ENVIRONMENTAL PRODUCT DECLARATION

CEMENT GROUT FOR TILE INSTALLATION

INDUSTRY-WIDE REPORT
PRODUCTS MANUFACTURED IN NORTH AMERICA

This Environmental Product Declaration is provided by Tile Council of North America (TCNA) and its members and contains a comprehensive environmental analysis of approximately 270 million kg of grout produced in North America.

This is an industry-wide EPD facilitated by TCNA with participation from the following companies:

- Ardex
- Bexel
- Bostik
- Crest
- Custom Building Products
- HB Fuller/TEC
- Interceramic
- Laticrete
- MAPEI
- Cemix/Texrite

Established in 1945 as Tile Council of America (TCA), TCNA is recognized for its leadership role in promoting the use of ceramic tile, conducting independent research and product testing, and developing industry standards.

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ENVIRONMENTAL PRODUCT DECLARATION

NORTH AMERICAN CEMENT GROUT FOR TILE INSTALLATION
AS DEFINED BY ANSI A118.6 AND ANSI A118.7

According to ISO 14025

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL Environment
DECLARATION HOLDER	Tile Council of North America (TCNA)
DECLARATION NUMBER	4787109018.101.1
DECLARED PRODUCT	Cement grout for tile installation
REFERENCE PCR	IBU Part A & B for Mineral Factory-made Mortar, 07.2014, with UL addendum
DATE OF ISSUE	September 30, 2016
Valid Through	December 31, 2021
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications
The PCR review was conducted by:	PCR Review Panel Independent Expert Committee (SRV)
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	Wade Stout, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Industrial Ecology Consultants

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Tile Council of North America (TCNA)

TCNA is a trade association representing manufacturers of ceramic tile, tile installation materials, tile equipment, raw materials, and other tile-related products. Through its Green Initiative, TCNA and its members are industry leaders in distinguishing and communicating the sustainability and environmental attributes of ceramic tile and related installation materials by conducting research, developing educational programs, and providing a forum through which TCNA members can be active in the green building community.

Information in this document has been coordinated by TCNA's technical staff based on information submitted by leading North American tile manufacturers. The life cycle data and product information presented herein are representative of a range of grout products from the following manufacturers:

Product Description

Product Definition

The primary function of grout is to fill joints, that is, the spaces between tiles. Grouting materials for tile installation are available in different forms, with cement-based grouts being most common.

Typically, cement grout for tile installation is a factory-prepared mixture of cement, aggregate, and other ingredients to

produce a water-resistant, dense, uniformly-colored material. Cement grout for tile installation may be unsanded or sanded. Unsanded products utilize fine aggregates, are meant for joints 1/8" in width or less and/or are sometimes required for use with glass tile. Sanded products utilize graded sand as a coarser aggregate and are meant for joints 1/8" in width or greater.

Cement grouts for tile installation are characterized as standard or high performance. High performance products typically contain latex or other polymers to achieve improved characteristics such as increased bond strength, flexural strength, and lower water absorption for frost resistance.

Performance criteria for cement grout for tile installation are defined by ANSI A118.6 (standard) and A118.7 (high performance) and include linear shrinkage, water absorption, compressive strength, tensile strength and flexural strength.

Additionally, a variety of cement grouts for tile installation may be classified by ISO 13007 – Terms, Definitions and Specifications for Ceramic Tile Grouts and Adhesives.

As is the case with tile, cement grout is capable of withstanding a wide range of environmental stresses. Once cured, it is durable, fire- and heat-resistant, non-combustible, and non-sensitive to moisture.

Range of Applications

Cementitious grout products are commonly used in interior, exterior, commercial, institutional, and residential tile installations.

