Environmental Product Declaration

as per ISO 14025 and EN 15804

Owner of the declaration:	MINIERA SAN ROMEDIO SRL
Publisher:	Kiwa-Ecobility Experts
Programme operator:	Kiwa-Ecobility Experts
Registration number:	EPD-Kiwa-EE-322-EN
Issue date:	07.08.2023
Valid to:	07.08.2028

Natural Hydraulic Lime (NHL): FENIX

Natural hydraulic lime is a binder with a low content of water-soluble salts suitable for the packaging of mortars or plasters, characterized by a high breathability and a high sulphates resistance.

1. General information

Miniera San Romedio

Programme operator
Kiwa-Ecobility Experts
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Registration number
EPD-Kiwa-EE-322-EN

This declaration is based on the Product Category Rules
EN 16908:2017+A1:2022

Issue date
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Valid to
07.08.2028

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(Head of Kiwa-Ecobility Experts)

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Natural Hydraulic Lime (NHL)

Owner of the declaration
Miniera San Romedio Srl
Località alla Miniera
38012 Predaia (TN)
Italy

Declared product / declared unit
1 ton (1000 kg) of Natural Hydraulic Lime (NHL)

Scope
This EPD refers to a specific product, Natural Hydraulic Lime (NHL) produced by Miniera San Romedio Srl in its plants in the province of Trento (Italy). The data used to perform the LCA analysis were provided by Miniera San Romedio Srl and referred to the production of one year, and the information are relative to the period 2021-2022. The geographical area assumed for the application and end-of-life of the product is Italy. The study was performed following the so-called from-cradle-to-gate approach with modules C1-C4 and D.
This EPD is intended to be used for business-to-consumer communications. The owner of the declaration is liable for the underlying information and evidence.
Kiwa-Ecobility Experts assumes no liability for manufacturer's information, LCA data and evidence.

Verification
The European standard EN 15804+A2:2019 serves as the core PCR.

Independent verification of the declaration and data according to ISO 14025:2006.

☐internal ☒external

Dr.-Ing. Morteza Nikravan
(External verifier of Kiwa GmbH)

2. Product

2.1 Product description

The premixed Miniera San Romedio's products are inorganic finely grinded materials, obtained by means of the combinations at different relative concentrations of natural hydraulic lime, cement and dolomia. In this EPD only the binder (natural hydraulic lime) is considered.

2.2 Application

NHL binder: Natural hydraulic lime binder with a low content of water-soluble salts suitable for the packaging of mortars or plasters characterized by a high breathability and a high sulphates resistance. According to UNI EN 459-1:2010 ("Building lime - Part 1: Definitions, specifications and conformity criteria"), it is classified as NHL5 and subjected to CE marking according to current legislation. It is obtained from the cooking at low temperatures of natural marlstone with Trentino red flakes (clay limestone) known as "Scaglia Rossa", the main mineralogical constituent is the bi-silicatecalcic, able to confer excellent mechanical characteristics and elasticity to the materials, resistance to salts and chemical inertia, such as to guarantee its durability over time. It is tricalcium silicate and tricalcium aluminate free, typical constituents that can be found in Portland cements and in any other form of clinker. It can be mixed with any inert as long as it has no organic content.

2.3 Technical data

In Table 1 the main physical and applicative properties of the considered product are reported.

Table 1: Physical and applicative properties of the NHL.

Characteristic	Unit	Value	Standard
Density	kg/m^3	~ 1100	UNI EN 1015-10
Mixing water	l/kg	*	-
Classification	-	NHL 5	UNI EN 459-1
pH	-	> 10.5	-
Fire reaction class	-	A1	-

*Since the binder is not intended for direct use alone but for mixing with inert on the building site, it's not declared the amount of mixing water needed, which is to be assessed at the moment in relation to the kind and quantity of inert used.

2.4 Placing on the market/ Application rules

The pre-mixed Miniera San Romedio's products are powder or granulates and therefore they have to be transported to the building site by using 25 kg paper bags, collected over a pallet. Pallets range from 50 to 60 bags each one, and can be mechanically moved. Once the product reaches the building site the bags can be used to mix the product with the specified amount of water and either be manually stirred or mechanically mixed. It can be also transported to the construction site unpackaged and directly pumped into a silo already settled on a nearby position.

