MPI 25, Primo 2 and KlimaWhite

Lime-cement plasters
by BAUMIT Bulgaria EOOD

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1. General Information

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This declaration is the type III Environmental Product Declaration (EPD) based on EN 15804 and verified according to ISO 14025. It contains information about the impact of declared construction materials on environment and their aspects verified by the independent Advisory Board according to ISO 14025.

Basically, a comparison, or evaluation of EPD data is possible only if all the compared data were created according to EN 15804.

Life Cycle analysis (LCA): Modules A1-A3, C1-C4 and Module D in accordance with EN 15804 (Cradle to Gate with options)

Declared durability: 50 years under normal conditions of use

Product standard: BDS EN 998-1, BDS EN 998-1 (NA)

PCR: ITB-EPD General PCR v1.4/2014

Representativeness: BG, RER, GLO

Declared unit: 1 ton lime-cement plaster dry mix

LCA scope: Product stage (modules A1-A3), End-of-life stage (C1-C4) and Benefits and loads beyond the system boundary (module D)

Year of preparing the characteristic: 2020

2. Product Description

BAUMIT MPI 25

BAUMIT MPI 25 is a lime-cement plaster for manual and machine application, only for indoor use. MPI 25 creates ready-to-paint surfaces, it is water-absorptive mineral plaster with good vapor permeability to regulate the air-humidity and achieve a cosy room-climate. MPI 25 can be applied as a machine plaster with rubbed surface for all interior rooms including commercial wet rooms (moisture load classification: W4). MPI 25 is convenient for wall heating systems. BAUMIT MPI 25 is a factory-made dry mix for lime-cement plaster. It consists of limestone crushed sand, hydrated lime, cement and additives. MPI 25 lime-cement plaster covers the requirements for lime-cement plasters of group GP – CS II as per BDS EN 998-1. MPI 25 is packed in bags with unit mass 40 kg – Figure 1.

BAUMIT PRIMO 2

BAUMIT Primo 2 is a factory-mixed, dry lime-cement -plaster for machine application indoors and outdoors and can be coarsely levelled or smoothed with a trowel. Primo 2 is water-repellent mineral lime-cement plaster with good vapor permeability which makes it suitable for ground floors and wet rooms. Figure 2 shows a picture of packed Primo 2 lime-cement plaster. BAUMIT Primo 2 is a factory-made dry mix for lime-cement plaster. It consists of limestone crushed sand, hydrated lime, cement and additives. Primo 2 lime-cement plaster covers the requirements for lime-cement plasters of group GP – CS II as per BDS EN 998-1. Primo 2 is packed in bags with unit mass 40 kg.

BAUMIT KlimaWhite

BAUMIT KlimaWhite is a factory-mixed, dry mix lime-cement plaster for indoor machine or manual application. The structure of the plaster absorbs moisture from its surroundings and returns it in the event of a decrease in moisture. Klima White has antibacterial effects, reduced risk of mold, and reduced smell due to lime hydrate content. Klima white is characterised by high vapour permeability which supports fast transfer of moisture and prevents condensation.

KlimaWhite can be used in all internal rooms, including industrial wet rooms (moisture load classification: W4). KlimaWhite is suitable for wall heating systems. It can be applied as both basecoat and topcoat plasters. A paint finish may be applied if required.

Baumit Klima White can be mixed with clean water in a tub to a lump free, creamy consistency with an electric hand mixer. Automated continuous horizontal mixers may also be used. For small areas the mixed plaster can be manually applied. For larger areas the fresh plaster can be fed into a mortar pump for spray application. Alternatively, mortar mixing pumps provide an all-in-one mixing and spraying solution.

BAUMIT KlimaWhite is a factory-made dry mix for lime-cement plaster. It consists of limestone crushed sand, hydrated lime, white cement, expanded perlite and additives. KlimaWhite lime-cement plaster covers the requirements for lime-cement plasters of group GP – CS II as per BDS EN 998-1. KlimaWhite is packed in bags with unit mass 25 kg - Figure 3.

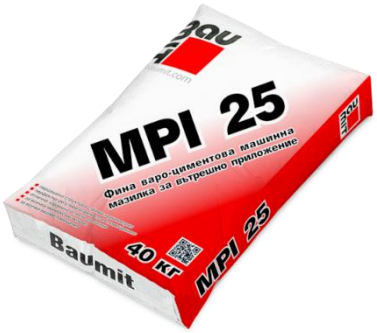

Figure 1: Packed MPI 25

Figure 2: Packed Primo 2

Figure 3: Packed KlimaWhite

Table 1 lists the essential characteristics of MPI 25, Primo 2 and KlimaWhite as per the Product specification sheets.

