ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/

Owner of the Declaration	KEIMFARBEN GMBH
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-KEI-20170175-IBG1-EN
Issue date	29/11/2017
Valid to	03/04/2020

Silicate Interior Paints

KEIMFARBEN GMBH

Institut Bauen und Umwelt e.V.

www.ibu-epd.com / https://epd-online.com

1. General Information

KEIMFARBEN GMBH

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

Declaration number
EPD-KEI-20170175-IBG1-EN

This Declaration is based on the Product Category Rules:
Coatings with organic binders, 09.2017
(PCR tested and approved by the SVR)

Issue date
29/11/2017

Valid to
03/04/2020

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

Dr. Burkhart Lehmann
(Managing Director IBU)

Silicate Interior Paints

Owner of the Declaration
KEIMFARBEN GMBH
Keimstraße 16
86420 Diedorf

Declared product / Declared unit
1kg/1kg; density 1.300 -1.700 kg/m³

Scope:
This validated declaration gives the entitlement to carry the symbol of the Institute for Construction and Environment e.V. It applies exclusively to the product groups named for members in Germany for five years from date of issue. This is an individualized collective EPD, in which the environmental impact was calculated for the group of products by choosing the product, which has the biggest environmental impact in this group.

This EPD is based on the sample declaration **EPD-DIV-20140058-IBG1-DE** and applies to the following KEIM products:

KEIM Biosil
KEIM Optil
KEIM Innotop
KEIM Innostar
KEIM Ecosil-ME
KEIM Mycal-Top

This document is translated from the German Environmental Product Declaration into English. It is based on the German original version EPD-KEI-20170175-IBG1-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.

Verification

The CEN Norm /EN 15804/ serves as the core PCR
Independent verification of the declaration according to /ISO 14025/
☐ internally ☒ externally

Matthias Schulz
(Independent verifier appointed by SVR)

2. Product

2.1 Product description / Product definition

The KEIM interior paints described in this declaration comply with DIN EN 13300:2002 and fulfil the requirements of DIN 18363:2010-4, para.2.4.1. The interior paints use minerals as binding agents and are based on silicate technology. This is based on silification of the binding agent potassium water glass and silica sol with the underlying substrate in which a chemical reaction with the mineral fraction takes place. Silicate-based interior paints fulfil a variety of roles in the construction, furnishing and renovation of buildings, some of which are often very specific. The use of silicate products improves the usability of

buildings decisively and extends their useful life significantly.
The product with the greatest environmental impact was taken as a representative product to calculate the results of the environmental impact assessment.

The relevant national regulations at the location where they are being used apply when using the products - in Germany for example these include the state building regulations and the technical specifications based on these regulations.

2.2 Application
The declared products are used as interior paints.

2.3 Technical Data
- Density in [g/cm³]
  Biosil 1.4-1.6
  Optil 1.3-1.5
  Innotop 1.4-1.7
  Innostar 1.4-1.6
  Ecosil-ME 1.4-1.7
  Mycal-Top 1.5-1.7.

- The solid content is between 40% and 65%.
- The pH-value of all interior paints is approx. 11.
- The water vapour diffusion current density of all interior paints is >2000 g/m²d.(DIN EN ISO 7783-2:1999).
- The gloss level is between 0.5 and 4.2 (DIN EN ISO 2813:1999) .
- For KEIM interior paints, the degree of whiteness (WI) according to CIE is between 74 and 81 and the brightness (brightness reference value, Y-value) is between 87 and 91.

Other structural data according to PCR (such as salt, spray resistance, sulphur dioxide resistance, moisture condensation test and brief weathering) are not relevant for the products in this declaration.