2.5 Base materials / Ancillary materials

In order to apply this product, it must be premixed combining at different relative concentrations natural hydraulic lime, acting as the inorganic binder, and the fillers (i.e dolomia, expanded perlite). Water and small amounts of additives (less than 3 wt%) are then added to the mix, in order to develop innovative materials with very peculiar properties and suitable for a wide range of applications in the constructions field. The relative composition of the binder is summarized in Table 2.

Table 2: Composition of Natural Hydraulic Lime.

Product	Dolomia [wt%]	NHL* [wt%]	Cement [wt%]	Additives [wt%]
NHL binder	-	100	-	-

* Comprising setting retardant (4 wt% of the total NHL content)

The paper bag used as packaging (2.74 kg for 1 ton of product) contains 1.77 kg of biogenic carbon. The product does not contain biogenic carbon.

2.6 Manufacturing

2.6.1. Manufacturing process of the Binder (Natural Hydraulic Lime)

The unprocessed marlstone is extracted from the pit in Predaia (TN), through a mixed explosive. The obtained marlstone is then collected through a Diesel bulldozer and transported with a Diesel lorry from Predaia (TN) to the Ville d'Anaunia (TN) facility, where the material is subjected to a first crushing. After the first crushing of the marlstone, part of this material is used as corrective and it is not crushed anymore, but it is transported into a specific hopper. Through a conveyor belt the crushed marlstone that is not intended to be used as corrective is then transported to the cooking plant, fed with hard coal. In the cooking plant, the material is subjected to a slow thermal treatment at 900-1200 °C, that can last up to 48 hours, and the treated material is then transported through a conveyor belt in the maturation hopper. After the thermal treatment, the material is then subjected to a first and a second milling phase, in order to reach the required granulometry. The lime-based end product (i.e. the binder) is obtained by mixing the milled lime, the setting retardant and the corrective marlstone (i.e. the marl-stone extracted from the pit of Predaia, transported to the cooking plant, milled and not subjected to the thermal treatment).

Manufacturing of the lime based premixed products

The lime used in the premixed products as binder is loaded on a truck and trasported from the Ville d'Anaunia (TN) plant to the Mollaro (TN) facility, and put in a cisterns. The powders are then packed through a bagging system, by using a paper bag with capacity of 25 kg, palletized and then directly distributed.

According to the EN 15804:2012+A2:2019 standard, the present LCA study was performed following the so-called from-cradle-to-gate approach with modules C1-C4 and D considering thus the following steps:

- Extraction and processing of the raw materials (A1);
- Transport of the acquired raw materials to the manufacturer and internal transport of the extracted raw materials (A2);
- Production of the materials and mixing operations (A3).
- Deconstruction/demolition (C1)
- Transport of demolition wastes (C2)
- Waste treatment (C3)
- Waste disposal (C4)
- Benefits and impacts beyond the system boundaries (D)

A schematic process flow diagram is shown in Figure 1.

