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A VERIFIED ENVIRONMENTAL DECLARATION

ECO PLATFORM EPD VERIFIED

AENOR

CEMENTOS TUDELA VEGUÍN

ENVIRONMENTAL PRODUCT DECLARATION

PORTLAND CEMENT CLINKER

ROBLA FACTORY

Independent verification of the declaration and data, according to:

EN ISO 14025:2010
EN 15804:2012+A2:2019

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The owner of the EPD shall be liable for the underlying life cycle assessment data and evidences.

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AENOR is a founding member of ECO Platform, the European Association of Environmental Product Declaration Verification Programmes.

Product Category Rule:

The European Standard EN 15804:2012+A2:2019 serves as the basis for CPRs.

Independent verification of the declaration and data, in accordance with the Standard UNE EN ISO 14025:2010

☐ Internal ☒ External

Third Party verified:

AENOR

Product certification body accredited by ENAC with accreditation No. 1/C-PR468

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1. GENERAL INFORMATION

1.1. The Organization

Cementos Tudela Veguín, S.A. is one of the companies of Masaveu Industria, which operates four plants located in Narón, Tudela Veguín, Aboño and La Robla.

La Robla plant, which is the focus of this EPD, has the following production capacities (in tonnes/year):

- Gray clinker: 1,000,000
- Gray cement: 1,200,000

1.2. Scope of the Environmental Product Declaration

This EPD covers all product stages from cradle to gate (A1-A3) for the year 2024. The system boundaries include all processes from raw material extraction to the production of clinker ready for export at the factory gate.

1.3. Lifecycle and compliance

This EPD has been developed and independently verified in accordance with UNE-EN ISO 14025:2010 and EN 15804:2012+A2:2020.

This Environmental Product Declaration includes the following life cycle stages:

SYSTEM BOUNDARIES. LIFE CYCLE STAGES

PRODUCT STAGE	A1	Raw materials supply	X
	A2	Transport	X
	A3	Manufacturing	X
CONSTRUCTION	A4	Transport	MNA
	A5	Construction installation process	MNA
STAGE OF USE	B1	Use	MNA
	B2	Maintenance	MNA
	B3	Repair	MNA
	B4	Replacement	MNA
	B5	Refurbishment	MNA
	B6	Operation energy use	MNA
	B7	Operational water use	MNA
END OF SERVICE LIFE	C1	De-construction/demolition	MNA
	C2	Transport	MNA
	C3	Waste processing	MNA
	C4	Disposal	MNA
	D	Reuse - Recovery - Recycling potential	MNA

X = Module included in the LCA; NR = Module not relevant; MNA = Module not assessed

This EPD may not be comparable with those developed in other programmes or in accordance with different reference documents, specifically it may not be comparable with EPDs not prepared according to the EN 15804+A2 Standard.

Likewise, this EPD may not be comparable if the data source is different (for example, databases), not all relevant information modules are included, or they are not based on the same scenarios.

The comparison of construction products must be made on the same function, applying the same functional unit and at the level of the building (or architectural or engineering work), i.e. including the behaviour of the product throughout its life cycle, as well as the specifications of section 6.7.2 of UNE-EN ISO 14025.

2. PRODUCT INFORMATION

2.1. Product identification

Clinker is an intermediate product in the manufacture of Portland cement. According to the European Standard EN 197-1, Portland cement clinker (K) is defined as a nodular material produced by heating a carefully prepared mixture of raw materials in a kiln to temperatures above 1,400ºC, at which the major components react chemically to form new compounds. This material is then cooled and ground, alone with gypsum or with other components, to produce cement.

Clinker typically consists primarily of calcium silicates and minor amounts of other compounds formed during the high-temperature.

CPC code is 37410.

Portland Cement Clinker

2.2. Technical characteristics

Clinker, as an intermediate product, does not exhibit specific technical characteristics or performance properties on its own. Its relevance lies in its role as the principal constituent in the production of cement. The technical properties and performance of clinker are thus intrinsically linked to the final cement product in which it is incorporated, in accordance with the requirements defined in standards such as EN 197-1.

2.3. Product composition

Portland cement clinker is a hydraulic material that must consist of at least two-thirds by mass of calcium silicates ([$3CaO{\cdot}SiO_2$] and [$2CaO{\cdot}SiO_2$]), with the remainder made up of clinker phases containing aluminium, iron, and other compounds. The mass ratio of CaO to SiO_2 shall not be less than 2.0, and the magnesium oxide (MgO) content shall not exceed 5.0% by mass.

