Statement of Verification

BREG EN EPD No.: 000579 Issue 01

This is to verify that the

Environmental Product Declaration

provided by:

C-Probe Systems Limited

is in accordance with the requirements of:

EN 15804:2012+A2:2019

and

BRE Global Scheme Document SD207

This declaration is for:

1kg of LoCem® AACM concrete repair binder

Company Address

C-Probe Systems Limited,
Unit 2 Wharton Street,
Sherdley Road Industrial Estate,
St Helens,
WA9 5AA

Signed for BRE Global Ltd	Emma Baker Operator	27 June 2024 Date of this Issue
27 June 2024 Date of First Issue		26 June 2029 Expiry Date

Environmental Product Declaration

EPD Number: 000579

General Information

EPD Programme Operator	Applicable Product Category Rules
BRE Global Watford, Herts WD25 9XX United Kingdom	BRE 2023 Product Category Rules (PN 514 Rev 3.1) for Type III environmental product declaration of construction products to EN 15804:2012+A2:2019.
Commissioner of LCA study	**LCA consultant/Tool**
C-Probe Systems Limited, Unit 2 Wharton Street, Sherdley Road Industrial Estate, St Helens, WA9 5AA	LCA Consultant: Bala Subramanian Tool: BRE LINA A2
Declared/Functional Unit	**Applicability/Coverage**
1kg of LoCem® AACM concrete repair binder	Other (please specify). Product specific
EPD Type	**Background database**
Cradle to Gate with options	Ecoinvent 3.8

Demonstration of Verification
CEN standard EN 15804 serves as the core PCR [a]
Independent verification of the declaration and data according to EN ISO 14025:2010 ☐Internal ☒ External
(Where appropriate [b])Third party verifier: Roger Connick
a: Product category rules b: Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4)

Comparability
Environmental product declarations from different programmes may not be comparable if not compliant with EN 15804:2012+A2:2019. Comparability is further dependent on the specific product category rules, system boundaries and allocations, and background data sources. See Clause 5.3 of EN 15804:2012+A2:2019 for further guidance

Information modules covered.

Product			Construction		Use stage							End-of-life					Benefits and loads beyond the system boundary
					Related to the building fabric					Related to the building							
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4		D
Raw materials supply	Transport	Manufacturing	Transport to site	Construction – Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal		Reuse, Recovery and/or Recycling potential
☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☐	☐	☑	☑	☑	☑		☑

Note: Ticks indicate the Information Modules declared.

Manufacturing site(s)

C-Probe Systems Limited,
Unit 2 Wharton Street,
Sherdley Road Industrial Estate,
St Helens
WA9 5AA

Construction Product:

Product Description

LoCem® is the alkali-activated cementitious material formulation that is the basis for a range of restoration, build and corrosion protection products.
This EPD focuses on the non-conductive form used as a concrete repair material with enhanced refractory qualities.
The formulation uses a variety of feedstocks derived from repurposing of wastes with GGBS (slag from steel production) being the Main Constituent with various secondary constituents that are individually <5% each of the total volume (declared in compliance with BSI PAS8820:2016).
The purpose of all these ingredients is to provide sources of silicon, aluminium, calcium, sodium that are activated by a sodium silicate (alkaline) solution to harden a form of cross-linked geopolymeric aluminosilicate material.
LoCem® can be hand-placed, gunned, formed, sprayed and moulded as with any conventional mortar and concrete mix. It has the physical and mechanical features of a Portland mortar and concrete with enhanced refractory properties withstanding 1200C for at least 5 hours without material change (to EN1363-1).