Product Standards

The products considered in this EPD meet or exceed the following technical specifications:

- ANSI A118.6 – American National Standard Specifications for Standard Cement Grouts for Tile Installation
- ANSI A118.7 – American National Standard Specifications for High Performance Cement Grouts for Tile Installation
- ISO 13007 – Terms, Definitions and Specifications for Ceramic Tile Grouts and Adhesives

Additionally, some cement grout for tile installation considered in this EPD have been certified to meet the following sustainability specification:

- ANSI A138.1 – Green Squared® American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles and Tile Installation Materials

Fire performance: cement grout is non-flammable and non-combustible

No environmental burdens are expected for unforeseen flooding or mechanical destruction.

Information on leaching performance: No industry-wide data available as this EPD represents a broad range of cement grout products. Consult with manufacturers and/or reference product-specific EPDs for additional information.

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Product Characteristics

Table 1: Construction data of cement grout included in this EPD

	Value	Unit
Compressive strength	See ANSI A118.6, ANSI A118.7 and ISO 13007**	
Adhesive shear strength	Industry-Wide Data Not Available*	
Water absorption	See ANSI A118.6, ANSI A118.7 and ISO 13007**	
Water vapor diffusion equivalent air layer thickness	Industry-Wide Data Not Available*	
Thermal conductivity	Industry-Wide Data Not Available*	
Tensile bond strength	Industry-Wide Data Not Available*	
Flexural strength	See ANSI A118.6, ANSI A118.7 and ISO 13007**	

*Industry-wide data are not available as this property is not relevant and/or not standardized for cement grout for tile installation. Consult with manufacturers and/or reference product-specific EPDs for additional information.

**This industry-wide EPD represents a broad range of cement grout products. Compressive strength, water absorption, and flexural strength can vary depending on the type of grout and its intended application. Consult with manufacturers and/or reference product-specific EPDs for additional information. For industry-wide construction data on these properties, reference product standards.

Material Content

Table 2: Average material content per kg of grout included in this EPD

Material	Mass [kg]
Grout	
Sand	0.53
White cement	0.27
Limestone	0.10
Grey cement	0.045
Calcium aluminate	0.017
Calcium formate	0.011
Other additives	0.023
Packaging	
Composite plastic and paper film	5.7E-03
Corrugate	2.8E-03
Paper	2.5E-03
Plastic film	2.0E-03
Wooden pallets	0.019
Installation solution*	
Acrylate	0.026
Tap Water	0.22

*Installation solution concentration based on production weighted average of manufacturer recommendations