Table 1: Technical characteristics of MPI 25, Primo 2 and KlimaWhite

Characteristics	Value/Class			Units	Technical specification
	MPI 25	Primo 2	KlimaWhite		
Dry density	≈ 1500	≈ 1600	≈ 1300	kg/m^3	BDS EN 998-1
Maximum grain size	0.6	2	0.6	mm	BDS EN 998-1
Compressive strength (28 day)	> 2.5	> 2.5	> 2.5	N/mm²	BDS EN 998-1
Tensile strength (28 day)	> 1.0	> 1.0	> 1.0	N/mm²	BDS EN 998-1
Thermal conductivity, $\lambda_{10, dry}$	0.47	≈ 0.67	0.47 (p=50 %) 0.54 (p=90 %)	W/(m.K)	Referent value, EN 1745
Diffusion resistance factor μ	5/20	15/35	5/20		Referent value, EN 1745:2002
Consumption of the product	≈ 15	≈ 16	≈ 12-12.5	kg/m^2 for 10 mm thickness of the plaster	
Minimal thickness of the coat	walls: 10 ceiling: 8	20	walls: 10 ceilings: 8	mm mm	
Maximal thickness of the coat	25	30	25	mm	

3. LCA Information

FUNCTIONAL UNIT 1 ton lime-cement plaster

SYSTEM BOUNDARIES Cradle to Gate + options: Modules A1-A3, C1-C4 and Module D

DECLARED DURABILITY 50 years for indoor applications under normal conditions of use
25 years for outdoor applications, if the plaster is subjected to severe environmental impact (freeze-thaw cycles in saturated condition)

CUT-OFF CRITERIA As per EN 15804, in the case that there is not enough information, the process energy and materials representing less than 1% of the energy and mass used per module can be excluded (if they do not cause significant impacts). The addition of all the inputs and outputs excluded is less than 5% of the whole mass and energy used, as well of the emissions to environment occurred.
Flows related to human activities such as employee transport are excluded. In accordance with EN 15804 the construction of plants, production of machines and transportation systems are excluded.
Environmental burden of the administrative building is partly considered.
Some additives in very small amounts (less than 0.5 %) are excluded due to lack of enough data and negligible potential environmental impacts.
The total sum of omitted processes does not exceed 5% of the whole mass of inputs and outputs.

ASSUMPTIONS AND LIMITATIONS Generic data from ecoinvent v.3.6 database is used to model the lime-cement plasters components that are delivered by external suppliers and the manufacturer does not have influence on their production processes.
Packaging materials and packaging waste are considered in the

assessment of all components of MPI 25, Primo 2 and KlimaWhite.

GEOGRAPHICAL COVERAGE AND TIME PERIOD

All data related to the lime-cement plasters is collected from BAUMIT Bulgaria EOOD and represents the manufacturing process in 2018.
Assessment of transport of all components covers all used transport types, external and internal transport activities.

DATA QUALITY

The information on the production process of the plasters is collected from BAUMIT Bulgaria EOOD.
Information on the transport and composition of components is provided by BAUMIT Bulgaria EOOD.
Information on the production process of additives is accounted as presented in ecoinvent v.3.6 database.

ALLOCATION

The factory of BAUMIT Bulgaria EOOD in Elin Pelin produces various construction products for external and internal finishing layers of buildings. The manufacturing processes for all three lime-cement plasters are equivalent with slight variance in terms of working regime of drying and mixing stations. Even though, allocation is done regarding energy and fuel use, and generated waste. Environmental impacts, resource use and waste generation are calculated based on yearly data about the inputs/outputs and the yearly production of lime-cement plasters for 2018.

4. Manufacturing process

The received fraction of crushed stone is 20/60 mm and it is dried in an oven, if necessary. This fraction is then crushed in a coarse crusher and subsequently sieved into seven smaller fractions. The smaller fractions are fed into pipelines and then carried to silos.

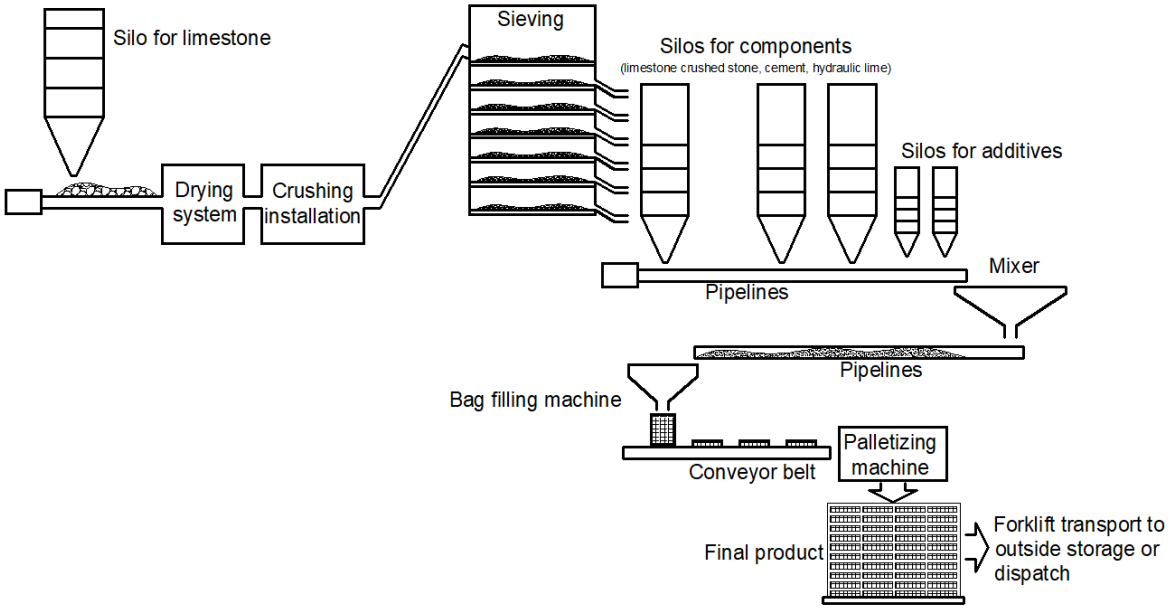

Figure 4: Production process of MPI 25, Primo 2 and KlimaWhite lime-cement plasters

