

Environmental Product Declaration

Lightweight Blocks with Glass Powder - Milton Plant (Ontario)



Permacon



Permacon is pleased to present this environmental product declaration (EPD) for Lightweight blocks. This EPD was developed in compliance with CAN/CSA-ISO 14025 and has been verified by Lindita Bushi, Athena Sustainable Materials Institute.

The LCA and the EPD were produced by Vertima. The EPD includes cradle-to-gate life cycle assessment (LCA) results.




For more information about Permacon, please go to <http://www.permacon.ca/home>.

For any explanatory material, in regards to this EPD, please contact the program operator.

EPDs from different programs may not be comparable.

1 GENERAL INFORMATION

PROGRAM OPERATOR	CSA Group 178 Rexdale Blvd, Toronto, ON, Canada M9W 1R3 www.csagroup.org
PRODUCT	Lightweight Blocks with Glass Powder - Milton Plant (ON)
EPD REGISTRATION NUMBER	8187-4735
EPD RECIPIENT ORGANIZATION	Permacon 8140, rue Bombardier, Anjou (Québec), H1J 1A4, CANADA (514) 351-2120 http://www.permacon.ca/ 
REFERENCE PCR	Product Category Rules (PCR) For Preparing an Environmental Product Declaration for: Manufactured Concrete and Concrete Masonry Products ASTM International December, 2014 to November, 2019 UN CPC 3755 cert@astm.org
DATE OF ISSUE	November 28, 2017
PERIOD OF VALIDITY	November 28, 2022
CONTENT OF THE EPD	Product System Description
	LCA Calculation Rules
	LCA Results and Interpretation
	Additional environmental information
	References
The PCR review was conducted by:	Nicholas Santero, PE International (Chairperson) Christine Subasic, Consulting Architectural Engineer Juan Tejeda, ORCO Block Company
The LCA and EPD were prepared by:	Vertima Inc. www.vertima.ca

This EPD and related data were independently verified by an external verifier, Lindita Bushi, according to CAN/CSA-ISO 14025:2006 and ISO 21930:2007.



Lindita Bushi, Athena Sustainable Materials Institute

2 DESCRIPTION OF PERMACON

For over sixty years, Permacon, pioneer, innovator and champion of growth, has been Canada's largest producer of concrete products. Offering an evolving line of over 1000 masonry and landscaping products, Permacon helps diversify and adorn the outdoors of residential, institutional, commercial and industrial environments.

3 DESCRIPTION OF PRODUCT

Concrete blocks are defined in ASTM C1232 as manufactured masonry unit made of concrete in which the binder is a combination of water and cementitious materials. Lightweight blocks are loadbearing units. Physical properties are in compliance with the requirements of the CSA A165.1-04 Concrete block masonry units' standard and present a compressive strength of 22 MPa after 28 days.

LW blocks exist in various dimensions. Their length is equal to 390 mm and they can be 90 or 190 mm high. Width varies between 40 mm and 290 mm. They might be 100% solid or include empty space (hollow block). They are only available in grey color.

(See: http://www.permaconpro.ca/products.html?product_id=352&lang=en&z=Standard)

Lightweight blocks include post consumer glass powder in replacement of 10% of the Portland cement from the original recipe.

They are produced at Permacon manufacturing plant located in Milton, Ontario. Milton manufacturing plant address is 8375 5th Side Road, Milton, Ontario, L9T 2X7, CANADA.

Raw materials inputs are detailed in table 1.

Table 1: Material composition of 1 m³ of Lightweight blocks

Materials	Lightweight block	
	Amount (kg)	Proportion
Portland Cement	193.51	11.1%
GGBFS* (Slag cement)	1093.76	62.5%
Stone dust	336.54	19.2%
Glass powder	67.31	3.8%
Admixtures	0.82	0.05%
Water	58.05	3.3%

TOTAL	1750	100%
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* Ground Granulated Blast Furnace Slag

4 SCOPE OF EPD

Reference flow and declared unit

The selected declared unit for this study is **1 m³ of concrete formed into manufactured concrete masonry products.**

Lightweight blocks have a density of 1750 kg/m³. They are available in a wide number of dimensions. Therefore, the reference mass is 1750 kg of product.

