

SM Transparency Catalog ▶ Polycor ▶ Limestone Floor and Pavers



# **POLYCOR**

## **Limestone Floor and** Pavers

Originating at the Polycor quarries and through production, limestones are manufactured to tiles and pavers with a wide range of finishes. Limestone is an inherently nonemitting source of VOCs and its durability allows it to perform impeccably in commercial & residential applications, interior or exterior.



#### Performance dashboard



Covers the wide selection of Polycor's heritage limestones and any surface finishes available

Covers interior flooring solutions to exterior paving products, from tiles to XL pavers

Has an unmatched durability and minimal maintenance needs

Visit Polycor for more product information

Limestones **Commercial Flooring** Walkways and patios Floor tile

#### **Environment & materials**

Improved by:

Polycor's commitment to carbon neutrality translates

Reduction of product's GWP

Reduction of product's energy intensity

Polycor's ownship of the chain of custody from quarries to plants ensures:

No child labor and forced labor

Materials remain 100% natural, free from chemicals or dyes

#### **Certifications & rating systems:**

**Environmental Product Declaration (EPD)** 

Natural Stone Sustainability Standard (ANSI 373)

Health Product Declaration (HPD)

Polycor Limestone Flooring LCIA results show a 30% reduction in global warming potential impacts compared to the industry average.

This product-specific EPD compares results to the NSI industry-wide Type III EPD, a product group benchmark done in conformance with benchmarking guidance in the SM PCR and the SM Part B: Benchmarking Addendum.

MasterFormat® 09 30 33, 09 63 40, 32 14 40 **Limestone Floor and Pavers Guide Specs** For spec help, contact us or call 418.692.4695

See LCA, interpretation & rating systems

See materials, interpretation & rating systems





### SM Transparency Report (EPD)™ - LEED 4.1 EPD Option 2. Optimization

**VERIFICATION** 

3rd-party reviewed

3rd-party verified

**LCA** 

declaration (EPD) was externally verified, according to ISO 21930:2017, SM Part A, and ISO

This environmental product

Transparency Report (EPD)



Validity: 2023/02/13 - 2028/02/13 Decl #: POL - 20230213 - 002

14025:2006, by Jack Geibig, President, Ecoform.

**Ecoform, LLC** 11903 Black Road, Knoxville, TN 37932

(865) 850-1883

**SUMMARY** 

Reference PCR

Regions; system boundaries

North America; Cradle to grave

Functional unit / reference service life:

1 m<sup>2</sup> of floor covering; 75 years

LCIA methodology: TRACI 2.1

LCA software; LCI database SimaPro Developer 9.4

Ecolnvent 3.8, US-El 2.2

LCA conducted by: Sustainable Minds

**Public LCA:** 

Life Cycle Assessment of Natural Stone Flooring for Polycor

Polycor Inc.

76 rue Saint-Paul, Suite 100 Quebec City (Quebec), Canada G1K 3V9 418-692-4695

Contact us

**Limestone Floor and Pavers** 

# SM Transparency Catalog ▶ Polycor ▶ Limestone Floor and Pavers

# Life cycle assessment

LCA results & interpretation

# Scope and summary

**Product description** Limestone flooring can be applied as interior flooring, exterior flooring,

○ Cradle to gate ○ Cradle to gate with options **♡** Cradle to grave

#### landscaping, and terracing. It tends to be durable and easy to maintain, with an elegant outlook. Limestone makes up 100% of the total mass of the

flooring and is used in commercial, residential, and public sector buildings. The results in this study are presented for flooring with a thickness of 0.5 inches. However, this study applies to both interior flooring and exterior paving with a range of thicknesses and can be scaled using the scaling

factors on Page 4. **Functional unit** The functional unit is **one square meter** of floor covering. The amount of limestone needed to meet the functional unit is 18.20 kg.

#### Manufacturing data The data for all limestone products were collected from Polycor's limestone

quarries and processing facilities covering a period of two years: January 2020 to December 2021. Data for limestone quarry operations were collected from four quarry sites across North America and two quarries from France and grouped as North American limestone quarries and French

stone and all the manufacturing facilities are located in North America.

# quarries. Quarries in France are responsible for 5% of the total quarried

based on North American conditions.