The other ingredients - cement, hydrated lime and additives, are delivered as dry substances. Cement, hydrated lime and expanded perlite in KlimaWhite are delivered in mobile (transportable silos) and are discharged into the factory silos (in the factory tower) through pneumatic compressed air pipe system. Expanded perlite is delivered in ready-to-use status and no additional processing is done.

The additives are delivered in paper bags or big bags and are also discharged into smaller silos in the factory tower.

After the predefined quantity of each material is set, the materials are dosed and released on gravity pipelines that take them to a mixing facility. The ready mix is then transported to a machine for bag-filling. All products are packed in paper bags with mass 40 kg. The sealed bags are transported to the palletizing station through conveying belt. The bags are arranged on the pallets and covered by elastic polyethylene film. The pallets are transported by forklifts to an outside storage space.

5. System boundaries

Module A1: Raw materials supply and transport
Module A1 describes the acquisition of raw materials and manufacturing of pre-products. The production processes of the limestone crushed stone, Portland cement, hydrated lime, expanded perlite and additives are considered using referent data for the ecoinvent database. Production of packaging materials is also considered using referent data from the ecoinvent database.

Module A2: Transport of raw materials to the production site
The transport to the factory of the Portland cement, hydrated lime, limestone crushed stone, expanded perlite, additives and packaging materials is considered using real data from the manufacturer.

Module A3: Manufacturing
This module includes considers the actual production process: This includes the process of crushing, drying, sieving, dosing, packaging and palletizing. Energy, water and fuel consumption are considered in full based on 1-year consumption data provided by the manufacturer.

Module C1: Deconstruction/Demolition of the building
Module C1 describes processing of plastered building elements with lime-cement mortar during the deconstruction/demolition as part of the deconstruction/demolition process of the entire building.

The deconstruction/demolition of the plastered/rendered walls with lime-cement mortar is considered as a part of the entire demolition process of the whole building. There are no specific demolition/deconstruction methods, applied in Bulgaria, in regards with the lime-cement mortars. When the mortars are self-detached, they are collected as construction and demolition waste (C&DW) code 17 01 07 (as per the European Waste Catalogue EWC) and transported to a disposal site, because in the national legislation there are no requirements for the material recovery degree of that C&DW code. When part of the plaster remains attached to the substrate, it forms waste code 17 01 01 (concrete) and 17 01 02 (bricks) and is transported to a treatment plant for recovery operations. The quantity (per mass) of the mortar is very small, so its contribution to the demolition of the entire building can be neglected and the impact of this module is assumed to be zero.

Module C2: Transport to waste treatment facility

Module C2 refers to the transport of the waste containing lime-cement plaster to a facility for waste treatment.

The transport of waste containing lime-cement mortars is transported to a disposal facility (landfill) or recovery facility

The following assumptions are made to calculate the impacts of this module:

- 75% is transported to a landfill as waste code 17 01 07;
- 25% is transported to a processing plant as part of waste 17 01 01 or 17 01 02.

The corresponding environmental impacts are calculated based on the following assumed machinery and transport:

Table 2: Information on assumed transport for module C2

Parameter	Data
Collection of waste by	Loader with bucket capacity 3,6 m^3, tipping load 13.7 tons, operating weight 18.4 tons, Euro IV emissions class, rated power 165 кW / 224HP.
Transport of waste by	Lorry of the size class 7.5-16 tons, Euro IV emissions class.
Distance of transportation	25 km

Module C3: Waste processing

Module C3 accounts for the environmental impacts during the processing of lime-cement plaster waste at the waste recovery facility (crushing and screening). The lime-cement mortar-containing waste for recovery operations is classified as 'non-hazardous waste' of code 17 01 01 when the substrate is concrete wall or ceiling) or code 17 01 02 when the substrate is masonry wall. The first group of waste is recycled for all-in fraction 0/63 mm acc. to BDS EN 13242:2002+A1:2007. The recycling process includes crushing and screening. No preliminary treatment, additional sieving to fractions or post-treatment (washing, air cyclone) are applied. In Bulgaria, the recycling is usually performed in a treatment plant, but the main recycling equipment is mobile.

The second group of waste is usually recovered in backfilling and is subject of a crushing only to a suitable grain size.