Technical Information

Property	Value, Unit
Compressive strengths	Mix designs up to 60 N/mm^2
Flexural strength	8 N/mm^2
Workability	With retarder use from 10mins to 2hours
Ultra-low resistivity of anode materials	2.5-3kohm.cm

Property	Value, Unit
Fireproof	EN1363-1 (at least 5 hours at 1200C with only 140C heat Y transference at 150mm thick)

Note: For more information: ***https://www.c-probe.co.uk/products-solutions-for-resilience-management-of-corrosion/locem/***

Main Product Contents

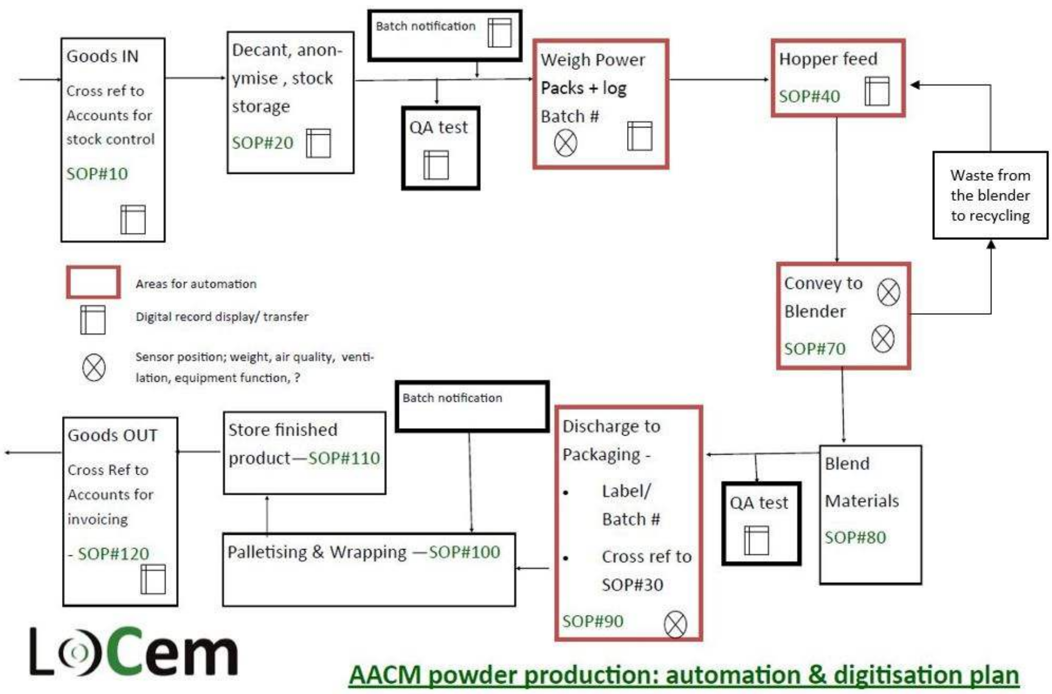
Material/Chemical Input	%
GGBS	20-30
Dry silica sand	50-60
Other constituents	10-30

Manufacturing Process

1. Goods In receives raw feedstocks from delivery as powder bags (binder components) and within an IBC for the activator (sodium silicate) liquid.
2. Bags are decanted and anonymised within the decant room and placed into numbered tubs. At this point a quality check is undertaken using the inhouse x-ray fluorescence (XRF) equipment to assess consistency of supply with respect to contaminants, such as chloride and heavy metals.
3. Each ingredient is weighed on electronic scales and placed into the hopper at ground level.
4. Once the ingredients are placed in the hopper then they are transferred vertically to the blender using the air transporter.

5. Once in the blender the formulation is shear-mixed for 5 minutes and a visual check made to assess completeness of the blending process. Samples are taken to reassess blend constituents using XRF equipment.
6. On completion of the blending the final product is gravity fed to the automated bagging equipment to packaging, sealing, and labelling.
7. On completion of the packaging the bags are transported to the palletising area using roller conveyors by hand.
8. On palletising the end product is plastic wrapped using a hand-held pallet wrapper and placed in the Goods Out area for despatch.
9. For the activator liquid the sodium silicate (SS) is diluted with water in the proportion 30:70 SS: water.
10. The diluted liquid is dispensed using a peristaltic pump into plastic bottles.
11. If needed, retarder liquid is added to the activator liquid.
12. The bottles are packaged on to the pallets quantified in proportion with the LoCem® powder bags and wrapped for despatch together.