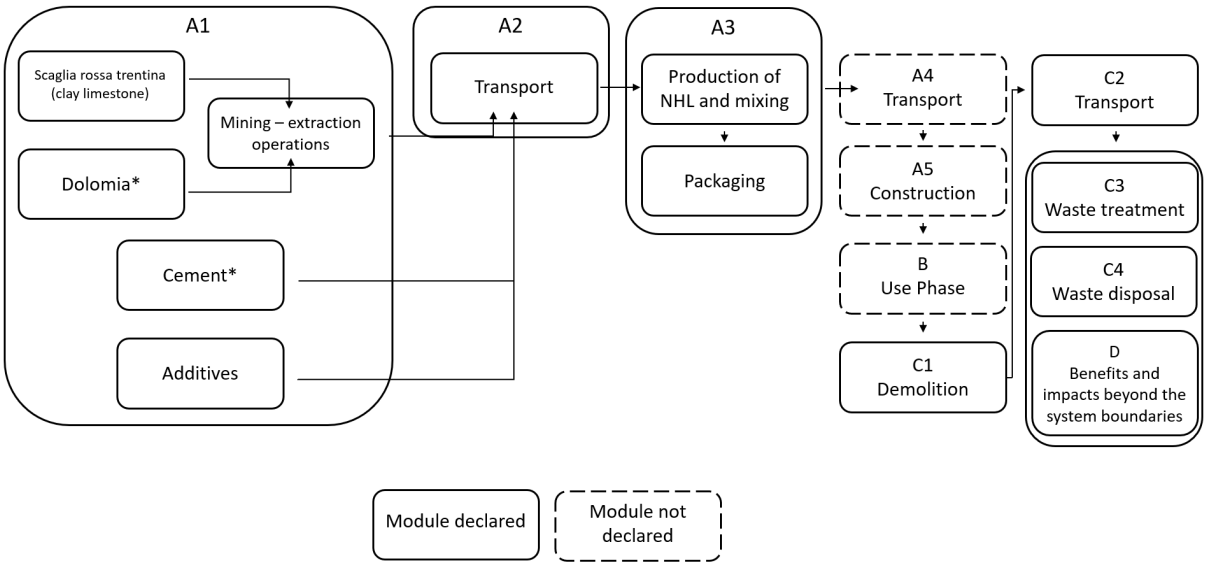

Figure 1: [Graphic schematic process flow diagram for the analysed product.]

2.7 Packaging

Paper bags are used to stow 25 kg of premixed product.

2.8 Reference Service Life (RSL)

Since the use phase is not considered, the reference service life (RSL) as per ISO 15686-1, -2, -7 and -8 has not been declared.

2.9 Other Information

For further information on this product please visit the webpage under the following link: https://www.tassullo.it/it/

3. LCA: Calculation rules

3.1 Declared unit

In accordance with the EN 15804+A2:2019 and EN 16908:2017+A1 1 ton of product is chosen as the declared unit (see Table 3).

Table 3: Declared unit used for the calculations.

Product	Unit	Value
Declared Unit	Ton	1
Conversion factor to 1 kg	kg	1000

3.2 System boundary

In accordance with the EN 15804+A2:2019 this study was performed following the so-called from-cradle-to-gate approach with modules C1-C4 and D. In Table 4 the system boundaries of the considered product are listed.

Table 4: system boundaries of the Natural Hydraulic Lime.

Module	Modul declared	within the system boundary	Outside the system boundary
A1 Raw Material	Yes	X	
A2 Transport	Yes	X	
A3 Manufacturing	Yes	X	
A4 Transport	No		X
A5 Installation	No		X

B1 Use Phase	No		X
B2 Maintance	No		X
B3 Repair	No		X
C1 De-Construction	Yes	X	
C2 Transport	Yes	X	
C3 Waste treatment	Yes	X	
C4 Landfill	Yes	X	
D Considered loads and benefits outside of the system boundary in Module D	Yes	X	

3.3 Estimates and assumptions

The electrical energy consumed in Miniera San Romedio Srl plants is a fully renewable certified energy. The electrical energy is derived from renewable energy source (hydropower) that have obtained certification with the guarantee of origin. The electrical energy is converted from high voltage to low voltage using an electrical transformer located close to the plants. The certification of the renewability of the energy covers to whole period analysed in this study (2021-2022). For as concerns the energy source to feed the furnace for the NHL production, hard coal, with a total heat evolution of 787 Mcal to cook 1 ton of NHL, was considered. For the internal transportations, gasoline with a calorific power of 45 MJ/kg was considered.

For as concerns the end-of-life stage, the demolition, transport, treatment, and disposal of wastes were modelled using processes present in the Ecoinvent database and modified to the specific case. In particular,

- for the C1 stage (demolition/deconstruction) the use of a diesel operating machine with a productivity of 16.6 min/ton of demolished material and a diesel consumption of 0.9 lt/m^3 was considered. A water consumption of 0.018 m^3/m^3 was considered. Both references were taken from Ivanica et al.
- for the C2 stage a distance of 15 km was assumed according to data provided by Italia del Riciclo referred to the year 2021.
- for the C3 and C4 stages, despite the NHL binder can be fully recycled and due to the lack of specific information regarding the end-of-life of this product, it was assumed that, after a sorting and crushing process, 78.1 wt% of inert wastes is recycled (reaching the end-of-waste state) while the remaining part is landfilled (data provided by Italia del Riciclo referred to the year 2021). For the sorting and crushing process an existing Ecoinvent process was adapted to the specific case.
- for the stage D it was considered that the secondary materials were used as alternative to gravel for the production of concrete and for road construction (the background process used refers to the period 2013-2021). Benefits and impacts associated to these operations were therefore evaluated.

