Environmental Product Declaration (EPD)

NW STD 20CM GLPW CONCRETE BLOCK

Permacon

Permacon is pleased to present this environmental product declaration (EPD) for the Normal Weight Standard (NW STD) 20CM Glass Powder (GLPW) concrete block. 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 and Ellio.

The EPD includes cradle-to-gate life cycle assessment (LCA) results.

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

Environmental Product Declaration

CSA Group Registered Based on ISO 14025 and Other Requirements

For more information visit csaregistries.ca/epd

#7135-8939

November 2016-2021

This environmental product declaration (EPD) is in accordance with CAN/CSA-ISO 14025 and the PCR noted below. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	CSA Group 178 Rexdale Blvd Toronto, ON Canada M9W 1R3 www.csagroup.org
PRODUCT	Concrete block, NW STD 20CM GLPW
EPD REGISTRATION NUMBER	7135-8939
EPD RECIPIENT ORGANIZATION	PERMACON THE HARMONY OF SPACE Permacon 8140, rue Bombardier Anjou (Québec) H1J 1A4 CANADA
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
DATE OF ISSUE	November 1, 2016
PERIOD OF VALIDITY	October 31, 2021

The PCR review was conducted by:	Nicholas Santero, Apple (Chairperson) Christine Subasic, Consulting Architectural Engineer Juan Tejeda, ORCO Block Company

This EPD and related data were independently verified by an external verifier, Lindita Bushi, Athena Sustainable Materials Institute, according to CAN/CSA-ISO 14025:2006	 Lindita Bushi, Athena Sustainable Materials Institute

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.

DESCRIPTION OF PRODUCT

The NW STD 20CM GLPW is a loadbearing concrete block masonry unit, used in wall construction. Its specificity lays in the use of glass powder in replacement of a part of the cement. It is produced at Permacon manufacturing plant located in Milton, Ontario. The Milton plant address is 8375 5th Side Road, Milton, ON L9T 2X7 CANADA.

NW STD 20CM GLPW meets the requirements of the CSA A165.1-04 - concrete block masonry unit standard.

The compressive strength of the product is 22 MPa after 28 days.

The raw materials input are detailed in table 1.

Table 1: Material composition of 1m3 of NW STD 20CM GLPW

Materials	Amount	Proportion
Cement 30	137 kg	6.1 %
Asphalt sand	947.4 kg	42.2 %
Natural aggregates	1122.4 kg	50.0 %
Quantec (admixture)	0.5 kg	0.02 %
Glass powder	38 kg	1.7 %
TOTAL	**2245 kg**	**100%**

SCOPE OF EPD

Reference flow and declared unit

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

The NW STD 20CM GLPW has dimensions of 20 cm x 20 cm x 40 cm. The blocks have a density of 2245 kg/m³. One block weights 18.27 kg. Block's design includes empty spaces. Therefore, the reference flow should include the amount of concrete in the block, and not the outside volume of the block. In this case, the reference flow is **122.9 blocks**.

System boundaries

This EPD focuses on a Cradle-to-Gate life cycle impact assessment (LCIA) of the NW STD 20CM GLPW Concrete Block. 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.