Clinker typically consists primarily of calcium silicates (alite [C_3S] and belite [C_2S]) and minor amounts of calcium aluminates (C_3A) and calcium aluminoferrites (C_4AF), formed during the high-temperature sintering process. It is characterized by the following typical molar ratios:

- **Silica ratio (SR)** = SiO_2 / (Al_2O_3 + Fe_2O_3): typically between 2.0 and 3.0
- **Alumina ratio (AR)** = Al_2O_3 / Fe_2O_3: typically between 1.3 and 2.5

These compositional requirements and ratios ensure the appropriate formation of the main clinker phases and influence the hydraulic reactivity and performance of the resulting cement.

None of the components of the final product are included in the Candidate List of Substances of Very High Concern for Authorization.

3. LCA INFORMATION

3.1. Life cycle analysis

The Life Cycle Assessment (LCA) covers the cradle-to-gate boundary, including modules A1 to A3 (product stage), with reference to the year 2024. The LCA is detailed in its corresponding report, which is complemented by a series of annexes describing specific aspects of the production process.

3.2. Declared unit

The declared unit is **1 tonne (1,000 kg)** of Portland cement clinker .

3.3. Reference service life (RSL)

Cement, and therefore clinker, does not possess a standalone identity and cannot be individually distinguished or separated at the construction site. Therefore, its reference service life is linked to the service life of the structural elements in which is integrated.

3.4. Allocation criteria

When allocation could not be avoided, **mass-based allocation** was applied. This approach has been used for energy consumption, waste, and emissions to water.

For waste, the **'polluter pays' principle** has been followed. As stated in **Annex D of UNE-EN 16908:2019**, the entity generating the waste is responsible for declaring both the use of the waste and the associated environmental impact in the module where the waste is used.

3.5. Cut-off rules

More than 99% of the materials and energy consumption have been included.

3.6. Representativeness, quality and selection of data

The data used in this EPD are representative of clinker production for the reference year 2024. Site-specific data were collected directly from the manufacturing plant, ensuring high temporal and technological representativeness. The geographical representativeness corresponds to the location of the production site.

Data quality has been evaluated in terms of completeness, consistency, and reliability. All relevant inputs and outputs have been considered, and the data selection ensures conformity with the requirements of EN 15804 and the applicable PCR. Cut-off criteria were applied according to standard rules, and no significant data were excluded.

3.7. Other calculation rules and assumptions

3.7.1. Biogenic carbon content

The declaration of biogenic carbon content is not required, as the biogenic fraction is significantly below the 5% threshold relative to the total product mass, in accordance with the provisions of EN 15804:2012+A2:2019, considering the intrinsic characteristics of the product.

4. SYSTEM BOUNDARIES, SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION

This EPD includes only modules A1-A3, product stage, according to the modular scheme of the EN 15804+A2 standard, and presents the results in an aggregated form.

The life cycle assessment encompasses the following subprocesses of the clinker manufacturing chain:

A1. Raw material supply

The principal raw materials used for clinker production—mainly limestone—are extracted from quarries owned by the company. Depending on availability and formulation targets, externally sourced and alternative raw materials may also be incorporated into the raw mix.

A2. Transport

External raw materials and fuels arrive by truck and are incorporated into the production process.

A3. Manufacturing

PREHOMOGENIZATION

The flow of raw materials, after a crushing process, is stored in the prehomogenization warehouse, where it is positioned in uniform layers ensuring that the mixture has an adequate composition and its variability is reduced.

GRINDING OF RAW MATERIALS

The raw materials are ground to obtain a product of uniform composition and to reduce its size in order to facilitate calcination in the kiln. This grinding is carried out using a mill.

CALCINATION

The kiln is fed through a cyclone preheater, which heats the ground raw material with exhaust gases from the klin and with a contribution of fossil and/or alternative fuels.

CLINKERIZATION

The ground raw material advances through the rotary kiln, where temperatures, above 1,400 ºC are reached, giving rise to the clinker sintering process. To reach these temperatures, it is necessary, as in calcination, to consume fuels that, again, can be fossil and/or alternative.