Table 3: Information on assumed processing for module C3

Parameter	Data
Factory transport of waste and recovered material	Loader with bucket capacity 3,6 m^3, tipping load 13.7 tons, operating weight 18.4 tons, Euro IV emissions class, rated power 165 кW / 224HP.
Waste crushing and screening	Mobile impact crushing equipment: Feed opening 1,320 x 900 mm; Engine 310 kW / 415 HP and Weight 43 300 kg
Distance of in-plant transportation	0.5 km

Module C4: Disposal

Module C4 considers the effects from lime-cement plaster that is disposed. When the lime-cement mortar is collected as a waste code 17 01 07 it is transported to the so-called regional landfill, receiving

non-hazardous not-recyclable municipal waste. At the landfill, the waste is unloaded by the loader and since it is of a mineral origin, it is usually used as a separation layer between two layers (1 – 1.5 meters of thickness each) of municipal waste. For this purpose, the waste code 17 01 07 is spread out by a dozer to a layer of thickness of 30 to 60 cm.

Table 4: Information on assumed processing for module C4

Parameter	Data
Spreading out of waste	Operating dozer weight 23,347–23,488 kg; Blade capacity 12.7 m^3 Engine output kW/HP 150/204
Max distance of dozer spreading	0.020 km

Module D: Benefits and loads beyond the system boundary

Module D regards the effects and impact of the secondary material derived from recycling of lime-cement plaster waste. The recycled crushed stone fraction 0/63 mm of concrete C&DW code 17 01 01, containing lime-cement mortar contributes to saving of natural materials and reduction of landfilled material. However, the very low content of lime-cement mortar (about 1.6%) in the total fraction allows to neglect these positive impacts.

6. LCA Results

Declared unit

The declaration refers to 1 ton of lime-cement plaster dry mix.

Table 5: Description of the system boundary

Environmental assessment information (☒ – Included in LCA, MNA – Module not assessed, IND – Indicator not determined)															
Product stage			Construction process		Use stage							End of life				Benefits and loads beyond the system boundary
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Raw material supply	Transport	Manufacturing	Transport to construction site	Construction – assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/ demolition	Transport	Waste processing	Disposal	Reuse- Recovery- Recycling potential
☒	☒	☒	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	☒	☒	☒	☒	IND

The following tables provide the LCA results on the evaluated environmental categories. A list of the used abbreviations is given below:

GWP-total	Global warming potential total (sum of GWP-fossil, GWP-biogenic and GWP-luluc)
GWP-fossil	Global warming potential fossil fuels
GWP-biogenic	Global warming potential biogenic
GWP-luluc	Global warming potential land use and land use change
ODP	Ozone depletion potential
AP	Acidification potential
EP-freshwater	Eutrophication potential, fraction of nutrients reaching freshwater end compartment
EP-marine	Eutrophication potential, fraction of nutrients reaching marine end compartment
EP-terrestrial	Eutrophication potential, Accumulated Exceedance
POCP	Photochemical ozone creation potential
ADP-minerals & metals	Abiotic depletion potential for non-fossil resources
ADP-fossil fuels	Abiotic depletion potential of fossil resources
RPER	Renewable primary energy resources
NRPER	Non-renewable primary energy resources
ETP-fw	Eco-toxilcity freshwater (Potential Comparative Toxic Unit for ecosystems)
HTP-c	Human toxicity, cancer effects (Potential Comparative Toxic Unit for humans)
HTP-nc	Human toxicity, non-cancer effects (Potential Comparative Toxic Unit for humans)
IRP	Ionizing radiation, human health (Potential Human exposure efficiency relative to U-235)
SQP	Land use related impacts/ Soil quality (Potential soil quality index)
PM	Particulate Matter emissions (Potential incidence of disease due to PM emissions)

Table 6: Environmental information about 1 ton MPI 25 lime-cement plaster

Environmental impacts for 1 ton MPI 25									
Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
GWP-total	kg CO_2–eq.	1.23E+02	7.25E+00	2.29E+01	0.00E+00	7.81E+00	7.50E+00	1.11E+00	IND
GWP-fossil	kg CO_2–eq.	1.23E+02	7.25E+00	2.29E+01	0.00E+00	7.81E+00	7.49E+00	1.11E+00	IND
GWP-biogenic	kg CO_2–eq.	4.36E-01	0.00E+00	1.73E-02	0.00E+00	0.00E+00	9.00E-04	7.52E-05	IND
GWP-luluc	kg CO_2–eq.	2.72E-03	5.69E-05	1.75E-05	0.00E+00	5.73E-05	1.79E-05	2.59E-06	IND
ODP	kg CFC 11–eq.	6.22E-06	1.69E-06	1.09E-06	0.00E+00	1.72E-06	1.60E-06	2.38E-07	IND
AP	mol H^+–eq.	2.86E-01	1.70E-02	1.62E-01	0.00E+00	1.69E-02	1.30E-02	1.89E-03	IND
EP-freshwater	kg PO_4–eq.	1.26E-02	5.20E-04	5.14E-02	0.00E+00	5.50E-04	3.40E-04	4.01E-05	IND
EP-marine	kg N–eq.	7.05E-02	2.39E-03	2.39E-02	0.00E+00	2.31E-03	1.76E-03	2.50E-04	IND
EP-terrestrial	mol N–eq.	8.13E-01	2.55E-02	1.43E-01	0.00E+00	2.45E-02	1.88E-02	2.72E-03	IND
POCP	kg NMVOC–eq.	2.08E-01	1.37E-02	4.23E-02	0.00E+00	1.23E-02	1.03E-02	1.51E-03	IND
ADP-minerals&metals	kg Sb–eq.	4.70E-04	1.50E-04	6.25E-05	0.00E+00	2.00E-04	1.15E-05	1.69E-06	IND
ADP-fossil	MJ	6.53E+02	1.11E+02	3.59E+02	0.00E+00	1.12E+02	1.01E+02	1.50E+01	IND
WDP	m^3	1.89E+03	9.25E+01	5.03E+03	0.00E+00	1.03E+02	4.47E+01	3.22E+00	IND

