Provisional Environmental Profile

Provisional Environmental Profile for Pirrouet® facing bricks produced by Vandersanden

Following the principles of EN 15804+A2, ISO 14025, B-PCR

Vandersanden wishes to communicate environmental impacts of their new product, Pirrouet® facing bricks, manufacturing of which has just begun. This environmental profile is, therefore, a provisional and not based on real production data.

December 2023

Owner of the profile:

Vandersanden
Riemsterweg 300,
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Author(s) of the LCA and this profile:

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General information

Declared product:

Pirrouet® 'carbon negative' facing bricks produced by Vandersanden in Belgium with the following references: **LF-S, XXL44-S, DF, WF**

Declared unit / functional unit:

Covering 1 m^2 of façade with the reference product LF-S (72 mm wide) Pirrouet bricks.
Reference flow: 122.88 kg of bricks.
Variability study has been performed for other products covered by this document.

Year of Study:

The study has been performed in 2023.
Vandersanden wishes to communicate environmental impacts of their new product, manufacturing of which has just started. This study is, therefore, based on theoretical data (estimations, recipe, etc.) and not using data of a full production year.

Declared lifecycle stages:

Cradle-to-grave, including module D.

Life cycle stages and modules: (MND: module not declared)

Product stage			Construction process stage		Use stage							End-of-life stage					Beyond the system boundaries
Raw material supply	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport	Waste processing	Disposal		Potentials for reuse, recovery and/or recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4		D
☒	☒	☒	☒	☒	MND	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒		☒

Product Description

Product name

Pirrouet® 'carbon negative' facing bricks.

Product description and intended use

This sustainable, CO_2-negative product is produced from residual streams from the stainless steel production process. These residual materials contain CaO, which is converted to $CaCO_3$ or calcium carbonate after mixing with water and curing with CO_2.
The typical texture is obtained by hydraulic pressing in a mould. The stretches of this facing brick are refined by providing them with an aesthetic and protective top coat. The top layer of 25% of the bricks also has a similar aesthetic finish.

Table 1

Product	Dimensions of 1 brick, mm	Weight of 1 brick, kg	Number of bricks for 1 m² masonry	Weight per 1 m², kg
LF-S - reference product	240 x 50 x 72	1.920	64.0	123
XXL44-S	440 x 44 x 72	3.097	39.5	122
DF	215 x 65 x 100	3.105	57.2	178
WF	210 x 50 x 100	2.333	72.7	170

Description of the production process and technology

The production process of the carbonated Pirrouet facing brick consists of 3 main steps:

1. The raw materials Carbinox, Stinox and sand are mixed into a homogeneous mixture by adding water. Pigments are also added for the coloured top layer. The added water provides the intermediate phase in the carbonation process, converting the CaO or calcium oxide present into $Ca(OH)_2$ or calcium hydroxide.

2. A hydraulic press compacts this mixture in a mould into the shape of a facing brick with predetermined dimensions. A stamp is used to apply the characteristic surface structure.

3. In curing chambers, the bricks are cured with CO_2 or carbon dioxide at an ambient temperature of about 40°C. Specifically, $Ca(OH)_2$ or calcium hydroxide is converted into $CaCO_3$ or calcium carbonate, which creates a hard limestone-like bond of the whole.

Product composition and content

Pirrouet facing bricks consist mainly of cured Carbinox and Stinox, 2 residues from stainless steel production. $CaCO_3$ or calcium carbonate is the dominant component. Sand is used as an additional filler.
Various pigments are used in small amounts for the aesthetic, coloured finish, depending on the colour required.
Finally, a Pirrouet facing brick consists of 7% CO_2, which is permanently chemically bound thanks to carbonation.

Material	Content
Carbinox & Stinox materials	67%
Silica sand	22%
CO_2	7%
Additives & pigments	>4%

The product does not contain materials listed in the "Candidate list of Substances of Very High Concern for authorization".

Technical data / Physical Characteristics

Table 2 technical properties of the product

Technical property	Standard	Value	Unit
Reaction To Fire	EN 13501-1	A1	n.a.
Freeze thaw Resistance	EN 772-22	F2	n.a.
Net dry Density	EN 772-13	2090 (D1)	Kg/m³
Compressive Strength	EN 772-1	>20	N/mm²
ʎ 50/50	EN 1745	0,9	%

LCA STUDY

DATE OF LCA STUDY
December 2023

SOFTWARE

SimaPro 9.5.0.1 (PRé Consultants, 2021)

DECLARED UNIT / FUNCTIONAL UNIT
Covering 1 m^2 of façade with the reference product LF-S (72 mm wide) Pirrouet bricks.
Reference flow: 122.88 kg of bricks.

