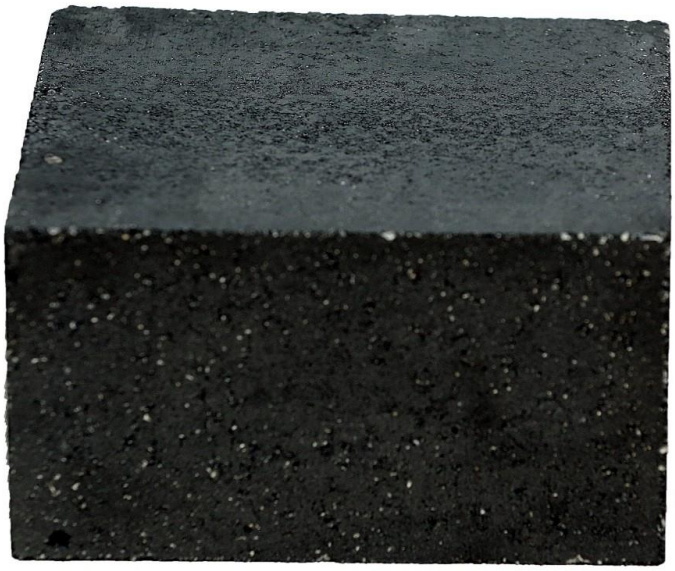
KÜMAŞ MANYEZİT SANAYİ A.Ş.

Alumina Magnesia Carbon Bricks

ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021



Programme
The International EPD

Licensee
EPD Türkiye

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2030–01-09

Geographical Scope
Türkiye

An EPD may be updated or depublished if conditions change. To find the latest version of the EPD and to confirm its validity, see www.environdec.com.

ECO PLATFORM EPD VERIFIED

TÜRKİYE EPD®
THE INTERNATIONAL EPD® SYSTEM

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Programme Information

Programme: The International EPD System,
Programme Operator: EPD International AB

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Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product Category Rules (PCR): PCR 2019:14 Construction Product 1.3.4, Valid until: 2025 – 06- 20 UN CPC Code: 373 Refractory products and structural non-refractory clay products
Life Cycle Assessment (LCA)
LCA accountability: Greenlife Danışmanlık Müh. Eğt. Ve Tas. Hiz. Tic. Ltd. Şti.
Third-party verification
External and independent (‘third-party’) verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification through an individual EPD verification Third-party verifier: Hudai Kara PhD, Metsims Sustainability Consulting, Oxford, U.K. Approved by: The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☐ Yes ☒ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

About KÜMAŞ

KÜMAŞ Magnesite Inc.

KÜMAŞ Magnesite Inc., founded in 1972, specializes in producing sintered magnesite, basic refractory bricks, and mortar using natural magnesite ore from the Kütahya-Eskişehir-Bilecik region. The company began producing sintered magnesite in 1976 and became an integrated organization with the addition of a brick factory in 1990. In 2008, they expanded to producing fused magnesite.

Today, KÜMAŞ provides sintered magnesite, fused magnesite, fused oxychrome, and calcined magnesite derivatives as industrial raw materials. Additionally, it manufactures magnesite, dolomite, and alumina-based refractory bricks and mortars at its integrated brick and mortar plants. Located on the Kütahya Province, Eskişehir Road 9th Km, KÜMAŞ operates over a total area of 695,270 m², with 68,561 m² dedicated to closed facilities. Their product range includes "Sintered Magnesite, Calcined Magnesite, Fused Magnesite, Kures Powder, and Refractory Bricks and Mortar."