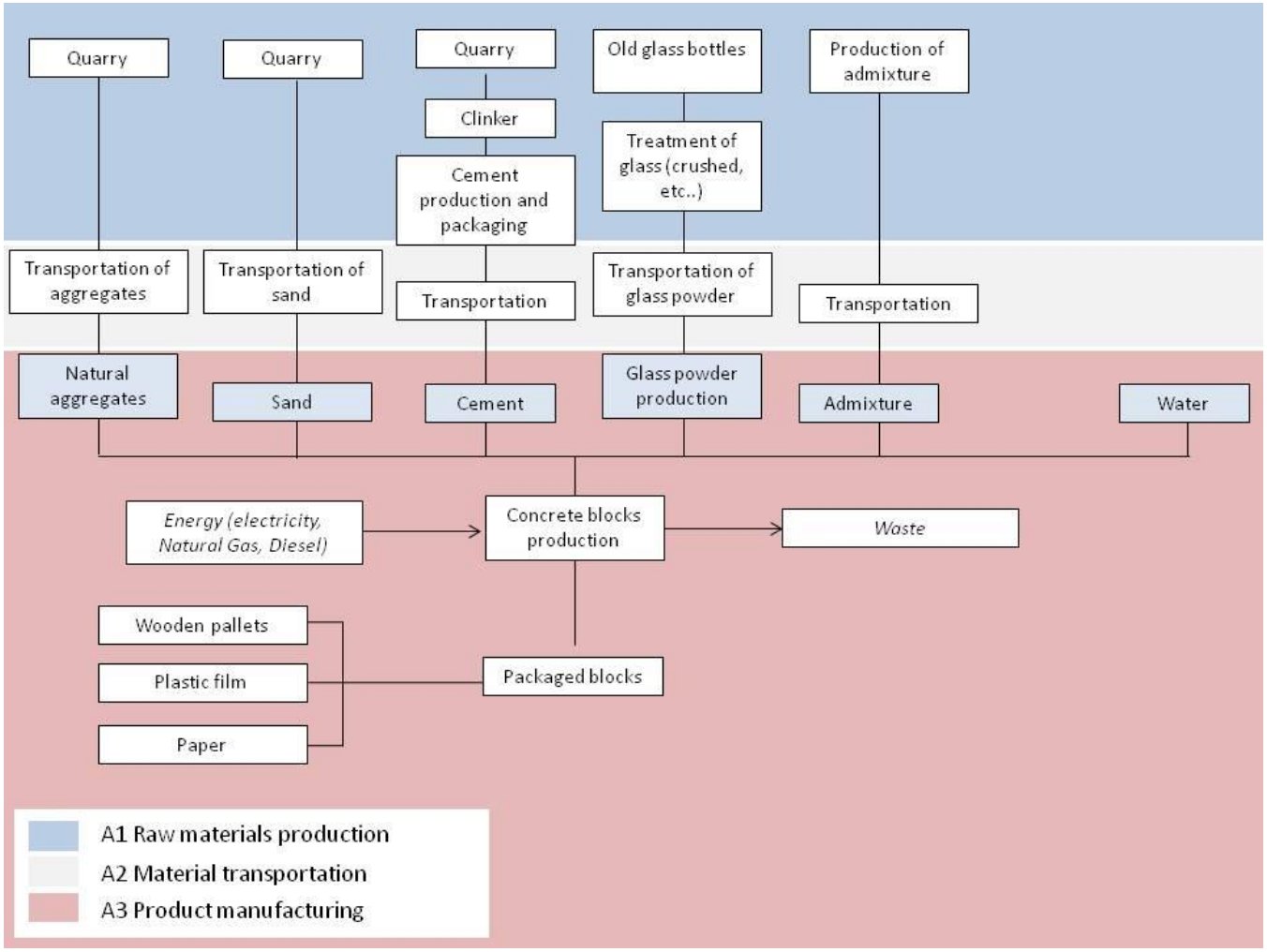

Figure 1: System boundaries for the NW STD 20CM GLPW concrete block Cradle-to-Gate LCA

Raw materials acquisition: this step includes extraction from the quarry (sand, aggregates), production of clinker and cement, as well as post-consumer glass collection and production of glass powder.

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

Blocks manufacturing: this step includes energy consumption (electricity, heat), water consumption and emissions to the environment related to the product manufacturing, including batching and mixing of concrete, forming of units, curing of units, and applicable post-production finishing of units. Concrete block production generates 1% of losses. This loss of material is considered as waste. Are also included packaging

materials to make the product ready for shipment, as well as transportation of these materials to Permacon's manufacturing plant.

Calculation method

SimaPro software v 8.0.4.30, developed by PRé Consultants, 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 production volumes, the amount of raw materials entering the production of concrete 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 cement production correspond to the most up-to-date data available and was taken directly from the Cement Association of Canada's EPD for General Use (GU) and Portland-Limestone (GUL) Cements [1].

Similarly, data used to model Quantec (admixture - plasticizer) was taken from the European Federation of Concrete Admixtures Associations' EPD for Concrete admixtures [2].

