

Environmental Product Declaration

Modular Brixx Bricks and Pavers





Program Operator Information

Program Operator	NSF Certification LLC 789 N. Dixboro, Ann Arbor, MI 48105 www.nsf.org	
Manufacturer Name and Address	Pittsburgh Mineral & Environmental Technology, Inc. 700 Fifth Avenue New Brighton, PA 15066-1837	
Declaration Number	EPD10744	
Product and Declared Unit	1 cubic meter of PMET Modular Brixx Bricks and Pavers	
Reference PCR and Version Number	International Standard: ISO 21930:2017 (E)	
Product's intended Application and Use	Building bricks, pedestrian paving bricks, light traffic paving bricks, and heavy vehicular paving bricks	
Product RSL	Not Applicable	
Markets of Applicability	North America	
Date of Issue	6/16/2022	
Period of Validity	5 years from date of issue	
EPD Type	Product Specific	
EPD Scope	Cradle to Gate	
Year of reported manufacturer primary data	2020	
LCA Software and Version Number	GaBi 10.0.0.71	
LCI Database and Version Number	GaBi Database 2021.2	
LCIA Methodology and Version Number	TRACI 2.1	
The sub-category PCR review was conducted by:	Christoph Koffler, PhD John P. Sanders, PhD, PE Christine A. Subasic, PE	
This declaration was independently verified in accordance with ISO 14025: 2006. ISO 21930:2017 serves as the core PCR. <input type="checkbox"/> Internal <input checked="" type="checkbox"/> External	Tony Favilla afavilla@nsf.org	
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting, LLC	
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Jack Geibig - EcoForm jgeibig@ecoform.com	
Limitations: Environmental declarations from different programs (ISO 14025) may not be comparable. Only EPDs prepared from cradle-to-grave life-cycle results and based on the same function, reference service life, and quantified by the same functional unit, and meeting all the conditions in ISO 14025, Section 6.7.2, can be used to assist purchasers and users in making informed comparisons between products. Full conformance with the PCR for Products allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared. Additional information on the life cycle assessment can be found by contacting Randy Stremmel (PMET) at randall@pmet-inc.com or 937-418-8489.		



Declaration of General Information

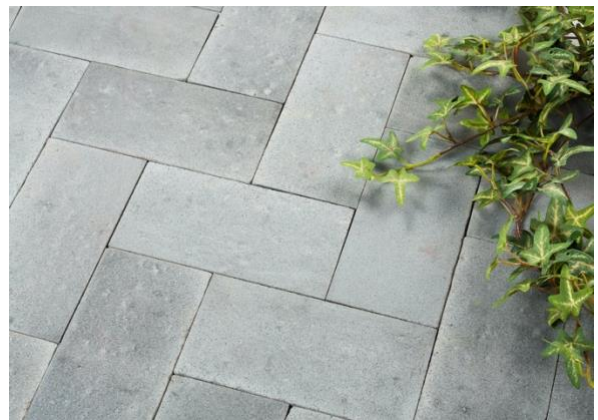
Company Description

Since 1985, Pittsburgh Mineral & Environmental Technology, Inc. (“PMET”) has assisted mining, minerals, chemical, O&G, metals companies and electric power generators worldwide in improving the efficiency, effectiveness, quality, and safety of their operations. PMET is a full-service technology development and service company specializing in inspection, technical writing manuals / procedures, welding development, metals and minerals processing, waste stream management, and precision analysis.

Product Description and Intended Use

This Environmental Product Declaration (“EPD”) is for PMET’s Brixx modular bricks and pavers. The products under review include all PMET Brixx bricks and pavers.

PMET’s products consist primarily of fly ash, bottom ash, and hydrated lime. A pigment is sometimes added to give the brick a reddish color. The results presented in this study cover the varying formulations for the products listed below and represent the worst performing product of the four in each of the impact categories. In other words, for GWP, the highest impact of the four is provided. For EP, the highest impact of the four is provided even if that product differs from the product with the highest GWP.



1. Bricks/pavers without reused brick or pigment
2. Bricks/pavers without reused brick and with pigment
3. Bricks/pavers with reused brick and without pigment
4. Bricks/pavers with reused brick and pigment

Products reviewed in this study include building bricks, pedestrian paving bricks, light traffic paving bricks, and heavy vehicular paving bricks.

Material Composition

The raw materials for the product were obtained from various suppliers across North America. The general composition is represented in Table 1 below.

Table 1: Material Composition

	Average Used in Product
Coal Ash*	85-92%
Pigment	0-1%
Hydrated Lime	7-8%
Post-industrial Reused Brixx	0-7%
*This material is intentionally added to the formula and is considered to be hazardous according to NRDC (National Resources Defense Council). The CAS numbers for fly ash and bottom ash are 68131-74-8 and 69012-84-6, respectively.	