IND – Indicator not declared

Additional environmental impacts for 1 ton MPI 25									
Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
ETP-fw	CTUe	8.87E+00	4.39E+00	1.17E+00	0.00E+00	2.47E+00	6.05E-01	8.99E-02	IND
HTP-c	CTUh	1.74E-08	2.12E-09	7.04E-09	0.00E+00	3.47E-09	4.73E-09	7.02E-10	IND
HTP-nc	CTUh	1.31E-06	1.38E-07	1.35E-06	0.00E+00	1.29E-07	5.05E-08	6.82E-09	IND
IRP	kBq U-235-eq.	5.04E+00	5.72E-01	1.12E+01	0.00E+00	5.78E-01	5.02E-01	6.90E-02	IND
SQP	-	7.83E+02	1.69E+02	2.31E+01	0.00E+00	6.94E+01	5.90E+00	7.76E-01	IND
PM	Disease incidence	2.08E-06	5.78E-07	2.59E-07	0.00E+00	4.25E-07	3.52E-07	5.26E-08	IND

Resource use for 1 ton MPI 25									
Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
RPER excluding RPER used as raw materials	MJ	5.60E+01	1.46E+00	2.75E+01	0.00E+00	1.54E+00	8.14E-01	8.22E-02	IND
RPER used as raw materials	MJ	2.51E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND
PERT	MJ	8.11E+01	1.46E+00	2.75E+01	0.00E+00	1.54E+00	8.14E-01	8.22E-02	IND
NRPER excluding NRPER used as raw materials	MJ	7.18E+02	1.13E+02	5.55E+02	0.00E+00	1.15E+02	1.03E+02	1.51E+01	IND
NRPER used as raw materials	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND
PENRT	MJ	7.18E+02	1.13E+02	5.55E+02	0.00E+00	1.15E+02	1.03E+02	1.51E+01	IND
Use of secondary material	kg	2.79E+00	4.07E-02	3.86E-02	0.00E+00	5.59E-02	5.11E-02	7.46E-03	IND
Use of renewable secondary fuels	MJ	1.99E+00	5.16E-02	1.12E+00	0.00E+00	5.36E-02	3.61E-02	2.02E-03	IND
Use of non-renewable secondary fuels	MJ	1.55E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND
Net use of fresh water	m^3	3.34E-01	8.01E-03	1.59E-01	0.00E+00	7.75E-03	4.07E-03	4.20E-04	IND

Output flows and waste categories for 1 ton MPI 25									
Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
Hazardous waste disposed	kg	1.85E+00	1.10E-01	2.94E-01	0.00E+00	1.31E-01	1.15E-01	1.64E-02	IND
Non-hazardous waste disposed	kg	6.02E+01	1.07E+01	0.00E+00	0.00E+00	5.62E+00	1.53E+00	1.75E-01	IND
Radioactive waste disposed	kg	3.18E-03	7.70E-04	2.77E-03	0.00E+00	7.80E-04	7.20E-04	1.10E-04	IND
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND
Materials for recycling	kg	2.29E+00	3.47E-02	1.84E+01	0.00E+00	4.83E-02	4.97E-02	7.33E-03	7.50E+02
Materials for energy recovery	kg	2.51E-02	5.70E-04	1.10E-02	0.00E+00	6.00E-04	3.70E-04	2.27E-05	IND
Exported energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND

Biogenic carbon content	**Unit**	
Biogenic carbon content in product	kg C	0.39E+00
Biogenic carbon content in accompanying packaging	kg C	3.60E+01