INFORMATION ON ALLOCATION
NA

INFORMATION ON EXCLUDED PROCESSES
Following processes were excluded from the inventory:

- Production of CO_2, as CO_2 is an unwanted by-product/waste, its production impacts are attributed to the primary product (ethylene oxide and ethanol). The capturing, filtration & cooling process and the transportation of the CO_2 has been accounted for.
- Waste treatment of the final product packaging
- Infrastructure (land use, buildings) of Vandersanden.

End-of-life of reused packaging of raw materials.

REFERENCE SERVICE LIFE

The reference service life is estimated at 150 years.

Pirrouet bricks have passed the same stringent durability testing methodology as for ceramic bricks used for masonry (EN772-22)

DESCRIPTION OF GEOGRAPHICAL REPRESENTATIVITY
The profile is representative for the Belgian market.

PRODUCTION SITES
Vandersanden Pirrouet Plant in Lanklaar, Belgium.

DATABASE USED FOR BACKGROUND DATA
The main LCI source used in this study is the Ecoinvent 3.9 database.

Details of the underlying scenarios used to calculate the impacts

A1 – A2 raw materials & its transport
This module considers the extraction and processing of all raw materials, packaging, and energy, which occur upstream to the studied manufacturing process and its transport to the manufacturing site in Belgium.

A3 – manufacturing
Electricity and water are used to manufacture Pirrouet facing bricks.
100% of electricity used for production of the Pirrouet bricks is coming from renewable energy sources.
Manufacturing outputs include:

- raw materials packaging waste
- CO_2 emissions – small share of CO_2 escapes during production process

A4 – transport to the application site
Following the default provided in B-PCR, a transport distance of 100 km has been assumed.

A5 – installation on application site
The following has been used to model installation of 1 m^2 of facing bricks:

- 24.35 kg of mortar
- 4.9 kg of jointing mortar

It is assumed that 5% of bricks are 'lost' during installation (offcuts) and that 15% of mortar is wasted.

B – use stage
B1: NA

B2: No maintenance is required.

B3: No repair is required.

B4: No replacement required.

B5: No refurbishment.

B6: No operational energy use.

B7: No operational water use.

C – End of life
Demolition of facing bricks (C1) has been modelled using data record 'Waste brick {CH}| treatment of waste brick, collection for final disposal | Cut-off, U'. This data record has been adapted to only consider diesel and direct emissions from burning it.
End-of-life has been modelled using default scenarios provided in B-PCR: 95% of bricks is recycled at the end of its life and 5% is landfilled (C4).
Default transport distances B-PCR are: 30 km to sorting and 50 km to landfill (C2).
As end-of-waste state is reached after sorting, only sorting is included in C3. Sorting is modelled following the recommendations of B-PCR.

D – Benefits and loads beyond the system boundaries
Following waste streams were considered after their end-of-waste point: 122.88 kg of facing bricks.

Module D	
Loads beyond the system boundaries	Rock crushing (122.88 kg of stone-like waste)
Benefits beyond the system boundaries	Avoided production of 116.7 kg (95% of 122.88 kg; 5% are assumed to be lost) of crushed gravel