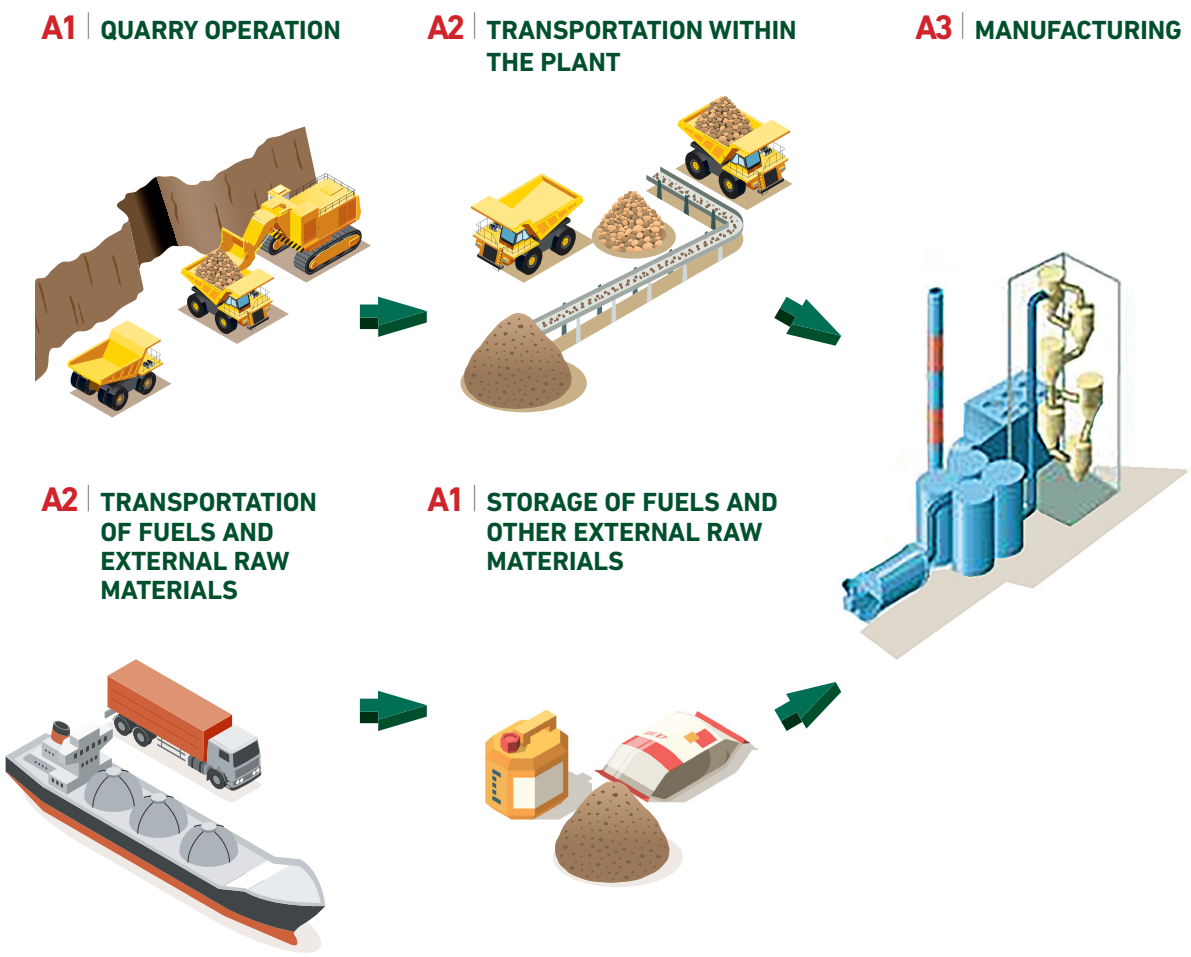
COOLING

Upon leaving the kiln, the clinker is introduced into the cooler, which injects cold air to reduce its temperature and set the desired mineralogical composition.

PRODUCT STORAGE

Cement is stored in silos for future shipment.