System boundaries

This EPD focuses on a Cradle-to-Gate life cycle impact assessment (LCIA) of Lightweight blocks. Therefore, three (3) life cycle stages are considered, namely A-1) Raw materials acquisition, A-2) Raw materials transportation to the manufacturing plant, and, A-3) blocks manufacturing. Figure 1 illustrates the process flow diagram. The following stages are not included: construction process, use and end-of-life.

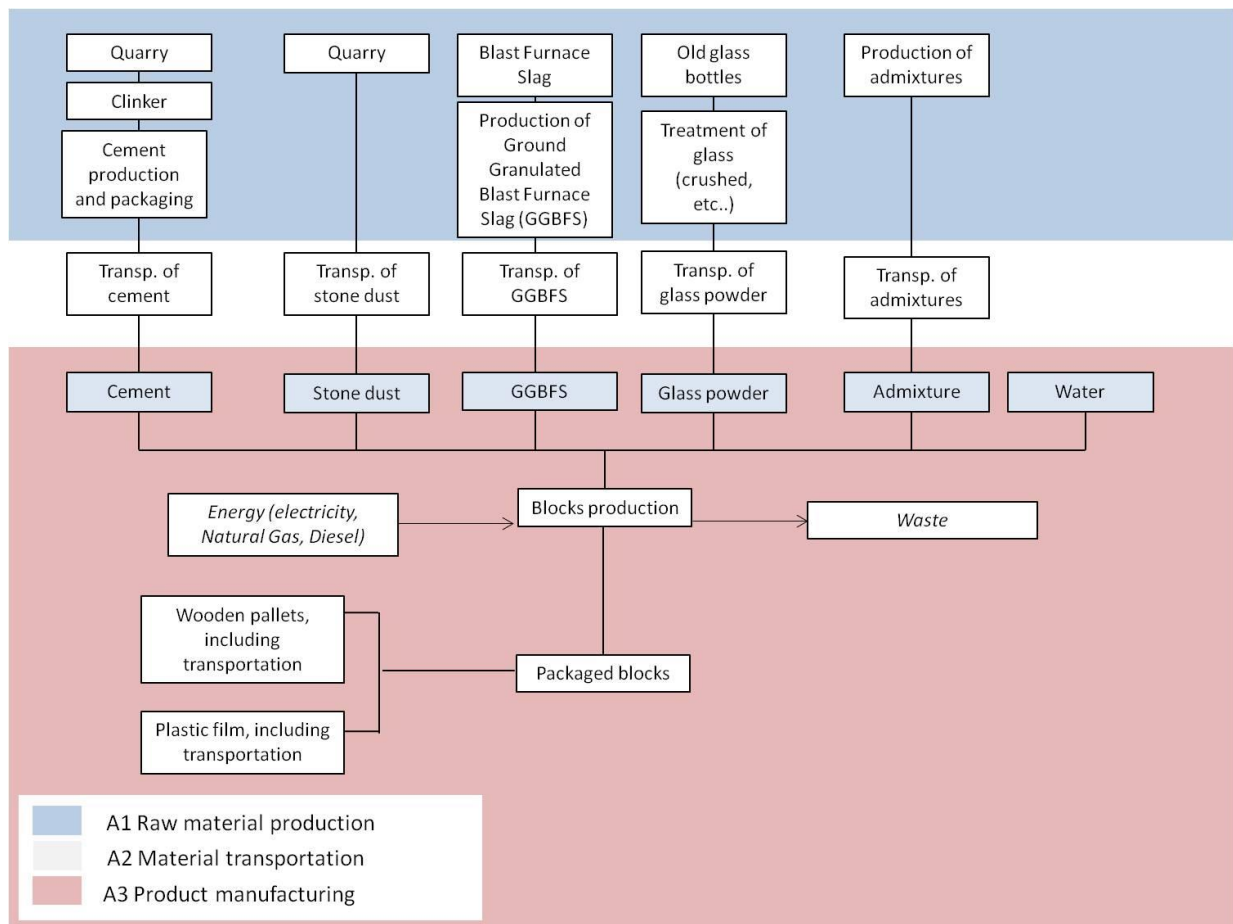


Figure 1: System boundaries for Lightweight blocks - Cradle-to-Gate LCA

Raw materials acquisition: this includes the extraction from the quarry, the crushing of stone for stone dust production, the production of clinker and Portland cement, the production of Ground Granulated Blast Furnace Slag (GGBFS) from Blast Furnace Slag (BFS) through a (i) quenching, (ii) dewatering and/or drying, (iii) crushing and (iv) grinding process, the production of admixtures as well as the glass collection and production of glass powder. Water consumption at plant is mainly linked to water inputs in products' recipe, and is considered negligible for other activities (e.g. employees' needs). Therefore, water is also included in the raw materials stage.

Raw materials transportation: this step includes the transportation of raw materials from Permacon's suppliers to the Milton manufacturing plant.

Blocks manufacturing: this step includes the energy requirements (electricity, heat) and emissions to the environment related to the manufacturing of the product, including batching and mixing of the concrete, forming units, curing of units, and applicable post-production finishing of units. Lightweight blocks manufacturing generate between 2% and 12% scrap, depending on their size, with a weighted average of 3.1% (mass). This loss of material is considered as waste. This step also includes packaging materials to make the products ready for shipment, as well as the transportation of these materials to Permacon's manufacturing plant.

Calculation method

The OpenLCA software v1.6, an open source software, was used to calculate the inventory and to assess potential environmental impacts associated with the inventoried inputs and outputs.

Data sources

Inventory data was collected from the Permacon manufacturing plant located in Milton, ON, using a LCI questionnaire. Inventory data included both the total annual mass of products from Milton plant and the total annual mass of the products under study, the yearly number of production cycles at plant, as well as the yearly number of production cycles of the products under study, the amount of raw materials entering the manufacturing of Lightweight blocks, losses of these materials, distances and transportation mode for the raw materials supply, energy consumption, emissions to the environment, water consumption, and materials needed for packaging.

