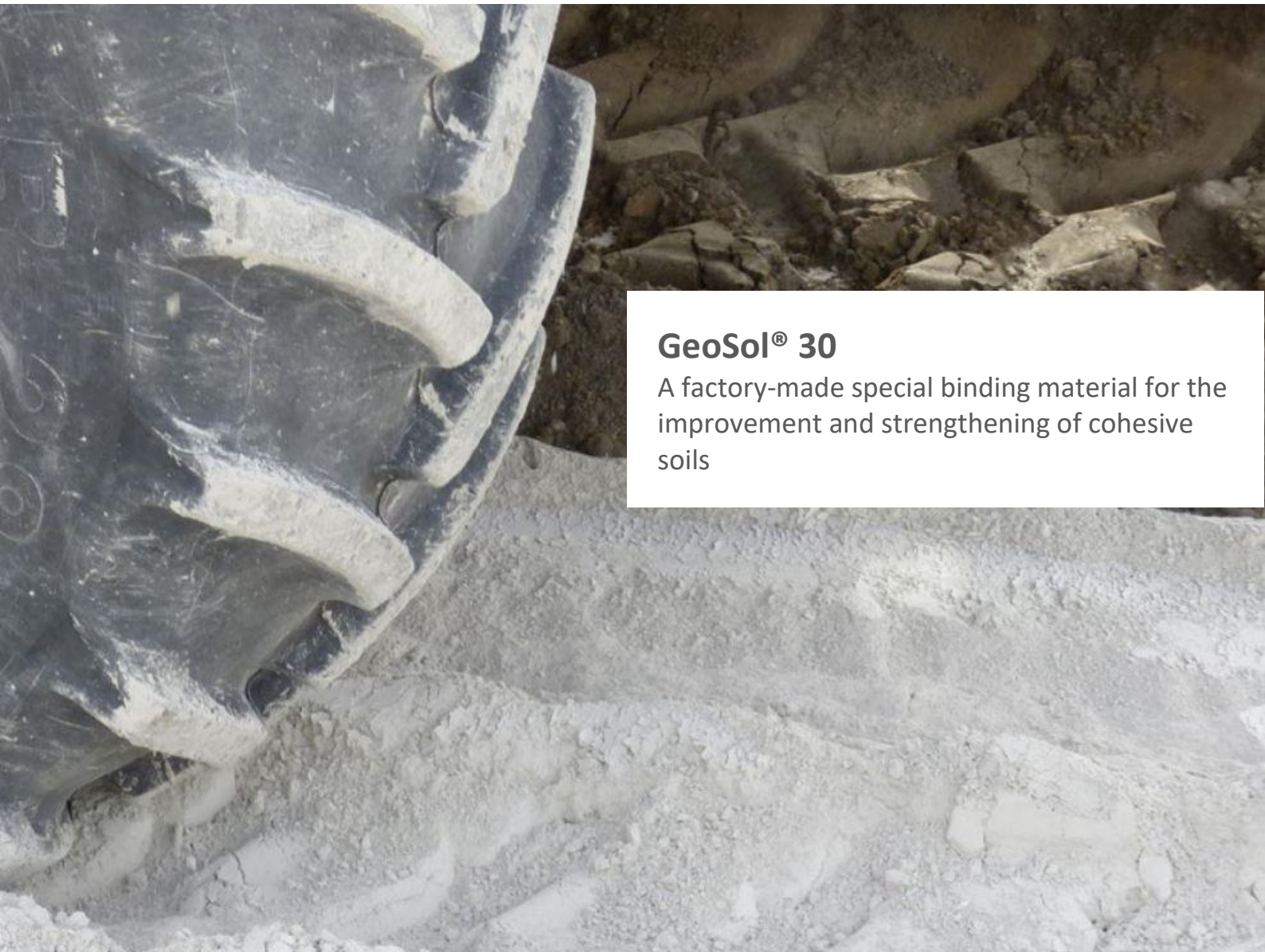
Environmental Product Declaration

as per ISO 14025 and EN 15804 +A1

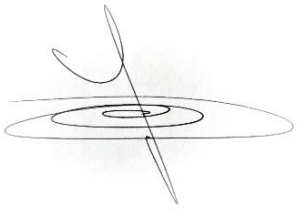
Owner of the declaration:	GHT GmbH & Co. KG
Publisher:	Kiwa - Ecobility Experts
Programme holder:	Kiwa - Ecobility Experts
Declaration number:	EPD-GHT-103-EN
Issue date:	23.12.2021
Valid to:	22.12.2026



