliminary products, Packaging is incinerated during

installation (A5) and the ensuing emissions contribute max. ~16% to the GWP. The credits arising from electricity and heat production in the waste incineration plants reduce the GWP by up to 7%. Electricity consumption during manufacturing and transport to the construction site play a subordinate role. Carbon dioxide emissions are the main contributor to the Global Warming Potential.

In the case of the **Ozone Depletion Potential (ODP)**, it is apparent that the influences are usually necessitated by the preliminary products (~70 up to 100%) which is primarily attributable to the upstream chain of additives such as accelerators or dispersion powder as well as cement production.

The **Acidification Potential (AP)** is primarily caused by nitric oxides and sulphur dioxide which are in turn incurred during manufacturing of the preliminary products in particular (up to 85%). Portland cement and/or dispersion powder and alumina cement – where higher percentages are contained - play a dominant role. But additives such as the accelerator also make a significant contribution to the Acidification Potential. During production, the Acidification Potential is primarily necessitated by electricity consumption. Transport to the building site (A4) also plays a significant role.

In terms of the **Eutrophication Potential (EP)** and similar to the Acidification Potential, manufacturing of the accelerator, production of Portland cement and dispersion powder play the greatest role. If large percentages of dispersion powder are contained as in Group 3, it dominates the Eutrophication

Potential, whereby nitrogen oxide emissions into air contribute to approx. 78%. Ammonium, nitrate and phosphate emissions into water make a contribution of max. 20% to the EP.

The contribution by preliminary products to the **Photochemical Ozone Creation Potential (POCP)** accounts for approx. 58-81%, whereby manufacture of the dispersion powder - where contained - plays the greatest role. The influence of cement produc-

tion and the accelerator continues to be clearly apparent. The nitrogen monoxide emissions incurred during transport have a negative influence on the POCP which leads to credits. The POCP is primarily caused by emissions of non-methane volatile organic compounds (NMVOC), carbon monoxide, nitrogen dioxide, sulphur dioxide and VOCs.

7 Requisite evidence

7.1 VOC

«M_7_Nachweis_2» Special tests and evidence have not been carried out or provided within the framework of drawing up this model Environmental Product Declaration.

Where the products are used in an area of application demanding testing/provision of VOC emissions, such evidence should always be submitted in the individual EPDs.

Evidence pertaining to VOC can be listed for selected products or applications (e.g. indoor areas with permanent stays by people). The following limit values (maximum values in [$\mu\text{g}/\text{m}^3$]) apply:

Classification / EMICODE	EC1 PLUS	EC1	EC2	RAL UZ 113 (*)	DIBt/AgBB
TVOC (C ₆ -C ₁₆) after 3 / 28 d	750 / 60	1000 / 100	3000 / 300	1000/100	10000 / 1000
TSVOC (C ₁₆ -C ₂₂) at 28 days	40	50	100	50	100
C1, C2 substances * Total after 3 days ** for each substance after 28 days	10* / 1**	10* / 1**	10* / 1**	10* / 1**	- / 1**
Total formaldehyde / acetaldehyde [ppb] at 3 days	50/50	50/50	50/50	50/50	- / -
VOC without LCI at 28 days	40	-	-	40	100
R value (28 days)	1	-	-	1	1

(*) e.g. for adhesive floor coverings and other covering materials

Measuring process: GEV test method for determining the emissions of volatile organic compounds from building products in accordance with DIN EN ISO 16000 Parts 3, 6, 9 and 11 in a test chamber; testing for CMR substances and TVOC/TSVOC after 3 and 28 days

The corresponding test certificate (e.g. EMICODE licence, Blue Angel as per RAL 113) shall apply as **evidence**. If necessary, the results are to be provided in the form of the emission class.«M_7_Nachweis_2_Text»