After limestone is extracted from the quarry, it goes to a processing facility. Stone processor operations data were collected from three Polycor limestone processing sites across North America and grouped together as American limestone plants. • American limestone plants: three manufacturing facilities in Indiana. Data were collected from quarries and producers mainly operating in North

America (mainly the US). As such, the geographical coverage for this study is

Default installation, packaging, and disposal scenarios Flooring is delivered at the job site ready for installation, where minor cuts may be necessary to accommodate design. Ancillary materials used in the installation of the product include mortar, grout, and acrylate. These

materials are structural enhancement components used as bonding agents or fillers for joints. Wood and cardboard used as packaging to safely deliver

the stone to the site is then transported to be either landfilled or recycled, following US EPA's end of life scenarios for containers and packaging. At the

# end of its useful life, the flooring is removed and transported to be landfilled.

Material composition greater than 1% by weight **MATERIAL** AVG % WT. Limestone 100% Total impacts by life cycle stages [mPts/per func unit] 1.80E+00 LIFE CYCLE STAGE MPTS/FUNC. UNIT

Installation

Use

Quarry and processor operations

Stone transport to building sites

7.36E-01

1.46E-01

1.20E-01

8.10E-01

**+76**%

STONE TRANSPORT

**A4** Transport to

1.46E-01 mPts

transportation

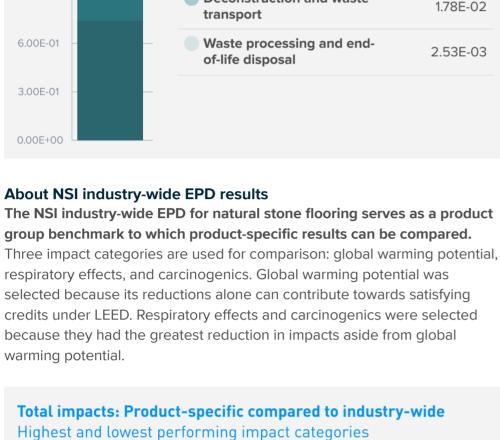
product to building site

used to transport

Truck

building sites

PERFORMANCE IMPROVEMENT



Carcinogenics (CTUh)

INDUSTRY POLYCOR

1.00E-06

8.00E-07

2.00E-07

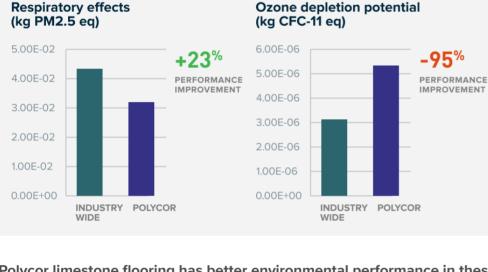
0.00E+00

#### 2.00E+01 6.00E-07

+19%

PERFORMANCE

IMPROVEMENT



**A3 Processor** \*Module D is excluded. operations

covering

**PRODUCTION** 

**OPERATIONS)** 

A1 Quarry

operations

processors

**A2** Transport to

7.36E-01 mPts

Energy consumed

during stone

Industry

8.53E-07

1.80E-06

2.75E-02

Industry

ISO 21930:2017 serves as the core PCR along with EN 15804 and SM Part

March, 2018. Document created by Joep Meijer, Naji Kasem, and Kim Lewis

SM Part B: Product group definition for Interior and exterior stone flooring,

rules for environmental product declarations of construction products and

Download PDF SM Transparency Report, which includes the additional EPD

SM Part A: Life Cycle Assessment Calculation Rules and Report

and is managed and maintained by the Sustainable Minds Technical

Advisory Board (TAB) as outlined in ISO 14025:2006.

2.77E+01

7.07E-07

1.24E-02

**Product** 

1.44E-

1.30E-

6.80E-

2.85E-

09

07

04

**Product** 

7.05E+00

Industry

5.06E-

4.57E-

2.39E-

1.00E-01

10

08

04

Industry

2.48E+00

#### results for all impact categories except eutrophication and respiratory effects. This study assessed a multitude of inventory and environmental

What's causing the greatest impacts

### indicators. In addition to the six major impact categories (global warming

All life cycle stages

potential, ozone depletion, acidification, smog, eutrophication, and fossil fuel depletion), additional impact categories have also been included. These six impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined, and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes. LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. Overall results are consistent with expectations for stone flooring's life cycles, with most of the impacts being generated during cradle-to-gate stages.

For limestone flooring, the cradle-to-gate stage (A1-A3) dominates the

highest contributor to most of the impact categories, followed closely by the maintenance stage. The transportation of stone from quarries to processing plants, transportation of flooring from processing plants to the installation sites, and use of mortar during installation also generate

at the processing plants. The processor operations (A3) stage is the

The primary finding, across the environmental indicators, was that cradle-

to-gate stage (A1-A3) dominates the impacts due to the energy consumed

significant impacts in the overall life cycle impacts of limestone flooring. **Quarry operations and transport to processors** Impacts generated at limestone quarries (A1) are mainly due to the use of grid electricity and fuels in the quarries. Other material inputs generate little impact in comparison to the electricity and fuel consumed. The transportation of limestone from quarries to processing plants generates insignificant impacts in overall life cycle impacts.

# greatest impact share in many of the impact categories. Energy

Processor operations and transport to building sites

consumed at processors (both electricity and fuels) is responsible for the majority of impacts, while other material inputs have an insignificant contribution. The transportation of limestone flooring manufactured in processor plants to the building sites also has a considerable impact on the overall life cycle impacts of limestone flooring.