Table 7: Environmental information about 1 ton Primo 2 lime-cement plaster

Environmental impacts for 1 ton Primo 2									
Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
GWP-total	kg CO_2–eq.	1.18E+02	7.10E+00	2.30E+01	0.00E+00	7.81E+00	7.50E+00	1.11E+00	IND
GWP-fossil	kg CO_2–eq.	1.18E+02	7.10E+00	2.30E+01	0.00E+00	7.81E+00	7.50E+00	1.11E+00	IND
GWP-biogenic	kg CO_2–eq.	5.79E-01	0.00E+00	1.73E-02	0.00E+00	0.00E+00	9.00E-04	7.52E-05	IND
GWP-luluc	kg CO_2–eq.	2.75E-03	5.56E-05	1.76E-05	0.00E+00	2.54E-03	8.00E-04	9.33E-05	IND
ODP	kg CFC 11–eq.	5.77E-06	1.66E-06	1.09E-06	0.00E+00	1.72E-06	1.60E-06	2.38E-07	IND
AP	mol H^+–eq.	2.76E-01	1.66E-02	1.63E-01	0.00E+00	1.69E-02	1.30E-02	1.89E-03	IND
EP-freshwater	kg PO_4–eq.	1.21E-02	5.10E-04	5.17E-02	0.00E+00	5.50E-04	3.40E-04	4.01E-05	IND
EP-marine	kg N–eq.	6.87E-02	2.35E-03	2.40E-02	0.00E+00	2.31E-03	1.76E-03	2.50E-04	IND
EP-terrestrial	mol N–eq.	7.93E-01	2.50E-02	1.44E-01	0.00E+00	2.45E-02	1.88E-02	2.72E-03	IND
POCP	kg NMVOC–eq.	2.02E-01	1.34E-02	4.25E-02	0.00E+00	1.23E-02	1.03E-02	1.51E-03	IND
ADP-minerals&metals	kg Sb–eq.	4.60E-04	1.40E-04	6.27E-05	0.00E+00	2.00E-04	1.15E-05	1.69E-06	IND
ADP-fossil	MJ	6.22E+02	1.08E+02	3.60E+02	0.00E+00	1.12E+02	1.01E+02	1.50E+01	IND
WDP	m^3	1.83E+03	9.02E+01	5.05E+03	0.00E+00	1.61E+02	8.01E+01	8.48E+00	IND

IND – Indicator not declared

Additional environmental impacts for 1 ton Primo 2									
Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
ETP-fw	CTUe	8.17E+00	4.31E+00	1.18E+00	0.00E+00	2.47E+00	6.05E-01	8.99E-02	IND
HTP-c	CTUh	1.68E-08	2.07E-09	7.07E-09	0.00E+00	3.47E-09	4.73E-09	7.02E-10	IND
HTP-nc	CTUh	1.27E-06	1.35E-07	1.36E-06	0.00E+00	1.29E-07	5.05E-08	6.82E-09	IND
IRP	kBq U-235-eq.	4.82E+00	5.60E-01	1.12E+01	0.00E+00	5.78E-01	5.02E-01	6.90E-02	IND
SQP	-	7.31E+02	1.67E+02	2.32E+01	0.00E+00	6.94E+01	5.90E+00	7.76E-01	IND
PM	Disease incidence	2.03E-06	5.68E-07	2.60E-07	0.00E+00	4.25E-07	3.52E-07	5.26E-08	IND

Resource use for 1 ton Primo 2									
Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
RPER excluding RPER used as raw materials	MJ	4.85E+01	1.43E+00	2.76E+01	0.00E+00	1.54E+00	8.14E-01	8.22E-02	IND
RPER used as raw materials	MJ	2.70E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND
PERT	MJ	7.55E+01	1.43E+00	2.76E+01	0.00E+00	1.54E+00	8.14E-01	8.22E-02	IND
NRPER excluding NRPER used as raw materials	MJ	6.84E+02	1.10E+02	5.57E+02	0.00E+00	1.15E+02	1.03E+02	1.51E+01	IND
NRPER used as raw materials	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND
PENRT	MJ	6.84E+02	1.10E+02	5.57E+02	0.00E+00	1.15E+02	1.03E+02	1.51E+01	IND
Use of secondary material	kg	2.83E+00	3.98E-02	3.87E-02	0.00E+00	5.59E-02	5.11E-02	7.46E-03	IND
Use of renewable secondary fuels	MJ	1.93E+00	5.04E-02	1.13E+00	0.00E+00	5.36E-02	3.61E-02	2.02E-03	IND
Use of non-renewable secondary fuels	MJ	1.43E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND
Net use of fresh water	m^3	3.19E-01	7.84E-03	1.59E-01	0.00E+00	1.36E+00	8.29E-01	1.23E-01	IND

Output flows and waste categories for 1 ton Primo 2									
Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
Hazardous waste disposed	kg	1.79E+00	1.08E-01	2.95E-01	0.00E+00	1.31E-01	1.15E-01	1.64E-02	IND
Non-hazardous waste disposed	kg	5.81E+01	1.05E+01	0.00E+00	0.00E+00	5.62E+00	1.53E+00	1.75E-01	IND
Radioactive waste disposed	kg	3.00E-03	7.60E-04	2.78E-03	0.00E+00	7.80E-04	7.20E-04	1.10E-04	IND
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND
Materials for recycling	kg	2.32E+00	3.39E-02	1.84E+01	0.00E+00	4.83E-02	4.97E-02	7.33E-03	IND
Materials for energy recovery	kg	2.45E-02	5.60E-04	1.11E-02	0.00E+00	6.00E-04	3.70E-04	2.27E-05	IND
Exported energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND

Biogenic carbon content	**Unit**	
Biogenic carbon content in product	kg C	0.31E+00
Biogenic carbon content in accompanying packaging	kg C	3.65E+01