GeoSol® 30

A factory-made special binding material for the improvement and strengthening of cohesive soils

1. General information

GHT GmbH & Co. KG	GeoSol® 30
Programme holder Kiwa - Ecobility Experts Voltastraße 5 13355 Berlin Germany	**Owner of the declaration** GHT GmbH & Co. KG Königsheide 145a 44359 Dortmund Germany
Declaration number EPD-GHT-103-EN	**Declared product / declared unit** 1,000 kg special binder
This declaration is based on the Product Category Rules PCR B - EN 16908:2017 - Cement and building lime.	**Scope** GeoSol is factory-made special binding material for the improvement and strengthening of cohesive soils GeoSol® is produced from lime, cement and from hydraulic road binders and their major and minor constituents. It is manufactured in Bottrop and Dortmund, Germany. The EPD is based on the production site of Bottrop, but representative for both locations. Kiwa – Ecobility Experts shall not be liable with respect to manufacturer information, life cycle assessment data and evidence.
Issue date 23.12.2021	
Valid to 22.12.2026	**Verification** The CEN Norm EN 15804:2012+A1:2013 serves as the core PCR Independent verification of the declaration and data according to ISO 14025:2011-10 ☐internally ☒externally
 Frank Huppertz (President of Kiwa – Ecobility Experts)	 Anne Kees Jeeninga (External verifier – Advieslab v.o.f.)
 Prof. Dr. Frank Heimbecher (Chairman of the independent expert committee Kiwa – Ecobility Experts)	

2. Product

2.1 Product description

GeoSol® is a factory-made special binding material for the improvement and strengthening of cohesive soils. GeoSol® is produced from lime standardized according to DIN EN 459-1, from standard-ized cement according to DIN EN 197-1 and from hydraulic road binders according to DIN EN 13282 and their major and minor constituents.
GeoSol® generates a compression-willing soil structure and enables a sustainable high load-carrying capacity and shear strength within the compressed soil.

2.2 Application

GeoSol® is typically applied following the mixed-in-place process. It is directly scattered onto the soil followed by a milling procedure, using additional water, when required. According to soil type, the compression work can be done directly or after some hours laytime. The application of packed material also requires a homogeneous mixing of the hydraulic binder with the soil, preferably using crusher bucket attachment.
Major criteria for the choice of hydraulic binder quality and dosage is the geotechnical analysis with regards to grain size distribution, plasticity and the natural water content of the present soil. To determine those parameters a suitability test following the respective standards and regulations is to be carried out with the referring soil for every isolated case. Due to the powder-like properties, it is necessary that storage containers are dust-tight and suitable for pneumatic loading. Up to the final use material must be stored dry as it reacts with water releasing a considerable amount of heat. Hazards for flammable material may result from this. Packed material has to be protected against the penetration of moisture. Based on practical experience at construction sites and according to general recommendations, as possible no soil treatments should be executed at soil-and air temperatures below +5 °C as well as during heavy rainfall.
The volume of GeoSol® to be added to the soil according to the results of the suitability test is ap-prox. 2-6 M.-%. Like all hydraulic binders, GeoSol® must not be discharged into water bodies, as this leads to an increasing pH-value of the water. GeoSol® is delivered in powder form. When storing and processing, it must be ensured that there is no dusting or turbulence. GeoSol® should be used within the scope of processing in such a way that the discharge on the areas beyond the surface to be pro-cessed does not occur either during application or during further processing, not even by drifting.

For additional information regarding the processing of special binding materials please refer to „Handbuch für Bodenbehandlung und Tragschichten mit hydraulischen Bindemitteln“ at the download section of the website: www.ght-baustoffe.de

2.3 Technical Data

The technical data is listed in the table below.

Characteristic	Value	Unit
Raw density	2.5 – 2.9	kg/dm³
Bulk density, loose	0.75 – 1.0	kg/dm³

2.4 Placing on the market/ Application rules

For quality assurance purposes GeoSol® is produced from lime standardized according to DIN EN 459-1, from standardized cement according to DIN EN 197-1 and from hydraulic road binders according to DIN EN 13282 and their major and minor constituents. For the placing on the market the regulation (EU) No. 305/2011 of March 9, 2011 applies. For the use of the products the national regulations apply. The product is not included in the candidate list of substances of very high concern.

2.5 Base materials / Ancillary materials

Standardized lime, standardized cement and hydraulic road binders and their major and minor constituents are used to manufacture the different GeoSol® products.