PRODUCT STAGE



A1 RAW MATERIAL SUPPLY
A2 TRANSPORT
A3 MANUFACTURING

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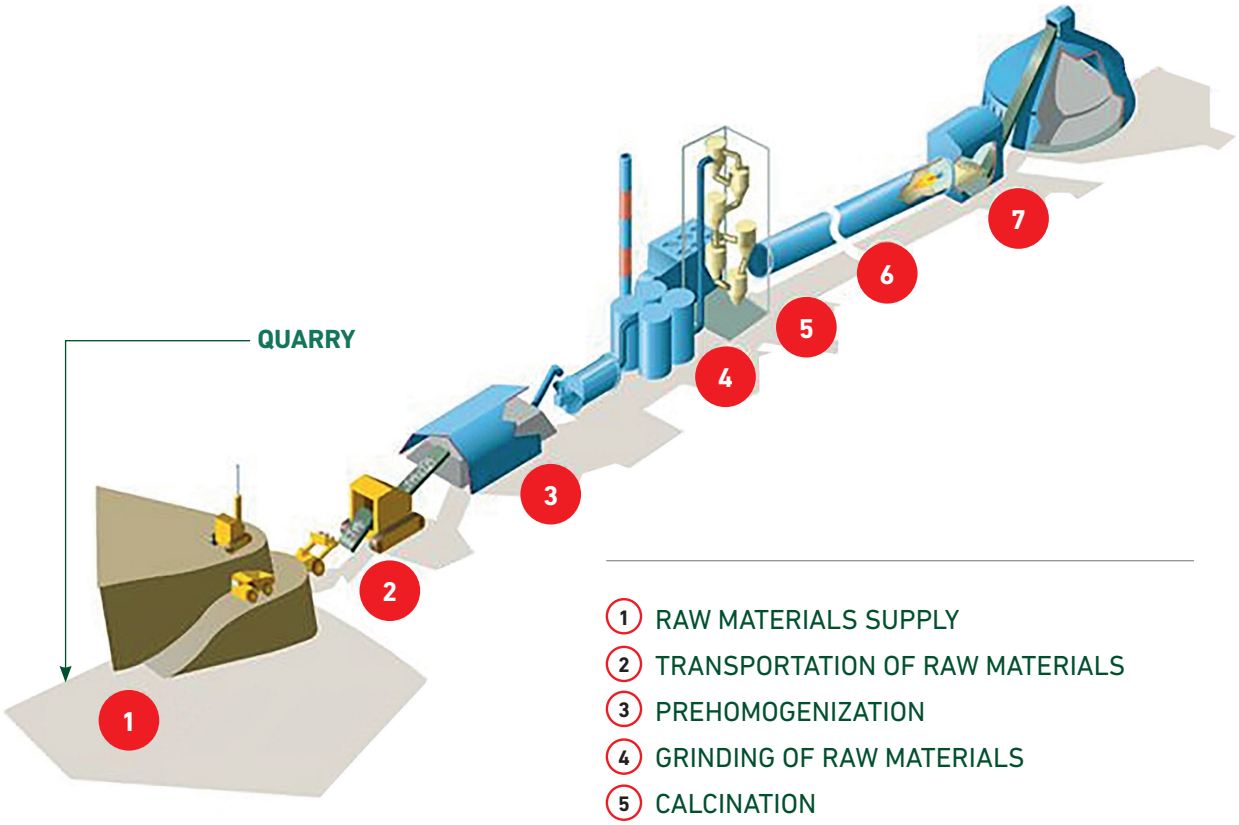
A3 | STEPS IN CLINKER MANUFACTURING



1. RAW MATERIALS SUPPLY
2. TRANSPORTATION OF RAW MATERIALS
3. PREHOMOGENIZATION
4. GRINDING OF RAW MATERIALS
5. CALCINATION
6. CLINKERIZATION
7. COOLING

5. DECLARATION OF ENVIRONMENTAL LCA AND LCI PARAMETERS

ENVIRONMENTAL IMPACTS

IMPACT CATEGORY	UNITS	A1-A3
GWP- total	kg $CO_{2\text{-equivalent}}$	7.00E+02
GWP- fossil	kg $CO_{2\text{-equivalent}}$	6.98E+02
GWP- biogenic	kg $CO_{2\text{-equivalent}}$	1.48E+00
GWP- lu&luc	kg $CO_{2\text{-equivalent}}$	1.30E-02
ODP	kg $CFC_{11\text{-equivalent}}$	2.93E-06
AP	mol $H^{+}_{\text{equivalent}}$	4.47E-01
EP- freshwater	kg $P_{\text{equivalent}}$	1.55E-03
EP- marine	kg $N_{\text{equivalent}}$	4.03E-01
EP- terrestrial	mol $N_{\text{equivalent}}$	1.72E+00
POCP	kg $NMVOC_{\text{equivalent}}$	1.07E+00
ADP - minerals & metals (1)	kg $Sb_{\text{equivalent}}$	2.85E-05
ADP - fossil (1)	MJ	2.71E+03
WDP (1)	m^3	3.80E+01

