ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	**RHEINZINK GmbH & Co. KG**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-RHE-2012131-E
Issue date	28.12.2012
Valid to	27.12.2017

RHEINZINK-INTERIEUR®
RHEINZINK GmbH & Co. KG

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

Institut Bauen und Umwelt e.V.

INTERIEUR

INTERIEUR LINE

1. General Information

RHEINZINK GmbH & Co. KG

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Rheinufer 108
D-53639 Königswinter

Declaration number
EPD-RHE-2012131-E

This Declaration is based on the Product Category Rules:
Building metals, 07-2012
(PCR tested and approved by the independent expert committee [SVA])

Issue date
28.12.2012

Valid to
27.12.2017

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

Prof. Dr.-Ing. Hans-Wolf Reinhardt
(Chairman of SVA)

RHEINZINK-INTERIEUR®

Owner of the Declaration
RHEINZINK GmbH & Co. KG
Bahnhofstraße 90
45711 Datteln

Declared product / Declared unit
RHEINZINK-INTERIEUR®

Scope:
The **Life Cycle Assessment (LCA)** was carried out according to DIN ISO 14040 et sqq. Specific data from the company RHEINZINK in Datteln, Germany, and from the data base "GaBi 5" were used. The LCA was carried out for the manufacturing phase of the products, taking into account all background data such as raw material production and transports ("cradle to gate"). The use phase of the titanium zinc sheets is divided into several application areas: roofing applications, roof drainage and facade claddings. The treatment for the titanium zinc sheets was modeled in re-melting furnaces for the end of life phase. The thereby resulting credit of extracted zinc is counted as replacement for primary zinc. The owner of the declaration shall be liable for the underlying information and evidence.

Verification

The CEN Norm EN 15804 serves as the core PCR

Independent verification of the declaration and data according to ISO 14025

☐ internally ☒ externally

Dr.-Ing. Ivo Mersiowsky
(Independent tester appointed by SVA)

2. Product

2.1 Product description

The basis of the RHEINZINK® alloy is electrolytic high-grade fine zinc in accordance with DIN EN 1179, with a 99.995 % degree of purity. Added to this are small amounts of titanium and copper based on EN 988. In addition to other factors, the alloy composition is not only of importance for the technological material properties of RHEINZINK®, but also for the colour of its surface after the preweathering process. This surface is protected with a transparent organic coating.

2.2 Application

• Titanium zinc sheets and profiles for interior use (RHEINZINK-INTERIEUR® LINE)

2.3 Technical Data

The following table gives conversion data from product surface mass per unit area for the relevant product systems.

System	Area of Application	Thickness of metal	Weigh per m²
Double-standing seam	Roof	0,70	5,8 kg/m²
Roll-cap System	Roof	0,70	5,8 kg/m²
Square tiles	Roof	0,70	7,7 kg/m²
Gutter	Roofdrainage	0,70	1,7 kg/m
Downpipe	Roofdrainage	0,70	1,6 kg/m
Angle-standing seam	Façade cladding	0,70	5,7 kg/m²
Angle-standing seam	Façade cladding	0,80	6,6 kg/m²
Flat-lock tiles	Façade cladding	0,70	7 kg/m²
Reveal panel	Façade cladding	1,00	9,8 kg/m²
Horizontal panel	Façade cladding	1,00	9,8 kg/m²
Shipboard panel	Façade cladding	1,00	10,4 kg/m²

Technological Data

Name	Testing standard	Value	Unit
Coefficient of thermal expansion	*	22	$10^{-6}K^{-1}$
Tensile strength	EN 10002-1	≥ 150	N/mm²
Modulus of elasticity	*	≥ 80.000	N/mm²
Melting point	*	420	°C
Thermal conductivity	*	109	W/(mK)
Density	*	7200	kg/m³

* No testing standard required: Test related to F. Porter, Zinc Handbook, Marcel Dekker Inc., 1991 (ISBN 0824783409)

2.4 Placing on the market / Application rules
EN 988:1996-08, Zinc and zinc alloys - Specification for rolled flat products for building
EN 506:2000-12, Roofing products from metal sheet - Specification for self-supporting products of copper and zinc sheet

2.5 Delivery status
The material RHEINZINK® is delivered in thicknesses from 0,5 – 1,5 mm. The maximum width of strips and sheets is 1.000 mm. The max. width of the material RHEINZINK-INTERIEUR graphite-grey is 700 mm. The standard sheets are delivered in 1x2 m and 1x3m, strips are coiled up to 1 to weight. Finished products are delivered to customer specification.

