Environmental Product Declaration

Standard and Noble® Blocks with Glass Powder - Montreal Plant (Quebec)

PERMACON
THE HARMONY OF SPACE

Permacon

Permacon is pleased to present this environmental product declaration (EPD) for Standard and Noble® 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 Inc. 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.

Environmental Product Declaration

CSA Group Registered
Based on ISO 14025
and Other Requirements
For more information visit
csaregistries.ca/epd

#3937-5301
November 2017 - 2022

1 GENERAL INFORMATION

PROGRAM OPERATOR	CSA Group 178 Rexdale Blvd, Toronto, ON, Canada M9W 1R3 www.csagroup.org
PRODUCT	Standard and Noble® Blocks with Glass Powder - Montreal Plant (QC)
EPD REGISTRATION NUMBER	3937-5301
EPD RECIPIENT ORGANIZATION	Permacon 8140, rue Bombardier, Anjou (Québec), H1J 1A4, CANADA (514) 351-2120 http://www.permacon.ca/ PERMACON THE HARMONY OF SPACE
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 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. Standard and Noble® 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).

Standard 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&z=Standard).

Noble® blocks exist in three (3) different finishes, with a choice of thirteen (13) colors per finish. Their length can be 290 mm, 390 mm or 590 mm, their height can be 90 mm, 140 mm, 190 mm, 240 mm or 290 mm, and their width varies between 90 mm and 295 mm. They might be 100% solid or include empty space (hollow block).
(See: http://www.permaconpro.ca/products.html?product_id=351&z=Noble).

Only five (5) colours are studied here, as it has been estimated that they cover most of the products' sales: Universal Grey (further referred as "Grey"), Cypress Beige ("Beige"), Porcelain White ("White"), Pearl Silver and Charcoal.

Standard and Noble® blocks include post consumer glass powder in replacement of 10% of the Portland cement from the original recipe.

Both products are produced at Permacon manufacturing plant located in Montreal, Quebec. Montreal manufacturing plant address is 8140, rue Bombardier, Anjou (Québec), H1J 1A4
CANADA.

Raw materials inputs are detailed in table 1.

Table 1: Material composition of 1 m³ of Standard and Noble® blocks

Materials	Standard blocks		Noble® blocks All colors	
	Amount (kg)	Proportion	Amount (kg)	Proportion
Portland Cement	185.0	8.5%	0 - 382.7	0% - 17.3%
Portland Cement – White			0 - 279.1	0% - 12.8%
Glass powder	20.6	0.9%	22.9 - 42.5	1.0% - 1.9%
Sand	1229.7	56.7%	0 - 1393.7	0% - 63.1%
Mortar Sand			0 - 982.0	0% - 41.4%
Natural aggregates	384.5	17.7%	0 - 308.5	0% -14.1%
Stone dust	236.5	10.9%	0 - 291.6	0% - 13.3%
Stone dust - recycled			0 - 982.0	0% - 41.4%
Stone dust - White			0 - 1281.8	0% - 58.8%
Admixtures	0.6	0.03%	3.0 - 4.3	0.1% - 0.2%
Pigments	-	-	0 - 13.4	0% - 0.6%
Water	113.1	5.2%	108.5 - 127.6	5.0% - 5.8%
TOTAL (without water)	**2170.0**	**100%**	**2180.0 - 2370.0**	**100%**

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**.

Standard blocks have a density of 2,170 kg/m³. Therefore, the reference mass is 2,170 kg of product.

The density of Noble® blocks varies according to their color. The reference mass is therefore 2,210 kg for Noble® - Grey, 2,190 kg for Noble® - Beige, 2,180 kg for Noble® - White, 2,200 kg for Noble® Silver Pearl and 2,370 kg for Noble® - Charcoal.

System boundaries

This EPD focuses on a Cradle-to-Gate life cycle impact assessment (LCIA) of Standard and Noble® 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.

