ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A1*

Owner of the Declaration	Sto SE & Co. KGaA
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-IWM-STO-20210128-IBG1-DE
Issue date	07.07.2021
Valid to	06.07.2026

Mineral pre-made mortar: rendering mortar – normal/finishing render

Sto SE & Co. KGaA

Institut Bauen und Umwelt e.V.

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1. General Information

Sto SE & Co. KGaA

Rendering mortar – normal/finishing render

Programme holder
IBU – Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Owner of the declaration
Sto SE & Co. KGaA
Ehrenbachstraße 1
D-79780 Stühlingen
Germany

Declaration number
EPD-IWM-STO-20210128-IBG1-DE

Declared product / declared unit
1 kg rendering mortar as a mineral pre-made mortar, normal/finishing render product group with a dry bulk density greater than 1300 kg/m³ and less than 1800 kg/m³.
Product names:
Sto Grundputz CP, Sto Putsbruk CP, Sto Putsbruk CP, Sto Pudsmørtel CP, Sto Rappauslaasti CP, (DE, SE, NO, DK, FI); Sto Grundputz BP, Sto Putsbruk BP, Sto Putsbruk BP, Sto Pudsmørtel BP, Sto Rappauslaasti BP, (DE, SE, NO, DK, FI); Sto Grundputz A, Sto Putsbruk A, Sto Putsbruk A, Sto Pudsmørtel A, Sto Rappauslaasti A, (DE, SE, NO, DK, FI); Sto Grundputz B, Sto Putsbruk B, Sto Putsbruk B, Sto Pudsmørtel B, Sto Rappauslaasti B, (DE, SE, NO, DK, FI); Sto Grundputz C, Sto Putsbruk C, Sto Putsbruk C, Sto Pudsmørtel C, Sto Rappauslaasti C, (DE, SE, NO, DK, FI); Sto Kalkmörtel, Sto Kalkbruk, Sto Kalkbruk, Sto Kalkmørtel, Sto Kalkkilaasti, (DE, SE, NO, DK, FI); Sto-Hydraulischer Kalkmörtel Kh, Sto Hydrauliskt Kalkbruk Kh, Sto Hydraulisk Kalkbruk Kh, Sto Hydraulisk Kalkmørtel Kh, Sto Hydraulinen kalkkilaasti Kh, (DE, SE, NO, DK, FI); Sto-Hydraulischer Kalkmörtel KKh, Sto Hydrauliskt Kalkbruk KKh, Sto Hydraulisk Kalkbruk KKh, Sto Hydraulisk Kalkmørtel KKh, Sto Hydraulinen kalkkilaasti KKh, (DE, SE, NO, DK, FI);

This declaration is based on the product category rules:
Mineral factory-made mortar, 11.2017
(PCR checked and approved by the SVR)

Scope:
This document is a model EPD. When calculating the Life Cycle Assessment, the product selected to represent the group in question was the product with the highest environmental impact in that group. This EPD applies exclusively to rendering and plastering mortar – normal/finishing render or plaster as mineral pre-made mortars for association members; these can be found on the association's website. Any numerical values – e.g. for constructional data or concentration specifications – are average values that are customary in practice for this product group.

Issue date
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The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
The EPD was created according to the specifications of *EN 15804+A1*. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard *EN 15804* serves as the core PCR
Independent verification of the declaration and data according to *ISO 14025:2010*
☐ internally ☒ externally

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(chairman of Institut Bauen und Umwelt e.V.)

Dr. Alexander Röder
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Matthias Schulz
(Independent verifier)

2. Product

2.1 Product description/Product definition

Mineral pre-made mortars are mortars whose components are mixed at the factory and not on the construction site. They are divided into three different types – masonry mortar, rendering and plastering mortar, and screed material – depending on the type of application.
Mineral rendering and plastering mortars are mixtures of one or more mineral binders, aggregates, water, and – if applicable – additions or admixtures for the manufacture of renders or plasters. Rendering and plastering mortars are applied to walls and ceilings in one or more layers as required. Alongside the aesthetic design of the surface, they protect against effects of the weather when used as external renders and provide an even substrate for paint coats and wallpaper when used as internal plasters. In the case of reinforced concrete ceilings and stairs, renders/plasters also serve as fire protection; when porous aggregates are added, they serve as thermal protection. Depending on the technical data, the base materials and processing aids used, and the practical application, rendering and plastering mortars are divided into the following product groups: normal/finishing render or plaster, normal/finishing render, or plaster with special properties, lightweight render, reinforcement fibre plaster, and insulating render with an especially high proportion of lightweight aggregates.