According to EN 16908:2017+A1 the carbonation of natural hydraulic lime, cement and hydrated lime can be very relevant after demolition with consistent carbon dioxide uptake. The evaluation of carbon dioxide uptake was carried out according to the procedure described in EN 16757. In particular it was considered that:

- for the C1-C3 stages no carbonation occurs due to the limited time of exposure to air or to the lack of information regarding the duration of air exposure.

- for the C4 stage it was considered a carbon dioxide uptake equal to 75 % of the maximum theoretical carbon dioxide uptake for landfilled wastes. No uptake was considered for recycled wastes.
- for the D stage it was considered a carbon dioxide uptake equal to 100 % of the maximum theoretical carbon dioxide uptake.

The following values (evaluated according to stoichiometry) were used as maximum uptake values:

- Natural hydraulic lime: 440 kg/ton.

It should be highlighted that since Miniera San Romedio produces ready mixed products and has no control and no information regarding their applications it was impossible, due to lack of data, to calculate the contribution of carbonation in the use stage (module B).

Regarding the end-of-life of the packaging paper (100 % recyclable), it was not considered since beyond the boundaries of the system.

3.4 Cut-off Criteria

As reported in the EN 15804:2012+A2:2019 standard, all inputs and outputs for which data are available were taken into account in the calculation. Eventual data gaps have been filled with conservative assumptions of average data or generic data available in the Ecoinvent v3.8 database of the SimaPro software. All flows contributing to more than 1 % of the total mass, energy or environmental impact of the system have been included in the life cycle assessment. Eventual neglected processes do not contribute in total more than 5% to the impact categories considered. Moreover, the manufacture of machinery, plants and other infrastructure required for production of the products under review was not taken into consideration in the present analysis.

3.5 Period under review and Geographical reference area

The specific data were obtained directly by the commissioning company, and are related to the production of one year. The data are referred to the period June 2021-June 2022. They were obtained by means of specific measures related to the energy consumption and mass flows in the plant of Ville d'Anaunia (Trento), where the NHL is produced, and to the mass and energy flows in the plant of Mollaro (Trento), where NHL is packed. Manufacturer-specific data are referred to the period 2021-2022, while generic data are less than 10 years old. Moreover, process-specific data are based on the average of an operating year.

3.6 Data quality

For this study, the data quality requirements defined in ISO 14044 regulation have been considered. In order to ensure coherence, data with the same level of detail have been used, as well as under the same methodological considerations. Data and methods used for this study have been described with the purpose of being reproducible by a third independent party. Whenever possible, generic data used for the study are representative of the location where the process belongs (for example, the production of electrical energy). The data has been collected from the plants of Ville D'Anaunia and Mollaro (both in province of Trento). Data were associated to a specific input selected from the database Ecoinvent v3.8 (2021). The inventory analysis has been thus modelled by using the SimaPro software.

3.7 Allocation

Allocations were avoided.

3.8 Comparability

In order to assure the comparability of the obtained results, all datasets to be compared have been created in accordance with EN 15804, and the product-specific performance characteristics have been taken into account. 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.

4. LCA: Scenarios and additional technical information

No scenario or additional technical information to be declared.

5. LCA: Results

Table 5 shows the results of the impact assessment indicators, resource use, waste and other output streams for the declared unit (1 ton of NHL binder). The results presented here refer to the declared product. In Table 6 the results of the biogenic carbon content are reported.

Disclaimer on ADP-e, ADP-f, WDP, ETP-fw, HTP-c, HTP-nc, SQP: The results of these environmental impact indicators must be used with caution, as the uncertainties in these results are high or as there is limited experience with the indicator.

Disclaimer on IR: This impact category mainly addresses the potential effect of low dose ionizing radiation on human health in the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents and occupational exposures, nor does it consider radioactive waste disposal in underground facilities. Potential ionizing radiation from soil, radon, and some building materials is also not measured by this indicator.

Table 5: results of the impact assessment indicators, resource use, waste and other output streams for NHL binder.