Process flow diagram



Construction Installation

LoCem® concrete repair binder is mixed with the liquid activator after breakout and preparation of the concrete patch in accordance with industry practices. Installation wastage rate is very minimal which have been assumed as 0.01% so the resulty are negligible.

End of Life

The intent of using LoCem® concrete repair binder is for restoration, building, and corrosion protection products.
At the end-of-life, deconstruction takes place for the whole building, LoCem concrete repair binder attached to any concrete blocks or reinforcement structures will be sent to the pre-processing sector for separation and crushing. The deconstruction takes place over the entire building, so the energy attributed to removing the LoCem repair binder compared to the overall demolition will be effectively negligible.

Life Cycle Assessment Calculation Rules

Declared unit description

1kg of LoCem® AACM concrete repair binder.

System boundary

This is a cradle-to-gate with options LCA, reporting all production life cycle stages of modules A1 to A3, A4 and A5 (transportation and installation), end of life stages C1-C4, and D in accordance with EN 15804:2012+A2:2019 and BRE 2023 Product Category Rules (PN 514 Rev 3.1).

Data sources, quality and allocation

The quantity used in the data collection for this EPD is the total quantity of1kg of LoCem® AACM concrete repair binder manufactured during the data collection period (01/01/22-31/12/22). Other products have been manufactured along with the LoCem AACM concrete repair binder so therefore allocation of fuel, water is required, and this has been done by mass in accordance with the provision of BRE 15804 A2 PCR. Upon the data review, the output quantity is greater than the input quantity, so the data uplift has been performed and this has been done in accordance with the provision of BRE 15804 A2 PCR. During the manufacturing process, the manufacturer has confirmed that no production waste has been resulted.

Secondary data has been obtained for all other upstream and downstream processes that are beyond the control of the manufacturer (i.e., raw material production) from the ecoinvent 3.8 database. All ecoinvent datasets are complete within the context used and conform to the system boundary and the criteria for the exclusion of inputs and outputs, according to the requirements specified in EN15804.

In the raw material input, the manufacturer uses secondary raw materials such as GGBS and fly ash. GGBS is a co-product of steel manufacturing, while fly ash is a co-product of coal production. Therefore, both secondary raw materials are economically allocated. GGBS has been allocated economically by 2.3%, based on recommendations from "Embodied Carbon of Concrete in Buildings, Part 1: Analysis of Published EPDs" by Jane Anderson and Alice Moncaster, following EN15804 recommendations.

Fly ash is allocated economically using the revenue of 1 kg of fly ash and following the guidance of Shi, X et al. (2021), "Life Cycle Assessment and Impact Correlation Analysis of Fly Ash Geopolymer Concrete.
Specific European datasets have been selected from the ecoinvent LCI for this LCA.

ISO14044 guidance. **Quality Level**	**Geographical representativeness**	**Technical representativeness**	**Time representativeness**
Very Good	Data from area under study.	Data from processes and products under study. Same state of technology applied as defined in goal and scope (i.e., identical technology).	n/a
Very Good	n/a	n/a	There is approximately 1-2 years between the Ecoinvent LCI reference year, and the time period for which the LCA was undertaken.

Specific European datasets have been selected from the ecoinvent LCI for this LCA. Manufacturer uses the national grid electricity for production, so therefore the national grid electricity dataset has been used for the LCA modelling (Ecoinvent 3.8). The GWP carbon footprint for using 1 kWh of electricity, GB kWh is 0.239 kgCO2e/kWh and for the UK natural has carbon footprint for using 1 kWh is 0.232 kgCO2eq. The quality level of time representativeness is also Very Good as the background LCI datasets are based on ecoinvent v3.8 which was compiled in 2021. Therefore, there is less than 5 years between the ecoinvent LCI reference year and the time period for which the LCA was undertaken.

Cut-off criteria

All raw materials and energy input to the manufacturing process have been included, except for direct emissions to air, water, and soil, which are not measured. The inventory process in this LCA includes all data related to raw material, packaging material and consumable items. Process energy, water use, and discharge are included, except the production waste.