KÜMAŞ Magnesite Inc. Production site

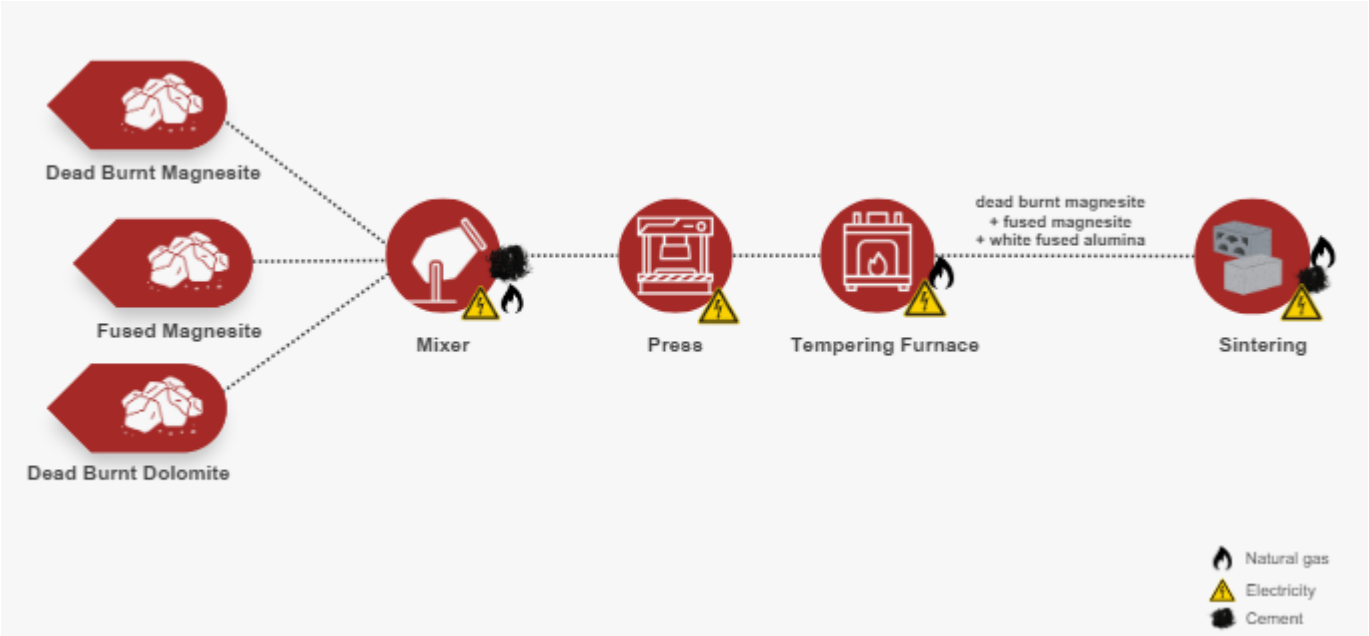
Owner of EPD: KÜMAŞ Magnesite Inc.
Adress of production site: Eskişehir Karayolu 9 km. Merkez, Kütahya/ Türkiye

KÜMAŞ
MANYEZİT SANAYİ A.Ş.

Product Information

Alumina Magnesia Carbon Bricks Manufacturing

The production flow chart of alumina magnesia carbon bricks is shown below.



Production flow chart of alumina magnesia carbon bricks

The production process of alumina magnesia carbon bricks begins with raw material preparation. Materials such as dead burnt magnesite, fused magnesite, and dead burnt dolomite are combined with high-purity alumina and carbon (usually in graphite form) in specified ratios. This mixture is prepared in mixers powered by electricity and natural gas to ensure consistency.

After mixing, the blend is subjected to hydraulic pressing, where it is compacted into the desired brick shapes. This pressing process increases the density and durability of the bricks. Following pressing, the bricks are directed to tempering furnaces, where they undergo a controlled heating process to reduce internal stresses and enhance their properties.

Once tempered, the bricks are transferred to sintering furnaces. In this stage, the bricks are heated to temperatures ranging from 2,000 to 2,200°C. This sintering process allows the bricks to fuse at the atomic level, significantly improving their strength and thermal resistance. After passing through quality control tests, the bricks that meet the standards are packaged and prepared for shipment. This comprehensive process ensures the production of high-performance alumina magnesia carbon bricks.

KÜMAŞ MANYEZİT SANAYİ A.Ş.

Product Information

Alumina Magnesia Carbon Brick

Alumina magnesia carbon bricks are widely used in industrial applications requiring high temperature and wear resistance. They are especially favored in steel production and metal smelting processes, utilized in melting furnaces and kilns. Their high heat resistance allows safe use in facilities processing metals like steel and iron. In foundries and casting furnaces, these bricks minimize material loss and enhance economic efficiency. Additionally, they are used in high-temperature power plants, boosting reliability and energy efficiency. Overall, alumina magnesia carbon bricks are durable materials critical for heavy industry and energy production.

Physical Properties	Value	Standards
Bulk Density	3.1-3.2 g/cm^3	ASTM C 830-00
Apparent Porosity	6.00 %	ASTM C 830-00
Cold Crushing Strength	60.0 N/mm^2	ASTM C 133-97

Content Declaration

Product Content	Mass, kg	Post-consumer recycled material, mass-% of product	Biogenic material, mass-% of product	Biogenic material, kg C/product
Al_2O_3	900-950	0.00	0.00	0.00
MgO	50-100	0.00	0.00	0.00
Others	1-10	0.00	0.00	0.00
Total	1000	0.00	0.00	0.00

Due to confidentiality, only a range is provided.