Grout Production

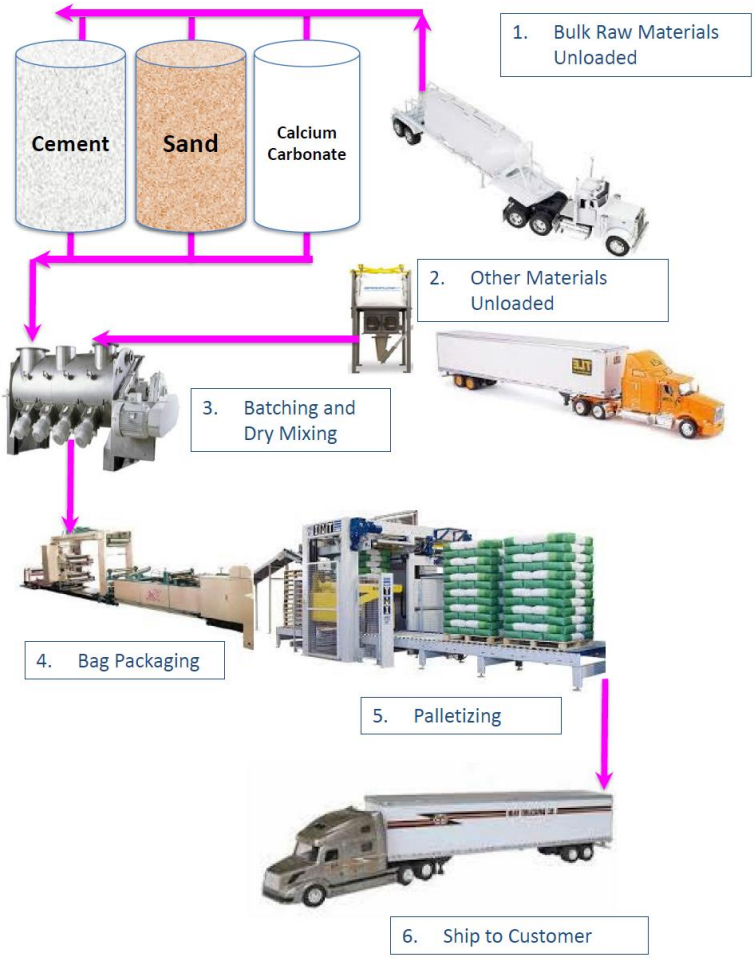

Figure 1: Process flow diagram for cement grout (for tile installation) manufacturing

Raw materials, including cement sand, calcium carbonate and other modifiers are unloaded and temporarily stored. When needed for production, materials are retrieved from storage, placed into specific batches based on formulation, dry-mixed, and then placed into packaging (usually bags). Packaged materials are then palletized, subjected to quality assurance inspections, placed into warehouse storage, and then shipped to customer warehouse or job site. All manufacturers of products represented by this EPD are governed by federal and local requirements for dust control. Where applicable, they have incorporated dust collection systems in their processes to optimize material usage and mitigate airborne dust and particulate matter within the factory

Production Waste

The vast majority of scrap and waste is recycled back into the product. A few sites produce a small amount of waste, the disposal of which is included in system boundaries. Where applicable, dust emissions during the mixing of the grout are collected through a dust collection system and recycled back into the production line.

Manufacturers of cement grout for tile installation offer varieties of products with pre- and post-consumer recycled content. This can contribute to overall building recycled content and help achieve compliance with recycled content targets in green building projects. Additionally, high levels of responsibly recovered waste, including dust and powder, are commonly reincorporated into grout manufacturing. Waste reclamation in such processes is a vital component to minimizing waste and maximizing resources. In fact, most grout factories included in this study are so efficient at waste reclamation, they are effectively closed loop facilities. Reducing waste to zero and fully utilizing all inputs is paramount to efficient manufacturing.

Delivery and Installation of the Grout

Delivery Status

For purposes of this study, the average transport distance from manufacturing to construction site was assumed to be 500 miles (805 km) by truck. The cementitious grouts included in this study are most commonly packaged in composite, plastic, or paper bags in units of 25 lbs.

Installation

Cement grout for tile installation is primarily installed by hand, with potential limited use of machines to mix the grout prior to application. Due to its material composition, grout is typically quite alkaline and, as such, eye and skin contact should be avoided, especially for prolonged periods. In addition, precautions should be taken to reduce dust emissions and inhalation during installation. The installation safety instructions of a given grout product should be followed during application. During installation, grout is applied at approximately 0.043 lb. / ft^2 (0.212 kg / m^2) with around 4.5% of the total material lost as waste. Though some of this waste could be recycled, this scrap is modeled as being disposed of in a landfill.

Packaging

Primary packaging is either a paper/plastic composite, plastic, or paper bag, with secondary/tertiary packaging of shrink film and pallets. Packaging is assumed to be sent to landfill after installation. Landfill emissions from packaging are allocated to installation, while electricity generated from landfill gas (produced from the decomposition of bio-based packaging) is credited to the installation stage of the life cycle.

Use Stage

The service life of grout depends on its care, but is expected to be equivalent to the service life of ceramic tile as the majority of tile installations keep the original grout throughout their lifespan. Ceramic tile service life is, in turn, assumed to be equivalent to the service life of the building in which the products are installed (TCNA, 2014). The level of maintenance depends on the use and desired appearance of the surface. A building's reference service life (RSL) is typically assumed to be 60 years. Grout (and ceramic tile) are thus assumed to have an RSL of 60 years.