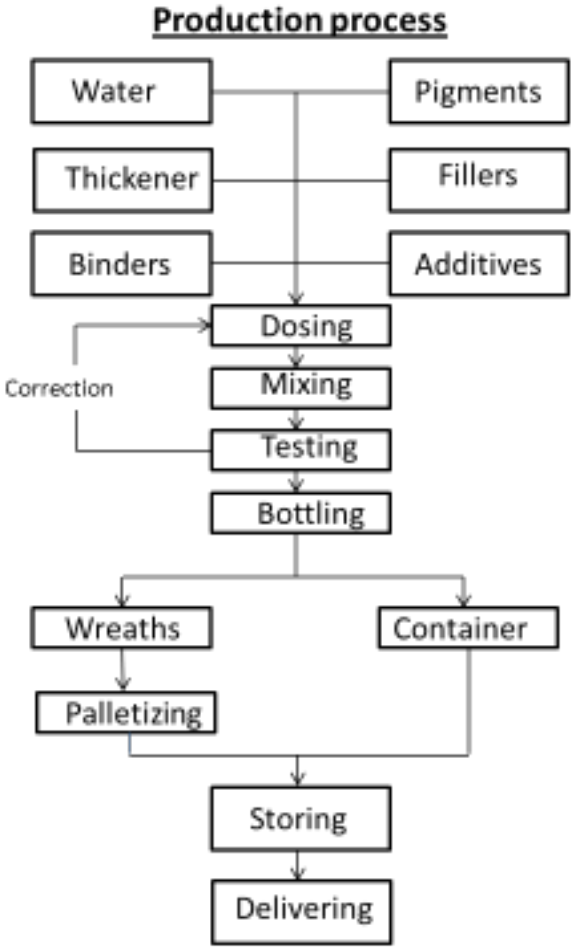
Rating values of the product in relation to its characteristics based on the relvant technical regulations (no CE-labelling).

2.4 Delivery status
The declared products are transported as liquid, ready for use products in white or in various shades of paints in buckets made of Polypropylene with 5l, 12.5l or 15l containers.

2.5 Base materials / Ancillary materials
Selected, natural raw materials form the basis for the high quality of KEIM silicate paints.
The base materials for all interior paints are water, silicate binding agents, mineral fillers, inorganic, brightening pigments and additives. For ancillary materials, special fixatives or dilutants are added to particular interior paints.

Raw materials	**[Mass %]**
Binding agents	15 - 35
Fillers	20 - 45
Pigments	5 - 15
Water	20–35
Other components	1 - 5

2.6 Manufacture
KEIM interior paints are mixed in non-continuous batch operation, i.e. in individual batches or series of individual batches and filled into delivery containers. Quality standards according to /DIN EN ISO 9001:2008/ and relevant regulations such as the Industrial Safety Ordinance and the Emissions Control Act are observed.



The figure shows the following working process during the production of interior paints: First, the silos and weighing containers are filled, followed by transportation and adjustment of raw material into the mixer for dispersion.
After a quality control, the interior paints are filled into containers. Then they are loaded and delivered.
KEIMFARBEN GMBH's quality management system has been certified according to ISO 9001:2008.

2.7 Environment and health during manufacturing
KEIMFARBEN GMBH fulfils all required national regulations relating to consumer health and environmental protection. The environmental management system is certified according to /ISO 14001:2004/.

There is no risk to the environment or negative effects on technical production staff during the production process of interior paints.

2.8 Product processing/Installation

For application, silicate interior paints are processed manually or mechanically by different tools. In this context, the following basing and dilutant products are used.

- Biosil --> water
- Optil --> water
- Innotop --> water
- Innostar --> water
- Ecosil-ME --> special fixative
- Mycal-Top --> special fixative

2.9 Packaging

Emptied containers can be recycled.
Returnable wooden pallets are taken back by the building materials trade (money back for returnable pallets using the deposit system), from there they are returned to the building product manufacturers and fed back into the production process.
Interior paints are packaged as standard in buckets made of Polypropylene (5 l, 12.5 l or 15 l).

2.10 Condition of use

KEIM interior paints have a mineral-based matt surface, they are highly diffusible, free of emissions, solvents and plasticizers. In addition, they are mechanically highly loadable, resistant to mould (because they are minerally alkaline), without the addition of preservatives and produced without fogging active substances.
KEIM interior paints are extremely porous with a microporous structure. Thus, moisture can be absorbed unhindered by the wall through the coat of paint, stored and gradually released. Painted walls using KEIM interior paints remain dry even under high humidity.
KEIM interior paints are antistatic. The mineral pigments and binding agents are highly durable. They remain colour-stable and lightfast with a high luminosity and natural look.