Placing normal/finishing render or plaster on the market in the EU/EFTA (with the exception of Switzerland) is subject to Regulation (EU) No. 305/2011 (CPR). Normal/finishing render or plaster requires a declaration of performance – taking into consideration *DIN EN 998-1:2017-02*, Specification for mortar for masonry - Part 1: Rendering and plastering mortar – and the CE marking.
The relevant national regulations apply with regard to usage.

2.2 Application

Rendering and plastering mortars produced in the factory for use as a base coat or finishing render/plaster on walls, ceilings, piers, and separating walls of structures which comply with the applicable standards or on similar backgrounds (e.g. in the case of existing buildings).
Normal render for the production of internal plaster and external render without special properties.

2.3 Technical Data

Constructional data

Name	Value	Unit
Compressive strength strength in accordance with DIN EN 1015-11	≤ 15	N/mm²
Thermal conductivity with DIN EN 1745 lambda10,dry,mat / P = 50 %	0.39 - 0.82	W/(mK)
Thermal conductivity conductivity in accordance with DIN EN 1745 lambda10,dry,mat / P = 90 %	0,43 - 0,89	W/(mK)
Sound absorption coefficient (as required)	-	%
Water-vapour transmission rate in accordance with DIN EN 1015-19	15/35	-
Dry bulk density in accordance with DIN EN 1015-10	1300 - 1800	kg/m³
Capillary absorption in accordance with DIN EN 1015-18	n/a	kg/(m²min ^0,5)

Performance values of normal/finishing render or plaster according to the declaration of performance in relation to its key characteristics in accordance with *DIN EN 998-1:2017-02*, Specification for mortar for masonry - Part 1: Rendering and plastering mortar. Adhesive shear strength, bond strength, and flexural strength are not relevant.

2.4 Delivery status

Mineral rendering and plastering mortars – normal/finishing render or plaster are produced and delivered as pre-made dry mortars. Pre-made dry mortar is a mortar made from raw materials that are placed into containers dry at the factory, delivered to the construction site, and then mixed with the required quantity of water to form ready-to-use mortar based on the manufacturer's instructions and conditions.
Delivered in sacks up to 35 kg per sack or in silos up to 15 t per silo.

2.5 Base materials/Ancillary materials

Mineral building products such as mineral pre-made mortars and rendering and plastering mortars mainly consist of abundant mineral raw materials. Scarcity of resources is not an issue.

Name	Value	Unit
Aggregate	55-70	M.-%
Fine aggregate	10-20	M.-%
Lightweight aggregate	-	M.-%
Artificial lightweight aggregate	-	M.-%
Cement	7-20	M.-%
Hydrated lime [Ca(OH2]	≤ 17	M.-%

The permissible fluctuation range of the constructional data is enabled by the variety of proportions of base materials. In each case, the composition of the rendering and plastering mortars adds up to 100 m%.

The following processing aids and admixtures can be used as needed:

- Synthetic dispersion: < 0.50 m%
- Water retention agent: < 0.30 m%
- Air entraining admixture: < 0.03 m%

- Thickening agent: < 0.03 m%
- Mineral pigments: < 0.20 m%
- Hydrophobic agent: < 0.30 m%