Packaging materials	Mass, kg	Mass-% (versus the product)	Biogenic material, kg C/product
Big Bag	0.021	0.002	0.00
Pallet	19.10	1.91	8.96
Plastic Film	1.18	0.12	0.00
Total	20.3	2.03	8.96

No substances that are listed in the “Candidate List of Substances of very high concern for authorization” are contained in the declared unit.

LCA Information

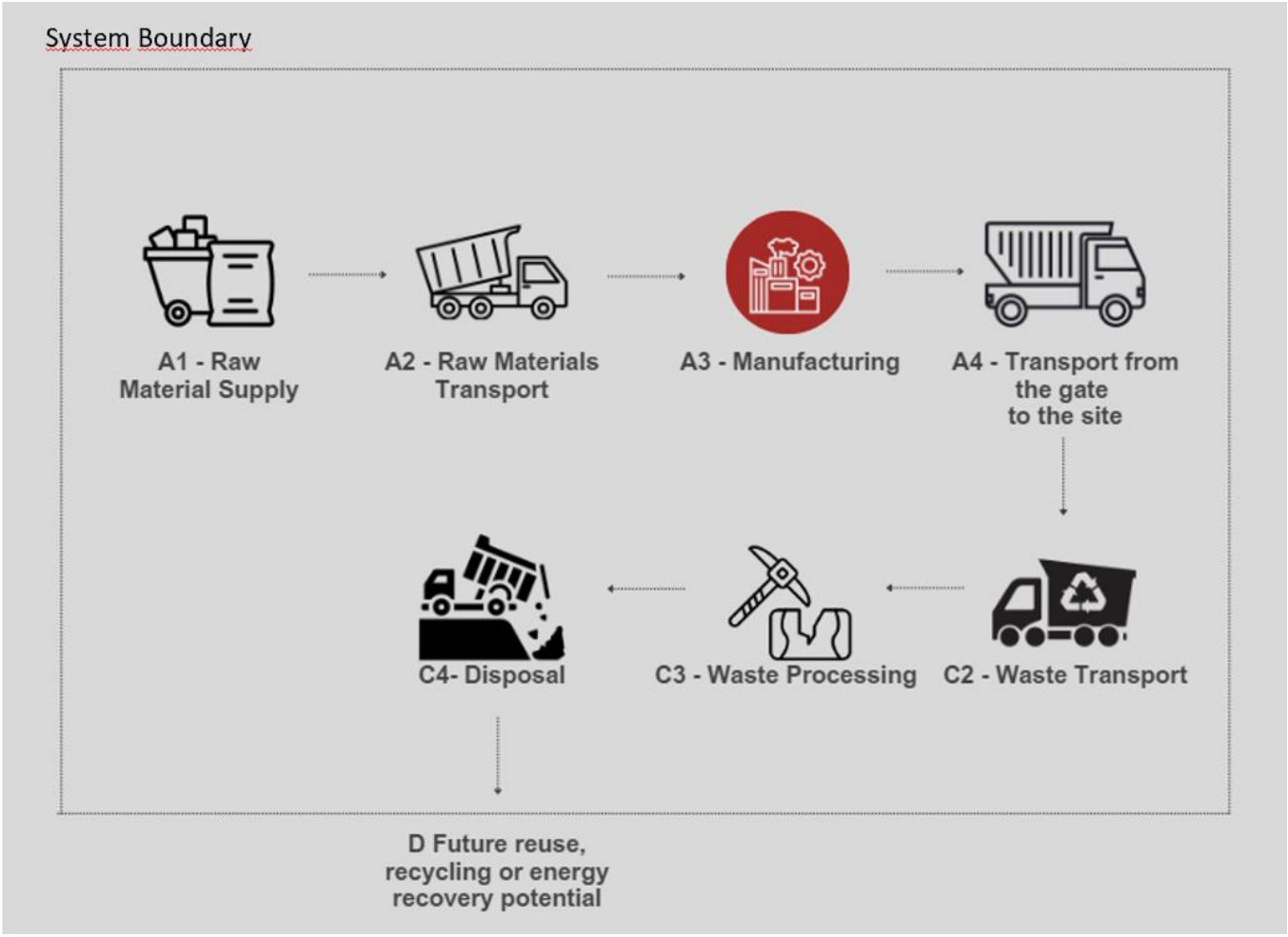
Declared unit: 1 tonne of Alumina Magnesia Carbon Bricks

Conversion factor: 1

Reference service life: NA

Database(s) and LCA software used: Ecoinvent 3.9.1 SimaPro 9.5.0.2.

Characterization factors used: EN 15804 method based on EF 3.1 normalization and weight values, puplished in July 2022, were used.



System boundary diagram

KÜMAŞ MANYEZİT SANAYİ A.Ş.