Potential environmental impacts per 1 m^2 of facing bricks

Environmental impacts	Product stage	Construction process stage		Use stage							End-of-life stage				D Reuse, recovery, recycling	Total excl module D
	A1-A3	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal		
GWP - total (kg CO2 eq./FU)	-2.06E+00	2.27E+00	7.86E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.38E-01	7.38E-01	1.17E-01	2.31E-02	-4.14E-01	9.39E+00
GWP - fossil (kg CO2 eq./FU)	-2.09E+00	2.27E+00	7.85E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.38E-01	7.38E-01	1.17E-01	2.31E-02	-4.11E-01	9.34E+00
GWP - biogenic (kg CO2 eq./FU)	2.58E-02	7.32E-04	1.10E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.09E-05	2.38E-04	2.86E-04	2.07E-05	-1.96E-03	3.82E-02
GWP – luluc (kg CO2 eq./FU)	5.13E-03	1.12E-03	2.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.93E-05	3.64E-04	3.79E-05	4.27E-06	-3.03E-04	8.93E-03
ODP (kg CFC 11 eq./FU)	4.29E-07	4.94E-08	2.89E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.96E-09	1.61E-08	4.99E-09	5.34E-10	-6.78E-09	5.36E-07
AP (mol H+ eq./FU)	2.84E-02	4.96E-03	2.76E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.06E-03	1.61E-03	6.78E-04	1.90E-04	-3.41E-03	6.75E-02
EP - freshwater (kg P eq./FU)	1.48E-04	1.84E-05	1.47E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E-06	5.99E-06	2.10E-06	1.77E-07	-1.03E-05	3.23E-04
EP - marine (kg N eq./FU)	7.08E-03	1.22E-03	6.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.88E-03	3.97E-04	1.89E-04	8.10E-05	-9.92E-04	1.69E-02
EP – terrestrial (mol N eq./FU)	7.83E-02	1.27E-02	6.97E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.04E-02	4.13E-03	2.12E-03	8.85E-04	-1.35E-02	1.88E-01
POCP (kg NMVOC eq./FU)	2.65E-02	7.70E-03	2.03E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.05E-03	2.50E-03	6.47E-04	2.64E-04	-3.44E-03	6.40E-02
ADP – minerals&metals (kg Sb eq./FU)	8.07E-05	7.42E-06	8.55E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.53E-07	2.41E-06	2.07E-06	1.16E-07	-1.64E+00	1.01E-04
ADP - fossil (MJ/FU)	8.83E+01	3.22E+01	4.31E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E+00	1.05E+01	4.95E+00	4.82E-01	-6.13E+00	1.85E+02
WDP (m3 world eq. deprived/FU)	2.20E+00	1.33E-01	1.46E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E-02	4.32E-02	4.90E-02	3.06E-03	-1.02E-01	3.90E+00

PM (disease incidence eq./FU)	3.67E-07	1.68E-07	3.50E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-06	5.48E-08	9.21E-09	4.85E-09	-7.43E-08	1.98E-06
IRP (kg U235 eq./FU)	1.44E-01	1.63E-02	1.96E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-03	5.31E-03	5.35E-02	2.87E-03	-4.22E-02	4.19E-01
ETP - fw (CTUe/FU)	3.65E+01	1.59E+01	1.42E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.74E+00	5.18E+00	5.73E-01	1.36E-01	-2.96E+00	7.52E+01
HTP - c (CTUh/FU)	6.31E-09	1.03E-09	1.66E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.34E-10	3.36E-10	1.11E-10	1.10E-11	-8.01E-10	9.60E-09
HTP - nc (CTUh/FU)	9.90E-08	2.29E-08	4.05E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.32E-10	7.44E-09	2.40E-09	1.66E-10	-6.64E-09	1.73E-07
SQP (/)	9.00E+01	1.95E+01	5.69E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.86E-01	6.34E+00	2.61E+00	4.12E-01	-1.21E+01	1.76E+02

GWP-total = Global Warming Potential (Climate Change) total; GWP-fossil = Global Warming Potential (Climate Change) fossil fuels; GWP-biogenic = Global Warming Potential (Climate Change) biogenic; GWP-luluc = Global Warming Potential (Climate Change) land use and land use change; ODP = Depletion Potential of the Stratospheric Ozone Layer; AP = Acidification Potential; EP-freshwater = Eutrophication Potential freshwater; EP-marine = Eutrophication Potential marine; EP-terrestrial = Eutrophication Potential terrestrial; POCP = Formation Potential of Tropospheric Ozone; ADP-minerals&metals = Abiotic Depletion Potential for non-fossil resources; ADP-fossil = Abiotic Depletion Potential for fossil resources; WDP = water deprivation potential; PM = Particulate Matter Emissions; IRP = ionising radiation, human health; ETP-fw = Ecotoxicity, Freshwater; HTP-c = Human Toxicity, Cancer Effects; HTP-nc = Human Toxicity, non-Cancer effects; SQL = Land use related impacts