Use of sealants for periodic resealing of limestone flooring and use of mortar during installation also generate significant contributions to the overall life cycle impacts. Under normal operating conditions, limestone

flooring requires not only monthly cleaning but also resealing every five years. Due to the nature of natural stone, it is anticipated that the limestone

flooring products will last for the lifetime of the building. The reference

replacements during its service life. End-of-life stages have lower

service life (RSL) thus meets an ESL of 75 years, and flooring will need no

published an industry-wide Type III EPD in which Polycor participated. It

Manufacturing operations at limestone processing plants make up the

## How our product compares to the industry benchmark Interpretation summary In November 2022, Natural Stone Institute (NSI)

improvement.

contributions to the total life cycle impacts.

Other life cycle stages

followed the SM PCR and SM Part B Benchmarking addendum that enables comparison of a product-specific EPD to the industry benchmark. The SM Part B benchmarking addendum requires the selection of the greatest improvement and lowest performing impact categories. Polycor limestone flooring LCIA results show environmental performance improvements across all impact categories evaluated in this study except for ozone depletion. The impact reductions primarily stem from A3. Differences in electricity and fuel consumption during fabrication operations contribute significantly when comparing Polycor to

industry-average results and identifying the contributors to performance

The lowest performing impact category (higher impact results than average) is ozone depletion. It is the only category where impacts were

greater than the industry average. Since non-granite stone flooring

requires re-sealing every five years, it was assumed that a silicone-based

sealing for limestone flooring was applied as part of regular maintenance.

The addition of the sealer contributed significantly when comparing Polycor to industry-average results. Other natural stone flooring manufacturers may or may not include this as part of their maintenance activities. Sensitivity analysis Based on the recommendation provided by Polycor, impacts for processor operations specific to a square meter of limestone flooring was assumed to match the average stone processing for a square meter of limestone. A sensitivity analysis was performed to check the robustness of the results

when the energy consumed during processing is varied by +/-20% from the

estimate used in this study. The resulting variation in the total life cycle

impacts is about 8%, implying that the system is not sensitive to this

Another parameter that affects the overall life cycle impacts is the

thickness of limestone flooring. The thickness of stone flooring studied

varied up to 2 inches. Results have been presented for a typical interior

conducted for various thicknesses of limestone flooring used for different

thickness of 0.5 inches, but as the functional mass of varies with the

thickness, the impacts also vary. A sensitivity analysis has thus been

# flooring applications. For the thickness of 2 inches and larger, the variation

40% by the end of 2025!

throughout its life cycle.

B1-B7

**B1** Use

**B3** Repair

**B2** Maintenance

**B6** Operational water use

8.10E-01 mPts

Sealants used for

periodic resealing.

**A5** Installation

1.20E-01 mPts

Use of ancillary

mortar) for

installation.

materials (mainly

assumed value.

in overall life cycle impacts is greater than 20%, implying that the system is sensitive to thickness value. Natural stone is one of the lowest embodied carbon construction materials. Although we are proud of this intrinsic quality, we want to make sure that we'll never stop improving it. Our main driver is our ambitious 2025 carbon neutrality pledge. By increasing the use of renewable energy, reducing our dependency on fossil fuels, electrifying our car fleet and increasing the energy efficiency

throughout our value chain, we aim to reduce our embodied carbon by

Beyond embodied carbon, Polycor only uses rainwater for stone

extraction, recycles it, and also uses dry sawing technology in a

growing number of quarry operations. In quarrying, production,

installation and maintenance, natural stone lowers water use

Polycor is the leader within the Natural Stone Sustainability Standard (ANSI 373) with 25% of our sites certified. This standard examines and verifies numerous areas of natural stone production, effectively improving the baseline for the environmental and social performance of natural stone in alignment with green building practices. See how we make it greener

AND WASTE TRANSPORT

**Deconstruction** 

1.78E-02 mPts

Waste transport to

the landfill

centers.

C2 Waste

transport

WASTE

DISPOSAL

C3 Waste

disposal

**Processing** 

C4 End of life

2.53E-03 mPts

Landfilling after

the end of life.

