Insulcel System

Certified Environmental Product Declaration
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The Siplast story of uncompromising quality and commitment to our customers began over half a century ago. Since its origins in the late 1960s with the development of SBS-modified membranes, Siplast has expanded to polymethyl methacrylate (PMMA) liquid resins, lightweight insulating concretes, single-ply options and innovative products such as roof membranes surfaced with depolluting granules. Siplast has become an industry leader through a commitment to helping customers solve their toughest roofing and waterproofing challenges. For more information about Siplast, visit www.Siplast.com.

The Insulcel System combines the unique properties of lightweight insulating concrete and Insulperm premium expanded polystyrene foam insulation board. The Insulcel mix consists of pregenerated cellular foam aggregate and Portland cement. Insulcel is appropriate for jobs located in climates that are conducive for proper curing of cellular concrete. Insulcel System requires a 2-inch minimum thickness over the top of the insulation board.

The Insulcel System provides a solution to the difficulties presented by excessive moisture in structural lightweight concrete. This excessive moisture can affect the integrity and/or proper adhesion of roofing materials. Because the Siplast Insulcel System is engineered to manage high moisture conditions without affecting the roof membrane or insulation system and can be applied directly to structural lightweight decks, Insulcel presents an economical way to address the issue, as well help roofing application and construction sequencing.

For additional information visit our product website:
Product information

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EPD commissioner	Siplast
Company address	14911 Quorum Dr, Suite 600 Dallas, TX 75254 USA
Product group	Lightweight Insulating Concrete (LWIC) System
Product name	Insulcel System
Product intended use	Insulating intermediate layer in commercial roof systems
Product reference service life	75 years
Reference standards	ISO 14025, ISO 14040, ISO 14044, ISO 21930
EPD scope	Cradle to Grave
EPD number	EPD10962
EPD date of validity	July 16, 2024
EPD date of expiration	July 16, 2029
EPD type	Manufacturer specific
Intended audience	Business to Business
Years of reported manufacturer data	Three installations from 2023
Functional unit	One square meter of installed system with a thickness that gives an average thermal resistance R_{SI} = 1 m^2K/W (R-value 5.68 ft^2°F-hr/Btu) and with a building service life of 75 years (packaging included)
Applicable markets/regions	North America
LCA software and database version	SimaPro 9.5 (2023), Ecoinvent 3.9.1, USLCI
LCIA methodology and version number	TRACI 2.1, IPCC AR5
Program administrator	NSF Certification LLC 789 N. Dixboro, Ann Arbor, MI 48105 www.nsf.org
Reference PCR and version number	ISO 21930:2017
This declaration and its life cycle assessment was independently verified in accordance with ISO 14025: 2006, ISO 14040: 2006, 14044:2006, and 21930:2017. **Type of review** ☐ **INTERNAL** ☒ **EXTERNAL**	Jack Geibig, Ecoform [signature]
The reference life cycle assessment was conducted in accordance with ISO 14040, 14044, and 21930, by NSF:	Jim Mellentine, jmellentine@nsf.org

Disclaimer - This EPD was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the results due to and not limited to the practitioner's assumptions, the source of the data used in the study and the software tool used to conduct the study. EPDs are comparable only if they comply with ISO 21930, use the same sub-category PCR where applicable, include all relevant information modules, apply a functional unit, and are based on equivalent scenarios with respect to the context of construction works.

1.0 Product Information

1.1 Reference flow

One functional unit of the Insulcel System based on the average of three installations is listed in Table 1. A weighted average of the three installations was modeled to produce the results in this EPD. The installed Insulcel System has an average wet mass of 9.2 kg per functional unit, which dries to an average mass of 7.9 kg per functional unit. The Insulcel System has an average thickness of 4.76 cm per functional unit.

Table 1 *– Installations used to develop inventory for the Insulcel System.*

#	Location	Installation dates	Total system R-value / R_{SI}	Installation area (m^2)
1	Guyton, Georgia, USA	01 Jun. 2023 – 30 Jun. 2023	R-20 / R_{SI}-3.52	5,439
2	Pooler, Georgia, USA	07 Aug. 2023 – 12 Aug. 2023	R-25 / R_{SI}-4.40	3,287
3	Savannah, Georgia, USA	01 Jul. 2023 – 01 Aug. 2023	R-30 / R_{SI}-5.28	4,559

1.2 Material content

The following tables list the materials contained in both the product and associated product packaging.