2.11 Environment and health during use

Interior paints are not subject to requirements for labelling.
They do not release any harmful emissions.
Moreover, the products Optil and Biosil have a natureplus certificate.
Mycal-Top, Ecosil-ME and Optil hold test certificates which prove resistance against mould and fungal attack.
Suitability for allergy sufferers has been certified for Biosil, Ecosil-ME and Mycal-Top by the IUG (Institute for environment and health). These latter three products have a LGA certificate for the safety of foodstuffs for human consumption.

2.12 Reference service life

The reference service life for interior paints from the company KEIMFARBEN GMBH has been determined to 30 years. However, the interior paint systems can reach a service life of 100 years.
Due to properties of KEIM interior paint systems mentioned in point 2.10 a premature ageing is delayed.

2.13 Extraordinary effects

Fire

- Biosil non-flammable
- Optil non-flammable
- Innotop non-flammable
- Innostar non-flammable
- Mycal-Top non-flammable
- Ecosil-ME non-flammable

These silicate interior paints are non-flammable.
Thus they fulfill the criteria of class A2 according to /DIN 4102-A2:1998/ and A2-s1-d0 according to /DIN EN 13501-1:2010/.
Even during the strongest exposure to flames, KEIM interior paints do not ignite.

Water

The main constituents of KEIM interior paints are not hazardous to water or are only mildly hazardous as defined by the Administrative Regulations for Materials Hazardous to Water (/VwVwS/).
No negative effects are expected after the curing of the silicate coating material.

Mechanical destruction

The mechanical destruction of cured interior paints does not lead to decomposition products hazardous to the environment or to health.

2.14 Re-use phase

KEIMFARBEN can reach the life time of buildings. Interior paint systems do not have a real subsequent use stage. Final disposal is carried out in combination with parts of the building. If these are solely construction waste, recycling according to national contexts takes place.
Normally, construction waste is crushed and returned to the economic cycle to be used in place of fillings (road construction, concrete).

2.15 Disposal

Disposal of unused interior paints or leftover paint is handled according to official regulations.
The waste code according to the European waste list is: 08 01 12 and applies to all KEIM interior paints.

2.16 Further information

Homepage: www.keim.com
Technical data sheets, safety data sheets and further information can be downloaded from the website.

3. LCA: Calculation rules

3.1 Declared Unit

This individualized collective EPD is based on the declared unit of 1 kg interior paint. The consumption of the products applies over a wide area can be between 190 and 440 g/m². The product with the greatest environmental impact has been declared from each of the product groups.

The conversion from litres to kilogrammes is the result of the paints' density. The density and also the painting quantity based on two coats are shown in the following table.

	Density [g/cm³]	painting quantity [kg/m²]
Biosil	1.5	0.33
Optil	1.4	0.36
Innotop	1.4	0.44
Innostar	1.5	0.19 (single coat)
Ecosil-ME	1.5	0.39
Mycal-Top	1.5	0.38

These consumption figures are guidelines. Precise consumption figures should be determined by painting a test area.

Information about the declared unit

Name	Value	Unit
Declared unit	1	m²
Gross density	1300 - 1700	kg/m³

3.2 System boundary

The modules A1/A2/A3, A4, A5 and D have been taken into account for the calculation of the life cycle assessment.

- A1 Production of preliminary products
- A2 Transport to the factory
- A3 Manufacturing incl. energy supply, production of packaging (plastic containers) and also ancillary and operating matrials and waste treatment
- A4 Transport to construction site
- A5 Application (waste disposal and also emissions during application)
- D Credits from incineration of packaging materials and recycling of metal containers

This declaration is therefore based on "from the cradle to the factory gate – with options".

3.3 Estimates and assumptions

If no specific GaBi procedures were available then the individual recipe components for the formulations have been estimated based on information from the manufacturer or in the literature.