PROCESSING AND END-OF-LIFE

**B4** Replacement **B5** Refurbishment **B6** Operational energy use

LIFE CYCLE STAGE		A1-A3 PRODUC (QUARRY PROCESS OPERATI	AND SOR	TO BUILDI				B2 MAINTENANCE		C2 WASTE TRANSPORT		C4 END-OF-LIFE DISPOSAL	
Ecological o	lamage												
Impact category	Unit	Product	Industry	Product	Industry	Product	Industry	Product	Industry	Product	Industry	Product	Industry
Acidification	kg SO <sub>2</sub> eq	6.13E-02	1.07E-01	1.08E-02	3.81E-03	1.18E-02	1.18E-02	6.58E-02	4.20E-0	2 1.32E- 03	1.91E- 03	4.53E- 04	6.57E- 04
Eutrophication	kg N eq	7.40E-03	1.51E-02	1.46E-03	5.13E-04	6.91E-04	6.87E-04	2.82E-02	2.61E-02	1.77E- 04	2.57E- 04	4.44E- 05	6.42E- 05
Global warming (Embodied carbon)	kg CO <sub>2</sub> eq	9.18E+00	2.20E+01	3.46E+00	1.22E+00	2.56E+00	2.55E+00	7.28E+00	2.01E+0	01 4.21E-	6.10E- 01	4.70E- 02	6.80E- 02
Ozone depletion	kg CFC- 11 eq <sup>②</sup>	4.22E-07	1.13E-06	6.90E-07	2.43E-07	1.24E-07	1.22E-07	4.80E-06	1.51E-06	8.40E- 08	1.22E- 07	8.01E- 09	1.16E- 08

**Product** 

1.70E-

1.97E-07

1.07E-

1.70E-01

03

**Product** 

2.46E+00

80

Industry

1.70E-

1.97E-07

1.07E-

1.69E-01

03

Industry

2.44E+00

08

**Product** 

9.90E-

1.06E-

1.96E-

8.74E-01

**Product** 

2.00E+01

**Environmental product declarations** 

**Option 2: Multi-attribute optimization** 

Industry-wide (generic) EPD

✓ Product-specific Type III EPD

✓ Product-specific Type III EPD

✓ Product-specific Type III EPD

**Option 1: Environmental Product Declaration** 

80

06

02

Industry

5.30E-

5.65E-

1.49E

5.58E-

Industry

1.06E+01

80

07

02

01

**Product** 

1.75E-10

1.58E-

8.28E-

3.47E-

**Product** 

8.58E-

80

05

02

Industry

2.54E-

2.29E-

1.20E-

5.02E-

Industry

1.24E+00

10

80

04

02

**Product** 

1.38E-11

5.44E-

5.88E-

1.37E-02

**Product** 

9.95E-

10

05

Industry

1.99E-11

7.88E-10

8.52E-

1.98E-

Industry

1.44E-

½ product

1 product

1 product

1.5 products

05

02

#### kg PM<sub>2.5</sub> effects eq kg O<sub>3</sub> eq 1.61E+00 2.46E+00 **Smog**

Additional environmental information

MJ, LHV

**Product** 

1.62E+01

CTU<sub>h</sub>

ee the additional  References	CTU <sub>e</sub> 2	45.5 % required by	72.7 % / the SM Pa	7.9 % art B for inte	2.0 %	2.4 %	1.8 %	43.2 %	22.4 %	1.0 %	1.0 %	0.0 %	0.0 9
	l content	required by	y the SM Pa	ırt B for inte	arior and ev								
	l content	required by	y the SM Pa	rt B for inte	rior and ev								
Deferences					chor and ex	terior stone	flooring on	page 4 of tl	ne <b>Transpa</b>	rency Rep	oort PDF.		
Deferences													
References							Rating sy	<b>ystems</b>					
LCA Background		oring I CA I	Daalearaune	d Donart (n.	ublic version	۵)	The intent is to reward project teams for selecting products from						
Polycor Natural S Polycor 2023. Sin		•	Ü			1),	manufactur performanc		ve verified	improved	life-cycle e	environme	ntal
PCRs							Building pro						

Building product disclosure and optimization April, 2022. Part B review conducted by the Sustainable Minds TAB, **Environmental product declarations** tab@sustainableminds.com **Option 1: Environmental Product Declaration** ISO 14025, "Sustainability in buildings and civil engineering works -- Core ( ) Industry-wide (generic) EPD

Product-specific Type III EPD SM Transparency Reports (TR) are ISO 14025 Type III environmental declarations (EPD) that enable purchasers and users to compare the potential environmental performance of products

sufficiently align to support direct comparisons. They therefore, cannot be used as comparative assertions unless the conditions defined in ISO 14025 Section 6.7.2. 'Requirements for Comparability' are satisfied. Comparison of the environmental performance of building envelope thermal insulation using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under the PCR. Full conformance with the PCR for stone flooring allows EPD comparability only when all stages of a life cycle have been considered, when they comply with all referenced standards, use the same sub-category PCR, and use equivalent scenarios with respect to construction works. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI data sets may lead to different results upstream or downstream of the life cycle stages declared.

#### The comparative analysis must show impact reduction(s) of at least 10% in the global warming potential (GWP) impact category relative to baseline and includes a narrative describing how the impact reductions were achieved.