Table 2 *– Material contents of the Insulcel System*

Material	Weight (kg)	Weight (%)
Portland limestone cement	5.48	59.3%
Expanded polystyrene insulation board	0.59	6.4%
Foam aggregate	0.41	4.5%
Water	2.75	29.8%
Total	9.24	100.0%

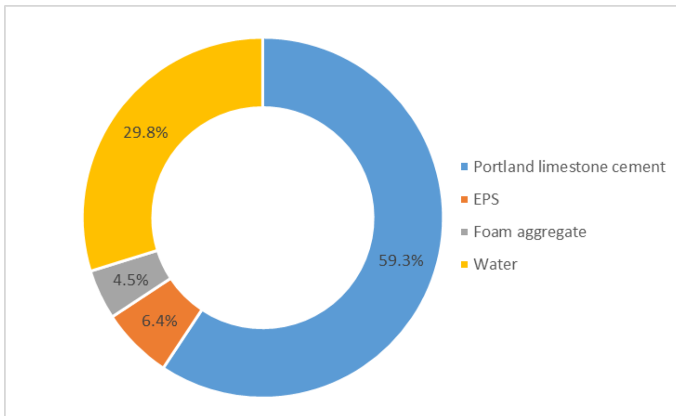

Figure 1 *– Material contents of the Insulcel System*

Table 3 *– Insulcel System packaging materials*

Packaging	Weight (kg)	Weight (%)
High density polyethylene packaging	0.025	97.5%
Low density polyethylene packaging	0.001	2.5%
Total	0.025	100.0%

The Insulcel System does not contain any recycled content or biogenic content.

1.3 Technical Standards

The Insulcel system complies with the following standards, by component:

- Portland cement: ASTM C150
- Expanded polystyrene board: ASTM C578

2.0 Methodology Summary

2.1 Goal and scope

The potential environmental impacts of the Insulcel System (including packaging) throughout its entire life cycle were assessed conforming to international standards for life cycle assessment (ISO 14040 / 14044 (2006) and ISO 21930 (2017)). This business-to-business Type III declaration conforms to ISO 14025 (2006) and considers the typical Insulcel System.

2.2 Functional unit

One square meter of installed system with a thickness that gives an average thermal resistance R_{SI} = 1 m^2K/W (R-value 5.68 ft^2°F-hr/Btu) and with a building service life of 75 years (packaging included).

With professional installation and proper maintenance, the condition and material content of the Insulcel System remain unchanged throughout its service life, which is expected to last the full life of the building.

2.3 System boundary

The life cycle assessment considers the full life cycle of the product (cradle to grave). This includes all activities from raw material acquisition and pre-processing, manufacturing, installation, use, and end-of-life management. The stages of the life cycle were separated into modules according to ISO 21930, as shown in Figure 2.

Production			Construction		Use							End of life			
Extraction and upstream production	Transport of materials	Manufacturing	Transport of finished product	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/Demolition	Transport	Waste processing	Disposal of waste
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Note – MND = module not declared; X = module included															

Figure 2 *- Life cycle stages and modules according to ISO 21930*

The life cycle stages included in this assessment follows ISO 21930. The figure above identifies the life cycles stages and information modules in scope and considered in this life cycle assessment. It is important to clarify that for transport of finished product, maintenance, replacement, refurbishment, operational energy, operational water use, and waste processing, the study assumes there is no relevant activity and therefore no impacts to report. Therefore, they have zero contribution to the overall life cycle assessment. While these stages are included in the system boundary, for ease of formatting they are not specifically included in the results tables in this document.

2.4 Allocation

The general principles of allocation were provided by ISO 21930. In this study, allocation of co-products was avoided since each installation occurs for a single product and data were collected separately for each installation. For materials that cross the system boundary, this study follows the cut-off approach. Any recovery processes for secondary (i.e., recycled) materials carry no burden as they enter the system, and likewise there is no allocation of impacts away from the studied system to any wastes that might be reused, recycled, or recovered for use in a subsequent product system. The only secondary materials that enter the system are small amounts upstream in the limestone cement and expanded polystyrene (based on the published EPDs used as background data) as well as some fly ash in the patching compound used for repairs. A small amount of material goes to recycling upstream in the limestone cement and EPS material systems (based on the published EPDs).

2.5 Cut-off criteria

Cut-off criteria from ISO 21930 were used. Any mass, energy flow, or environmental impact within the product boundary, which consists of less than 1%, may be omitted. Cumulative omitted mass or energy flows shall not exceed 5%. Cut-off rules shall not be applied to hide data. In this study, no known substances or energy were excluded. Therefore, the cut-off criteria were met. Further, all substances with hazardous or toxic properties that can be of concern for human health and/or the environment must be identified and included even if it is less than 1% of the total mass. The products in this study do not contain any hazardous or toxic substances.