The EPD presents results for the full 60 year RSL of the product, including the use stage impacts associated with that service life. Other scenarios such as the impacts for a 1-year service life or per m^2 of installed tile that are also of interest are included in the appendix.

Cleaning and Maintenance

Tile products should be cleaned routinely with warm tap water. For the purposes of this EPD, average maintenance is presented based on a mix of residential and commercial installations. The quantity of water required to clean 1 m^2 of installed tile was allocated by area between the grout and the tile. The amount of water allocated to the grout is reported in Table 4.

Table 3: Cleaning process

Level of Use	Cleaning Process	Cleaning Frequency	Consumption of Energy & Resources
Commercial / Residential	Dust mop	Daily	None
	Damp mop	36 times / year (commercial) 4 times / year (residential)	Tap water

Table 4: Cleaning inputs

Input	Amount	Units
Tap water (40°C)	0.011	L / m^2 / yr.

Prevention of Structural Damage

Tile should not be installed until any and all structural damage to the building has been adequately repaired and determined to be code compliant. Surfaces must be structurally sound, stable and rigid enough to support the grout, mortar, and tile, in addition to any other ancillary tile installation products.

Health Aspects during Usage

Inherently, cement grouts do not emit VOCs. For polymer-modified cement grouts, the South Coast Air Quality Management District (SCAQMD) Rule #1168 details VOC thresholds that are most commonly specified. Cement grouts for tile installation represented by this industry-wide EPD are typically in compliance. Additionally, some products covered by this EPD have been engineered to minimize airborne dust or other job-site particulates. Some cement grout for tile installation also has built-in mold and mildew protection to complement tile's inherent resistance to mold and mildew growth.

End of Life

As grout is bound to the tile during application, it is typically disposed with the tile and as such, can be used in multiple applications—for example, clean fill material in land reclamation/contouring projects, base or substrate material for roadways and/or parking lots, replacement for raw materials used in cement or brick kilns, etc.

However, for purposes of this EPD, the analysis represents the most conservative approach and assumed that 100% of all tile removal waste is disposed of in a landfill.

Life Cycle Assessment

A full Life Cycle Assessment has been carried out according to ISO 14025 (ISO, 2011), ISO 14040 (ISO, 2009), and ISO 14044 (ISO, 2006), per the Product Category Rules (PCR) for Mineral Factory-made Mortar, as published by Institut Bauen und Umwelt e.V. (IBU, 2014), and the addendum as published by UL Environment (UL, 2016).

Declared Unit Description

The declaration refers to the declared unit of 1 kg of product.

Table 5: Declared unit

	Value	Unit
Declared unit	1	kg
Gross density	1590	kg/m^3
Conversion factor to 1 kg	1	–
Application rate	0.212	kg/m^2

System Boundaries

The chosen system boundary for this study is cradle to gate with options and the life cycle stages considered are summarized in Table 6.

Table 6: Life cycle modules included in EPD

Production			Installation		Use stage							End-of-Life				Next product system
Raw material supply (extraction, processing, recycled material)	Transport to manufacturer	Manufacturing	Transport to building site	Installation into building	Use / application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport to EoL	Waste processing for reuse, recovery or recycling	Disposal	Reuse, recovery or recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	X	MND	MND	MND	MND	MND	MND	X	MND	X	MND

X = declared module; MND = module not declared

Cut-off Criteria

No cut-off criteria were applied in this study. All reported data was incorporated and modeled using best available Life Cycle Inventory (LCI) data.

Background Data

For life cycle modeling of the considered products, the GaBi ts Software System for Life Cycle Engineering (thinkstep, 2016), developed by thinkstep AG, was used to model the product systems considered in this assessment. All relevant background datasets were sourced from the GaBi 2016 software database. The datasets from the GaBi database are documented in the online documentation (thinkstep, 2016).