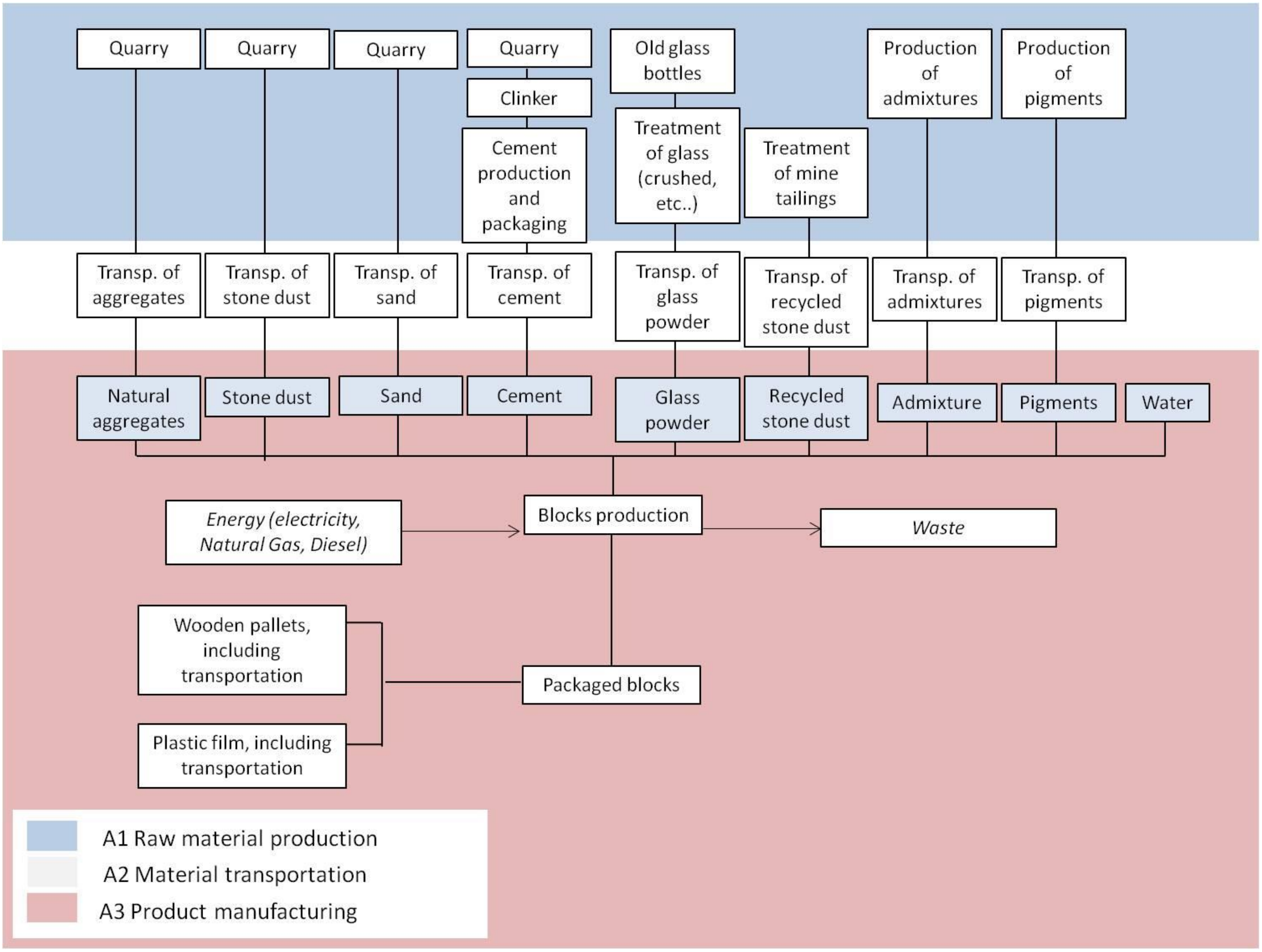

Figure 1: System boundaries for Standard and Noble® blocks - Cradle-to-Gate LCA

Raw materials acquisition: this includes the extraction from the quarry (sand, aggregates), the crushing of stone for stone dust production, the production of clinker and Portland cement, the production of pigments and 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 Montreal 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. Standard blocks manufacturing generates 1% of losses (mass). Noble® blocks manufacturing generates 5% of losses (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 Montreal, QC, using a LCI questionnaire. Inventory data included both the total annual mass of products from Montreal 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 Standard and Noble® 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 as well as data related to the production of recycled screenings 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 Standard and Noble® 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 and recycled screenings. 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 Standard and Noble® 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 and Table 3 present respectively the LCIA results for 1 m^3 of Standard blocks and for 1 m^3 of Noble® 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.

The Cradle-to-Gate impact assessment results of Permacon's Standard and Noble® blocks are summarized below.

Table 2: LCIA results for 1 m³ of Standard blocks

Environmental indicator	Unit	Value
Ozone depletion potential	kg CFC-11 eq	4.21E-06
Global Warming Potential	kg CO_2 eq	267
Smog creation potential	kg O_3 eq	27.0
Acidification potential	kg SO_2 eq	1.74
Eutrophication potential	kg N eq	0.25
Primary energy consumption (HHVs)		
Renewable (solar, wind, hydroelectric, and geothermal)	MJ	1114
Renewable (biomass)	MJ	20
Non-renewable nuclear	MJ	52