Aggregate: Natural sands as natural raw materials, which contain natural minor and trace minerals along with the main minerals quartz (SiO2) or calcite (CaCo3).
Fine aggregate: Limestone dusts which arise as a result of the preparation of natural sand for the production of aggregates, as well as ultra-fine sands.
Lightweight aggregate: Natural or artificial mineral lightweight aggregates for reducing the dry bulk density. Natural lightweight aggregates are manufactured from natural raw materials via grinding (e.g. pumice or vermiculite). Artificial lightweight aggregates are manufactured by processing, melting, and swelling suitable natural raw materials (swelling clay, perlite) or sorted recycled glass (expanded glass).
Artificial lightweight aggregate: Organic, expanded polystyrene (EPS) produced by foaming in spherical or particle form (recycled) for reducing the dry bulk density.
Cement: As per *DIN EN 197-1*; cement is used as a binder and is mainly made from limestone marl or a mixture of limestone and clay. The natural raw materials are baked and then ground.
Hydrated lime: As per *DIN EN 459*; white hydrated lime is used as a binder and is made by baking natural limestone followed by slaking.
Synthetic dispersion: Polymer powder for improving the adhesive bond, elasticity, mechanical properties, etc. in thin-bed mortar.
Water retention agent: Cellulose ether, made from cellulose, which prevents dehydration from occurring in the fresh mortar too quickly.
Air entraining admixture: Surfactants for reducing the surface tension of water and producing entrained air. This reduces the bulk density of fresh mortar, improves workability, and reduces the tendency towards contraction and stress cracking.
Thickening agent: Cellulose or starch ether, made from cellulose or crystal starch, improves the resistance to flow, and thus has a thickening effect, but does not have any water-retaining properties.
Mineral pigments: Natural or synthetic powder-form colouring materials which are produced by mechanical processing of the relevant mineral substances such as chalk, clay, etc.
Hydrophobic agent: Water-soluble sodium oleate or zinc stearate for reducing the capillary absorption of the solid mortar.

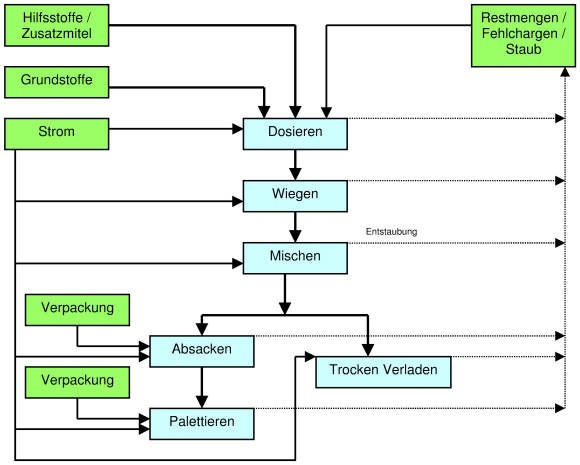
Information about Substances of Very High Concern:
The product contains substances from the *ECHA candidate list* (15.01.2019) above 0.1 % w/w: no.
The product contains further CMR substances from Category 1A or 1B which are not on the candidate list above 0.1 % w/w in at least one part of the product: no.
Biocide products have been added to this building product or it has been treated with biocide products (thus it is a treated product in the sense of the Biocide Products Ordinance (EU) No. 528/2012): no.

2.6 Manufacture

The graphic shows the manufacturing process.
Mineral rendering and plastering mortars are made in mixing plants in the following steps:

- Filling of the storage or weighing containers
- Conveyance of ingredients and substances being mixed into the mixer
- Mixing
- Conveyance of finished products
- Packaging
- Loading and shipping of the finished product

The raw materials – sand, binder, lightweight aggregates, processing aids, admixtures, and additions (see base materials) – are stored at the manufacturing plant in silos. From the silos, the raw materials are gravimetrically dosed and intensely mixed according to the respective formulation. The mixture is then packaged and shipped dry as pre-made dry mortar in containers or silos.



Graphic 1: Manufacturing process (green: input; blue: unit process)

2.7 Environment and health during manufacturing

The current state of the art includes the 100 % return of dry waste into production. In all places where dust can arise during production in the factory, this waste is fed into a central filter system using the appropriate extraction systems, taking into account the occupational limit values. The very fine dust filtered out in these systems is then fed back into the manufacturing process. As part of the quality management systems introduced, any off-specification batches are detected immediately by the automated process monitoring system and are fed into circulation via appropriate recovered-goods silos, i.e. they are fed back into the production process in very small quantities. This procedure is also applied for product residues which are transported back to the manufacturing plant in small quantities in silos or sacks.
Process exhaust air is dedusted until the level is far below the statutory occupational limit values.