When primary data was not available, the unit processes were selected either from the *ecoinvent* v3.1 database, one of the most comprehensive LCI databases currently available [2], or from the US LCI database [3], 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 NW STD 20CM GLPW is 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 was collected so as to be representative of the full year 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 the NW STD 20CM GLPW concrete block.

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, with similar sizes and weights that go through similar manufacturing steps. The difference in their economic value is less than a factor of 10. Therefore, mass allocation is suitable to estimate the share of the total energy that can be assigned to each product.

Cut-off methodology

According to the PCR [4], 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.

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.

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 Bare and Gloria [5].

Always in accordance with the PCR, Table 2 presents the LCIA results for 1 m^3 of NW STD 20CM GLPW using TRACI methodology, as well as total primary energy consumption, consumption of renewable and non-renewable materials, fresh water consumption, and waste generation.

The Cradle-to-Gate impact assessment results of Permacon's NW STD 20CM GLPW concrete block are summarized below.

Table 2: LCIA results for 1 m³ of NW STD 20CM GLPW

Category Indicator	Unit	Value
TRACI v2.1 Impact Category Indicators		
Global Warming Potential	kg CO_2 eq	209
Acidification potential	kg SO_2 eq	1.13
Eutrophication potential	kg N eq	0.17
Smog creation potential	kg O_3 eq	17.9
Ozone depletion potential	kg CFC-11 eq	4.3E-06
Total Primary energy consumption		
Non-renewable fossil	MJ	1964
Non-renewable nuclear	MJ	430
Renewable (biomass)	MJ	77
Renewable (solar, wind, hydroelectric and geothermal)	MJ	135
Resources consumption		
Non-renewable materials	kg	2392
Renewable materials	kg	25
Fresh water	L	804
Waste generated		
Non-hazardous	kg	35.4
Hazardous	kg	0.08

Interpretation

Figure 2 and Figure 3 present the relative contribution of raw materials acquisition and transportation, and blocks manufacturing to the LCIA impacts and to energy consumption.

Raw materials acquisition contributes for more than 60% of the five impact categories. Raw materials acquisition dominates the energy consumption, except for non-renewable energy from nuclear sources where block production accounts for 60% of the consumption.