Raw material	Value	Unit
Lime (DIN EN 459-1)	20 - 40	m%
Cement (DIN EN 197-1), sub-base binders (DIN EN 13282) and their main and secondary constituents	60 - 80	m%

2.6 Manufacture

Production takes place at the Dortmund and Bottrop sites. The raw materials used for the GeoSol® 30 are all transported by truck to the two sites. GeoSol® special binders are mixed as mineral factory dry mortars according to the mass proportions specified in the product formulations from the basic materials lime, cement, base course binder and their main and secondary constituents.
The raw materials are stored dry in silos at the respective manufacturing plant. Based on the product-specific formulations, they are first gravimetrically dosed onto corresponding weighing containers and, after emptying the weighing containers into the mixer, homogeneously mixed together in batches. The mixed material is then temporarily stored as factory dry mortar in finished product silos and from there loaded into silo trucks and transported to the respective construction sites.

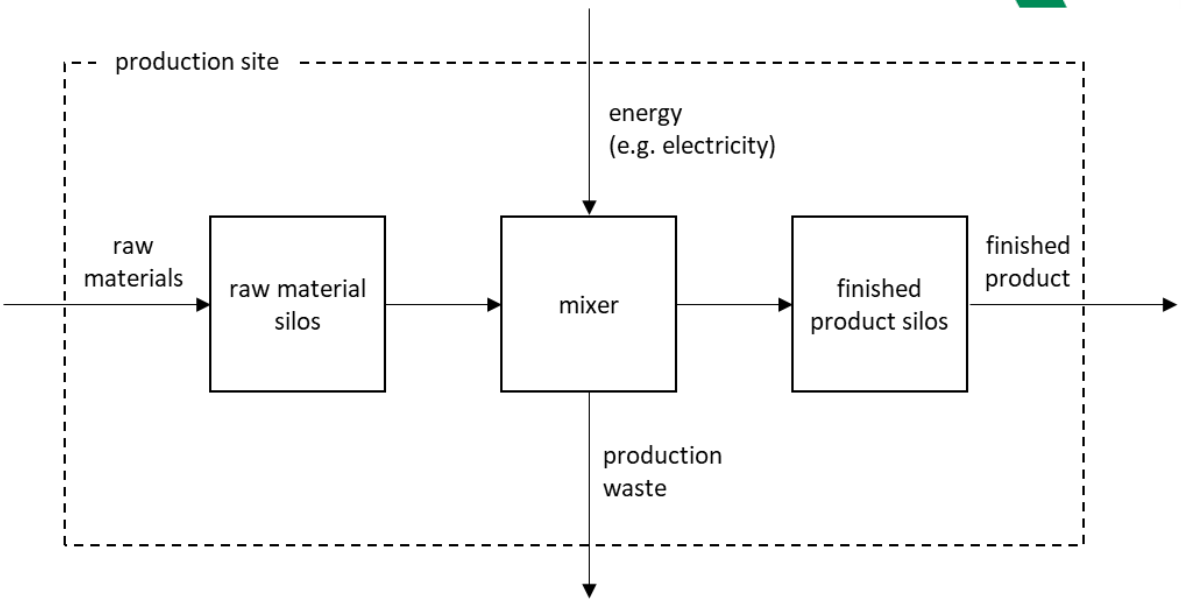


Figure 1: Process flow chart

2.7 Packaging

The special binder is loaded and transported in silo trucks, there is no additional packaging.

2.8 Reference Service Life (RSL)

There's no RSL state in the 'SBR levensdurengids voor bouwproducten'. This study covers the pro-duction stage information (from A1 to A3) of the product. As no use stage is declared, the reference service life for the special binder GeoSol® is not relevant.

3. LCA: Calculation rules

3.1 Declared unit

In accordance with the PCR B 1,000 kg special binder is chosen as the declared unit. It is considered to be a product unit.

Product	Unit weight [kg]	Conversion factor to 1 kg
GeoSol® 30	1,000	0.001

3.2 System boundary

The environmental product declaration is a cradle-to-gate EPD, i.e., all potential environmental impacts of the product from the cradle to the factory gate are considered. According to DIN EN 15804, this corresponds to product phases A1-A3.

The manufacturing phase includes the production or extraction of all raw materials, the transport to the respective production plant and the production of the GeoSol® products. All inputs (raw materials, energy and auxiliary materials) as well as the by-products and waste are considered. On the base of experience, it was assumed that the provision of the infrastructure accounts for less than 5% of the environmental impacts. Furthermore, only production-related energy consumption (excluding administration and social rooms) is considered.