Description of the system boundary																
Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Manu-facturing	Transport from manu-facturer to place of use	Construction -installation process	Use	Main-tenance	Repair	Replacement	Refur-bishmen	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	MNR	MNR	MNR	MND	MND	MND	MND	X	X	X	X	X
X=Module declared | MND=Module not declared																

LCA results - Indicators describing environmental impacts based on the impact assessment (LCIA): 1 ton of NHL binder (EN 15804+A2)							
Parameter	**Unit**	**A1-A3**	**C1**	**C2**	**C3**	**C4**	**D**
Core environmental impact indicators (EN 15804+A2)							
GWP-total	kg CO2 eqv.	6.07E+02	7.62E+00	1.37E+00	1.73E+00	-7.11E+01	-3.46E+02
GWP-f	kg CO2 eqv.	6.07E+02	7.61E+00	1.37E+00	1.68E+00	-7.11E+01	-3.46E+02
GWP-b	kg CO2 eqv.	1.14E-01	5.33E-03	1.39E-03	4.62E-02	1.25E-03	-1.11E-01
GWP-luluc	kg CO2 eqv.	4.51E-02	1.13E-03	4.90E-04	3.51E-03	1.09E-03	-2.15E-03
ODP	kg CFC 11 eqv.	7.52E-06	3.16E-06	3.31E-07	1.16E-07	4.67E-07	-3.55E-07
AP	mol H+ eqv.	2.34E+00	3.65E-02	9.54E-03	1.04E-02	1.08E-02	-2.35E-02
EP-fw	kg P eqv.	1.47E-01	3.03E-04	8.50E-05	1.50E-03	1.06E-04	-6.12E-04
EP-m	kg N eqv.	3.15E-01	9.56E-03	3.74E-03	2.26E-03	3.77E-03	-6.73E-03
EP-T	mol N eqv.	3.30E+00	1.05E-01	4.10E-02	2.18E-02	4.13E-02	-9.02E-02
POCP	kg NMVOC eqv.	9.22E-01	3.41E-02	1.15E-02	6.05E-03	1.20E-02	-2.11E-02
ADP-mm	kg Sb-eqv.	1.76E-04	4.85E-06	3.13E-06	1.47E-05	2.63E-06	-5.65E-05
ADP-f	MJ	2.77E+03	1.99E+02	2.16E+01	3.39E+01	3.22E+01	-4.07E+01
WDP	m3 world eqv.	7.98E+01	4.16E+00	7.31E-02	3.75E-01	1.45E+00	-8.13E-01
Additional environmental impact indicators (EN 15804+A2)							
CaPM	disease incidence	ND	ND	ND	ND	ND	ND
IR	kBq U235 eqv.	ND	ND	ND	ND	ND	ND
ETP-fw	CTUe	ND	ND	ND	ND	ND	ND
HTP-c	CTUh	ND	ND	ND	ND	ND	ND
HTP-nc	CTUh	ND	ND	ND	ND	ND	ND
SQP	Pt	ND	ND	ND	ND	ND	ND

ADP-mm= Abiotic depletion potential for non-fossil resources | **ADP-f**=Abiotic depletion for fossil resources potential | **AP**= Acidification potential, Accumulated Exceedance | **EP-fw** = Eutrophication potential, fraction of nutrients reaching freshwater end compartment | **EP-m**= Eutrophication potential, fraction of nutrients reaching marine end compartment| **EP-T**= Eutrophication potential, Accumulated Exceedance | **GWP-b**=Global Warming Potential biogenic | **GWP-f**=Global Warming Potential fossil fuels | **GWP-luluc**=Global Warming Potential land use and land use change |**GWP-total**=Global Warming Potential total| **ODP**=Depletion potential of the stratospheric ozone layer |**POCP**=Formation potential of tropospheric ozone | **WDP**=Water (user) deprivation potential, deprivation- weighted water consumption | **ETP-fw**=Potential Comparative Toxic Unit for ecosystems | **HTP-c**=Potential Toxic Unit for Humans toxicity, cancer | **HTP-nc**= Potential Toxic Unit for humans, non-cancer | **IRP**=Potential Human exposure efficiency relative to U235, human health | **PM**=Potential incidence of disease due to Particulate Matter emissions | **SQP**=Potential soil quality index

