ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	**Bundesverband der Gipsindustrie e.V.**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-BVG-20140073-IAG1-EN
Issue date	13.11.2014
Valid to	12.11.2020

GYPSUM PLASTER

Bundesverband der Gipsindustrie e.V.

Institut Bauen und Umwelt e.V.

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

1. General Information

Bundesverband der Gipsindustrie e.V.	GYPSUM PLASTER
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the Declaration** Bundesverband der Gipsindustrie e.V. Kochstraße 6/7 10969 Berlin
Declaration number EPD-BVG-20140073-IAG1-EN	**Declared product / Declared unit** 1 kg gypsum binder for powder products in accordance with /DIN EN 13279-1/
This Declaration is based on the Product Category Rules: Mineral factory-made mortar, 07.2014 (PCR tested and approved by the SVR)	**Scope:** The EPD applies for all member companies of the Bundesverband der Gipsindustrie e.V. in accordance with the current list of members on www.gips.de and for products manufactured in Germany. The Life Cycle Analysis considers specific information provided by manufacturers and suppliers of components exclusively for the cradle-to-gate product stage. This document is translated from the German Environmental Product Declaration into English. It is based on the German original version EPD-BVG-20140073-IAG1-DE. The verifier has no influence on the quality of the translation.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.
Issue date 13.11.2014	**Verification** The CEN Norm /EN 15804/ serves as the core PCR Independent verification of the declaration according to /ISO 14025/ ☐ internally ☒ externally
Valid to 12.11.2020	
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	
Dr. Burkhart Lehmann (Managing Director IBU)	Dr.-Ing. Wolfram Trinius (Independent verifier appointed by SVR)

2. Product

2.1 Product description

Gypsum binder in accordance with /DIN EN 13279-1/ is the base product for industrial manufacturing of various gypsum plasters but also for all prefabricated elements made of gypsum. It is extracted through calcination of calcium sulphate dihydrate ($CaSO_4$ 2 H_2O) and comprises calcium sulphate in its various hydrate phases, e.g. hemi-hydrate ($CaSO_4$ ½ H_2O) and anhydrite ($CaSO_4$).
Gypsum binder is a bindable material ground to powder whose curing process is triggered by the addition of water. This can be carried out at the construction site (gypsum plaster, gypsum filler and gypsum-based adhesive) or in the plant within the framework of production of prefabricated elements. Gypsum binder forms the basis for manufacturing gypsum plaster (for automatic or manual plastering), gypsum filler material and gypsum-based adhesives as well as for model plaster, stucco and fixing plaster.

2.2 Application

Gypsum binders can be manufactured for various applications which are indicated by the respective name in accordance with European standards or traditional, possibly deviating, names combined with applications indicated by the manufacturer only. An overview is provided by the Gypsum Data Book issued by the Bundesverband der Gipsindustrie e.V. /Gypsum Data Book/ and the IGB Stucco Manual /IGB/ published by the building plaster industrial group of the Bundesverband der Gipsindustrie e.V..

2.3 Technical Data

The technical data is based on the following standards: Definitions and requirements on gypsum binders and gypsum plasters in accordance with /DIN EN 13279-1. /DIN EN 13963/ also applies for materials for filling plasterboard joints (filler, fine filler and jointing compound).
Additional technical data refers to application of the products at the construction site. This technical construction data, which refers to the down-stream processing after the plant gate, results from following the manufacturer's processing information for the construction site. As this LCA only considers the production stage, these properties are not listed here for systematic reasons.

If necessary, more information is available in the standards, the Gypsum Data Book issued by the Bundesverband der Gipsindustrie e.V. /Gypsum Data Book/ and information supplied by the manufacturer.

2.4 Placing on the market / Application rules

Regulation (EU) No. 305/2011 dated 9 March 2011 /Construction Products Regulation/ applies for placing on the market in the EU/EFTA. The products require a Declaration of Performance and CE marking taking consideration of the /DIN EN 13279-1/ for gypsum plaster.
/DIN EN 13963/ also applies for filler, fine filler and jointing compound.
Applications should be in line with manufacturer's recommendations.
Use is governed by the respective national regulations.

2.5 Delivery status

The product is delivered in powder form. The product can be procured in various pack sizes, e.g. in sacks or loose from silos depending on the manufacturers' respective offers.
The list of manufacturers is available on the Bundesverband der Gipsindustrie e.V. web site: www.gips.de.