3.0 Technical Information and Scenarios

3.1 Transport of finished product

The manufacturing of the product occurs at the building site, so the manufacturing and installation stages of this product system are co-located. Therefore, there is no transport activity between the two stages. Therefore, the transport of finished product has zero activity and impacts.

3.2 Installation

The following information was used to represent installation of the product onto the building. Diesel-powered pumping equipment is required to pump the mixed concrete onto the roof, where it is poured directly onto the expanded polystyrene as it’s installed. Minimal materials are wasted during installation, though a conservative estimate of 2% of materials were lost during installation with corresponding materials counted in this stage to make up for the loss. Packaging for input materials is also disposed at this stage. No other emissions to air, soil, or water are generated. All waste materials and packaging are assumed to go to landfill. The waste is assumed to travel 32 km to a landfill in a diesel-fueled refuse truck that consumes 3.83E-05 liters of fuel per kg-km.

***Table 4** – Installation assumptions per functional unit*

Installation assumption	Quantity
Diesel fuel combusted in pumping equipment	0.0139 liters
Waste materials collected	0.185 kg
Waste packaging collected	0.0254 kg
Truck transport of waste to landfill	6.77 kg-km
Construction & demolition landfill	0.210 kg

3.3 Repair During Use

Like other cast-in-place concrete building components, the lightweight insulating concrete (LWIC) product is designed and expected to last the full estimated service life of the building, in this study assumed to be 75 years. This lifetime is supported by the National Roof Deck Contractors Association, which says LWIC systems are permanent and will last the life of the building. The reference in-use conditions to support this RSL are that the separately installed roofing membrane installed over the LWIC be of typical good quality, be competently installed, and be appropriately maintained. However, the separately installed roofing membranes that are laid on top of the concrete are typically replaced periodically. When the membranes are replaced, there can be damage caused to the concrete underneath, which requires patching during the membrane replacement process. The membrane is part of a different product system, but the patching process is considered to be part of the LWIC product system, as part of stage B3 (repair). One of the most common membrane overlays is a modified bitumen system, which is expected to last 25 years, based on Siplast experience and roofing company claims. Further, it is common to overlay the original membrane, without removing the original, upon installation of the second membrane. Therefore, we assumed that at the 25-year mark, there is no damage to the LWIC and no repair is necessary. However, at the 50-year mark, we assumed that both of the membranes were physically removed, leaving divots in the LWIC from removal of nails which attached the membrane to the LWIC. These divots must be patched. Siplast recommends the use of Zono-Patch for these repairs. Zono-Patch is most often mixed with water manually and applied by hand with a trowel, with no energy-powered equipment required. The waste Insulcel System material and Zono-Patch packaging is removed from the building and loaded in a refuse truck and transported a distance of 32 km to a construction & demolition landfill. The truck uses 3.83E-05 liters of diesel fuel per kg-km. Table 5 lists the input and output flows assumed for the repair process.

***Table 5** – Repair assumptions per functional unit*

Repair activity	Quantity
Zono-Patch	0.450 kg
Water	0.511 liter
Paper packaging	0.00496 kg
Materials transport to job site (diesel semi truck)	364 kg-km
Waste materials	0.955 kg
Waste packaging	0.00496 kg
Waste transport to landfill (diesel refuse truck)	30.9 kg-km
Landfill	0.960 kg

3.4 End of Life Materials Handling

The demolition stage (C1) of the life cycle involves break-up and removal of the LWIC. This activity is typically done with gasoline-powered roof-cutting equipment. Primary data for fuel consumption was not available for this study, so we developed estimates based on equipment data, typical fuel consumption rates for small engines, and worker cutting rate assumptions. The Insulcel System is removed from the building and loaded in an open dump trailer on an average semi-truck and transported a distance of 32 km to a construction & demolition landfill. The truck uses 2.72E-05 liters of diesel fuel per kg-km. Table 6 shows the end of life inventory quantities.

***Table 6** – Product end of life assumptions per functional unit*

End of life activity	Quantity
Gasoline combusted in roof cutter (stage C1)	0.0165 kg
Truck transport (stage C2)	253 kg-km
Construction & demolition landfill (stage C4)	7.86 kg

4.0 Insulcel System Environmental Indicator Results

4.1 Life cycle assessment results

All results are given per functional unit.