Parameter	Unit	A1-A3	C1	C2	C3	C4	D
PERE	MJ	4.09E+02	8.53E-01	2.71E-01	6.27E+00	2.75E-01	-1.30E+01
PERM	MJ	-	-	-	-	-	-
PERT	MJ	4.09E+02	8.53E-01	2.71E-01	6.27E+00	2.75E-01	-1.30E+01
PENRE	MJ	2.93E+03	2.12E+02	2.29E+01	3.56E+01	3.42E+01	-4.27E+01
PENRM	MJ	-	-	-	-	-	-
PENRT	MJ	2.93E+03	2.12E+02	2.29E+01	3.56E+01	3.42E+01	-4.27E+01
SM	Kg	-	-	-	-	-	-
RSF	MJ	-	-	-	-	-	-
NRSF	MJ	-	-	-	-	-	-
FW	M3	7.71E+01	3.99E+00	7.35E-02	3.69E-01	1.45E+00	-7.11E-01
HWD	Kg	1.45E-03	5.41E-04	5.23E-05	3.25E-05	4.87E-05	-1.76E-04
NHWD	Kg	1.36E+01	1.79E-01	1.99E+00	1.22E-01	2.19E+02	-6.55E-01
RWD	Kg	3.15E-03	1.40E-03	1.46E-04	2.45E-04	2.11E-04	-2.96E-04
CRU	Kg	-	-	-	-	-	-
MFR	Kg	4.10E-02	-	-	7.81E+02	-	-
MER	Kg	-	-	-	-	-	-
EET	MJ	-	-	-	-	-	-
EEE	MJ	-	-	-	-	-	-

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 fresh water | **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 | **EET**=Exported energy, thermical | **EE**=Exported energy, electrical

Table 6: results of the biogenic carbon content of NHL binder.

LCA results - information on biogenic carbon content at the factory gate: 1 ton of NHL binder (EN 15804+A2)		
Parameter	**Unit**	**Value**
biogenic carbon content in product	kg C	0
biogenic carbon content in accompanying packaging	kg C	1.77
NOTE 1 kg biogenic carbon is equivalent to 44/12 kg CO2		

6. References

ISO 14040:2006, Environmental management - Life cycle assessment - Principles and framework

ISO 14044:2006, Environmental management - Life cycle assessment - Requirements and guidelines

ISO 14025:2006: Environmental labels and declarations — Type III environmental declarations — Principles and procedures EN 13249

EN 15804:2012+A2:2019 Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

PCR A: General Program Category Rules for Construction Products from the EPD program Kiwa-Ecobility Experts, R.0_2021-07-16

EN 16908:2017+A1: Cement and building lime - environmental product declarations - product category rules complementary to EN 15804.

EN16757: Sustainability of construction works – Environmental product declarations – Product category rules for concrete and concrete elements.

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Frischknecht, R. and N. Jungbluth. Overview and Methodology. Ecoinvent report No. 1. 2007.

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Laveglia, A., L. Sambataro, N. Ukrainczyk, N. De Belie, and E. Koenders, Hydrated lime life-cycle assessment: Current and future scenarios in four EU countries. Journal of Cleaner Production, 2022. 369

7. ANNEX 1 Requirements of the Minimum Environmental Criteria (DM June 23th 2022)

In Table 7 the requirements imposed by Minimum Environmental Criteria (DM June 23th 2022) for the NHL binder considered in this project report are summarized. As it can be seen, the product satisfies the legislative requirements imposed by the Italian Legislation on the Minimum Environmental Criteria for construction services.

Table 7: Requirements of the Minimum Environmental Criteria DM June 23th 2022) for the NHL binder.

2.5.1	Emissions in confined environment	The required emission limits can not be applied to these materials since their applications are not included in the list provided in the DM June 23th 2022 at the point 2.5.1.
2.5.2	Premixed concrete or prepared on the building site	The required minimum recycled content is not applicable since the products considered in this EPD can not be considered as "concrete". According to EN 998-1 and EN 998-2 they can be defined as "plasters" or "mortars" depending on the specific application.
2.6.2	Dismantling and removal of the materials	All the products considered in this EPD, after the dismantling operations, can be fully sent to reuse, recovery and recycling operations.

Note: the other requirements imposed by the Minimum Environmental Criteria are not reported since not applicable for the analyzed products.

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