LCA Information

	Product Stage			Construction Process Stage		Use Stage							End of life Stage				Resource Recovery Stage
	Raw Material	Raw Material Transport	Manufacturing	Transport to Plant	Construction / Installation	Use	Maintennance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction / Demolition	Transport to Disposal Site	Waste Processing	Disposal	Future reuse, recycling or energy recovery potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Module Declared	X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X
Geography	GLO	GLO	TR	GLO	GLO	-	-	-	-	-	-	-	GLO	GLO	GLO	GLO	GLO
Share of specific data	85%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation-products	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation-sites	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = Included in LCA, MND = Module Not Declared

LCA Information

A1 Raw Material Supply

Dead burnt magnesite, fused magnesite and dead burnt dolomite, which are the main raw materials of alumina magnesia carbon brick in raw material supply, are produced by Kümaş Magnesite. Other cement products and packaging products are purchased. All products are included in the life cycle analysis.

A2 Raw Material Transport

The transport of raw materials and packaging used was calculated as the weighted average of the purchase data. The purchased products were transported by road and sea. For road transport, >32 metric ton EURO 6 lorry data was used and for sea transport, container ship data was used.

A3 Manufacturing

Annual weighted average method was used to calculate the amount of energy consumed in production. Natural gas and electricity are used in the production of the product. Electricity is taken from the electricity grid of the production site of Türkiye. Pallets and plastic bags used for transport in production are also included in the system.

A4 Transport

The distance of shipment of the products sold is calculated using the weighted average method according to the location of the customers. The products were transported by road and sea. For road transport, >32 metric ton EURO 6 lorry data was used and for sea transport, container ship data was used.

A5 Construction

The Al-Mag Carbon Brick used at iron and steel industry and there is not a need for mortar during the construction. Therefore, the construction assumed to be done via human power and no mortar is needed. Therefore, there is not an impact in A5 module. The packaging materials leaves the system in this stage and the packaging materials are send to recycling.

KÜMAŞ MANYEZİT SANAYİ A.Ş.

LCA Information

C1 Deconstruction

It is assumed that the deconstruction is done manually (human power is used) Therefore, there is not an impact in C1 module.

C2 Waste Transport

The distance for transportation of the product as waste after use is assumed to be 500 km and for road transport, 16-32 metric ton EURO 6 lorry data was used.

C3 Waste Processing

It is assumed that the alumina magnesia carbon bricks that can be recycled at the end of their lifetime are crushed and used by re-feeding method. It is assumed that 30 kWh electricity is consumed for the crushing of 1 tonne alumina magnesia carbon brick. In the modelling, it is assumed that the product is crushed at KÜMAŞ Magnesite sites.

C4 Disposal

It is assumed that 3% of the recovered bricks are reused, 56% is recycled and 41% is landfilled.

D Future reuse, recycling or energy recovery potential

It is accepted in C4 module that 41% of the products go to landfill after they become waste. The calculation was made based on the scenario that the remaining 56% is crushed and used by tertiary parties. In this module the benefit from the recycled 56% of raw material is shown.

Electricity data used in LCA model

Electricity Data: Residual mix is calculated from «Electricity, medium voltage {TR}| market for electricity, medium voltage | Cut-off, S» by excluding renewable energy generation. The composition of the residual mix was then 62.7% coal, 36.6% natural gas, and 0.7% oil. GWP-GHG value of the used electricity data is 0.79 kg CO2/kWh.

KÜMAŞ MANYEZİT SANAYİ A.Ş.