Technical Data

Table 2 shows the technical specifications of the products, including any testing data as appropriate.

Table 2: Technical Data

	Value	Unit
Compressive Strength of product pressed at 5000 psi	>10,000	psi
Water Absorption of product pressed at 5000 psi	2.4-2.6 (1 hour)	lb/cubic ft
	8.2-8.3 (24 hour)	lb/cubic ft

The products under review were tested in accordance with ASTM C 67-16 Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.



Transportation Data

Transportation data between PMET’s facility in Paloncha, India and suppliers was not available. Since the raw materials are sourced from local suppliers, transport distances for raw materials at PMET’s site in Toronto, Ohio, which is currently in the process of being constructed, were used as a proxy. The materials are delivered to the manufacturing facility via truck and are accounted for in the model. The fly ash is sourced from four suppliers. An average distance between each supplier and the manufacturing site was utilized. Transportation data are shown in the table below, though they are presented as an average to protect the identity of the suppliers.

Table 3: Transportation Data

Vehicle Type	GLO: Truck Euro 6, 12 – 14 gross weight / 9.3t payload capacity
Distance [km]	161
Capacity Utilization [%]	51%



Manufacturing Data

Inputs and Outputs

Energy resources used in the manufacturing process are accounted for in the model. The electricity is sourced from the power grid, and no onsite electricity generation is used. Electricity production datasets from GaBi are used to assess the generation, distribution, and transmission of electricity. Secondary datasets for other fuels and packaging were utilized from the GaBi database. Plastic shrink wrap and steel banding packaging materials are used to bundle together multiple Brix to help them stay in place and to reduce the risk of damage.

The fly ash and bottom ash utilized in this product are sourced from the output of coal plants. These coal ash inputs were treated as waste by-products from the upstream electricity generation process, though additional processes associated with cooling the ashes were included in the study.

The manufacturing process mixes coal combustion residuals with a calcium hydroxide-based mineral binder, which is compacted to shape and hydrothermally cure, to produce attractive, high strength, weather-resistant building materials.

Primary data provided by the manufacturer is specific to PMET's Paloncha, India facility. As additional PMET manufacturing sites begin producing Brix products at scale, the results from this assessment will be updated accordingly. Manufacturing energy inputs and outputs per declared unit were calculated by using annual figures and dividing them by annual production.

Declaration of the Methodological Framework

Type of EPD and Declared Unit

The LCA methodology utilized was chosen to directly align with the ASTM Clay Brick PCR. As such, this EPD is a Cradle-to-Gate EPD and includes the sourcing of raw materials, transportation of raw materials to the manufacturing facility, and the manufacturing and packaging of the product. These are the required modules, according to ISO 21930 (LCA modules A1-A3). As this study is a cradle-to-gate LCA, no reference service life is declared.

The declared unit was chosen to be one cubic meter to align with the ASTM Clay Brick PCR. In order to achieve the declared unit, 715 standard size Brix are required. Table 4 shows additional details related to the declared unit.

Table 4: Declared Unit

	Value
Declared Unit	1 m ³
Mass per declared unit	1,648 kg

System Boundary

This EPD is considered a Cradle-to-Gate study. A summary of the life cycle modules included in this EPD is presented in Table 5. Construction of the facility, the manufacturing of operational equipment, and the production of co-products leaving the system have been excluded.

Table 5: Summary of Included Life Cycle Modules

Module Name	Description	Analysis Period	Summary of Included Elements
A1-A3	Product Stage: Raw Material Supply, Transport, Manufacturing	2020	Raw Material sourcing and processing as defined by secondary data. Shipping from supplier to manufacturing site including fuel. Energy, water, and material inputs required for manufacturing products from raw materials. Manufacturing waste (none). Packaging materials.
A4	Construction Process Stage: Transport	MND	Module not declared
A5	Construction Process Stage: Installation	MND	Module not declared
B1-B7	Use Stage	MND	Modules not declared
C1-C4	End of Life	MND	Modules not declared
D	Benefits beyond system	MND	Module not declared



Additional Environmental Information

There is no additional environmental information to be included in this EPD.

Allocation Procedure and Cut-off Procedure

General principles of allocation were based on ISO 14040/44. There are no products other than the product under study that are produced as part of the manufacturing processes. Since there are no co-products, no allocation based on co-products is required.

To derive a per-unit value for manufacturing inputs such as electricity, thermal energy, and water, allocation based on total production by mass was adopted. As a default, secondary GaBi datasets use a physical basis for allocation.

Of relevance to the defined system boundary is the method in which recycled materials were handled. Throughout the study recycled materials were accounted for via the cut-off method. Under this method, impacts and benefits associated with the previous life of a raw material from recycled stock are excluded from the system boundary, however impacts associated with reprocessing and preparation of recycled materials that are part of the bill of materials of the products are included.