2.6 Base materials / Ancillary materials

As a general rule, gypsum binder comprises calcium sulphate of various hydrate stages, whereby the binding and processing characteristics are based on their respective combinations and possibly the addition of additives.
A distinction can generally be made between products containing non-hazardous substances and alkaline gypsum products.
Gypsum binders with added lime hydrate of 1 to 10% by weight bear the CLP label eye damage / eye irritation category 1 with the GHS05 pictogram, the signal word "Danger" and the H318 hazard statement "Causes serious eye damage".
A safety data sheet is available for all products from the respective manufacturer or from the GISBAU data base of the employers' liability insurance association of the building industry BG Bau.

2.7 Manufacture

During the manufacturing process, raw gypsum is burned as gypsum binder where it is available as hemi-hydrate, anhydrite III and anhydrite II gypsum phases. Gypsum plaster is also admixed with powdered limestone, sand or perlite, and additives such as binding retarders or cellulose derivatives which are added in dry form to the calcined calcium sulphates.

2.8 Environment and health during manufacturing

Gypsum products are manufactured in the "Installations for burning gypsum" which are outlined in the 4th Federal Immission Control Ordinance in the Annex to installations subject to approval. The immission control requirements comprise the guidelines outlined in the Federal Immission Control Act and the technical requirements on air as outlined in the "TA Luft".

Gypsum industry plants are only subject to emissions trading if the cumulated rated thermal input is ≥ 20 MW. This threshold value is only achieved by larger plants and/or joint production of several gypsum products.

The plants implemented an Energy Management system according to /DIN EN ISO 50001/.

2.9 Product processing/Installation

The subsurface must fulfil the following requirements for the professional manufacture of plaster surfaces:

- Even surface in accordance with the requirements of /DIN 18202/
- Load-bearing, solid and sufficiently inherently stable
- Dry, non-water-repellent and evenly absorbent
- Free of dust, soiling and harmful efflorescence
- Frost-free and/or tempered above +5 °C
- Free of sintered layers and release agent residue

Where concrete is used as a plaster base, residual moisture must not exceed 3% by weight. Moisture release by concrete must be finished in the surface zone. Freshly-plastered rooms must be protected from frost.

Other key information is represented by the absorptivity of the plaster base, material requirements and yield, water values when sprinkling the product into water, plaster layer and thickness, processing times, drying out as well as the requisite quality levels of surfaces and details on suitable coatings.

Plaster finishing spatulas (abbreviated as C7) in accordance with /DIN EN 13279-1/ are primarily used for flat coatings on smooth solid subsurfaces (plaster surfaces, plan stone masonry, smooth-formed concrete, prefabricated concrete parts) or on gypsum or gypsum fibreboard for subsequent surface treatment. Apart from full-surface coatings, textured designs are also possible. Depending on the product, plaster can be applied and processed manually or by machine. Layers have a thickness of 0.1 mm to 3 mm. Filler, fine filler and jointing compound are regulated according to /DIN EN 13963/ and are primarily used for filling plasterboard joints in accordance with /DIN EN 520/ as well as for fibre-reinforced plasterboard.

2.10 Packaging

Powder gypsum products must be protected from moisture absorption during transport and storage. Where possible, material delivered in sacks should be stored in enclosed spaces and on wooden gratings. The storage times specified – usually three to six months – must be observed. Gypsum products can usually still be processed after these times, whereby the information provided by the manufacturer concerning processing times no longer apply.

2.11 Condition of use

The product is intended for use as a construction product in interior areas and/or serves as an industrial interim product for the manufacture of other gypsum products.

2.12 Environment and health during use

All requirements of the AgBB test scheme (version 2008) are fully met /Scherer 2010/.

All of the criteria listed are significantly fallen short of. The products do not have any negative impact on the quality of indoor air.

2.13 Reference service life

The Reference Service Lives depend on the respective applications. The Reference Service Lives result from the application areas in accordance with the BSSR "Nutzungsdauern von Bauteilen für Lebenszyklusanalysen nach dem Bewertungssystem Nachhaltiges Bauen (BNB) (Useful life of components for the LCA according to the Sustainable Building assessment system)" table, last revised 03.11.2011 /BBSR Service Life/, as follows:

· for standard interior plasters (code 345.211, stucco, lime-gypsum plaster and much more) ≥ 50 years (the same applies for plaster profiles (code 345.221) and plaster bases (code 345.222) which may be used in combination with gypsum products)
· for filling compounds, adhesive binders and adhesives made of gypsum in stud wall systems (code 342.411) or partitions made of gypsum plasterboards (code 342.511) ≥ 50 years

There are no influences on ageing when the recognised rules of technology are applied.