Table 8: Environmental information about 1 ton KlimaWhite lime-cement plaster

Environmental impacts for 1 ton KlimaWhite									
Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
GWP-total	kg CO_2–eq.	1.94E+02	1.47E+01	2.62E+01	0.00E+00	7.81E+00	7.50E+00	1.11E+00	IND
GWP-fossil	kg CO_2–eq.	1.93E+02	1.47E+01	2.61E+01	0.00E+00	7.81E+00	7.49E+00	1.11E+00	IND
GWP-biogenic	kg CO_2–eq.	1.07E+00	0.00E+00	1.97E-02	0.00E+00	0.00E+00	9.00E-04	7.52E-05	IND
GWP-luluc	kg CO_2–eq.	4.48E-03	1.20E-04	2.00E-05	0.00E+00	5.73E-05	1.79E-05	2.59E-06	IND
ODP	kg CFC 11–eq.	1.09E-05	3.41E-06	1.24E-06	0.00E+00	1.72E-06	1.60E-06	2.38E-07	IND
AP	mol H^+–eq.	5.99E-01	3.44E-02	1.85E-01	0.00E+00	1.69E-02	1.30E-02	1.89E-03	IND
EP-freshwater	kg PO_4–eq.	2.50E-02	1.08E-03	5.88E-02	0.00E+00	5.50E-04	3.40E-04	4.01E-05	IND
EP-marine	kg N–eq.	1.20E-01	4.78E-03	2.73E-02	0.00E+00	2.31E-03	1.76E-03	2.50E-04	IND
EP-terrestrial	mol N–eq.	1.34E+00	5.08E-02	1.63E-01	0.00E+00	2.45E-02	1.88E-02	2.72E-03	IND
POCP	kg NMVOC–eq.	3.58E-01	2.63E-02	4.83E-02	0.00E+00	1.23E-02	1.03E-02	1.51E-03	IND
ADP-minerals&metals	kg Sb–eq.	7.10E-04	3.50E-04	7.14E-05	0.00E+00	2.00E-04	1.15E-05	1.69E-06	IND
ADP-fossil	MJ	1.25E+03	2.23E+02	4.10E+02	0.00E+00	1.12E+02	1.01E+02	1.50E+01	IND
WDP	m^3	2.50E+03	2.01E+02	5.74E+03	0.00E+00	1.03E+02	4.47E+01	3.22E+00	IND

IND – Indicator not declared

Additional environmental impacts for 1 ton KlimaWhite									
Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
ETP-fw	CTUe	1.47E+01	8.14E+00	1.34E+00	0.00E+00	2.47E+00	6.05E-01	8.99E-02	IND
HTP-c	CTUh	3.40E-08	4.46E-09	8.05E-09	0.00E+00	3.47E-09	4.73E-09	7.02E-10	IND
HTP-nc	CTUh	2.30E-06	2.82E-07	1.54E-06	0.00E+00	1.29E-07	5.05E-08	6.82E-09	IND
IRP	kBq U-235-eq.	7.21E+00	1.16E+00	1.28E+01	0.00E+00	5.78E-01	5.02E-01	6.90E-02	IND
SQP	-	1.39E+03	2.84E+02	2.64E+01	0.00E+00	6.94E+01	5.90E+00	7.76E-01	IND
PM	Disease incidence	5.87E-06	1.07E-06	2.96E-07	0.00E+00	4.25E-07	3.52E-07	5.26E-08	IND

Resource use for 1 ton KlimaWhite									
Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
RPER excluding RPER used as raw materials	MJ	9.79E+01	3.07E+00	3.15E+01	0.00E+00	1.54E+00	8.14E-01	8.22E-02	IND
RPER used as raw materials	MJ	4.16E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND
PERT	MJ	1.40E+02	3.07E+00	3.15E+01	0.00E+00	1.54E+00	8.14E-01	8.22E-02	IND
NRPER excluding NRPER used as raw materials	MJ	1.34E+03	2.27E+02	6.34E+02	0.00E+00	1.15E+02	1.03E+02	1.51E+01	IND
NRPER used as raw materials	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND
PENRT	MJ	1.34E+03	2.27E+02	6.34E+02	0.00E+00	1.15E+02	1.03E+02	1.51E+01	IND
Use of secondary material	kg	4.54E+00	8.66E-02	4.41E-02	0.00E+00	5.59E-02	5.11E-02	7.46E-03	IND
Use of renewable secondary fuels	MJ	2.60E+00	1.09E-01	1.28E+00	0.00E+00	5.36E-02	3.61E-02	2.02E-03	IND
Use of non-renewable secondary fuels	MJ	1.49E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND
Net use of fresh water	m^3	5.68E-01	1.62E-02	1.81E-01	0.00E+00	7.75E-03	4.07E-03	4.20E-04	IND