In the following table, global warming potential is assessed using the 100-year time horizon based on factors in the International Panel on Climate Change (IPCC) fifth assessment report (AR5). All other results are reported based on required indicators from The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), version 2.1.

***Table 7** – Life cycle assessment results per functional unit*

Indicator	Unit	A1-A3	A5	B3	C1	C2	C4
Global warming potential	kg CO_2 eq	8.50E+00	2.16E-01	3.09E-01	6.00E-02	2.36E-02	1.87E-02
Acidification potential	kg SO_2 eq	2.60E-02	9.51E-04	1.80E-03	2.73E-04	1.40E-04	1.83E-04
Smog formation potential	kg O_3 eq	4.73E-01	2.32E-02	2.33E-02	8.72E-03	3.83E-03	5.66E-03
Eutrophication potential	kg N eq	1.36E-02	6.81E-04	8.05E-04	1.84E-05	7.81E-06	1.70E-05
Ozone depletion potential	kg CFC-11 eq	4.21E-07	1.84E-08	2.53E-08	1.68E-08	8.95E-13	4.42E-09

4.2 Resource use and waste indicators

The following inventory-based indicators are calculated using the suggested methods in the American Center for Life Cycle Assessment (ACLCA) Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017. The abiotic depletion potential metric uses TRACI version 2.1.

***Table 8** – Resource use and waste indicators per functional unit*

Indicator	Unit	A1-A3	A5	B3	C1	C2	C4
Renewable primary resources used as energy carrier	MJ, LHV	8.03E+00	1.62E-01	4.14E-01	2.40E-04	0.00E+00	6.91E-03
Renewable primary resources with energy content used as material	MJ, LHV	1.49E-01	2.97E-03	6.69E-02	0.00E+00	0.00E+00	0.00E+00
Nonrenewable primary resources used as energy carrier	MJ, LHV	8.76E+01	2.34E+00	3.40E+00	8.19E-01	3.02E-01	2.60E-01
Nonrenewable primary resources with energy content used as material	MJ, LHV	2.69E+01	5.39E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Secondary materials	kg	5.89E-01	1.18E-02	2.32E-01	0.00E+00	0.00E+00	0.00E+00
Renewable secondary fuels	MJ, LHV	2.69E-01	5.37E-03	1.10E-03	0.00E+00	0.00E+00	0.00E+00
Nonrenewable secondary fuels	MJ, LHV	2.59E+00	5.19E-02	1.06E-02	0.00E+00	0.00E+00	0.00E+00
Recovered energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Freshwater consumed (net)	m^3	6.69E-02	1.40E-03	2.28E-03	1.75E-04	0.00E+00	5.48E-06
Hazardous waste disposed*	kg	2.13E-04	4.27E-06	2.54E-07	0.00E+00	0.00E+00	0.00E+00
Nonhazardous waste disposed*	kg	1.86E+00	1.49E+00	6.27E-03	0.00E+00	0.00E+00	6.18E+01
High-level radioactive waste	kg	1.03E-05	2.21E-07	3.36E-06	3.24E-09	0.00E+00	1.07E-08
Intermediate and low-level radioactive waste	kg	2.41E-04	3.52E-05	4.31E-05	3.51E-06	1.17E-08	1.39E-05
Components for reuse	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling*	kg	1.52E-02	3.05E-04	1.06E-05	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered energy exported from the product system	MJ, LHV	9.65E-03	1.93E-04	3.96E-05	0.00E+00	0.00E+00	0.00E+00
Abiotic depletion potential for fossil resources	MJ, LHV	6.79E+01	1.45E+00	2.62E-01	1.25E-01	4.49E-02	3.95E-02
** Many datasets for upstream materials do not quantify these metrics and thus results may be incomplete. Use caution when interpreting data in these categories.*							

4.3 Carbon dioxide removals and emissions

The following inventory-based indicators of carbon dioxide removals and emissions are calculated using the suggested methods in the American Center for Life Cycle Assessment (ACLCA) Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017. Emissions from land use and land use change are insignificant and not included in the analysis.