GWP - total: Global warming potential total
GWP - fossil: Global warming potential fossil
GWP - biogenic: Global warming potential biogenic
GWP - lu&luc: Global warming potential of land use and land use change
ODP: Depletion potential of the stratospheric ozone layer
AP: Acidification potential, accumulated exceedance
EP - freshwater: Eutrophication potential, fraction of nutrients reaching freshwater end com-partment
EP - marine: Eutrophication potential, fraction of nutrients reaching marine end compart-ment
EP - terrestrial: Eutrophication potential, accumulated exceedance
POCP: Formation potential of tropospheric ozone
ADP - minerals & metals: Abiotic depletion potential for non-fossil resources
APD - fossil: Abiotic depletion potential for fossil resources
WDP: Water (user) deprivation potential, deprivation weighted water consumption

The estimated impact results are relative and do not indicate the final value of the impact categories, nor do they refer to threshold values, safety margins or risks.

(1) The results of this environmental impact indicator shall be used with caution, since the uncertainties of the results are high and there is limited experience with the indicator.

ADDITIONAL ENVIRONMENTAL IMPACTS

IMPACT CATEGORY	UNITS	A1-A3
PM	Disease incidence	6.89E-06
IRP (2)	kBq U235 equivalent	9.96E+00
ETP-fw (1)	CTUe	7.53E+02
HTP-c (1)	CTUh	1.46E-08
HTP-nc (1)	CTUh	1.54E-06
SQP (1)	Pt	5.46E+01

PM: Potential for disease incidence due to particulate matter emissions
IRP: Human potential exposure efficiency relative to U235
ETP-fw: Comparative potential toxic unit for humans - freshwater
HTP-c: Comparative potential toxic unit for humans - carcinogenic effects
HTP-nc: Comparative potential toxic unit for humans - non-carcinogenic effects
SQP: Soil quality potential index

PARAMETERS DESCRIBING RESOURCE USE

PARAMETER	UNITS	A1-A3
PERE	MJ	4.14E+01
PERM	MJ	0.00E+00
PERT	MJ	4.14E+01
PENRE	MJ	2.71E+03
PENRM	MJ	0.00E+00
PENRT	MJ	2.71E+03
SM	kg	6.36E+02
FW	m^3	0.00E+00

PERE: Use of renewable primary energy excluding renewable primary energy resources used as raw materials
PERM: Use of renewable primary energy used as raw material
PERT: Total use of primary renewable energy
PENRE: Use of non-renewable primary energy, excluding non-renewable primary energy resources used as raw materials
PENRM: Use of non-renewable primary energy used as raw material
PENRT: Total use of primary non-renewable energy
SM: Use of secondary materials
FW: Net use of running water resources

(1) The results of this environmental impact indicator shall be used with caution, since the uncertainties of the results are high and there is limited experience with the indicator.

(2) This impact category deals mainly with the eventual impacts of low doses of ionizing radiation on human health, from the nuclear fuel cycle. It does not consider the effects due to possible nuclear accidents or occupational exposure due to the disposal of radioactive waste in underground facilities. The potential for ionizing radiation of the soil, due to radon or some construction materials, is not measured in this parameter either.

WASTE CATEGORIES

PARAMETER	UNITS	A1-A3
HWD	kg	1.42E-02
NHWD	kg	1.59E+00
RWD	kg	6.37E-03

HWD: Hazardous waste disposed
NHWD: Non-hazardous waste disposed
RWD: Radioactive waste disposed

OUTPUT FLOWS

PARAMETER	UNITS	A1-A3
CRU	kg	0.00E+00
MFR	kg	1.62E-02
MER	kg	0.00E+00
EE	MJ	0.00E+00

CRU: Components for re-use
MFR: Materials for recycling
MER: Materials for energy recovery
EE: Exported energy

BIOGENIC CARBON CONTENT

PARAMETER	UNITS	A1-A3
Biogenic carbon content of product	kg C	0.00E+00

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