Data related to energy, materials and waste needed to produce glass powder from post-consumer materials was collected directly from Permacon's suppliers.

Data used to model Admixtures was taken from the European Federation of Concrete Admixtures Associations' EPDs for Concrete admixtures (2015).

When primary data was not available, the unit processes were selected either from the *ecoinvent* v3.3 database, one of the most comprehensive LCI databases currently available, or from the US LCI database, that is specific to the North American context. When necessary, the electricity grid mix of unit processes has been adapted to specific contexts (Quebec or Ontario).

Data quality

This study is specific to a particular manufacturer: Permacon. The primary data, mostly obtained from the manufacturer, is representative of the current technologies and materials used by the company. As

primary data was collected directly from the only plant where Lightweight blocks are manufactured, it can be stated that it is 100% representative of the technologies in use and of the geographical areas.

Primary data was also collected from one of Permacon's suppliers, concerning glass powder production. Data related to raw materials and transportation distances is from 2016. Data related to energy consumption at plant and packaging materials had already been collected for previous LCAs, and are therefore from 2014.

Secondary data was used only for upstream processes. For some processes, the *ecoinvent* database provided representative data for a Canadian context. These processes were used in priority. When necessary, the electricity grid mix was changed for the electricity grid mix of the province where the production takes place.

When *ecoinvent* processes were not available for a North American context, processes were taken from the US LCI database.

Allocation

Data relative to energy consumption (electricity, heat) was provided for the whole manufacturing plant. ISO 14040 allocation procedure states that, whenever possible, allocation should be avoided by collecting data related to the process under study or by expanding the product system. In the present case, data was provided by the manufacturing plant as a total value, and not specifically for Lightweight blocks.

According to ISO 14040, step 2 consists of partitioning the inputs and outputs between the different products in a way that reflects the physical relationship between them.

This manufacturing plant produces various concrete masonry blocks. These blocks are produced by batch, through a production cycle that produces a variable number of blocks, depending on their size.