Data Quality

A variety of tests and checks were performed throughout the project to ensure high quality of the completed LCA. Checks included an extensive review of project-specific LCA models as well as the background data used.

Temporal Coverage

Primary data collected from TCNA members represent consecutive 12 month averages during 2014 and/or 2015. Background datasets are primarily based on data from the last 5 years (since 2011), with the exception of cement, which dates from 2004.

Technological Coverage

Data on material composition and manufacturing are primary data from TCNA members. The raw material inputs, energy, waste, and emissions in the calculation for this LCA are based on annual total purchases divided by annual production during the reference year.

Geographical Coverage

This background LCA represents TCNA products produced in the Canada, Mexico, and the United States.

Manufacturing energy representative for each country was included; proxy datasets were used as needed for raw material inputs to address lack of data for a specific material or for a specific geographical region. These proxy datasets were chosen for their technological representativeness of the actual materials.

Allocation

Co-Product Allocation

Where manufacturing inputs, such as electricity use, were not sub-metered, they were allocated by mass to the respective products produced at each facility. No other co-product allocation occurs in the product system.

Multi-Input Processes Allocation

No multi-input allocation occurs in the product system.

Reuse, Recycling, and Recovery Allocation

The cut-off allocation approach is adopted in the case of any post-consumer recycled content, which is assumed to enter the system burden-free. Only environmental impacts from the point of recovery and forward (e.g., collection, sorting, processing, etc.) are considered.

Product and packaging waste is modeled as being disposed in a landfill rather than incinerated or recycled. Plastic and

other construction waste is assumed to be inert in landfills so no system expansion or allocation is necessary as no landfill gas produced.

Scenarios and Additional Technical Information

Information relevant to the life cycle modules included in this study are summarized in the following tables.

Table 7: Transport of 1 kg of grout to the building site (A4)

	Value	Unit
Liters of fuel	0.0024*	L / (100 km.kg)
Transport distance	805	km
Capacity utilization (including empty runs)	78	%

*Equivalent to a fuel consumption of 38.8 L / 100 km or a fuel economy of 6.0 mpg

Table 8: Installation of 1 kg of grout at the building site (A5)

	Value	Unit
Polymer (acrylate)	0.0257	kg
Water consumption	2.23E-04	m^3
Material loss (to landfill)	0.0448	kg
Dust in the air	unknown	kg

Table 9: Maintenance of 1 kg of grout over RSL (B2)

	Value	Unit
Water consumption	3.1E-03	m^3 / RSL
Electricity consumption	0.259	kWh / RSL

Table 10: Reference service life (RSL)

	Value	Unit
Reference service life	60	yr.

Table 11: End of life (C1-C4)

	Value	Unit
Collected as mixed construction waste	1	kg
Landfilling	1	kg

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Life Cycle Assessment – Results and Analysis

Results

Results for one kg installed grout over the service life of 60 years are presented below. Results for the grout required in 1 m^2 installed tile, as well as the impacts of a one-year service life, are included in the appendix.

POTENTIAL ENVIRONMENTAL IMPACTS

CML 2001 (Apr 2013)

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
GWP	kg CO_2 eq	6.77E-01	6.14E-02	1.19E-01	5.35E-02	2.43E-03	4.48E-02
ODP	kg CFC-11 eq	1.36E-09	5.05E-13	2.78E-12	1.74E-11	2.00E-14	8.58E-13
AP	kg SO_2 eq	2.91E-03	2.27E-04	2.14E-04	1.65E-04	9.02E-06	1.94E-04
EP	kg PO_4^3 eq	2.24E-04	5.86E-05	3.67E-05	9.71E-05	2.33E-06	2.48E-05
POCP	kg C_2H_4 eq	2.00E-04	2.71E-05	3.33E-05	1.16E-05	1.07E-06	1.97E-05
ADPE	kg Sb eq	8.84E-07	9.18E-09	1.83E-07	1.17E-08	3.64E-10	1.72E-08
ADPF	MJ	5.01E+00	8.62E-01	2.59E+00	5.77E-01	3.42E-02	6.77E-01