The year 2019 represents the time reference. Due to the production locations and the main economic connections, Germany is considered as the geographical reference area. However, environmental effects such as the greenhouse effect can occur with a strong spatial and temporal offset.

The production phase includes dosing and weighing of the various components, mixing and loading onto silo trucks.

About 40 % of the raw material is secondary material. Secondary fuels are not included in the production process and are therefore not considered. The waste materials and quantities produced are included in the respective modules.

3.3 Estimates and assumptions

All data were collected for both sites, Bottrop and Dortmund. As the results for the environmental impacts are very similar, Bottrop has been chosen as the representative location, with slightly higher values which means a worst-case scenario.

The energy consumption was averaged over the production quantity. The distances for transport could be recorded for all raw materials. For all truck transports (suppliers, disposal transports and in-ternal transports) a payload factor of 50%, is used for the trucks (loading capacity 16-32t), which effectively corresponds to delivering full and going back empty (SBK 2019). The return journey and the payload factor have already been incorporated into the Ecoinvent transport processes.

The electricity mix was chosen according to the geographical reference area (Germany) and time reference. As only the conventional electricity mix is used, no other energy sources were considered. No CO2 certificates were taken into account.

It was assumed that 5% loss occurs during production.

3.4 Cut-off criteria

For the process modules A1 to A3 all process-specific data was collected. All flows could be assigned potential environmental impacts through the Ecoinvent database. All flows that contribute to more than 1 % of the total mass, energy or environmental impact of the system were considered in the LCA. It can be assumed that the neglected processes would have contributed less than 5 % to the impact categories considered.

3.5 Period under review

All process-specific data was collected for the operating year 2019.

3.6 Data quality

All process-specific data was collected for the 2019 operating year and is therefore up to date. The data is based on the annual average. The secondary data was taken from the database of the Ecoinvent software (version 3.6). The database is checked regularly and thus meets the requirements of EN 15804+A1 (background data not older than 10 years). The data quality can be classified as high, since values could be specified for all process-specific data.

3.7 Allocation

Allocations were avoided within the scope of the LCA. There are no co-products. There are no multi-input processes.

3.8 Comparability

In principle, a comparison or assessment of the environmental impacts of different products is only possible if they have been prepared in accordance with EN 15804 [for EPD] or ISO 14067 [for CFP]. For the evaluation of the comparability, the following aspects have to be considered in particular: PCR used, functional or declared unit, geographical reference, definition of the system boundary, declared modules, data selection (primary or secondary data, background database, data quality), scenarios used for use and disposal phases, and the life cycle inventory (data collection, calculation methods, allocations, validity period).

4. LCA_ Results

The following tables show the results of the impact assessment indicators, resource use, waste and other output streams. The results presented here refer to the declared average product.

Description of the system boundary

Product stage			Construction process stage		Use stage							End of life stage				Benefits & loads beyond the system boundaries
Raw material supply	Transport	Manufacturing	Transport from manu-facturer to place of use	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishmen	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	MND

X=Module declared | MND=Module not declared

Results of the LCA – Environmental impact: 1,000 kg GeoSol® 30

Parameter	Unit	A1	A2	A3	Total
ADP(e)	[kg Sb-eq]	4,61E-04	4,42E-04	5,79E-05	9,60E-04
ADP(f)	MJ	8,71E-01	1,27E-01	5,93E-02	1,06E+00
AP	[kg SO_2-eq]	5,58E-01	7,61E-02	3,54E-02	6,69E-01
ODP	[kg CFC 11eq]	1,41E-05	3,07E-06	9,87E-07	1,82E-05
GWP	[kg CO_2-eq]	3,71E+02	1,73E+01	2,07E+01	4,09E+02
EP	[kg $(PO_4)^{3-}$eq]	9,14E-02	1,49E-02	6,27E-03	1,13E-01
POCP	[kg Ethene eq]	5,81E-02	1,04E-02	3,76E-03	7,23E-02

ADPe=Depletion of abiotic resources-elements | ADPf=Depletion of abiotic resources-fossil fuels | AP=Acidification of soil and water | ODP=Ozone layer depletion | GWP=Global warming | EP=Eutrophication | POCP=Photochemical oxidants creation

Results of the LCA –Resource Use: 1,000 kg GeoSol® 30

Parameter	Unit	A1	A2	A3	Total
PERE	[MJ]	1,04E+02	3,29E+00	9,86E+00	1,17E+02
PERM	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	[MJ]	1,04E+02	3,29E+00	9,86E+00	1,17E+02
PENRE	[MJ]	1,80E+03	2,79E+02	1,26E+02	2,20E+03
PENRM	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	[MJ]	1,80E+03	2,79E+02	1,26E+02	2,20E+03
SM	[kg]	4,00E+02	0,00E+00	2,02E+01	4,20E+02
RSF	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW	[m^3]	8,32E-01	3,20E-02	1,46E-02	8,78E-01