**Option 2. Embodied Carbon/LCA Optimization** 

LEED BD+C: New Construction | v4.1 - LEED v4.1

**BREEAM New Construction 2018** Mat 02 - Environmental impacts from construction products **Environmental Product Declarations (EPD)** 

Industry average EPD .5 points Multi-product specific EPD .75 points ✓ Product-specific EPD 1 point

#### **SUMMARY** declaration (EPD) was externally **Reference PCR** verified, according to ISO

Validity: 2023/02/13 - 2028/02/13 Decl #: POL - 20230213 - 002

Transparency Report (EPD)

3rd-party reviewed

3rd-party verified

14025:2006, by Jack Geibig, President, Ecoform.

21930:2017, SM Part A, and ISO

Regions; system boundaries North America; Cradle to grave

Functional unit / reference service life: 1 m<sup>2</sup> of floor covering; 75 years LCIA methodology: TRACI 2.1 LCA software; LCI database SimaPro Developer 9.4

**Public LCA:** 

1.50E+00

1.20E+00

9.00E-01 **Deconstruction and waste** 

#### 1.50E+01 4.00E-07 1.00E+01

INDUSTRY POLYCOR

Global warming (kg CO2 eq)

3.00E+01

2.50E+01

5.00E+00

0.00E+00



manufacturer participating in the industry average.

**LCA results** LIFE CYCLE STAGE

Excluded\* (MND)

Information modules: Included (X)

Stages B1, B3-B7, C1, and C3 though

included, have no associated activities.

# **SM Single Score** Learn about SM Single Score results Impacts of 1 square meter of floor

processing cycle stage (electricity and fuels). TRACI v2.1 results per functional unit

Materials or processes contributing

>20% to total impacts in each life

# Human health damage Impact category **Product** CTU<sub>h</sub> Carcinogenics 1.07E-07

Ecotoxicit	y
See the ad	dition
Refere	nces
LCA Back Polycor N Polycor 2	latura
PCRs	

A.

2022

Non-

carcinogenics

Respiratory

Impact category

Fossil fuel

services"

content required by the SM Part B.

Requirements, v2018

on a life cycle basis. They are designed to present information transparently to make the limitations of comparability more understandable. A limitation to this study is that not all manufacturers in North America participated. TRs/EPDs of products that conform to the same PCR and include the same life cycle stages, but are made by different manufacturers, may not

SM Transparency Report (EPD)™ - LEED 4.1 EPD Option 2. Optimization **VERIFICATION** LCA This environmental product

> **Ecoform, LLC** 11903 Black Road, Knoxville, TN 37932 (865) 850-1883

Ecolnvent 3.8, US-El 2.2

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LCA conducted by: Sustainable Minds

76 rue Saint-Paul, Suite 100

Quebec City (Quebec), Canada G1K 3V9

1.5 products

Polycor Inc.

418-692-4695

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Collapse all



### How we make it greener

See LCA results by life cycle stage

**Limestone Floor and Pavers** 

RAW MATERIALS ACQUISITION

Natural stone quarrying process has high yields and little excess material because the stone is close to surface. It's different from metal mining, where large amounts of earth must be removed to extract very little quantities. Also, underground quarrying, which has been perfected for generations at our Eureka Quarry, reduces land use and is a practice that Polycor wishes to extend to several quarries.

In addition, few consumables are needed to extract natural stone. Contrast that with other building materials, Polycor specifically focuses on sourcing the highest grades of natural stone so that, for instance, a black granite stone, doesn't need dyes to achieve its rich color.

From the bedrock to the point of sale, Polycor maintains an unbroken ownership of the supply chain allowing it to maintain standards of quality and practice.



#### TRANSPORTATION

Using stone from local sources is the single biggest opportunity to reduce its embodied carbon. Since natural stone is a heavy material, the environmental impacts for transporting it end up being one of its most significant source of carbon. Natural stone is sourced world-wide and each deposit has unique aesthetic and performance characteristics so this is not always avoidable. Be sure to understand the distances between the quarry, the processing facility, sometimes the distribution centers but also the transportation mode. In most of Polycor's operations, the quarry is within miles of the processing facility.



#### MANUFACTURING

Manufacturing natural stone is so simple that you can sumarize it by a single action, cutting. Cutting large piece into smaller pieces ending in a finished product. Also, the beauty of natural stone products is that there is no chemical mixed within our products. Therefore, they are inherently a non-emitting source of VOCs.

Recycling water is reused several times into the manufacturing process and is compulsory to achieve ANSI 373 Standard.

There are a large variety of sizes and finishes that are commonly used for natural stone. Design teams can help reducing energy consumption in the following ways: Usage of low embodied carbon finishes such as water jet, 3D analysis to loose as few stone as possible troughout it's transformation, accepting the natural variation in the material so there is more usable material.



## OTHER (USE, END OF LIFE)

Whether you think of the Egyptian pyramids, the Colosseum of Rome, the cathedrals of the European capitals or closer to us; the famous Empire State building; natural stone is the most durable, classic and timeless building material on Earth. With 100+ years of durability, natural stone lasts longer than other building construction material and projects that use natural stone require less maintenance.