Non-renewable fossil	MJ	2188
Resources consumption		
Non-renewable materials	kg	2273
Renewable materials	kg	18.9
Fresh water	L	273
Waste generated		
Non-hazardous	kg	137
Hazardous	kg	0.022

Table 3: LCIA results of 1 m³ of Noble® blocks

Environmental indicator	Unit	Noble® blocks				
		Grey	Beige	White	Pearl Silver	Charcoal
Ozone depletion potential	kg CFC-11 eq	7.71E-06	5.99E-06	6.92E-06	5.16E-06	7.89E-06
Global Warming Potential	kg CO_2 eq	471	357	451	349	360
Smog creation potential	kg O_3 eq	41.3	32.7	45.8	36.5	33.1
Acidification potential	kg SO_2 eq	2.87	2.14	2.82	2.25	2.16
Eutrophication potential	kg N eq	0.48	0.38	0.43	0.32	0.35
Primary energy consumption (HHVs)						
Renewable (solar, wind, hydroelectric, and geothermal)	MJ	1415	857	1378	1382	1154
Renewable (biomass)	MJ	27	20	30	24	22
Non-renewable nuclear	MJ	64	52	446	107	71
Non-renewable fossil	MJ	3102	2403	3703	2993	2833
Resources consumption						
Non-renewable materials	kg	2511	2429	2486	2423	1566
Renewable materials	kg	19.4	18.9	19.5	19.2	19.1
Fresh water	L	440	396	875	404	366
Waste generated						
Non-hazardous	kg	392	326	325	278	179
Hazardous	kg	0.029	0.026	0.021	0.022	0.021

Interpretation

This LCA showed that raw materials acquisition is the stage with the highest environmental impacts. Because of the clinker component, Portland cement is the raw material with the highest impacts, even though its weight ratio is only 8 % to17 %. Therefore, any way of reducing the cement (or clinker) proportion in the final product, without impacting on the product quality, is likely to reduce the environmental impacts.

Standard blocks were selected as an example to illustrate the contribution to the impacts of different life cycle stages. 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 (>40%), together with manufacturing in the case of smog (40%). Raw materials acquisition and manufacturing both contribute significantly to energy consumption.