2.14 Extraordinary effects

Fire

The product is allocated to class A1 according to /DIN EN 13501/ (no contribution to fire load) provided that it contains less than 1% by weight or volume of organic substances (the higher value applies).
According to /DIN EN 13501-1/, this also satisfies the additional requirements concerning "no smoke gas development" (s1) and "no burning droplets/drips" (d0).

Water

The product is intended for use in interior applications only. Permanent penetration of the product with water must be avoided as recrystallisation and structural changes can arise due to the water solubility of gypsum.
In the event of any temporary moisture penetration at a later stage, strength diminishes. But the original values are achieved again after drying. This is why application in domestic kitchens and bathrooms only exposed to occasional and temporary moisture does not present any problems.
A leaflet /Flooding Leaflet/ is available from the Bundesverband der Gipsindustrie e.V. on how to repair damage caused by flooding.

Mechanical destruction

Mechanical stress does not occur during the service life of the building. As the product is used for interior applications, there are no negative consequences for the environment in the event of unforeseen mechanical destruction.

2.15 Re-use phase

Waste processing (recycling or disposal) depends on the respective substrate due to the low material hardness displayed by the component. The actual material is suitable for disposal on landfills from landfill class DK I in accordance with the Landfill Ordinance. Recycling options can be restricted by sulphate content caused by gypsum in the eluate.

2.16 Disposal

The waste code for the unused material is 10 13 06 "Particulates and dust (with the exception of 10 13 12 and 10 13 13)" in category 10 13 "Waste from the manufacture of cement, unhydrated lime, gypsum and products made from these materials" or 17 08 02 "Construction products based on gypsum with the exception of those included in 17 08 01" in category 17 08 "Construction materials based on gypsum".
Neither represents hazardous waste.
After processing, the waste code must be selected depending on the respective substrate.

2.17 Further information

www.gips.de

3. LCA: Calculation rules

3.1 Declared Unit

This declaration refers to 1 kg material in the respective delivery form (powder product, not mixed with water).
Material requirements and yield are indicated in the product information or can be obtained from the manufacturer.

Details on declared unit

Name	Value	Unit
Declared unit Powder product	1	kg

Material requirements comprise between 8 kg/m2 and 11 kg/m2 for 10 mm plaster thickness on subsurfaces which are solidly filled and of normal absorbency.

3.2 System boundary

Type of EPD: cradle to gate
Modules A1-A3 include the production of raw materials and transport thereof, the provision of energy and manufacturing processes required for production.

3.3 Estimates and assumptions

Packaging material for powder products to be delivered were considered. As a general rule, the products can be delivered in bags; larger volumes can also be supplied loose in silos or tank trucks.
Assumptions were made regarding packaging and transportation for all materials required for manufacturing and packaging the product. In the case of product packaging, average values concerning various paper bag volumes were considered (see section 5) and an LCA comparison made with the unpackaged product (see section 6).

3.4 Cut-off criteria

All components for manufacturing as well as all electricity and water required were considered. Accordingly, material and energy flows accounting for a share of less than 1% were also considered.
It can be assumed that the processes ignored would have contributed less than 5% to the impact categories under review.

3.5 Background data

"GaBi 5" – the software system for comprehensive analysis developed by PE INTERNATIONAL AG – was used for modelling the life cycle of all components /GaBi 5, 2012/.
The Life Cycle Assessment was modelled for Germany as a reference area. This means that apart from the production processes within the system boundaries, the upstream processes of relevance for Germany such as provision of electricity or energy carriers were taken into account, too. The power mix for Germany 2008 is used.

3.6 Data quality

All background data sets of relevance were taken from the GaBi 5 software data base.

3.7 Period under review

The data used by PE INTERNATIONAL AG complies with the current level of knowledge at the time of modelling the LCA in early 2013.

3.8 Allocation

Allocations were used in the background data for modelling the requisite components, e.g. for the provision of electricity. An allocation was avoided for the production of FGD gypsum which is partially used for the production of calcium sulphate-β-hemi-hydrate.

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.

4. LCA: Scenarios and additional technical information

Technical information on the application forms the basis for developing specific scenarios within the context of a building evaluation.
No scenarios are developed within the framework of this cradle-to-gate declaration.