Since we don't use any chemicals, natural stone products as well as excess process materials throughout the extraction and transformation phases can be reused or recycled into gravel for roads, landscaping products and even furniture and jewelry. In short, natural stone can be reused and recycled multiple times during its life cycle; the only limit is your imagination!

Nevertheless, even if natural stone ends up in a construction landfill, there will be no toxic chemicals seeping into the earth as the material degrades. It simply returns to the earth, cradle to cradle.



## SM Transparency Report (EPD)™ - LEED 4.1 EPD Option 2. Optimization

**VERIFICATION** 

3rd-party reviewed

LCA

Transparency Report (EPD)

3rd-party verified

Validity: 2023/02/13 - 2028/02/13 Decl #: POL - 20230213 - 002

This environmental product declaration (EPD) was externally verified, according to ISO 21930:2017, SM Part A, and ISO 14025:2006, by Jack Geibig, President, Ecoform.

Ecoform, LLC 11903 Black Road, Knoxville, TN 37932

(865) 850-1883



#### **SUMMARY Reference PCR**

Regions; system boundaries

North America; Cradle to grave

Functional unit / reference service life:

1 m<sup>2</sup> of floor covering; 75 years LCIA methodology: TRACI 2.1

LCA software; LCI database

SimaPro Developer 9.4 EcoInvent 3.8, US-EI 2.2

**LCA conducted by:** Sustainable Minds

# Polycor Inc.

76 rue Saint-Paul, Suite 100 Quebec City (Quebec), Canada G1K 3V9 418-692-4695

Contact us

### Additional EPD content required by: SM Part B: Interior and Exterior Stone Flooring EPD Requirements

#### Data

Background This product-specific declaration was created by collecting data for one square meter of limestone floor covering. Material and production inputs from each quarry and processor site were used to calculate weighted averages of those inputs based on the production share of the site.

Allocation The allocation methods used were examined according to the updated allocation rules in ISO 21930:2017. Quarry inputs and outputs were divided evenly among the quarried limestone by mass, and no co-product allocation was needed. Similarly, no co-product allocation was required for processor operations as well since processing data was collected from Polycor's processing plants specific to limestone. The processor inputs and outputs were divided evenly among the processed stone by area.

Cut-off criteria for the inclusion of mass and energy flows are 1% of renewable primary resource (energy) usage, 1% nonrenewable primary resource (energy) usage, 1% of the total mass input of that unit process, and 1% of environmental impacts. The total of neglected input flows per module does not exceed 5% of energy usage, mass, and environmental impacts. No known flows are deliberately excluded from this declaration. Biogenic carbon is included in reported results.

Quality Primary data was collected for a time period of two years, which represents typical operations of Polycor's limestone quarry and processors across North America. Inventory data is considered to have a good precision and provide a representative depiction of the industry average. Data is also considered to be complete as no know flows are deliberately excluded from this analysis other than those defined to be outside of the system boundary. Proxy and generic datasets have been used for some materials and processes, but are considered to be  $% \left\{ 1,2,\ldots,n\right\}$ sufficiently representative.

**Quarry and Manufacturing Plant information** 

Data Group	Quarry location(s)				
North American Limestone Quarries	Adams Quarry, Bloomington, IN Empire Quarry, Oolitic, IN Eureka Quarry, Bedford, IN Victor Quarry, Bloomington, IN				
French Limestone Quarries (5% of the total quarried stone)	Massangis Quarry, Massangis, France Rocherons Quarry, Corgoloin et Comblanchien, France				
Data Group	Manufacturing Plant location(s)				
	Empire Plant, Oolitic, IN Eureka Plant, Bedford, IN Victor Plant, Bloomington, IN				
North American Limestone Plants	Eureka Plant, Bedford, IN				

Parameter	Unit	Test Method	Value
CSI Masterformat classification	09 30 33; 09 63	40; 32 14 40	
Stone type	Limestone		
Stone grades	All grades		
Thickness to achieve functional unit	mm		12.70
Product weight	kg		18.20
Density	kg/m <sup>3</sup>		2307
Flexural strength	Мра	C880	3.45
Modulus of rupture	MPa	C99	2.76
Compressive strength	MPa	C170	12.41
Thermal conductivity	W/m.k	C518	1.26
Thermal resistance	m.K/W	C518	0.79
Liquid water absorption	% of dry wt	C97	10-15
Major system boundary	exclusions		

# • Capital goods and infrastructure,

- Maintenance and operation of support equipment;
- Human labor and employee transport;
- Building operational energy and water use not associated with final product.