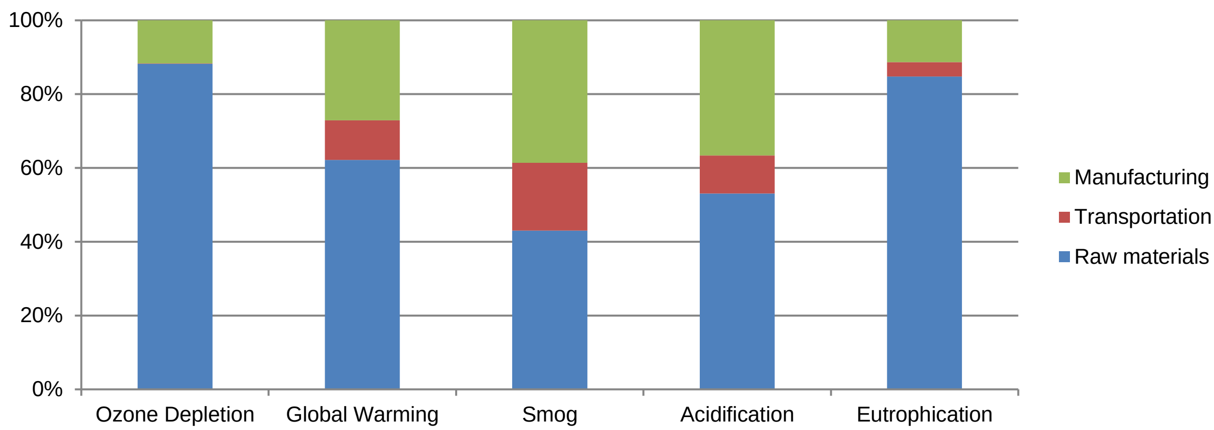

Figure 2: Contribution of life cycle stages to the environmental impacts of 1m³ of Standard blocks, TRACI indicators

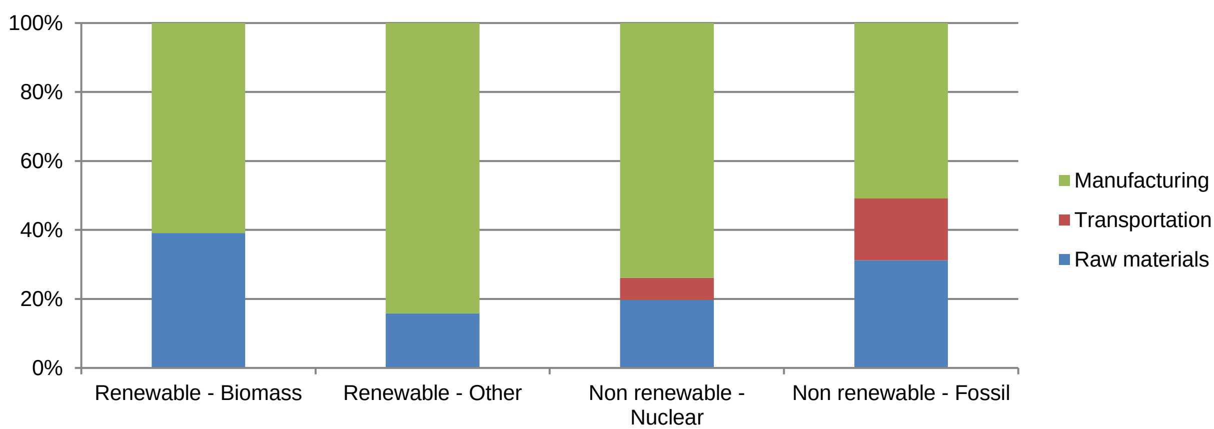

Figure 3: Contribution of life cycle stages to the environmental impacts of 1m³ of Standard blocks, Energy consumption

6 Additional environmental information

Standard and Noble® blocks use glass powder from post consumer sources in replacement of a part of the Portland cement. Charcoal blocks use recycled stone dust.

Also, black and yellow pigments are produced of iron scrap (cast iron borings), which is a recovered material. Noble® Beige contains yellow pigments. Noble® Charcoal contains black pigments.

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 Standard and Noble® blocks. More details are available on the HPDC public repository: https://www.hpd-collaborative.org/hpd-public-repository/.

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