5. LCA: Results

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

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

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 kg GYPSUM PLASTER

Parameter	Unit	A1-A3
Global warming potential	[kg CO_2-Eq.]	0.14
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	2.29E-11
Acidification potential of land and water	[kg SO_2-Eq.]	2.04E-4
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	2.65E-5
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	2.09E-5
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	1.84E-5
Abiotic depletion potential for fossil resources	[MJ]	2.11

RESULTS OF THE LCA - RESOURCE USE: 1 kg GYPSUM PLASTER

Parameter	Unit	A1-A3
Renewable primary energy as energy carrier	[MJ]	0.21
Renewable primary energy resources as material utilization	[MJ]	0.00
Total use of renewable primary energy resources	[MJ]	0.21
Non-renewable primary energy as energy carrier	[MJ]	2.12
Non-renewable primary energy as material utilization	[MJ]	0.00
Total use of non-renewable primary energy resources	[MJ]	2.12
Use of secondary material	[kg]	0.64
Use of renewable secondary fuels	[MJ]	0.00
Use of non-renewable secondary fuels	[MJ]	0.00
Use of net fresh water	[m^3]	0.00

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 kg GYPSUM PLASTER

Parameter	Unit	A1-A3
Hazardous waste disposed	[kg]	0.00
Non-hazardous waste disposed	[kg]	0.00
Radioactive waste disposed	[kg]	0.00
Components for re-use	[kg]	IND
Materials for recycling	[kg]	IND
Materials for energy recovery	[kg]	IND
Exported electrical energy	[MJ]	IND
Exported thermal energy	[MJ]	IND

6. LCA: Interpretation

In calculating the LCA, a generic national raw material mix for gypsum is applied for the upstream chain in order to comply with the various levels of availability in the individual plants and the interchangeability and/or combination possibilities offered by raw gypsum.
Gypsum can be procured as a raw material from nature or as a by-product from desulphurisation of coal-fired power stations (FGD gypsum). While all material and energy flows are considered for natural gypsum, the cut-off limit for FGD gypsum is represented by the material and energy flows associated with the manufacture of FGD gypsum following desulphurisation (e.g. electricity consumption of the belt filter but not the use of limestone in the flue gas scrubber or the disposal of FGD waste water).
Delivery to the gypsum plant is initially followed by the production of the gypsum binder by burning the raw gypsum (calcination), whereby a mixture of stucco and multi-phase gypsum is generated in one or several stages.
This gypsum binder is then blended with additives and aggregates prior to delivery.
During production, the LCA impact categories are dominated by calcination of the raw gypsum associated with the consumption of fossil energy sources; this is responsible for approximately 50% of the GWP, whereby 21% of the GWP is attributable to production of the calcium sulphate phases as well as stucco, additives and aggregates.
There is no scarcity of resources in terms of the gypsum raw material used or the additives and aggregates used.
More than 99% of the ADPE is dominated by the use of natural gypsum for which the sulphur content of the

earth's crust is applied as a criterion for calculating the Sb equivalent. As the LCA was recorded from the cradle to the factory gate, no credits are considered for possible recycling of gypsum at the end of life.

Unpackaged products do not display any serious differences from packaged products in the impact categories (all differences < 10%) but packaging necessitates around 50% more primary energy (PERE and PERT) than for the unpackaged product.

7. Requisite evidence

7.1 Leaching

On analysis according to the Landfilling Ordinance, the product displays the sulphate concentration in the saturation range which is typical for gypsum (approx. 1500 mg/l), resulting in disposal options only from landfill class I upwards.
Gypsum is classified as a listed substance in Water Hazard Class 1 (slightly hazardous for water).
Heavy metal content is significantly below the corresponding criteria for landfill class I.

Proper disposal in accordance with the parameters which can depend on use, sorting depth during de-construction, collection (separately or together with other construction waste) and treatment, and must be determined by the waste producer responsible.

7.2 Radioactivity

The product can be used without restriction with overall dose contributions of significantly lower than 0.3 mSv/a, determined on the basis of the index calculation to RP 112 and the radon concentration /BfS report/.

7.3 VOC emissions

The requirements in accordance with the AgBB test scheme, version 2008, are satisfied with regard to all test criteria /Scherer 2010/:
$TVOC_3$ < 10 mg/m³
$Carcinogens_3$ EU cat. 1 and 2 ≤ 0.01 mg/m³
$TVOC_{28}$ < 1.0 mg/m³
$SVOC_{28}$ ≤ 0.1 mg/m³
$Carcinogens_{28}$ EU cat. 1 and 2 ≤ 0.001 mg/m³
Total VOC_{28} excl. LCI ≤ 0.1 mg/m³
Total VOC incl. LCI $R = \Sigma C_i/LCI_i$ < 1