Noise:
Noise level measurements have shown that all values determined inside and outside the production facilities are well below the required specifications of the technical standards thanks to noise protection measures being taken.

2.8 Product processing/Installation

Mineral rendering and plastering mortars are normally applied by machine. They are extracted from the silo with a dry-materials conveying machine or from

individual containers and mixed with a mixing pump before being conveyed and applied. Silo mixing pumps can also be used.
The rendering and plastering mortars are then levelled, and textured if necessary, on site with suitable tools.
The regulations of the employers' liability insurance associations and the respective safety data sheets of the building products apply.
With the cement and lime binders in mineral pre-made mortars, the fresh mortar mixed with water is strongly alkaline. Prolonged contact can cause serious skin damage owing to the alkalinity. Personal protective measures must therefore be taken (*EU Health & Safety Data Sheet*) to avoid any contact with eyes or skin.
No special measures are required for protection of the environment. Unchecked dust emissions must be avoided.
Mineral pre-made mortars must not enter the sewer system, surface water, or ground water.

2.9 Packaging

Bagged cargo from a paper bag with a plastic insert, sacks stored on wooden pallets, pallets wrapped in plastic film, silo-based goods stored in steel silos.
Possibilities of reuse for the packaging of bagged cargo – separation if necessary. Unsoiled polythene films (correct sorting must be applied) and reusable wooden pallets are taken back by the building material dealer (reusable wooden pallets subject to reimbursement as per the deposit system), returned to the mortar plants by the dealer, and fed back into the production process. The films are forwarded to the film manufacturers for recycling.

2.10 Condition of use

The specified products are rot-resistant and ageing-resistant during normal use that conforms to the intended purpose of the products described.
Rendering and plastering mortars made from mineral pre-made mortars must be protected from long-term weather effects, e.g. by properly connecting the facade plinth (*SAF*).
The cracking resistance of rendering and plastering mortars made from mineral pre-made mortars can be increased with cracking reinforcement in the tension-stressed areas of the render *DIN EN 13914-1, -2*, *DIN 18550-1, -2*.

2.11 Environment and health during use

Due to the stable calcium silicate hydrate (CSH) adhesion and the firm structures achieved through curing on the substrate, emissions are rendered impossible. During normal use conforming to the intended purpose of the products described, any adverse health effects have been rendered impossible.
No hazards for water, air, and soil are known for use as per the intended application of the products.
The natural ionising radiation of the rendering and plastering mortars made from mineral pre-made mortars is extremely low and does not pose any health-related risks.

2.12 Reference service life

A reference service life (RSL) as per *ISO 15686-1, -2, -7,* and *-8* is not declared. Provided they are used as intended and properly applied, the service life of rendering and plastering mortars made from mineral pre-made mortars on walls and ceilings has been known to be 40 years or longer (*BBSR*).

2.13 Extraordinary effects

Fire
Fire protection class A1

The reaction to fire can be verified in the following ways in accordance with the regulations:

Option 1: Based on *Commission Decision 94/611/EC*, normal/finishing render or plaster is to be placed in fire protection class A1 "No contribution to fire" without testing in accordance with *DIN EN 13501-1* as the proportion of finely dispersed organic components is not greater than 1 %.
Option 2: Because the proportion of finely dispersed organic components is greater than 1 %, the fire protection class A1 is verified with a test as a matter of course.

Regardless of the product group, it has been shown in the "hot" measurement (structural analysis with the resistance of the masonry reduced under the influence of fire temperatures) that rendering and plastering mortar made from mineral pre-made mortars has a beneficial effect on the required minimum wall thickness.
Depending on the product, additional labels will appear on containers with the CE mark or declaration of performance.

Fire protection

Name	Value
Building material class	A1
Burning droplets	-
Smoke gas development	-

Water
Mineral pre-made mortars as rendering and plastering mortars are structurally stable and are not subject to changes in shape as a result of water exposure and drying.

Mechanical destruction
No specifications required.

2.14 Re-use phase

The service life of masonry coated with normal/finishing render normally ends along with the service life of the simultaneously erected building.
Reuse and further use of masonry coated with render after demolition is not possible.
Elements of building construction made from mineral rendering and plastering mortars can normally be stripped down easily. During demolition of a building, these elements do not have to be treated as special waste, but the sorting during demolition must be as exact as possible. Mineral rendering and plastering mortars can be recycled as building materials. They are normally reused in structural and civil engineering in the form of recycled aggregates.