2.6 Base materials / Ancillary materials

Components of RHEINZINK-alloy
- Special-High-Grade zinc 99.995% (Z1 according to DIN EN 1179): ≤ 99,835%
- Copper: 0,08 - 1,0%
- Titanium: 0,07 - 1,2%
- Aluminium: ≤ 0,015%

Auxiliary substances
Lubricant emulsion: 0.08 kg/t zinc
Sulphuric acid: 15 g/kg zinc
Nitric acid: 5 g/kg zinc
Temporary protection: 10 µm thickness (incl. primer)

2.7 Manufacture
Structure of the manufacturing process:
The manufacturing process comprises nine steps:

Pre-alloy: To improve the quality, and for energy-saving reasons, a pre-alloy is produced at 760 °C in an induction crucible stove (meltdown of fine zinc, copper, titanium and aluminium). The pre-alloy blocks produced contain the titanium and copper portions of the subsequent rolled alloy.

Melting: The pre-alloy blocks and fine zinc are melted together in large melting stoves (induction channel stoves) at 500 – 550 °C and mixed together completely with induction currents.

Casting: The final alloy is cooled down below melting point with a closed water circuit in the casting machine, resulting in a solid cast string.

Rolling: There is a cooling distance between casting machine and roller racks. The rolling is done by 5 roller pairs, so-called roller racks. With adequate pressures the material thickness is reduced by up to 50% at each of these roller racks. Simultaneously, the material is cooled and greased using a special emulsion.

Coiling: Subsequently, the readily rolled RHEINZINK® is wound up into coils of 20 tons weight (so-called big-coils). They are still at a temperature of 100 °C and are stored for further cooling.

Stretching and cutting: The tensions developed inside the RHEINZINK® coils during rolling are “stretched-out” by a stretching-bending-straightening-process.

Preweathering: After a cleaning process the material is pickled and rinsed. The complete pickling process is carried out in a continuously operating enclosed production process.

Coating: A primer is applied onto the surface and afterwards the surface is coated with a clear polyester coat.

Quality control:
Control by the manufacturer and by TÜV Rheinland Group. Control of zinc material according to the QUALITY ZINC list of requirements as set up by TÜV Rheinland Group. Quality management control according to DIN ISO 9001.

2.8 Environment and health during manufacturing

Environmental management according to DIN EN ISO 14001. Energy management according to ISO 50001.

2.9 Product processing/Installation

Basic principles:
During transportation and storage, RHEINZINK® should be kept dry and ventilated.
The thermic stretching of the material has to be taken into consideration when handling/installing the product. Due to the typical brittleness of zinc under cold conditions, the temperature of the product should be 10 °C. In other cases, adequate mechanical equipment should be used, e.g. hot air blasts.

2.10 Packaging
Packaging of the titanium zinc sheets:
The packaging materials in use, paper/cardboard, polyethylene (PE foils), polypropylene (PP foils) and steel, are recyclable (non-reusable wooden pallets, reusable wooden and metal pallets). If gathered separately, return in Germany is organised by INTERSEROH which collects the packaging material at given sites with exchangeable containers upon request and complies with legal regulations. The reusable wooden and steel pallets are taken back and are reimbursed by RHEINZINK GmbH & Co. KG and the wholesale trade (refund system).

2.11 Condition of use
RHEINZINK® is UV-resistant and does not rot. It is resistant against a rust film, nonflammable and resistant to radiating heat and against most of the chemical substances used in building construction. Effects on the durability of RHEINZINK® products with regard to snow, rain and hail are not known. The effects of snow and rain may be neglected. This material has a repellent effect to electrosmog (electromagnetic radiation in excess of 98%).
RHEINZINK does not require any maintenance and cleaning for the material as such.