Resource use, output flows and waste flows per 1 m² of facing bricks

Resource use

Resource use	Product stage	Construction process stage		Use stage							End-of-life stage					
	A1-A3	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal	D Reuse, recovery, recycling	Total excl module D
PERE (MJ eq./FU)	7.50E+01	4.99E-01	1.22E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.22E-02	1.62E-01	3.50E-01	2.46E-02	-1.94E+00	8.83E+01
PERM (MJ eq./FU)	2.08E+00	0.00E+00	1.04E-01	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	0.00E+00	0.00E+00	1.15E-03	2.18E+00
PERT (MJ eq./FU)	7.71E+01	4.99E-01	1.23E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.22E-02	1.62E-01	3.50E-01	2.46E-02	-1.94E+00	9.05E+01
PENRE (MJ eq./FU)	6.83E+01	3.22E+01	4.65E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E+00	1.05E+01	4.95E+00	4.82E-01	-9.98E+00	1.69E+02
PENRM (MJ eq./FU)	1.02E+01	0.00E+00	-3.39E+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	0.00E+00	0.00E+00	0.00E+00	3.85E+00	6.82E+00
PENRT (MJ eq./FU)	7.85E+01	3.22E+01	4.31E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E+00	1.05E+01	4.95E+00	4.82E-01	-6.13E+00	1.75E+02

SM (kg/FU)	8.37E+01	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.30E+01	8.37E+01
RSF (MJ eq./FU)	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF (MJ eq./FU)	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW (m^3 water eq./FU)	6.78E-04	6.29E-06	3.72E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.48E-07	2.04E-06	1.83E-07	3.15E-08	-2.00E-06	7.24E-04

Waste categories and output flows

Waste categories and output flows	Product stage	Construction process stage		Use stage							End-of-life stage				D Reuse, recovery, recycling	Total excl module D
	A1-A3	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction / demolition	C2 Transport	C3 Waste processing	C4 Disposal		
Hazardous waste disposed (kg/FU)	4.52E-04	2.05E-04	1.33E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.86E-05	6.67E-05	1.09E-05	2.06E-06	-4.04E-05	9.09E-04
Non-hazardous waste disposed (kg/FU)	1.85E+00	1.60E+00	8.56E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.21E-03	5.21E-01	1.10E-02	6.14E+00	-1.02E-01	1.10E+01
Radioactive waste disposed (kg/FU)	4.13E-05	1.06E-05	1.08E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.28E-07	3.45E-06	4.36E-05	2.32E-06	-2.30E-05	2.10E-04
Components for re-use (kg/FU)	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling (kg/FU)	7.00E-04	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	0.00E+00	0.00E+00	1.17E+02	0.00E+00	0.00E+00	1.17E+02
Materials for energy recovery (kg/FU)	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy (MJ/FU)	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

QUALITY INFORMATION:

An important side effect of the Pirrouet facing brick is that it continues to carbonate during its lifetime and will therefore absorb additional CO_2. This additional carbon capture was not included in this assessment, even though it will lead to a reduction in total environmental impact.

ENVIRONMENTAL IMPACTS OF OTHER PRODUCTS:
Results provided in the tables above are representative of a reference product LF-S facing bricks. To obtain environmental impact results for other 3 products covered by this document, the above provided results have to be multiplied by the following correction factors.

Life Cycle Stage:	A1-A3, A4, C1-C4, D			A5		
Impact category/product	**XXL44-S**	**WF**	**DF**	**XXL44-S**	**WF**	**DF**
Acidification	0.99	1.38	1.45	1.00	1.29	1.09
Climate change	0.99	1.38	1.45	1.01	1.33	1.13
Climate change - Biogenic	0.99	1.38	1.45	1.01	1.37	1.16
Climate change - Fossil	0.99	1.38	1.45	1.01	1.33	1.13
Climate change - Land use and LU change	0.99	1.38	1.45	1.00	1.32	1.12
Ecotoxicity. freshwater - part 1	0.99	1.38	1.45	1.00	1.32	1.13
Particulate matter	0.99	1.38	1.45	1.01	1.33	1.14
Eutrophication. marine	0.99	1.38	1.45	1.00	1.32	1.13
Eutrophication. freshwater	0.99	1.38	1.45	1.01	1.33	1.12
Eutrophication. terrestrial	0.99	1.38	1.45	1.01	1.36	1.16
Human toxicity. cancer	0.99	1.38	1.45	1.00	1.25	1.07
Human toxicity. non-cancer	0.99	1.38	1.45	1.01	1.33	1.13
Ionising radiation	0.99	1.38	1.45	1.00	1.30	1.10
Land use	0.99	1.38	1.45	1.01	1.33	1.13
Ozone depletion	0.99	1.38	1.45	1.00	1.31	1.12
Photochemical ozone formation	0.99	1.38	1.45	1.00	1.30	1.12
Resource use. fossils	0.99	1.38	1.45	1.00	1.31	1.12
Resource use. minerals and metals	0.99	1.38	1.45	1.00	1.30	1.11
Water use	0.99	1.38	1.45	1.00	1.30	1.11

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