A production cycle starts when ingredients are introduced into the mixer. Once the batch is mixed, a mold is introduced in the mixture to form the products. A pestle ensures that the mixture is well compacted, by inducing a vibration to the system. After compaction, the pestle and the mold are pulled up, and the batch is ejected on a conveyor to be conveyed to curing chambers. At the exit of the curing chamber, the batch of product is placed on a pallet to be packaged. Therefore, a theoretical assumption is that, in a given plant, the energy spent for the manufacturing of blocks of all types is the same for all production cycles, not matter the variations in the mass of block produced, or in the size of blocks. The difference in their economic value is less than a factor of 10. Therefore, allocation was performed on the basis of the yearly number of cycles to estimate the share of the total energy that can be assigned to each product.

Cut-off methodology

According to the PCR, if a mass flow or energy flow represents less than 1% of the cumulative mass or energy flow of the system, it may be excluded from system boundaries. However, these flows should not have a relevant environmental impact. Also, at least 95% of the energy usage and mass flow shall be included. In the present study, no primary data (input material, energy consumption) was excluded from the system boundaries. Water consumption was assumed to be 100% dedicated to product manufacturing, i.e. used in finished product.

Exclusions

No data on the construction, maintenance or dismantling of the capital assets, daily transport of the employees, office work, business trips and other activity from Permacon employees was included in the model. The model only takes into account processes associated with infrastructures that are already included in *ecoinvent* modules. Water consumption at plant for other purposes (e.g. employees' needs) was excluded from the study.

5 ENVIRONMENTAL IMPACTS

The five impact indicators required by the PCR, namely global warming potential (GWP), acidification potential, eutrophication potential, smog creation potential and ozone depletion potential were calculated using the TRACI 2.1 impact assessment methodology developed by U.S. EPA.

Always in accordance with the PCR, Table 2 presents the LCIA results for 1 m³ of Lightweight blocks using TRACI methodology, as well as total primary energy consumption (HHVs), consumption of renewable and non-renewable materials, fresh water consumption, and waste generation.

Table 2: LCIA results for 1 m³ of Lightweight blocks

Environmental indicator	Unit	Value
Ozone depletion potential	kg CFC-11 eq	1.57E-05
Global Warming Potential	kg CO ₂ eq	480
Smog creation potential	kg O ₃ eq	20.2
Acidification potential	kg SO ₂ eq	2.35
Eutrophication potential	kg N eq	0.37
<i>Primary energy consumption - (HHVs)</i>		
Renewable (solar, wind, hydroelectric, and geothermal)	MJ	237
Renewable (biomass)	MJ	39
Non-renewable nuclear	MJ	1462
Non-renewable fossil	MJ	2262
<i>Resources consumption</i>		
Non-renewable materials	kg	734
Renewable materials	kg	19.9
Fresh water	L	1995
<i>Waste generated</i>		
Non-hazardous	kg	274
Hazardous	kg	0.026

Interpretation

This LCA showed that raw materials acquisition is the stage with the highest environmental impacts. Portland cement production is the largest contributor to the total impacts for EP (60%) and POCP (55%). Portland cement also contribute to 40% of the AP, 36% of the GWP and 18% of the ODP. GGBFS production is the largest contributor to AP (45%), GWP (53%) and ODP (62%). It also contributes to 27% of the EP and 9% of the POCP.

Portland cement's impacts are mainly caused by the production of clinker. GGBFS's impacts on ODP are mainly caused by the use of natural gas. Impacts on AP and GWP come from substances emitted to the environment during the quenching, crushing and grinding of BFS for GGBFS production (Carbon dioxide, methane, SO_x, and NO_x mainly).

Figure 2 and Figure 3 present the relative contribution of raw materials acquisition, transportation and product manufacturing to the LCIA impacts, and to energy consumption. Raw materials acquisition is the main contributor to the environmental impacts and energy consumption (>70%).