2.12 Environment and health during use

Environmental aspects:
As the material is provided with a coating that protects it from external influences, there is no interaction with the environment during the phase of use. Tests per-

formed over a period of seven years show no zinc run-off above background. (Lit. KTH Stockholm, Sweden).

Health aspects:
There will be no effects to health if the RHEINZINK® products are used according to their designated function. Zinc, like iron, belongs to the essential metals. Zinc is not accumulated in the body. The recommended daily intake of zinc according to the Deutsche Gesellschaft für Ernährung (DGE - German Society for Nutrition) is 15 mg.

2.13 Reference service life
Service lifetime according to BBSR: > 50 years, theoretical lifetime according to available literature > 100 years. The standard ISO 15686 has not been considered.
Influences on ageing when applied in accordance with the rules of technology.

2.14 Extraordinary effects

Fire

Fire performance:
The RHEINZINK® products comply with DIN 4102, Part 1 and to DIN EN 13501-1 the Requirements of Building Material Class A1 "non-combustible".

Smoke production/smoke concentration:
When heated above 650 °C vaporization as zinc oxide (ZnO) occurs, producing smoke.
Toxicity of the fumes:
The ZnO smoke may cause zinc fever (diarrhoea, fever, dry throat) when inhaled over some period time, this disappears completely 1 to 2 days after inhalation.

Change of state (burning drip down/drop-out):
The melting point is 420°C.

Water
None.

Mechanical destruction
None.

2.15 Re-use phase

Disassembly
When renovating or disassembling a building, RHEINZINK® products can easily be collected.

Circulation
The trimming scrap and the cuttings occurring at building sites as well as used zinc from renovation sites are gathered and may be sent directly or via scrap gathering organisations to secondary melting plants - several exist in Germany. The energy necessary for recycling titanium zinc sheets is only 5% of the primary energy content of zinc. The demand for zinc scrap, resulting from zinc recycling's low energy requirement, is also mirrored by the fact that generally about 70% of the value of the zinc content is reimbursed. According to the newest information, the total recycling rate is up to 96%.

2.16 Disposal
Due to the effective recycling process, no zinc has to be disposed.

2.17 Further information
Additional information: www.rheinzink.de

3. LCA: Calculation rules

3.1 Declared Unit
The declared unit is 1 kg of RHEINZINK-INTERIEUR®.

3.2 System boundary

Type of the EPD: cradle to gate - with options
In this study, the product stage information modules A1, A2, and A3 are considered. These modules include production of raw material extraction and processing (A1), processing of secondary material input (A1), transport of the raw materials to the manufacturer (A2), manufacturing of the product (A3) and the packaging materials (A3).
The EoL of the product (Modul D) is also included.

3.3 Estimates and assumptions
No assumptions and estimations were necessary for the LCA.

3.4 Cut-off criteria
Criteria for the exclusion of inputs and outputs (cutoff rules) in the LCA and information modules and any additional information are intended to support an efficient calculation procedure.
All inputs and outputs to a (unit) process are included in the calculation, for which data were available. The applied cut – off criteria is 1 % of renewable and non-renewable primary energy usage and 1 % of the total mass input of that unit process in case of insufficient input data or data gaps for a unit process. The total of neglected input flows per module, e.g. per module A, B, C or D is a maximum of 5 % of energy usage and mass.

3.5 Background data
Background processes are taken from the publicly Professional GaBi 5 databases as far as available. Country and region specific data on energy sources including electricity and region specific data on raw materials such as high grade zinc were taken from GaBi databases.

3.6 Data quality
The process data and the used background data (GaBi 5) are consistent. In addition, the origin of the data is documented. Additional information is gathered regarding the age of the data.
The input and output data of the whole process Plant was strongly emphasized. The supplied data (Processes) were provided by RHEINZINK and checked for plausibility. Therefore, the data quality can be described as good.
The age of the data employed in this study is due to 2010.

3.7 Period under review
Modeling is based on production data from 2010. Background data refer from 2008 to 2011.

3.8 Allocation

In this study, allocation was avoided wherever possible as required in EN 15804.
However, the following allocations had to be done:

- Credits from energy recovery of production waste (Modul A3)
- Credits from recycling from the end of life of the product (ModulD)

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: Scanrios and additional technical information

The modules A4, A5, B1, B2, B3, B4, B5, reference service life, B6, B7 and C1 – C4 are not considered and declared in this study.
The credits given in Module D are a result of the 100% recyclability of each zinc-product. After the scrap collection (a collection rate of 96% was assumed), zinc scrap is sent to a re-melting process, where the scrap is converted to secondary zinc. The credit for the zinc gained through re-melting is calculated with the dataset of the primary production.