3.4 Cut-off criteria

No cut-off rules were used to calculate the environmental impact assessment. All raw materials submitted collectively for the formulations have been included.
The production of machinery, equipment and other infrastructure needed for the production of the products in this declaration have not been included in this environmental impact assessment.

3.5 Background data

Data from the /GaBi 6B/ database was used as background data. If no background data was available, then this was supplemented using manufacturer's information and research in the literature.

3.6 Data quality

Both representative products and also the product for a group with the greatest environmental impact were used to calculate the environmental impact assessment for this EPD. The datasets are in general less than 7 years old. Data has been taken from the /GaBi 6B/ databases and are therefore consistent interiorly.

3.7 Period under review

The selected observation period is the production year 2011.

3.8 Allocation

No allocations have been applied to the production. For the incineration of the packaging a multi-input allocation has been used with a credit for electricity and thermal energy based on the methodology of the single credit. Credits from disposal of packaging have been applied 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.

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4. LCA: Scenarios and additional technical information

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

Transport to construction site (A4)

Name	Value	Unit

Litres of fuel (Diesel)	0.0016	l/100km
Transport distance	500	km
Capacity utilisation (including empty runs)	85	%
Gross density of products transported	1300 - 1700	kg/m^3
Volume-utilisation factor	100	%

Application onto the building (A5)

Name	Value	Unit
Auxiliary	0	kg
Water consumption	0	m^3
Other resources	0	kg
Electricity consumption	0	kWh
Other energy carriers	0	MJ
Material loss	0.01	kg
Output substances following waste treatment on site	0	kg
Dust in the air	0	kg
VOC in the air	< 0,1	%

5. LCA: Results

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

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

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 kg Silicate Interior Paints

Parameter	Unit	A1-A3	A4	A5	D
Global warming potential	[kg CO_2-Eq.]	9.55E-1	2.46E-2	1.59E-1	-7.86E-2
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	2.34E-10	5.14E-13	1.00E-12	-2.38E-11
Acidification potential of land and water	[kg SO_2-Eq.]	2.54E-3	1.62E-4	1.68E-5	-1.09E-4
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	3.04E-4	4.03E-5	3.44E-6	-1.22E-5
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	5.88E-4	-6.81E-5	3.66E-4	-9.99E-6
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	4.15E-7	1.14E-9	2.09E-9	-8.14E-9
Abiotic depletion potential for fossil resources	[MJ]	2.51E+1	3.37E-1	2.87E-2	-1.04E+0

RESULTS OF THE LCA - RESOURCE USE: 1 kg Silicate Interior Paints

Parameter	Unit	A1-A3	A4	A5	D
Renewable primary energy as energy carrier	[MJ]	1.48E+0	IND	IND	IND
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	IND	IND	IND
Total use of renewable primary energy resources	[MJ]	1.48E+0	2.00E-2	2.91E-3	-1.14E-1
Non-renewable primary energy as energy carrier	[MJ]	1.43E+1	IND	IND	IND
Non-renewable primary energy as material utilization	[MJ]	1.24E+1	IND	IND	IND
Total use of non-renewable primary energy resources	[MJ]	2.67E+1	3.38E-1	3.30E-2	-1.20E+0
Use of secondary material	[kg]	0.00E+0	IND	IND	IND
Use of renewable secondary fuels	[MJ]	3.27E-4	2.51E-6	5.11E-7	-1.73E-5
Use of non-renewable secondary fuels	[MJ]	3.43E-3	2.63E-5	5.34E-6	-1.82E-4
Use of net fresh water	[m^3]	7.58E-3	1.93E-5	3.81E-4	-1.78E-4

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 kg Silicate Interior Paints

Parameter	Unit	A1-A3	A4	A5	D
Hazardous waste disposed	[kg]	1.99E-3	0.00E+0	7.77E-4	0.00E+0
Non-hazardous waste disposed	[kg]	6.07E-3	6.68E-5	1.53E-5	-4.50E-4
Radioactive waste disposed	[kg]	6.60E-4	4.85E-7	1.76E-6	-6.82E-5
Components for re-use	[kg]	IND	IND	IND	IND
Materials for recycling	[kg]	IND	IND	IND	IND
Materials for energy recovery	[kg]	IND	IND	IND	IND
Exported electrical energy	[MJ]	IND	IND	2.40E-1	IND
Exported thermal energy	[MJ]	IND	IND	5.77E-1	IND