LCA Results

(MND = module not declared; MNR = module not relevant; INA = indicator not assessed; AGG = aggregated)

Parameters describing environmental impacts			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CFC11 eq	mol H^+ eq	kg $(PO_4)^{3-}$ eq
Product stage	Raw material supply	A1	1.76E-01	1.73E-01	1.78E-03	4.99E-04	4.13E-08	1.00E-03	6.35E-05
	Transport	A2	1.75E-02	1.75E-02	2.36E-05	8.34E-06	3.91E-09	8.02E-05	1.64E-06
	Manufacturing	A3	1.83E-02	5.32E-02	-3.50E-02	6.72E-05	1.94E-09	2.22E-04	1.44E-05
	Total	A1-3	2.11E-01	2.44E-01	-3.32E-02	5.75E-04	4.72E-08	1.30E-03	7.95E-05
Construction process stage	Transport	A4	6.51E-02	6.50E-02	5.54E-05	2.55E-05	1.50E-08	2.64E-04	4.19E-06
	Construction	A5	1.12E-03	4.07E-04	6.99E-04	1.84E-07	1.12E-10	9.46E-06	4.16E-06
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95% - recycling 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	8.32E-03	8.31E-03	7.08E-06	3.26E-06	1.92E-09	3.37E-05	5.35E-07
	Waste processing	C3	3.82E-03	3.82E-03	1.35E-06	3.81E-07	8.16E-10	3.97E-05	1.18E-07
	Disposal	C4	2.64E-04	2.63E-04	2.61E-07	2.49E-07	1.07E-10	2.48E-06	2.41E-08
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-8.00E-03	-7.88E-03	-1.02E-04	-1.11E-05	-6.36E-10	-5.07E-05	-4.29E-06
100% - Landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	8.32E-03	8.31E-03	7.08E-06	3.26E-06	1.92E-09	3.37E-05	5.35E-07
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	5.28E-03	5.27E-03	5.22E-06	4.97E-06	2.13E-09	4.95E-05	4.82E-07
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

GWP-total = Global warming potential, total;
GWP-fossil = Global warming potential, fossil;
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; and
EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

LCA Results (continued)

Parameters describing environmental impacts			EP-marine	EP-terrestrial	POCP	ADP-mineral&metals	ADP-fossil	WDP	PM
			kg N eq	mol N eq	kg NMVOC eq	kg Sb eq	MJ, net calorific value	m^3 world eq deprived	disease incidence
Product stage	Raw material supply	A1	1.85E-04	2.01E-03	6.07E-04	2.15E-06	1.79E+00	1.13E+00	1.09E-08
	Transport	A2	2.42E-05	2.65E-04	8.34E-05	1.32E-07	2.62E-01	1.44E-03	1.64E-09
	Manufacturing	A3	4.57E-05	4.67E-04	2.14E-04	3.34E-07	1.60E+00	3.95E-02	2.83E-09
	Total	A1-3	2.55E-04	2.75E-03	9.04E-04	2.61E-06	3.66E+00	1.17E+00	1.54E-08
Construction process stage	Transport	A4	7.94E-05	8.68E-04	2.66E-04	2.26E-07	9.82E-01	4.42E-03	5.61E-09
	Construction	A5	4.21E-06	4.82E-05	1.30E-05	1.48E-09	8.96E-03	1.02E-03	1.02E-10
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95% - recycling 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.02E-05	1.11E-04	3.40E-05	2.89E-08	1.26E-01	5.65E-04	7.17E-10
	Waste processing	C3	1.76E-05	1.92E-04	5.29E-05	1.96E-09	5.24E-02	1.21E-04	8.13E-09
	Disposal	C4	8.61E-07	9.42E-06	2.74E-06	6.01E-10	7.35E-03	3.37E-04	4.99E-11
Potential benefits and loads beyond the system boundarie	Recycling potential	D	-1.17E-05	-1.41E-04	-3.63E-05	-7.45E-08	-1.16E-01	-1.52E-02	-6.41E-10
100% - Landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.02E-05	1.11E-04	3.40E-05	2.89E-08	1.26E-01	5.65E-04	7.17E-10
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	1.72E-05	1.88E-04	5.48E-05	1.20E-08	1.47E-01	6.74E-03	9.97E-10
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
EP-terrestrial = Eutrophication potential, accumulated exceedance;
POCP = Formation potential of tropospheric ozone;
ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;
ADP-fossil = Depletion potential of the stratospheric ozone layer;
WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and
PM = Particulate matter.