LCA Results

Mandatory impact category indicators according to EN 15804+A2

Environmental Impacts for 1 tonne of alumina magnesia carbon brick									
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
GWP - Total	kg CO2 eq.	1.90E+03	6.07E+01	0.00E+00	0.00E+00	5.01E+01	5.32E+02	2.65E+01	-1.05E+03
GWP - Fossil	kg CO2 eq.	1.93E+03	6.07E+01	0.00E+00	0.00E+00	5.01E+01	5.32E+02	2.65E+01	-1.05E+03
GWP - Biogenic	kg CO2 eq.	-3.45E+01	0.00E+00	3.45E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+0	0.00E+00
GWP - Luluc	kg CO2 eq.	2.67E+00	2.96E-02	0.00E+00	0.00E+00	2.44E-02	4.33E-01	4.33E-01	-8.51E-01
ODP	kg CFC11 eq	5.88E-05	1.38E-06	0.00E+00	0.00E+00	1.14E-06	1.68E-05	1.73E-07	-3.31E-05
AP	mol H+ eq	1.46E+01	1.53E-01	0.00E+00	0.00E+00	1.24E-01	4.05E+00	8.39E-02	-7.97E+00
EP-freshwater	kg P eq	8.86E-01	4.48E-03	0.00E+00	0.00E+00	3.70E-03	2.30E-01	7.78E-03	-4.53E-01
EP-marine	kg N eq	2.30E+00	4.16E-02	0.00E+00	0.00E+00	3.38E-02	6.25E-01	8.78E-01	-1.23E+00
EP-terrestrial	mol N eq	2.45E+01	4.27E-01	0.00E+00	0.00E+00	3.47E-01	6.73E+00	2.37E-01	-1.32E+01
POCP	kg NMVOC eq	7.52E+00	2.47E-01	0.00E+00	0.00E+00	2.02E-01	2.05E+00	1.80E-01	-4.04E+00
ADP minerals&metals*	kg Sb eq	2.59E-03	1.70E-04	0.00E+00	0.00E+00	1.40E-04	7.12E-04	3.06E-05	-1.40E-03
ADP fossil*	MJ	2.10E+04	9.21E+02	0.00E+00	0.00E+00	7.60E+02	5.42E+03	1.68E+02	-1.07E+04
WDP	m3 depriv.	3.34E+02	4.40E+00	0.00E+00	0.00E+00	3.63E+00	8.19E+01	5.85E+00	-1.61E+02

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 = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; 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 = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption

KÜMAŞ MANYEZİT SANAYİ A.Ş.

LCA Results

Additional mandatory and voluntary impact category indicators

Environmental Impacts for 1 tonne of of alumina magnesia carbon brick									
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
GWP-GHG[1]	kg CO2 eq	1.94E+03	6.09E+01	0.00E+00	0.00E+00	5.02E+01	5.34E+02	3.06E+02	-1.05E+03

Resource use indicators

Environmental Impacts for 1 tonne of of alumina magnesia carbon brick									
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	1.24E+03	1.35E+01	0.00E+00	0.00E+00	1.11E+01	1.82E+02	7.89E+00	-3.57E+02
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.58E+03	1.35E+01	0.00E+00	0.00E+00	1.11E+01	1.82E+02	7.89E+00	-3.57E+02
PENRE	MJ	2.11E+04	9.21E+02	0.00E+00	0.00E+00	7.60E+02	5.59E+03	1.68E+02	-1.10E+04
PENRM	MJ	4.84E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	2.27E+04	9.21E+02	0.00E+00	0.00E+00	7.60E+02	5.59E+03	1.68E+02	-1.10E+04
SM	kg	3.00E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m3	3.38E+02	4.39E+00	0.00E+00	0.00E+00	3.62E+00	8.27E+01	5.86E+00	-1.63E+02

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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

1 This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO2 is set to zero.

LCA Results

Waste indicators

Environmental Impacts for 1 tonne of alumina magnesia carbon brick									
Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed	kg	2.37E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-hazardous waste disposed	kg	2.42E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radioactive waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Output flow indicators

Indicator	**Unit**	**A1-A3**	**A4**	**A5**	**B**	**C1**	**C2**	**C3**	**C4**	**D**
Components for re-use	kg	3.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Material for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.60E+02	0.00E+00	0.00E+00
Materials for energy	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, electriicity	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, thermal	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

References

GPI / General Programme Instructions of the International EPD® System. Version 4.0.

EN ISO 9001/ Quality Management Systems - Requirements

EN ISO 14001/ Environmental Management Systems - Requirements

ISO 14020: 2000 / Environmental Labels and Declarations - General principles
EN 15804:2012+A2:2019 / AC: 2021 Sustainability of construction works - Environmental Product Declarations - Core rules for the product category of construction products

ISO 14025 / DIN EN ISO 14025:2009-11: Environmental labels and declarations - Type III environmental declarations — Principles and procedures

ISO 14040/44 / DIN EN ISO 14040: 2006-10, Environmental management - Life cycle assessment - Principles and framework (ISO14040:2006) and Requirements and guidelines (ISO 14044:2006)

PCR for Construction Products The International EPD System, 2019:14 Version 1.3.4. Date:2024.04.30

The International EPD® System / The International EPD® System is a programme for type III environmental declarations, maintaining a system to verify and register EPD®s as well as keeping a library of EPD®s and PCRs in accordance with ISO 14025. www.environdec.com

Ecoinvent / Ecoinvent Centre, www.ecoinvent.org

SimaPro / SimaPro LCA Software, Pré Consultants, the Netherlands, www.pre-sustainability.com

Munoz,I., Soto, A., Maza, D., and Bayon, F., Life cycle assessment of refractory waste management in a Spanish steel works, 2020.

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