6. LCA: Interpretation

The main part of the **non renewable primary energy requirement (PENRT)** is caused by the manufacture of preliminary products (> 85 %). This is explained by the fact that the formulation process is not associated with any major effects, which means that the production of raw materials is comparatively high. The main energy sources used are natural gas and mineral oil, also mainly for the production of the preliminary products. The manufacture of the polypropylene (PP) container contributes approx. 7 % of the production. At approx. 5% (of the total primary energy), the proportion of **renewable primary energy** is very low. This is demonstrated with the production of the preliminary products in particular, the renewable part of the mixed electricity, with the main effect in A3 being with the use of wooden pallets. Solar energy is needed for photosynthesis when wood grows, which explains why it appears here as a renewable source of primary energy.

Up to 70% of the **global warming potential (GWP)** is caused by the manufacture of preliminary products. In A3, which contributes 5% to the GWP, the manufacture of polypropylene containers is particularly important. With the application of the product, the incineration of containers and wooden pallets dominates the GWP (total contribution approx. 15%). The credits from the thermal recycling of the waste reduce the GWP by approx. 6%. In general the GWP is dominated by carbon dioxide emissions (> 90%).

With the **ozone depletion potential (ODP)** it is apparent that most of the impact is caused by the production of preliminary products (approx. 80%), which mainly comes from the halogenated organic emissions from the electricity mix used. Production

only contributes approx. 10%, most notably from the manufacture of the packaging materials. The credits from waste incineration reduce the ODP by approx. 10%.
In addition, up to 80% of the **acidification potential (AP)** comes from the manufacture of the preliminary products. Production contributes 6% of the acidification potential, with the biggest influence from the PP containers. The credits from waste incineration reduce the AP by approx. 5%. Overall the biggest impact comes from emissions of sulphur oxides (> 50%) and nitrogen oxides (approx. 25%).
About 90% of the **eutrophication potential (EP)** is caused by emissions into the atmosphere and about 10% by emissions into the water. Nitrogen oxide emissions are responsible for approx. 60% of the emissions into the atmosphere, followed by ammonia emissions (20%). Almost 80% of the EP is caused by the manufacture of preliminary products. Production contributes about 5% of the EP, which can be mainly traced back to the manufacture of the containers.
The **summer smog potential (POCP)** as also dominated by the production of the preliminary products: These contribute approx. 55% of the POCP. A major contribution also comes from the application of the dispersion-based product through emissions of NMVOC in low quantities.

7. Requisite evidence

7.1 VOC-emissions

Evidence of VOC emissions can be conducted for selected products or applications.
As a condition of the receipt of the natureplus-certificate, a chamber test based on /DIN EN ISO 16000-9:2008/ was carried out by TÜV Süd industry services for KEIM Biosil for example. All requirements were fulfilled, including the health criteria for building products of the AgBB (Committee on the health assessment of construction products). The results of emissions tests, shown in the table on emission assessments below, refer to measurements after 7 days. The research was terminated prematurely, because the measurement values came out to be already less than 50% of the 28-days critical change value.
The test procedure was carried out by TÜV Süd, the results of the assessment were summarised in the test report 161010-1 on the 10.10.2016.

VOC emissions	**after 7 days [µg/m³]**
• TVOC	46
• sum of SVOC	n.d.*
• R (no dimensions)	0.09
• Total VOC without NIK	2
• Carcinogens (3 day)	n.d.*

n.d. = not detected; detection limit = 1 µg/m³

7.2 Leaching

The use of silicate-based products in outdoor areas does not take place in areas in contact with surface water or the water table. There are currently no European or national assessment criteria or emission scenarios for a scenario where building sections are exposed to rainwater.

7.3 Toxicity of combustion fumes

KEIM paints are non-flammable. They do not ignite, even where flames are at their strongest, which means that if there is a fire: maximum safety and no toxic gases.

8. References

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Publisher
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