2.15 Disposal

Mortar is categorised as mineral construction waste. 78.4 % of construction waste is recycled. *German Building Materials Association*
The suitability of hardened mineral rendering and plastering mortars for landfill as per landfill class I is

ensured according to the Technical Instruction on Municipal Waste (*TASi*). The *EWC waste code* according to the waste reuse directory is 170101.

2.16 Further information

Further information is available online at www.vdpm.info.

3. LCA: Calculation rules

3.1 Declared Unit

This declaration refers to the production of one kilogram of typical rendering mortar of the normal/finishing render product group. Only dry mortars are taken into consideration.

Specification of declared unit

Name	Value	Unit
Declared unit	1	kg
Gross density	1300 - 1800	kg/m³
Spreading rate	0,70-0,85	l/kg
Conversion factor to 1 kg	1	-

The product which demonstrated the highest environmental impact of the normal/finishing render product group was selected from that group for calculating the Life Cycle Assessment.

3.2 System boundary

The lifecycle analysis of the products being examined encompasses the production of the mortar including raw material extraction and the provision of energy sources up to the packaged, finished product (module A1-A3), the application of the product including transportation to the construction site (module A4-A5), the usage phase (module B1), and disposal of the mortar (module C4). For silo-based goods, the proportionate expenditure for transportation and manufacturing of the silo is taken into account. Credit for packaging including energy recovery (module D) is also incorporated into the Life Cycle Assessment.

3.3 Estimates and assumptions

For the individual formulation components of the formulations, these were assessed according to manufacturer specifications or literature in the event that no specific GaBi 8 processes were available.

3.4 Cut-off criteria

At the input side, all material flows that enter the system and are greater than 1 % of their total mass or contribute more than 1 % to primary energy demand are taken into consideration. The total amount of input flows not taken into consideration is maximum 5 % of the energy and mass in use.
The manufacturing of the machines, facilities, and other infrastructure required for the production of the relevant products was not taken into consideration for the Life Cycle Assessments.

3.5 Background data

The software system *GaBi8* was used for modelling the life cycle for the production of the mortar products.

All of the background records relevant to the assessment have been retrieved from the GaBi8 database, with the exception of the pumice (ROTOCELL) record.

3.6 Data quality

Representative products were used for this model EPD – the product with the greatest environmental impact was declared to be representative of a group in order to calculate the Life Cycle Assessment results.
Corresponding background records were available in the GaBi database for all relevant primary products used.
The requirements in terms of data quality and background data correspond to the specifications of PCR Part A.
The technological background of the data collected reflects the physical reality for the declared product group.
The records are complete and fulfil the system boundaries and criteria for the exclusion of inputs and outputs.
The last audit of the data used was less than 8 years ago.

3.7 Period under review

The period under review is one year of production based on the year 2018. The reference area of the Life Cycle Assessments was limited to Germany. The result is that, besides production processes under these marginal conditions, the precursors also relevant for Germany, such as electricity and energy provision, were used.

3.8 Allocation

Specific information on the allocations within the background records can be found in the documentation of the GaBi records. The material and energy consumption for the declared product were allocated by the member companies of the VDPM. The data made available consists of internal key figures which have not been published. A multi-input allocation is used as per a simple credit method with a credit for power and thermal energy when burning packaging and production waste as well as the landfilling of production waste. The credit from the disposal of packaging is credited 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.

The *GaBi 8* background database was used for modelling purposes

4. LCA: Scenarios and additional technical information

The following technical information is necessary for the declared modules or can be used for the development of specific scenarios in the context of building assessment if modules have not been declared (MND).