No known flows or material inputs were deliberately excluded from the LCA.

Results per 1 cubic meter of Brix brick/paver

Abbreviation	Raw Material Supply (A1)	Transport (A2)	Manufacturing (A3)	Total (A1-A3)
CML LCIA Impacts (Europe, Rest of World)				
ADPF [MJ]	4.19E+02	2.09E+02	8.72E+02	1.50E+03
TRACI 2.1 LCIA Impacts				
AP [kg SO ₂ eq]	5.91E-02	1.35E-02	3.89E-01	4.62E-01
EP [kg N eq]	5.15E-03	3.46E-03	1.24E-02	2.10E-02
*GWP [kg CO ₂ eq]	1.26E+02	1.78E+01	6.71E+01	2.10E+02
ODP [kg CFC 11 eq]	2.91E-13	3.55E-15	1.66E-13	4.60E-13
Resources [MJ]	2.94E+01	3.33E+01	9.99E+01	1.63E+02
POCP [kg O ₃ eq]	1.49E+00	2.93E-01	4.59E+00	6.37E+00
Resource Use Indicators				
RPRE [MJ]	5.78E+01	1.04E+01	7.00E+01	1.38E+02
RPRM [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPRT [MJ]	5.78E+01	1.04E+01	7.00E+01	1.38E+02
NRPRE [MJ]	4.37E+02	2.52E+02	1.04E+03	1.73E+03
NRPRM [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRPRT [MJ]	4.37E+02	2.52E+02	1.04E+03	1.73E+03
SM [kg]	1.13E+02	0.00E+00	0.00E+00	1.13E+02
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW [m ³]	9.52E-02	4.43E-02	2.98E-01	4.38E-01
Output Flows and Waste Categories				
HWD [kg]	5.80E-08	2.11E-08	1.96E-07	2.75E-07
NHWD [kg]	1.88E-01	2.31E-02	6.99E-01	9.10E-01
HLRW [kg]	7.45E-06	8.47E-07	8.09E-06	1.64E-05
ILLRW [kg]	6.59E-03	7.14E-04	7.05E-03	1.44E-02
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Abbreviation	Raw Material Supply (A1)	Transport (A2)	Manufacturing (A3)	Total (A1-A3)
Total Primary Energy Consumption				
Non-renewable fossil [MJ]	5.92E+01	1.99E+01	7.78E+00	3.16E+01
Non-renewable nuclear [MJ]	7.00E-05	3.05E-05	3.33E-06	3.62E-05
Renewable (solar, wind, hydroelectric, geothermal) [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Renewable (biomass) [MJ]	1.50E-01	4.48E-07	4.79E-08	1.50E-01
Material Resources Consumption				
Non-renewable material resources [kg]	5.72E+02	4.16E+02	2.03E+00	1.54E+02
Renewable material resources (non-water) [kg]	5.53E+02	2.06E+02	5.43E+00	3.42E+02
<small>AP - Acidification potential of soil and water; EP - Eutrophication potential; GWP - Global warming potential (100 years, includes biogenic CO2); ODP - Depletion of stratospheric ozone layer; Resources - Depletion of non-renewable fossil fuels; POCP - Photochemical ozone creation potential (Smog formation potential, SFP); RPRE - Use of renewable primary energy excluding renewable primary energy resources used as raw materials; RPRM - Use of renewable primary energy resources used as raw materials; RPRT - Total use of renewable primary energy resources; NRPRE - Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; NRPRM - Use of non-renewable primary energy resources used as raw materials; NRPRRT - Total use of non-renewable primary energy resources; SM - Use of secondary materials; RSF - Use of renewable secondary fuels; NRSF - Use of non-renewable secondary fuels; RE - Recovered energy; FW - Net use of fresh water; HWD - Disposed-of-hazardous waste; NHWD - Disposed-of non-hazardous waste; HLRW - High-level radioactive waste, conditioned, to final repository; ILLRW - Intermediate- and low-level radioactive waste, conditioned, to final repository; CRU - Components for reuse; MR - Materials for recycling; MER - Materials for energy recovery; EEE - Exported electrical energy; EET - Exported thermal energy</small>				



References

1. Life Cycle Assessment, LCA Report for PMET. WAP Sustainability Consulting. November 2021.
2. ASTM Clay Brick, Clay Brick Pavers, and Structural Clay Tile (UNCPC 3731 and 3735)
3. ISO 14044: 2006 Environmental Management – Life cycle assessment – Requirements and Guidelines.
4. ISO 14044: 2006/ Amd 1:2017 Environmental Management – Life cycle assessment – Requirements and Guidelines – Amendment 1.
5. ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.
6. ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.
7. TRACI: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts. Version 2.1 – User Guide - <https://nepis.epa.gov/Adobe/PDF/P100HN53.pdf>.