8. References

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

/Construction Products Regulation/
Regulation (EU) No. 305/2011 of the European Parliament and Council dated 9 March 2011 establishing harmonised conditions for marketing construction products and replacing Council Guideline 89/106/EEC; ABl. EU L88/5 dated 4.4.2011

/BBSR service life/
BBSR table "Service lives of components for LCA in accordance with BNB"
"Sustainable Building Information Portal" by the Federal Ministry of Transport, Building and Urban Affairs: http://www.nachhaltigesbauen.de/baustoff-und-gebaeudedaten/nutzungsdauern-von-bauteilen.html; last revised: 03.11.2011

/BfS report/
Natural radioactivity in construction materials and the ensuing radiation exposure
Field of radiation protection and environment
K. Gehrcke, B. Hoffmann, U. Schkade, V. Schmidt, K. Wichterey: urn:nbn:de:0221-201210099810
Federal Office for Radiation Protection, Salzgitter, November 2012
http://doris.bfs.de/jspui/bitstream/urn:nbn:de:0221-201210099810/3/BfS_2012_SW_14_12.pdf

/DIN 18202/
DIN 18202:2013-04
Title: Tolerances in building construction – Buildings

/DIN EN 520/
DIN EN 520:2009-12
Title: Gypsum plasterboards – Definitions, requirements and test methods; German version EN 520:2004+A1:2009

/DIN EN 13279-1/
DIN EN 13279-1:2008-11
Title: Gypsum binders and gypsum plasters – Part 1: Definitions and requirements; German version EN 13279-1:2008

/DIN EN 13501-1/
DIN EN 13501-1:2010-01
Title: Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests; German version EN 13501-1:2007 + A1:2009

/DIN EN 13963/
DIN EN 13963:2011-11 Draft
Title: Jointing materials for gypsum boards – Definitions, requirements and test methods; German version prEN 13963:2011

/DIN EN ISO 50001/

DIN EN ISO 50001:2011-12
Energy management systems – Requirements with guidance for use (ISO 50001:2011); German version EN ISO 50001:2011

/ECHA 2013/
European Chemicals Agency (ECHA)
Candidate List of Substances of Very High Concern for Authorisation (published in accordance with Article 59(10) of the REACH Regulation)
http://echa.europa.eu/de/candidate-list-table; last revised: 20 June 2013

GaBi 5 2012
GaBi 5: Software and data base for comprehensive analysis LBP, University of Stuttgart and PE International
Documentation of GaBi 5 data sets
http://documentation.gabi-software.com/ (2012)

/Gypsum Data Book/
Gypsum Data Book
Pub.: Bundesverband der Gipsindustrie e. V.
Kochstraße 6–7, 10969 Berlin
Published on: www.gips.de (section: Publications / Books); last revised: May 2013

/IGB/
IGB Handbuch Gipsputze
Zukunftsaufgabe Bauen im Bestand
Pub.: Bundesverband der Gipsindustrie e. V.
Kochstraße 6–7, 10969 Berlin
Published on: www.gips.de (section: Publications / Books); last revised: 1st print run, September 2009.

/Flooding Leaflet/
Removing damage caused by flooding to components made of gypsum or gypsum plaster
BVG Information Service No. 01; published on: www.gips.de (section: Download, Publications, Information Services); last revised: June 2013

/Scherer 2010/
Fraunhofer-Institut für Bauphysik IBP, Holzkirchen
Test report: Cross-sectional study on the emission potential of volatile organic compounds from gypsum components and gypsum products for interior applications (July 2010); published on: www.gips.de (section: Research Association, Projects, 2010)

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

Tel +49 (0)30 3087748- 0
Fax +49 (0)30 3087748- 29
Mail info@bau-umwelt.com
Web **www.bau-umwelt.com**

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

Tel +49 (0)30 - 3087748- 0
Fax +49 (0)30 – 3087748 - 29
Mail info@bau-umwelt.com
Web **www.bau-umwelt.com**

Author of the Life Cycle Assessment
PE INTERNATIONAL AG
Hauptstraße 111 - 113
70771 Leinfelden-Echterdingen
Germany

Tel +49 (0)711 341817-0
Fax +49 (0)711 341817-25
Mail info@pe-international.com
Web **www.pe-international.com**

Owner of the Declaration
Bundesverband der Gipsindustrie e.V.
Kochstraße 6-7
10969 Berlin
Germany

Tel +49 (0)30 31169822-0
Fax +49 (0)30 31169822-9
Mail info@gips.de
Web **www.gips.de**