Transportation to the construction site (A4)

Name	Value	Unit
Litres of fuel	0.0062	l/100km
Transport distance	300	km
Capacity utilisation (including empty runs)	50 - 85	%
Gross density of products transported	1300 - 1800	kg/m^3

Installation into the building (A5)

Name	Value	Unit
Auxiliary	0	kg
Water consumption	0.0003	m^3
Other resources	0	kg
Electricity consumption	0.00045	kWh
Other energy carriers	0	MJ
Material loss	0	kg
Output substances following waste treatment on site	0	kg
Dust in the air	0	kg
VOC in the air	0	kg

For use (B1) see Chapter 2.12 on use

In the use stage, the carbon dioxide absorbed by means of carbonation is taken into consideration. The carbon dioxide released during the neutralisation of limestone (CaCO3) in the production of lime and cement is reabsorbed when reacting with the lime and cement binders, thus leading to an increase in strength. In line with *DIN EN 16757*, the resulting maximum theoretical carbon dioxide absorption for fully carbonated rendering and plastering mortars and the practical total maximum potential for carbon dioxide absorption – taking into account the degree of exposure of the surfaces – were calculated in the Life Cycle Assessment of the pre-made mortar.

End of the life cycle (C1-C4)

Name	Value	Unit
Collected separately waste type	0	kg
Collected as mixed construction waste	0	kg
Reuse	0	kg
Recycling	0	kg
Energy recovery	0	kg
Landfilling	1.04	kg

Reuse, recovery, and recycling potential (D); relevant scenario specifications

Name	Value	Unit
Recycling silo (packaging)	100	%
Burning of wooden pallets (packaging)	100	%
Burning of paper (packaging)	100	%
Burning of polythene film (packaging)	100	%

5. LCA: Results

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

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

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A1: 1 kg Mineral pre-made mortar: rendering and plastering mortar – normal/finishing render or plaster

Parameter	Unit	A1-A3	A4	A5	B1	C4	D
Global warming potential	[kg CO_2-Eq.]	2.08E-1	2.18E-2	4.17E-2	-1.08E-1	1.66E-2	-1.75E-2
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	4.97E-10	4.58E-16	5.71E-16	0.00E+0	3.69E-15	-1.27E-14
Acidification potential of land and water	[kg SO_2-Eq.]	2.78E-4	1.66E-5	5.46E-6	0.00E+0	9.80E-5	-1.91E-5
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	6.25E-5	3.74E-6	1.21E-6	0.00E+0	1.35E-5	-3.12E-6
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	2.79E-5	-2.35E-7	3.65E-7	0.00E+0	7.62E-6	-1.68E-6
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	9.43E-7	2.26E-9	7.30E-10	0.00E+0	6.37E-9	-4.04E-8
Abiotic depletion potential for fossil resources	[MJ]	1.40E+0	2.92E-1	1.11E-2	0.00E+0	2.14E-1	-2.25E-1

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A1: 1 kg Mineral pre-made mortar: rendering and plastering mortar – normal/finishing render or plaster

Parameter	Unit	A1-A3	A4	A5	B1	C4	D
Renewable primary energy as energy carrier	[MJ]	3.96E-1	1.97E-2	2.88E-1	0.00E+0	2.76E-2	-5.23E-2
Renewable primary energy resources as material utilization	[MJ]	2.86E-1	0.00E+0	-2.86E-1	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary energy resources	[MJ]	6.82E-1	1.97E-2	2.37E-3	0.00E+0	2.76E-2	-5.23E-2
Non-renewable primary energy as energy carrier	[MJ]	1.50E+0	2.93E-1	4.93E-2	0.00E+0	2.22E-1	-2.53E-1
Non-renewable primary energy as material utilization	[MJ]	3.70E-2	0.00E+0	-3.70E-2	0.00E+0	0.00E+0	0.00E+0
Total use of non-renewable primary energy resources	[MJ]	1.54E+0	2.93E-1	1.23E-2	0.00E+0	2.22E-1	-2.53E-1
Use of secondary material	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	[m^3]	4.44E-3	2.29E-5	4.02E-4	0.00E+0	4.23E-5	-3.33E-5

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A1: 1 kg Mineral pre-made mortar: rendering and plastering mortar – normal/finishing render or plaster