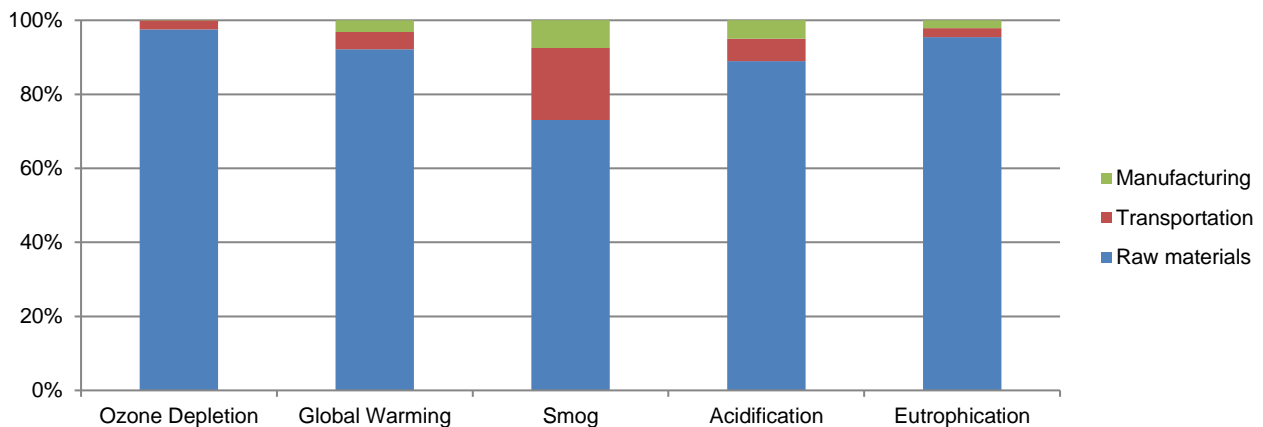


Figure 2: Contribution of life cycle stages to the environmental impacts of 1m³ of Lightweight block, TRACI indicators

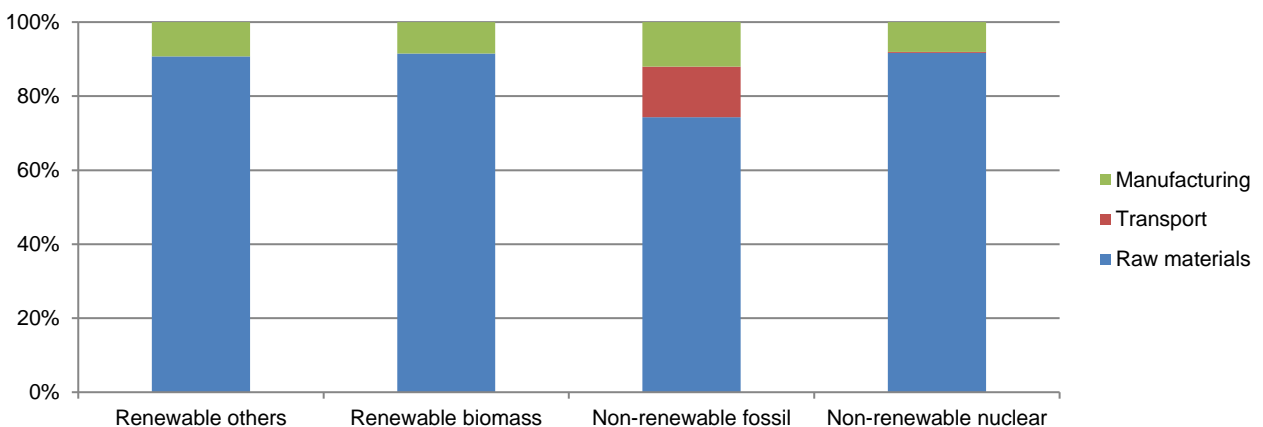


Figure 3: Contribution of life cycle stages to the environmental impacts of 1m³ of Lightweight block, Energy consumption

6 Additional environmental information

Lightweight blocks use glass powder from post consumer sources in replacement of a part of the Portland cement. Also, they contain some GGBFS, obtained from blast furnace slag, that is a recovered material (post-industrial).



In addition, Permacon has undergone a third-party verification process with Vertima Inc. where Permacon's products and their entire supply chain were assessed. At the end of the process, they received the certification Validated Eco-Declaration® summarizing verified environmental claims, as well as Vertima's Environmental Data Sheet.

Permacon has also published a Health Product Declaration® for Lightweight blocks. More details are available on the HPDC public repository: <https://www.hpd-collaborative.org/hpd-public-repository/>.

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