RHEINZINK®

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 BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport	Construction-installation process	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1kg Interieur

		Manufacturing	Credits
Parameter	**Unit**	**A1-A3**	**D**
GWP	[kg CO_2-Äq.]	5,7E+00	-2,6E+00
ODP	[kg CFC11-Äq.]	4,6E-07	-3,0E-07
AP	[kg SO_2-Äq.]	3,2E-02	-1,9E-02
EP	[kg PO_4^{3-}- Äq.]	3,6E-03	-2,1E-03
POCP	[kg Ethen Äq.]	2,1E-03	-1,1E-03
ADPE	[kg Sb Äq.]	2,7E-04	-1,6E-04
ADPF	[MJ]	5,8E+01	-2,5E+01
Caption	GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non fossil resources; ADPF = Abiotic depletion potential for fossil resources		

RESULTS OF THE LCA - RESOURCE USE: 1kg Interieur

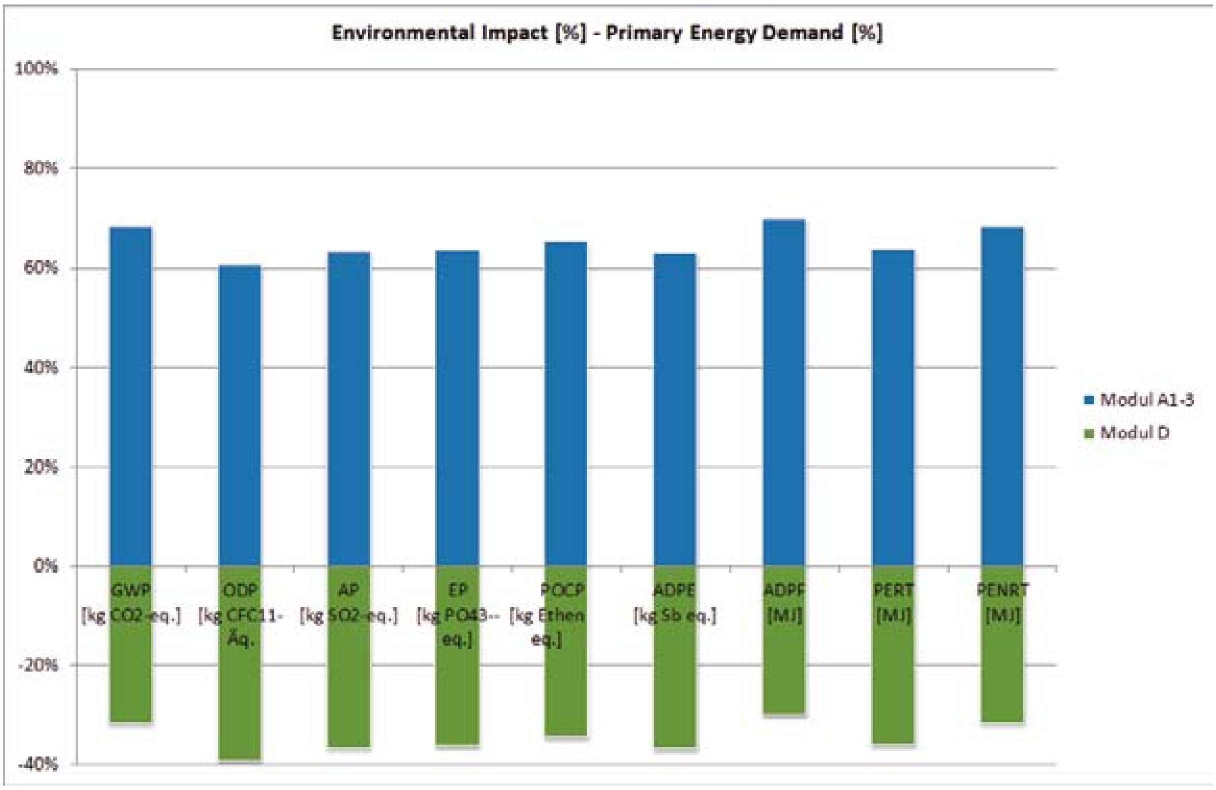
		Manufacturing	Credits
Parameter		**A1-A3**	**D**
PERE	[MJ]	1,2E+01	-6,7E+00
PERM	[MJ]	0	0
PERT	[MJ]	1,2E+01	-6,7E+00
PENRE	[MJ]	7,6E+01	-3,5E+01
PENRM	[MJ]	0	0
PENRT	[MJ]	7,6E+01	-3,5E+01
SM	[kg]	0	0
RSF	[MJ]	5,4E-04	4,0E-03
NRSF	[MJ]	5,7E-03	4,2E-02
FW	[m³]	-*	-*
Caption	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials; PENRM = Use of non renewable primary energy resources used as raw materials; PENRT = Total use of non renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non renewable secondary fuels; FW = Use of net fresh water		