8 References

Institute Construction and Environment 2012

Institut Bauen und Umwelt e.V., Berlin (pub.): Creation of Environmental Product Declarations (EPD); General principles for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2011-06

www.bau-umwelt.de

PCR 2012, Part A

Institut Bauen und Umwelt e.V., Königswinter (pub.): Product Category Rules for construction products from the range of Environmental Product Declarations from Institute Construction and Environment

(IBU) Part A: Calculation rules for the Life Cycle Assessment and requirements on the Background Report, 2011-07

www.bau-umwelt.de

PCR 2011, Part B:

Product Category Rules for Construction Products, Part B: Requirements on the EPD for mineral trade mortar, 2011-06

www.bau-umwelt.de

ISO 14025



DIN EN ISO 14025:2009-11, Environmental labels and declarations – Type III Environmental Declarations – Basic principles and procedures (ISO 14025:2006)

EN 15804

DIN EN 15804:2011-04, Sustainability of construction works – Environmental product declarations – Core rules for product category of construction

2000/532/EC: Commission decision of 3 May 2000 replacing decision 94/3/EC on a waste index as per Article 1 a) of Council Directive 75/442/EEC on waste and Council decision 94/904/EC on an index of hazardous waste according to Article 1, paragraph 4 of Directive 91/689/EEC on hazardous waste

GaBi software & documentation

GaBi 6: Software and data base for comprehensive analysis. LBP, University of Stuttgart and PE International, documentation of GaBi 6 data sets <http://documentation.gabi-software.com/>, 2012

96/603/EC: 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

DIN 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; German version EN 1504-3:2005

DIN EN 1504-2

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; German version EN 1504-2:2004

DIN EN 12190

Products and systems for the protection and repair of concrete structures – Test methods – Determination of compressive strength of repair mortar; German version EN 12190:1998s

DIN EN 1015-17

Methods of test for mortar for masonry – Part 17: Determination of water-soluble chloride content of fresh mortars; German version EN 1015-17:2000 + A1:2004

DIN EN 1542

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

DIN EN 12617-4

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

DIN EN 1504-7

Products and systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity – Part 7: Reinforcement corrosion protection; German version EN 1504-7:2006

DIN EN 15183

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

DIN EN 12004

Adhesive for tiles – Requirements, evaluation of conformity, classification and designation; German version EN 12004:2007+A1:2012

DIN EN 1348

Adhesive for tiles – Determination of tensile adhesion strength for cementitious adhesives; German version EN 1348:2007

ETAG 004:2001-02-20

Guideline for European technical approval of external thermal insulation composite systems with rendering (ETAG 004); edition 2000-03

DIN EN 13888

Grout for tiles – Requirements, evaluation of conformity, classification and designation; German version EN 13888:2009

DIN EN 13813

Screed material and floor screeds – Screed materials – Properties and requirements; German version EN 13813:2002

DIN EN 13501-1

Fire classification of construction products and building products – Part 1: Classification using data from reaction to fire tests; German version EN 13501-1:2007 + A1:2009

DIN EN 13892-2

Methods of test for screed materials – Part 2: Determination of flexural and compressive strength; German version EN 13892-2:2002

DIN EN 998-1

Specification for mortar for masonry – Part 1: Rendering and plastering mortar; German version EN 998-1:2010

DIN EN 13501-1

Fire classification of construction products building elements – Part 1: Classification using data from reaction to fire tests; German version EN 13501-1:2007 + A1:2009

DIN EN 13279-1

Gypsum binders and gypsum plasters – Part 1: Definitions and requirements; German version EN 13279-1:2008

DIN EN 14891

Liquid-applied water impermeable products for use beneath ceramic tiling bonded with adhesives – Requirements, test methods, evaluation of conformity, classification and designation; German version EN 14891:2012

DIN EN 998-1

Specification for mortar for masonry – Part 1: Rendering and plastering mortar; German version EN 998-1:2010

DIN EN 13279-1

Gypsum binders and gypsum plasters – Part 1: Definitions and requirements; German version EN 13279-1:2008

DIN EN 14891

Liquid-applied water impermeable products for use beneath ceramic tiling bonded with adhesives –

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