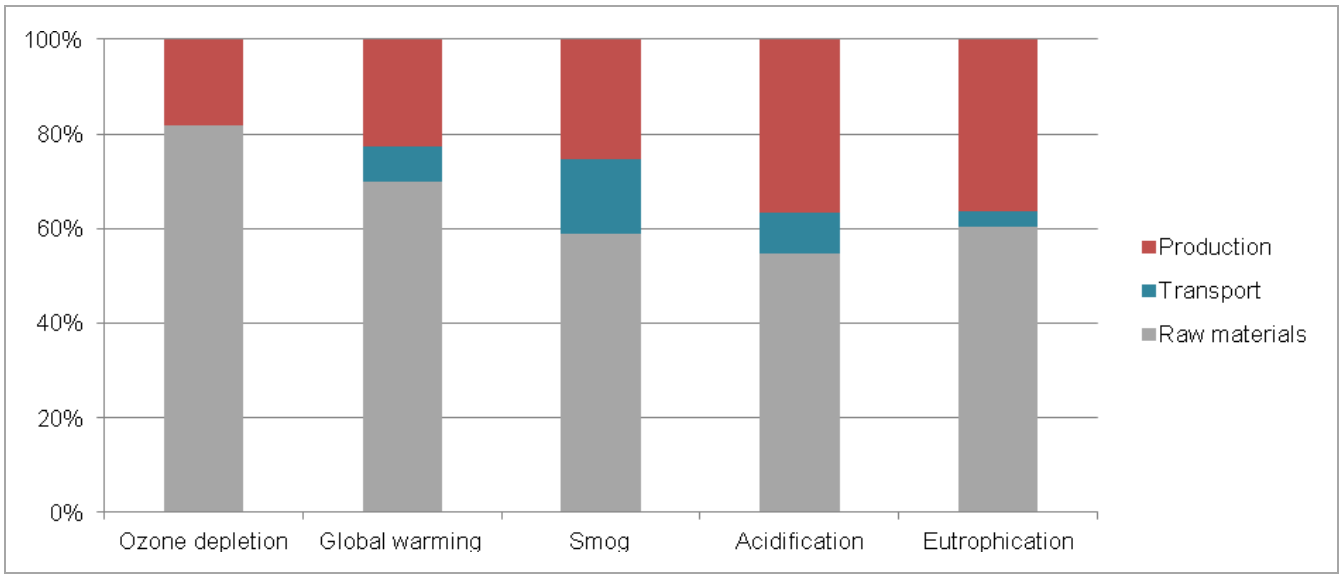

Figure 2: Contribution of life cycle stages to the environmental impacts of 1m³ of NW STD 20CM GLPW - TRACI Indicators

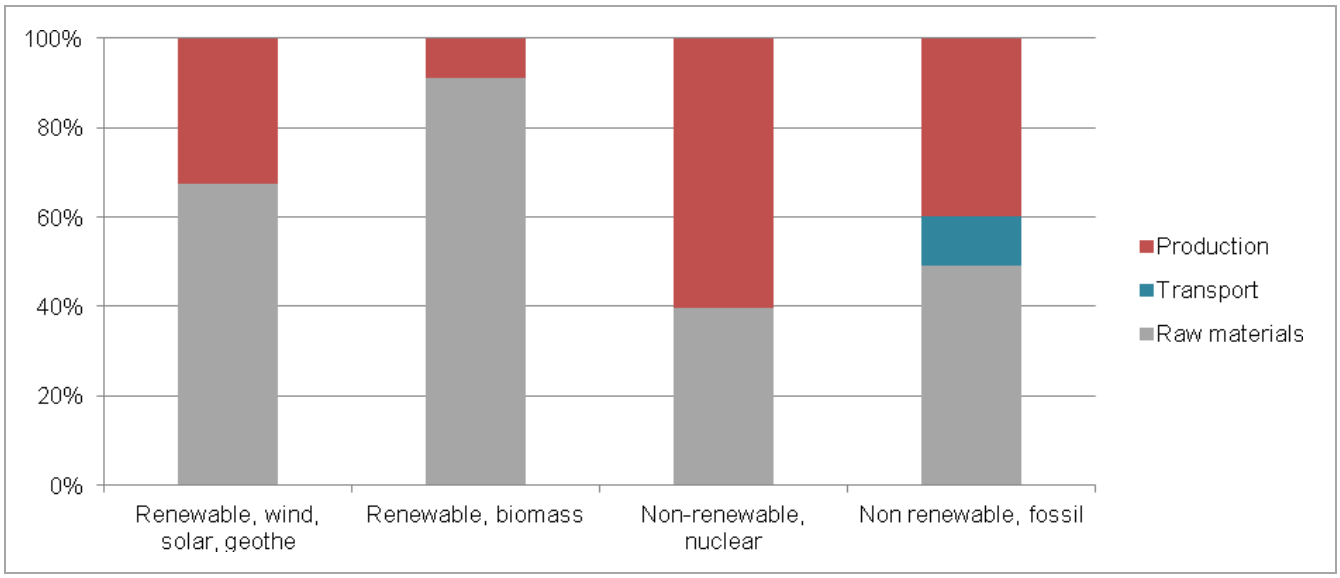

Figure 3: Contribution of life cycle stages to the environmental impacts of 1m³ of NW STD 20CM GLPW - Energy consumption

Additional environmental information

Glass powder, from post-consumer sources, is used in the manufacture of NW STD 20CM GLPW as a partial replacement of the cement.

REFERENCES

[1] Cement Association of Canada (2016). Environmental Product Declaration (EPD). General Use (GU) and Portland-Limestone (GUL) Cements. Revised Version 1.1. 17 pp

[2] European Federation of Concrete Admixtures Associations Ltd. (2015) Environmental Product Declaration: Concrete admixtures – Plasticisers and Superplasticisers. 9pp.

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[6] Bare, J. C., T. P. Gloria (2008). Environmental impact assessment taxonomy providing comprehensive coverage of midpoints, endpoints, damages, and areas of protection. Journal of Cleaner Production 16: 1021-1035.

[7] CSA Group Environmental Product Declaration (EPD) Program: Program requirements, November 2013.