Output flows and waste categories for 1 ton KlimaWhite									
Indicator	Unit	A1	A2	A3	C1	C2	C3	C4	D
Hazardous waste disposed	kg	4.12E+00	2.26E-01	3.36E-01	0.00E+00	1.31E-01	1.15E-01	1.64E-02	IND
Non-hazardous waste disposed	kg	1.21E+02	1.87E+01	0.00E+00	0.00E+00	5.62E+00	1.53E+00	1.75E-01	IND
Radioactive waste disposed	kg	4.67E-03	1.56E-03	3.17E-03	0.00E+00	7.80E-04	7.20E-04	1.10E-04	IND
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND
Materials for recycling	kg	3.67E+00	7.27E-02	1.84E+01	0.00E+00	4.83E-02	4.97E-02	7.33E-03	IND
Materials for energy recovery	kg	3.27E-02	1.21E-03	1.26E-02	0.00E+00	6.00E-04	3.70E-04	2.27E-05	IND
Exported energy	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	IND

Biogenic carbon content	Unit	
Biogenic carbon content in product	kg C	0.47E+00
Biogenic carbon content in accompanying packaging	kg C	3.67E+01

7. Interpretation

The production processes of the three products follows the same technologies and use the same facilities. The ingredients contents of MPI 25 and Primo 2 are similar, so the results and impact contributions from the manufacturing are also similar. Cement and electricity production are the input flows that form more than 50% of the values for MPI 25 and Primo 2, and between 30% and 50% of the values for KlimaWhite.

Comparing the results for the product stage (modules A1-A3) of all lime-cement plasters, it can be noticed that the environmental impacts of KlimaWhite are the highest. The increase varies per indicator and is around 50 % for GWP, EP, ADPE, 65-70% for ODP, AP, ADPF and 80 % POCP.

There are two main sources of this difference. On one hand, the cement quantity in KlimaWhite per ton plaster is more than that in MPI 25 and Primo 2. A significant share of the environmental impacts arises from module A1. Cement production is very energy intensive, which makes cement the most significant contributor to almost all assessed indicators, but the environmental impacts that are extremely dependent on cement production are global warming potential and depletion of elemental resources. On the other hand, expanded perlite is added to the mix of KlimaWhite to ensure specific features of the product. The production process of expanded perlite appears to be also a significant contributor to several environmental indicators.

It can be observed that processing of hydrated lime has also a noticeable share of the impacts. Its importance regarding the carbon emissions (GWP), ozone depletion and photochemical ozone creation are comparable to contribution from electricity production.

Regarding the energy consumption, the result of KlimaWhite is higher by around 30% for PENRT and 50% for PERT compared to the results of MPI25 and Primo 2. This is mainly due to the high energy demand for cement and perlite production. The results include both energies used for production of raw materials and energy used in the factory processes. Since KlimaWhite uses higher cement quantity and expanded perlite, the observed increase in used energy can be expected. Regarding the energy used in factory processes, which is mainly electrical energy, it is of similar magnitude as for the other lime-cement plasters (MPI 25 and Primo 2).

The production process does not use any water, but the results for the water use come from the calculations on the quantity of water necessary for production of raw materials – to be precise, cement and electricity production are the main contributors for MPI 25 and Primo 2. For KlimaWhite expanded perlite is the third highest contributor. Water use of KlimaWhite is higher by around 50% because of the higher cement content and the presence of expanded perlite.

Packaging materials also form very small share (less than 3%) of all assessed indicators.

Module A2 (transport of raw materials to the factory) is of secondary importance. The contribution of transportation activities is relatively small (5-19%) for most indicators, but distinctive for ODP (around 17 %) and ADPE (10 % – 15 %).

Fuels (natural gas, LPG), used during in the plasters production (module A3) altogether form less than 1% of the GWP, AP, POCP, EP and ADPE, and less than 3% of ODP. They are also insignificant in terms of energy and water use.

The environmental impact of modules C1-C4 is comparatively small. The indicators of importance are the abiotic depletion potential for fossil resources (ADPF) and the use of non-renewable resources (PENRT) and, to a smaller extent, the carbon footprint (GWP), i.e. indicators related to fuels use.

8. EPD verification

The process of verification of an EPD is in accordance with ISO 14025, clause 8.1.3 and ISO 21930, clause 9. After verification, this EPD is valid for a 5 years period. EPD does not have to be recalculated after 5 years if the underlying data has not changed significantly.

CEN standard EN 15804 serves as the core PCR along with ITB PCR A
Independent verification corresponding to ISO 14025 (subclause 8.1.3) ☒ external ☐ internal
Verification of EPD: PhD Eng. Halina Prejzner, PhD Eng. Justyna Tomaszewska LCI audit and input data verification: PhD Eng. Roumiana Zaharieva, PhD Eng. Yana Kancheva, PhD Eng. Justyna Tomaszewska LCA auditor: PhD Eng. Roumiana Zaharieva, PhD Eng. Yana Kancheva Verification of procedures and declaration: PhD Eng. Justyna Tomaszewska

Literature

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[23] Bulgarian Ordinance No 1 on the procedure and forms for providing information about the activities on waste and procedures for keeping the public registers, State Gazette No 51 dated 20 June 2014, last amend. SG No 51 dated 51 19 June 2018 (Наредба № 1 от 04 юни 2014 г. за реда и образците, по които се предоставя информация за дейностите по отпадъците, както и реда за водене на публични регистри)