• Manufacture and transport of packaging materials not associated with final product;

5/16"

0.625

1/2"

1.0

- **Production flow chart**

#### Stone Quarrying — Use of explosives, power drills,

power saws, diamond belts etc. — stone blocks extracted from natural rock layers. Stone transport from quarries to processing facilities

Stone Processing — Stone blocks go through block saws,

**Scaling factors** 

**Conversion factor** 

Renewable secondary fuels

Non-renewable secondary

Hazardous waste disposed

Recovered energy

fuels

MJ, LHV

MJ, LHV

MJ, LHV

Output flows and waste category indicators (per m<sup>2</sup> of limestone flooring)

4.15E-03

**Thickness** 

stone blocks processed to stone flooring and paving products.

saw slabs, bridge saws etc.-

# Scenarios and additional technical information

### **Transport from Quarry to Processor (A2)**

Based on the primary data, the transport distance between Polycor's limestone quarry and processing facilities varies, & the weighted distance is 36 km.

## Transport to the building site (A4)

Parameter	Value	Unit
Vehicle type	Lorry, 16-32 to	on
Fuel type	Diesel	
Liters of fuel	0.41	l/100 km
Distance from manufacturer to installation site	800	km (per PCR)
Capacity utilization (mass based)	100	%
Gross density of products transported	2,207	kg/m <sup>3</sup>
Capacity utilization volume factor	1	

#### Based on EPA's 2018 data, it has been assumed that 37% of all packaging will be landfilled, with the rest recycled.

Installation scrap assumed

Packaging scenario assumptions

Installation into the building (A5)

It is assumed that flooring fabrication (cutting and finishing to required size) is done at the processing plants and is typically delivered to the job site ready for installation. For the minor changes necessary to accommodate changes, we have considered the use of manual equipment like hackshaws, tile cutters, handle, chisels, tile nippers etc.

Ancillary materials -	Mortar	4.07	
	Grout	0.21	kg
	Acrylate	0.04	
Net freshwater consumption		0.0004	$m^3$
Electricity consumption		0	kWh
Product loss per functional unit (scrap)	0.91	kg	
Waste materials at the construction site be processing (stone scrap and packaging was	1.86	kg	
Output materials from on-site waste proce	0	kg	
Mass of packaging waste by type	Cardboard Wood	0 2.53	kg
Biogenic carbon contained in packaging		4.64	kg CO <sub>2</sub>
Direct emissions to ambient air, soil and w	ater	0	kg
VOC emissions		0	μg/m³
Transport distance for both stone scrap ar waste (Diesel-powered truck/trailer)	nd packaging	161	km

Maintenance process information	Cleaning and resealing the surface of limestone flooring					
Maintenance cycle	Monthly cleaning (900 cycles per RSL & ESL) Sealing every 5 years (14 cycles per RSL & ESL)					
Net freshwater consumption - municipal water supply	0.09 (for entire lifetime)	m <sup>3</sup>				
Ancillary materials - Soar Sealan	,	kg kg				
Energy input during maintenance	Not necessary					
Reference service life informat	ion					

Reference Service Life (RSL)

Assumptions for

Maintenance scenario parameters

Design application parameters	Outdoor and indoor applications
Outdoor environment	Installation as recommended by manufacturer.
Indoor environment	Installation as recommended by manufacturer.
Use conditions	All conditions
End of life (C1-C4)	

The product is dismantled and removed from the building

75

years

5"

10.0

0

0

0

2.10E+01

4.15E-03

0

0

0

0

Assumptions for scenario development	manually. It is transported to a local no further processing before final di				
Collection process	Collected separately	0	kg		
	Collected with mixed construction waste	22.27	kg		
Recovery	Reuse	0	kg		
	Recycling (0%)	0	kg		
	Landfill (100%)	22.27	kg		
Waste transport		161	km		
Final disposal		22.27	kg		
Removals of biogenic car	0	kg CO <sub>2</sub>			
Hazardous waste					

#### as hazardous according to the Resource Conservation and Recovery Act (RCRA), Subtitle C.

Calcination CO<sub>2</sub> emissions Although calcination and carbonation is not relevant to limestone flooring products, calcination occurs during installation stage due to the use of mortar.

Polycor's limestone flooring does not contain substances that are identified

#### separately using a carbon intensity factor of 886 ${\rm CO}_2$ per ton of cement (Source: U.S. Cement Industry Carbon Intensities (2019).

1 1/2"

3.0

The results presented below have been reported for a flooring thickness of 0.5 inches. However, they may be scaled according to different thicknesses as desired using scaling factors. To calculate the results for additional thickness options, simply multiply the results by the corresponding conversion factor presented here:

8.0

2"

4.0

Mortar includes cement calcination  ${\rm CO_2}$  emissions which is calculated & reported

#### Parameter Unit A4 A5 B2 B3-B7 C1 C2 C3 C4 **Total** LCIA results (per m<sup>2</sup> of limestone flooring)

LCIA results, resource use, output & waste flows, carbon emissions & removals per m<sup>2</sup> of limestone flooring

3/4"