LCA Results (continued)

Parameters describing environmental impacts			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U^{235} eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	1.22E-02	4.67E+00	2.82E-10	3.56E-09	1.73E+00
	Transport	A2	1.46E-03	2.25E-01	1.43E-11	2.58E-10	1.61E-01
	Manufacturing	A3	6.43E-03	5.07E-01	6.39E-11	4.88E-10	3.21E+00
	Total	A1-3	2.01E-02	5.40E+00	3.60E-10	4.31E-09	5.10E+00
Construction process stage	Transport	A4	5.05E-03	7.67E-01	2.48E-11	8.04E-10	6.75E-01
	Construction	A5	3.88E-05	6.71E-02	1.04E-11	1.03E-10	1.87E-02
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95% - recycling 5% landfill							
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	6.46E-04	9.81E-02	3.18E-12	1.03E-10	8.63E-02
	Waste processing	C3	2.36E-04	3.06E-02	1.19E-12	2.22E-11	6.67E-03
	Disposal	C4	3.27E-05	4.64E-03	1.18E-13	3.05E-12	1.54E-02
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.80E-03	-1.34E-01	-7.81E-12	-1.41E-10	-1.07E-01
100% - Landfill							
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	6.46E-04	9.81E-02	3.18E-12	1.03E-10	8.63E-02
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	6.53E-04	9.29E-02	2.36E-12	6.11E-11	3.09E-01
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

IRP = Potential human exposure efficiency relative to U235;
ETP-fw = Potential comparative toxic unit for ecosystems;
HTP-c = Potential comparative toxic unit for humans;
HTP-nc = Potential comparative toxic unit for humans; and
SQP = Potential soil quality index.

LCA Results (continued)

Parameters describing resource use, primary energy			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.50E-01	0.00E+00	1.50E-01	1.81E+00	0.00E+00	1.81E+00
	Transport	A2	4.91E-03	0.00E+00	4.91E-03	2.58E-01	0.00E+00	2.58E-01
	Manufacturing	A3	2.96E-01	3.36E-01	6.32E-01	7.68E-01	8.17E-01	1.58E+00
	Total	A1-3	4.51E-01	3.36E-01	7.87E-01	2.84E+00	8.17E-01	3.66E+00
Construction process stage	Transport	A4	1.38E-02	0.00E+00	1.38E-02	9.65E-01	0.00E+00	9.65E-01
	Construction	A5	4.53E-05	3.36E-05	7.89E-05	2.85E-04	8.17E-05	3.66E-04
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95% - recycling 5% landfill								
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.77E-03	0.00E+00	1.77E-03	1.23E-01	0.00E+00	1.23E-01
	Waste processing	C3	2.93E-04	0.00E+00	2.93E-04	5.14E-02	0.00E+00	5.14E-02
	Disposal	C4	6.27E-05	0.00E+00	6.27E-05	7.22E-03	0.00E+00	7.22E-03
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.09E-02	0.00E+00	-1.09E-02	-1.16E-01	0.00E+00	-1.16E-01
100% - Landfill								
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.77E-03	0.00E+00	1.77E-03	1.23E-01	0.00E+00	1.23E-01
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	1.25E-03	0.00E+00	1.25E-03	1.44E-01	0.00E+00	1.44E-01
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PERE = Use of renewable primary energy excluding renewable primary energy 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 resource

LCA Results (continued)