PERE=renewable primary energy ex. raw materials | PERM=renewable primary energy used as raw materials | PERT=renewable primary energy total | PENRE=non-renewable primary energy ex. raw materials | PENRM=non-renewable primary energy used as raw materials | PENRT=non-renewable primary energy total | SM=use of secondary material | RSF=use of renewable second-ary fuels | NRSF=use of non-renewable secondary fuels | FW=use of net fresh water

Results of the LCA –Resource Use: 1,000 kg GeoSol® 30

Parameter	Unit	A1	A2	A3	Total
HWD	[kg]	7,54E-04	6,67E-04	1,05E-04	1,53E-03
NHWD	[kg]	4,60E+00	1,67E+01	2,09E+00	2,34E+01
RWD	[kg]	9,15E-03	1,73E-03	6,61E-04	1,15E-02
CRU	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	[kg]	0.00E+00	0.00E+00	4.95E+01	4.95E+01
MER	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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

5. LCA: Interpretation

The following figure shows the influence of the different life stages. As shown in figure below, the raw material (A1) has the greatest influence on the life cycle of GeoSol® 30.

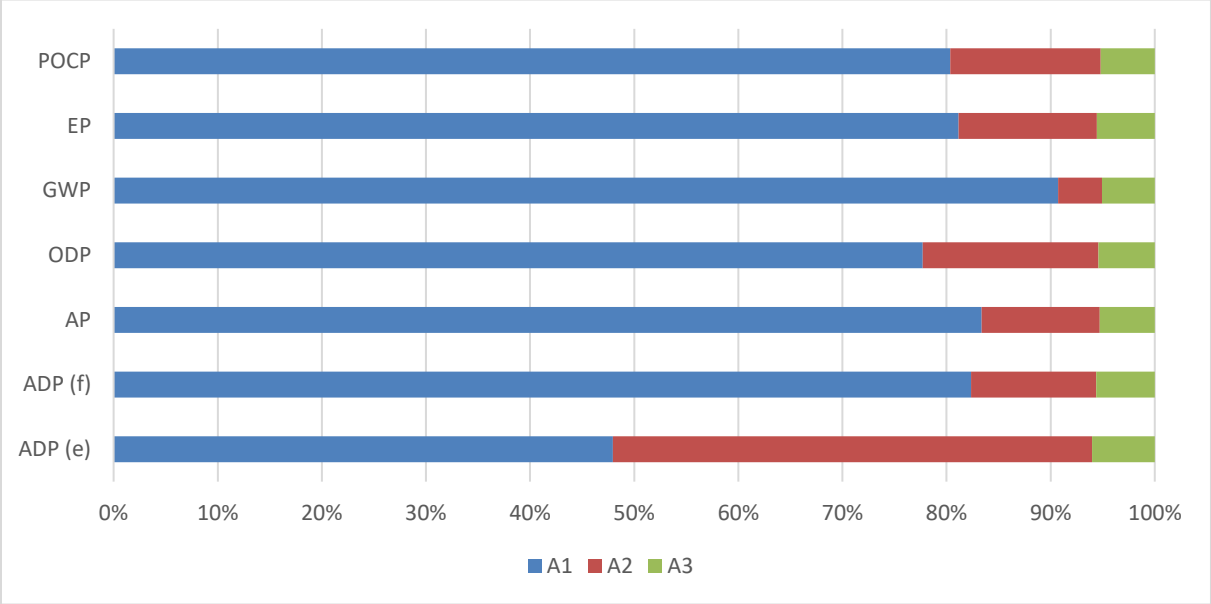


Figure 2: GeoSol® 30 - Influence of the environmental impact of modules A1 (raw material supply), A2 (transport) and A3 (production) according to environmental impact categories

6. References

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Standards and laws

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ISO 14044:2006. Environmental management - Life cycle assessment - Requirements and guidelines; EN ISO 14040:2006

ISO 14025:2011-10: Environmental labels and declarations — Type III environmental declarations — Principles and procedures EN 13249

EN 15804:2012-04+A1 2013: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

Deutsche Fassung EN 16908:2017: Zement und Baukalk – Umweltproduktdeklarationen –Produktkategorieregeln in Ergänzung zu EN 15804

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