***Table 9** – Carbon dioxide removals and emissions per functional unit*

Indicator	Unit	A1-A3	A5	B3	C1	C2	C4
Biogenic carbon removals (Product)*	kg CO_2 eq	3.54E-01	7.14E-03	5.03E-02	5.19E-06	1.53E-05	6.62E-04
Biogenic carbon emissions (Product)*	kg CO_2 eq	8.03E-02	1.69E-03	5.16E-02	1.45E-05	1.53E-05	7.22E-04
Biogenic carbon removals (Packaging)	kg CO_2 eq	0.00E+00	0.00E+00	9.08E-03	0.00E+00	0.00E+00	0.00E+00
Biogenic carbon emissions (Packaging)	kg CO_2 eq	0.00E+00	0.00E+00	9.08E-03	0.00E+00	0.00E+00	0.00E+00
Biogenic carbon emissions (Waste combustion)	kg CO_2 eq	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions from calcination	kg CO_2 eq	2.38E+00	4.76E-02	9.75E-03	0.00E+00	0.00E+00	0.00E+00
Carbon removals from carbonation	kg CO_2 eq	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from non-renewable sources used in production	kg CO_2 eq	9.87E-04	1.97E-05	4.05E-06	0.00E+00	0.00E+00	0.00E+00
Carbon emissions from combustion of waste from non-renewable sources used in production	kg CO_2 eq	2.42E-01	4.85E-03	9.93E-04	0.00E+00	0.00E+00	0.00E+00
** Biogenic carbon flows in the product reflect activity reported for these indicators in published EPDs used for cement and EPS inputs; Insulcel System does not directly contain biogenic materials.*							

4.4 Results variation

Since each product installation is unique, data from three installations were used to develop the weighted average results in this EPD. It's important to note that actual results for your installation may vary based on several factors. The following figure shows the range of variation of the three individual installations along with the weighted average.

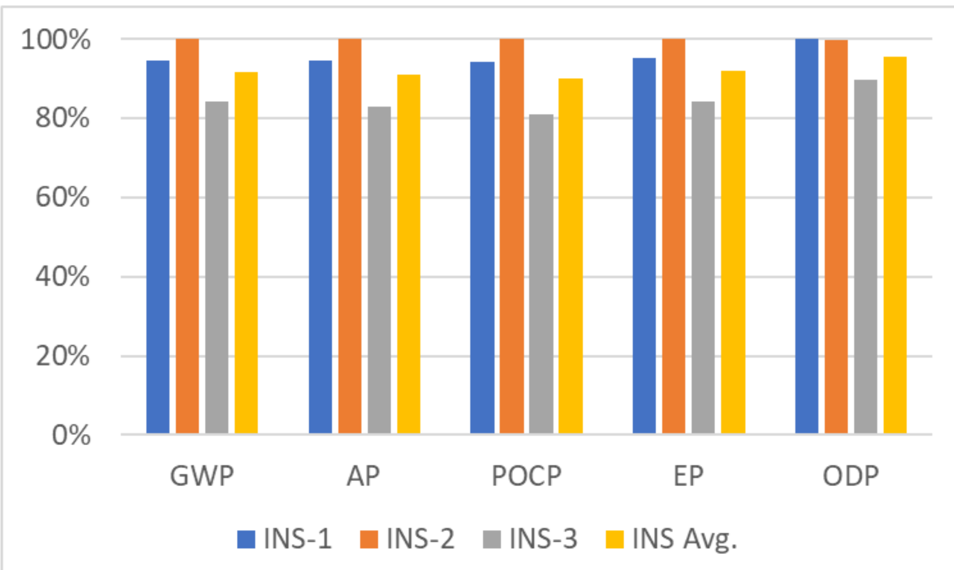

Figure 3 *– Relative cradle-to-grave impacts for three individual Insulcel System installations and the weighted average; GWP = global warming potential, AP = acidification potential, POCP = photochemical oxidant creation potential, EP = eutrophication potential, ODP = ozone depletion potential*

5.0 Additional Environmental Information – Building Use-Stage Benefits

Demonstration Summary

Lightweight Insulating Concrete's low thermal conductivity reduces energy consumption during a building's operation by reducing the associated environmental impacts of energy use. Quantifying the reduction in energy use for heating, cooling, and ventilating for a specific building use category and construction type that includes LWIC as part of the roof system can be modeled relative to a baseline design to demonstrate the energy saving benefits.

Roof Replacement Background

Reroofing of an existing commercial or industrial building is a common practice over its service life. Roof replacement or roof re-cover are the two distinct methods used when reroofing. This framework models a 25-year roof service life for each roof installation, presuming re-covering of the roofing membrane at year 25 and replacement of the roofing membrane at year 50 of the building's predicted 75-year service life. The LWIC remains in place over the 75 year service life with minimal repair to its top surface to allow for new roof membrane installation at year 50. The framework of this EPD conservatively presumes removal of the LWIC at year 75.

6.0 References

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