Parameters describing resource use, secondary materials and fuels, use of water			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m³
Product stage	Raw material supply	A1	2.75E-04	3.39E-06	0.00E+00	2.65E-03
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	3.58E-05
	Manufacturing	A3	1.29E-03	1.30E-10	0.00E+00	9.40E-04
	Total	A1-3	1.57E-03	3.39E-06	0.00E+00	3.63E-03
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	1.10E-04
	Construction	A5	1.57E-07	3.39E-10	0.00E+00	2.15E-05
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95% - recycling 5% landfill						
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	1.40E-05
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	2.99E-06
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	7.88E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	-3.58E-04
100% - Landfill						
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	1.40E-05
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	1.58E-04
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;
NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water

LCA Results (continued)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	1.66E-02	3.22E-01	5.35E-06
	Transport	A2	3.81E-04	7.29E-03	5.89E-01
	Manufacturing	A3	2.24E-03	6.69E-02	2.00E-06
	Total	A1-3	1.92E-02	3.96E-01	5.89E-01
Construction process stage	Transport	A4	1.08E-03	1.92E-02	6.65E-06
	Construction	A5	1.93E-06	3.98E-05	5.89E-05
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00
95% - recycling 5% landfill					
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.39E-04	2.46E-03	8.50E-07
	Waste processing	C3	6.87E-05	4.83E-04	3.62E-07
	Disposal	C4	7.65E-06	1.08E-04	4.82E-08
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-6.68E-04	-2.03E-02	-5.93E-07
100% - Landfill					
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.39E-04	2.46E-03	8.50E-07
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	1.53E-04	2.16E-03	9.64E-07
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00

HWD = Hazardous waste disposed;
NHWD = Non-hazardous waste disposed;
RWD = Radioactive waste disposed

LCA Results (continued)

Other environmental information describing output flows – at end of life			CRU	MFR	MER	EE	Biogenic carbon (product)	Biogenic carbon (packaging)
			kg	kg	kg	MJ per energy carrier	kg C	kg C
Product stage	Raw material supply	A1	0.00E+00	5.40E-06	7.47E-08	1.75E-03	0.00E+00	0.00E+00
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manufacturing	A3	0.00E+00	2.24E-09	1.03E-12	1.05E-07	0.00E+00	-2.35E-05
	Total (Consumption grid)	A1-3	0.00E+00	5.40E-06	7.47E-08	1.75E-03	0.00E+00	-2.35E-05
Construction process stage	Transport	A4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Construction	A5	0.00E+00	5.40E-10	7.47E-12	1.75E-07	0.00E+00	-2.35E-09
Use stage	Use	B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Maintenance	B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Repair	B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Replacement	B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Refurbishment	B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95% - recycling 5% landfill								
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0.00E+00	6.84E-08	1.09E-09	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100% - Landfill								
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling
MER = Materials for energy recovery;
EE = Exported Energy

Scenarios and additional technical information

<table>
<tr><th colspan="4">Scenarios and additional technical information</th></tr>
<tr><td>Scenario</td><td>Parameter</td><td>Units</td><td>Results</td></tr>
<tr><td rowspan="5">A4 – Transport to the building site</td><td colspan="3">Once the LoCem® AACM concrete repair binder manufactured, and they will be distributed to the customer site in the UK. In the worst case, the furthest distance has been used to calculate the impacts.</td></tr>
<tr><td>Transport mode / Vehicle type</td><td>Road transport</td><td>16–32-ton lorry</td></tr>
<tr><td>Manufacturing unit to customer site</td><td>km</td><td>391</td></tr>
<tr><td>Capacity utilisation (incl. empty returns)</td><td>%</td><td>49</td></tr>
<tr><td>Bulk density of transported products</td><td>ton/m^3</td><td>24</td></tr>
<tr><td>A5 – Installation in the building</td><td colspan="3">LoCem® concrete repair binder is mixed with the liquid activator after breakout and preparation of the concrete patch in accordance with industry practices. Installation wastage rate is very minimal which have been assumed as 0.01% so the results are negligible.</td></tr>
<tr><td>End of life</td><td colspan="3">Generally, the intent of the use of LoCem® concrete repair binder in restoration, build and corrosion protection products.