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

		Manufacturing	Credits
Parameter	**Unit**	**A1-A3**	**D**
HWD	[kg]	-*	-*
NHWD	[kg]	-*	-*
RWD	[kg]	6,6E-03	3,6E-03
CRU	[kg]	-	-
MFR	[kg]	0	9,6E-01
MER	[kg]	-	-
EE [Typ]	[MJ]	-	-
EE [Typ]	[MJ]	-	-
Caption	HWD = Hazardous waste disposed; NHWD = Non hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EE = Exported energy per energy carrier		

**These indicators are temporarily not reported as agreed in the advisory board meeting from 04.10.2012.*

6. LCA: Interpretation



Impact categories for the life cycle of 1kg RHEINZINK-INTERIEUR®

The **GWP** is dominated by the use of the high grade Zinc (78%). The pre-process of preweathered zinc sheet is contributing to 93% to the total GWP impact. Almost the rest is due to the energy consumption (4,1% due to thermal energy) and use of auxiliary materials. Around 30% of the impact is credited because of the high recycle rate of the product.
The **ODP** is most notably influenced by the use of the refined Zinc (99%), as raw material. These results come mainly from the used power grid mix and other energy carriers by the extraction and production of high grade zinc. The relevant emissions are the R 11 and R 114.
The **AP** is also dominated by the production due to the emissions related to use of the high grad zinc and to the energy consumption at the manufacture side. Mostly the impact refers to emissions to air: 52% from sulfur dioxide and 39% from nitrogen oxides.
The **EP** is significantly influenced by the use of the high grade zinc (93%) in the pre-process of bright-rolled zinc sheet. Almost the rest is due to the use of electric energy and auxiliary materials. Nitrogen oxides emissions contribute with around 91% to the total impact.

The **POCP** is particularly dominated by the use of the refined zinc (89%) and present a similar profile as the eutrophication potential. The main emissions contributing to this impact category are NMVOCs (14%), sulfur dioxide (31%) and nitrogen oxides (33%).

The **ADP elements** are dominated by the raw material high grade Zinc, coming from the consumption of copper-gold-silver-ore (82%) and lead zinc ore (20%).
The **ADP fossil** is dominated with around 75% by the raw material Zinc (44% coming from the consumption of hard coal) and 6,6% by the thermal energy used during the production of the product RHEINZINK-INTERIEUR®. The most important energy sources are crude oil (62%) and natural gas (31%).
The **total primary energy demand** is divided into around 85% of non-renewable energy and 15% of renewable energy.
The primary energy demand non-renewable **(PENRT)** is dominated by the raw material high grade zinc.
The renewable energy demand **(PERT)** present a similar profile as the non-renewable, the dominating contributor is the high grade zinc production (90%). 99% of the total impact comes from the pre-process of preweathered zinc sheet.

7. Requisite evidence

The material is coated with a thick clear polyester coat. According to a study by KTH Stockholm. Sweden, no zinc run-off can be detected over the test period of seven years.

Test setup: Test period 2004 - 2011, test site Stockholm, test stand according to ISO 17752.
Test laboratory: KTH Stockholm

8. References

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EN 988
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