1.5

Ozone depletion	kg CFC-11 eq	4.22E-07	6.90E-07	1.24E-07	0	4.80E-06	0	0	8.40E-08	0	8.01E-09	6.13E-06
Global warming	kg CO2 eq	9.18E+00	3.46E+00	2.56E+00	0	7.28E+00	0	0	4.21E-01	0	4.70E-02	2.29E+01
Smog	kg O3 eq	1.61E+00	2.85E-01	1.70E-01	0	8.74E-01	0	0	3.47E-02	0	1.37E-02	2.99E+00
Acidification	kg SO2 eq	6.13E-02	1.08E-02	1.18E-02	0	6.58E-02	0	0	1.32E-03	0	4.53E-04	1.52E-01
Eutrophication	kg N eq	7.40E-03	1.46E-03	6.91E-04	0	2.82E-02	0	0	1.77E-04	0	4.44E-05	3.80E-02
Carcinogenics	CTUh	1.07E-07	1.44E-09	1.70E-08	0	9.90E-08	0	0	1.75E-10	0	1.38E-11	2.25E-07
Non-carcinogenics	CTUh	7.70E-07	1.30E-07	1.97E-07	0	1.06E-06	0	0	1.58E-08	0	5.44E-10	2.17E-06
Respiratory effects	kg PM2.5 eq	1.24E-02	6.80E-04	1.07E-03	0	1.96E-02	0	0	8.28E-05	0	5.88E-05	3.39E-02
Ecotoxicity	CTUe	45.52%	7.9%	2.4%	0%	43.2%	0%	0%	1.0%	0%	0%	100%
Fossil fuel depletion	MJ surplus	1.62E+01	7.05E+00	2.46E+00	0	2.00E+01	0	0	8.58E-01	0	9.95E-02	4.66E+01
Resource use indicator	Resource use indicators (per m <sup>2</sup> of limestone flooring)											
Renewable primary energy used as energy carrier (fuel)	MJ, LHV	5.55E+01	7.21E-02	1.48E+00	0	2.07E+02	0	0	8.78E-03	0	1.35E-03	2.64E+02
Renewable primary resources with energy content used as material	MJ, LHV	1.72E+01	0	0	0	0	0	0	0	0	0	1.72E+01
Total use of renewable primary resources with energy content	MJ, LHV	7.28E+01	7.21E-02	1.48E+00	0	2.07E+02	0	0	8.78E-03	0	1.35E-03	2.81E+02
Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	1.92E+02	4.64E+01	2.35E+01	0	1.94E+02	0	0	5.65E+00	0	6.58E101	4.62E+02
Non-renewable primary resources with energy content used as material	MJ, LHV	7.38E-02	0	0	0	0	0	0	0	0	0	7.38E-02
Total use of non-renewable primary resources with energy content	MJ, LHV	1.93E+02	4.64E+01	2.35E+01	0	1.94E+02	0	0	5.65E+00	0	6.58E101	4.62E+02
Secondary materials	kg	0	0	0	0	0	0	0	0	0	0	0

#### Use of net fresh water 5.50E+00 7.86E-03 2.10E+00 1.34E+01 0 1.15E-04 9.57E-04 resources

0

0

0

0

0

0

0

0

0

0

Non-hazardous waste disposed	kg	8.19E-02	0	2.69E+00	0	0	0	0	0	0	1.91E+01	2.19E+01
High-level radioactive waste, conditioned, to final repository	kg	8.33E-03	3.77E-06	3.10E-04	0	2.11E-03	0	0	4.59E-07	0	7.06E-08	1.08E-02
Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	3.58E-05	3.96E-08	5.84E-07	0	1.26E-06	0	0	4.82E-09	0	7.44E-10	3.77E-05
Components for re-use	kg	0	0	0	0	0	0	0	0	0	0	0
Materials for recycling	kg	4.62E+01	0	2.35E+00	0	0	0	0	0	0	0	4.86E+01
Materials for energy recovery	kg	0	0	0	0	0	0	0	0	0	0	0
Exported energy	MJ, LHV	0	0	0	0	0	0	0	0	0	0	0
		_										

Carbon emissions and removals (per m <sup>2</sup> of limestone flooring)												
Biogenic carbon removal from packaging	kg CO <sub>2</sub>	4.65E+00	0	2.32E-01	0	0	0	0	0	0	0	4.88E+00
Biogenic carbon emission from packaging	kg CO <sub>2</sub>	0	0	3.53E+00	0	0	0	0	0	0	0	3.53E+00
Biogenic carbon emission from combustion of waste from renewable sources used in production processes	kg CO <sub>2</sub>	0	0	0	0	0	0	0	0	0	0	0
Calcination carbon emissions	kg CO <sub>2</sub>	0	0	1.01E+00	0	0	0	0	0	0	0	1.01E+00
Carbon emissions from combustion of waste from non-renewable sources used in production processes	kg CO <sub>2</sub>	0	0	0	0	0	0	0	0	0	0	0