At the end-of-life, deconstruction takes place for the whole building using the heavy machineries. LoCem concrete repair binder attached to any concrete blocks or reinforcement structures can’t be separated from the construction waste. The actual waste processing procedures depend on the availability of recycling sectors around the demolition unit. Therefore, for the end-user preferences, two end of life scenarios has been modelled and included in the results.

Scenario 1: 95% recycling and 5% landfill (BRE EN15804 A2 PCR 3.1).
Scenario 2: 100% to Landfill - In this scenario, it is assumed that there is no waste processing site near the deconstruction unit. Therefore, 100% of the recovered waste is sent to landfill without any pre-processing.</td></tr>
<tr><td>Scenario 1:
C1 - Deconstruction, Demolition

95% to Recycling and 5% to Landfill</td><td colspan="3">The deconstruction takes place over the entire building using the heavy machineries and the recovered waste will be sent to waste processing. The energy attributed to removing the LoCem concrete repair binder compared to the overall demolition will be effectively negligible. Therefore, no impacts are attributable to module C1.</td></tr>
<tr><td>Scenario 2:

C1 - Deconstruction, Demolition

100% Landfill</td><td colspan="3">LoCem concrete repair binder attached to any concrete blocks or reinforcement structures will be recovered for the waste processing at the deconstruction site. In this scenario, it is assumed that recovered structures associated with Binders will be sent to landfilling without pre-processing. As buildings, roads, bridges, and other concrete structures age or become obsolete, they often need to be demolished or renovated. During this process, the concrete is broken down into rubble, which may be deemed unsuitable for reuse due to contamination, structural integrity issues, or lack of demand</td></tr>
<tr><td rowspan="3">C2- Transportation</td><td>50km by road has been modelled for module C2 as a typical distance from the demolition site to the recycling/ landfill unit. However, end-users of the EPD can use this information to calculate the impacts of a bespoke transport distance for module C2 if required.</td><td>Litres per km</td><td>0.227</td></tr>
<tr><td>Distance: Deconstruction unit to pre-processing unit</td><td>km</td><td>50</td></tr>
<tr><td>Transportation</td><td>Road transport</td><td>Lorry, 16-32 metric ton</td></tr>
</table>

Scenarios and additional technical information			
Scenario	Parameter	Units	Results
C3- Scenario 1: C3- Pre-processing 95% to Recycling and 5% to Landfill	In the pre-processing sector, the separation process involves crushing the recovered concrete, thereby removing metals such as rebar and other components and recycling them separately. The concrete waste will be crushed, and it can be used for road gravel, revetments, retaining walls, landscaping gravel, or raw material for new concrete. Large pieces can be used as bricks or slabs or incorporated with new concrete into structures. As per BRE EN15804 A2 PCR 3.1 end of life scenario for the structure concrete, 95% of the concrete waste will be recycled and 5% sent to landfill. The sorting and separation and crushing processes have not been included in module C3 because it is assumed to be very small and are effectively negligible. The sorting and separation and crushing processes have not been included in module C3 because it is assumed to be very small and are effectively negligible.		
	95% of LoCem® concrete repair binder with concrete waste to recycling	kg	0.95
Scenario 2: 100% Landfill	100% sent to landfill no preprocessing		
Scenario 1: C4 – Disposal	The recovered concrete waste is sent for recycling, which is assumed to be 95%, while a small portion is assumed to be unrecoverable and is considered to be sent to landfills at 5%.		
	5% Unrecovered LoCem concrete repair binder with concrete waste to landfill	kg	0.05
Scenario 2: C4 – Disposal	100% of the concrete waste to Landfill		
	Binder combined concrete waste	kg	1
Module D for scenario 1	Recovered concrete blocks with the LoCem repair binder will be recycled used according to the need. It is assumed that there is a 100% recycling yield from the recycling process		

Interpretation of results

The manufacture of raw materials exerts the greatest influence across all impact categories. Of the total mass of input materials, GGBS accounts for 50%, silica sand for 31%, and the remaining materials collectively make up 0-20% of the total consumption.

In the analysis of environmental impact categories, GGBS contributes the most to the impacts, followed by sodium hydroxide, which has the most impact on the ecosystem.

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