Parameter	Unit	A1-A3	A4	A5	B1	C4	D
Hazardous waste disposed	[kg]	1.23E-8	1.88E-8	1.19E-11	0.00E+0	3.82E-9	-1.42E-10
Non-hazardous waste disposed	[kg]	5.22E-3	2.18E-5	1.80E-4	0.00E+0	1.04E+0	-1.39E-4
Radioactive waste disposed	[kg]	4.91E-5	3.54E-7	4.99E-7	0.00E+0	3.18E-6	-1.10E-5
Components for re-use	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	[kg]	0.00E+0	0.00E+0	1.87E-4	0.00E+0	0.00E+0	0.00E+0
Materials for energy recovery	[kg]	0.00E+0	0.00E+0	2.26E-2	0.00E+0	0.00E+0	0.00E+0
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	5.22E-2	0.00E+0	0.00E+0	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	1.22E-1	0.00E+0	0.00E+0	0.00E+0

6. LCA: Interpretation

The LCA results are dominated by the life cycle phases of raw material provision & transportation (A1 & A2), manufacture (particularly the manufacture of packaging in A3), and landfill disposal (C4) in all impact categories. Taken together, approx. 60 – 90 % of the environmental impact comes from these life cycle phases.

In total, raw materials used and their transportation contribute (excluding ADPE and ODP) to the environmental impact with a percentage of around 40 – 70 % – primarily due to the use of limestone dust, hydrophobic agent, dispersion powder, and quartz sand (together >80 % within A1). The manufacture of the dispersion powder dominates the indicator ODP (>95 %). The manufacture of the hydrophobic agent dominates the indicator ADPE (>95 %). Transportation of the raw materials plays a secondary role (<10 % of total A1-A2).

The manufacture of the packaging contributes (with the exception of GWP, ODP, ADPE, and PERT) approx. 10 – 20 %. The use of wooden pallets and paper contributes significantly to PERT (approx. 50 %

contribution) and leads to a low rate of carbon dioxide absorption in A3 (<5 %).

Transportation of the products to the construction site (A4) plays a secondary role (<10 %).

Landfill disposal at the end of the life cycle (C4) contributes (with the exception of ODP and ADPE) approx. 0 – 20 % to the environmental impact.

In the use phase, around 30 % of the GWP caused is reabsorbed by means of carbonation (= carbon dioxide absorption).

7. Requisite evidence

7.1 Leaching:
All specified products in this LCA comply with all emissions scenarios for a scenario involving the building elements that are subject to moisture.

7.2 VOC emissions:
Measuring location: Fraunhofer Institute for Building Physics (IBP), Holzkirchen Branch, D-83626 Valley
Measuring procedure: Determination of volatile organic compounds from building products and fixtures in accordance with *DIN EN ISO 16000-9* and *-11* in a 0.2 m3 test chamber (t0 = 7 days) and evaluation as per the schema of the Committee for Health-related Evaluation of Building Products (*AgBB*). Measurement of different products intended for both interior use and outdoors.
Test report: Results log 005/2008/281 from 20 March 2008
Results:

Probenbezeichnung	Normalputz	
AgBB Ergebnisüberblick	3 Tage [µg/m³]	28 Tage [µg/m³]
	Messwerte	Messwerte
[A] TVOC (C6-C16)	< 400	< 100
[B] Σ SVOC (C16-C22)	< 5	< 2
[C] R (dimensionslos)	< 1,5	< 0,2
[D] Σ VOC o. NIK	< 100	< 10
[E] Σ Kanzerogene	< 2	< 1
[F] VVOC (< C6)	< 60	< 40

All specified products remained below the recommended limiting value.

7.3 Radioactivity:
Measuring location: Fraunhofer Institute for Building Physics (IBP), Holzkirchen Branch, D-83626 Valley
Measuring procedure: Test of content for the radioactive nuclides radium-226, thorium-232, and potassium-40 by measuring the activity concentrations CNuclide through alpha spectrometry (delayed coincidence method via LSC) or gamma spectrometry
Test report: Inspection report from 12 December 2006 on the radioactivity of building products
Result: The activity concentration indices (I) calculated from the measured activity concentrations CNuclide were below the recommended limiting value of I = 2 for all specified products. Moreover, at no point was the recommended limiting value I = 0.5 either reached or exceeded for building products used in large quantities. Where I correlated with the dose criterion in accordance with the *Radiation Protection 112* guidelines from the European Commission, all specified products remained below the recommended limiting value of the annual radiation dose of 0.3 mSv/a.

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