TRACI 2.1

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
GWP	kg CO_2 eq	6.77E-01	6.14E-02	1.19E-01	5.35E-02	2.43E-03	4.48E-02
ODP	kg CFC-11 eq	1.74E-09	5.37E-13	2.96E-12	1.85E-11	2.13E-14	9.12E-13
AP	kg SO_2 eq	2.89E-03	2.98E-04	2.28E-04	1.95E-04	1.18E-05	2.09E-04
EP	kg N eq	9.85E-05	2.77E-05	3.26E-05	1.18E-04	1.10E-06	1.16E-05
SFP	kg O_3 eq	3.91E-02	9.47E-03	3.42E-03	1.60E-03	3.76E-04	4.06E-03

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; SFP = Smog formation potential

RESOURCE USE

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
PERE	[MJ]	8.21E-01	1.43E-02	8.85E-02	5.56E-02	5.69E-04	4.40E-02
PERM	[MJ]	-	-	-	-	-	-
PERT	[MJ]	8.21E-01	1.43E-02	8.85E-02	5.56E-02	5.69E-04	4.40E-02
PENRE	[MJ]	5.49E+00	8.67E-01	2.67E+00	7.31E-01	3.44E-02	6.95E-01
PENRM	[MJ]	-	-	-	-	-	-
PENRT	[MJ]	5.49E+00	8.67E-01	2.67E+00	7.31E-01	3.44E-02	6.95E-01
SM	[kg]	1.45E-05	-	-	-	-	-
RSF	[MJ]	1.20E-04	-	2.76E-05	6.68E-06	-	-
NRSF	[MJ]	1.76E-03	-	3.07E-04	1.01E-04	-	-
FW	[m^3]	1.05E-03	1.76E-04	6.98E-04	3.45E-04	6.97E-06	1.07E-04

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM= Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

OUTPUT FLOWS AND WASTE CATEGORIES

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
HWD	[kg]	4.88E-07	1.10E-09	4.23E-07	2.02E-09	4.37E-11	1.33E-09
NHWD	[kg]	6.01E-03	3.05E-05	5.89E-02	9.16E-03	1.21E-06	1.00E+00
RWD	[kg]	1.43E-04	1.82E-06	3.33E-05	6.05E-05	7.23E-08	7.07E-06
CRU	[kg]	-	-	-	-	-	-
MFR	[kg]	-	-	-	-	-	-
MER	[kg]	-	-	-	-	-	-
EEE	[MJ]	-	-	-	-	-	-
EET	[MJ]	-	-	-	-	-	-

HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

Interpretation

The results derived according to the CML 2001 (Apr. 2013) methodology find that, over the reference service life (60 years) of grout, the production of raw materials and the energy for manufacturing are the two largest contributors in all impact categories considered. Maintenance during use also represents a small but relevant fraction of the eutrophication. When results for the TRACI 2.1 methodology are examined, maintenance becomes a much more relevant stage of the grout's life cycle, dominating eutrophication. As raw material production and upstream manufacturing are such large contributors to impacts in both impact assessment methods, the formulation of grout would be the most effective area to focus burden reduction efforts.

When considering a 1-year product life, as shown in the appendix, production of raw materials and energy for manufacturing are by far the two largest contributors in all impact categories considered. The installation of grout is also a small but relevant contributor to abiotic depletion (fossil) and fresh water use.

These results do not constitute a comparative assertion, though architects and builders will be able to use them to compare TCNA's products with similar products presented in other EPDs that follow the same PCR.

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Appendix – Additional Results

The following two sections tabulate environmental impacts of the grout life cycle under two additional scenarios.

Results for 1 m^2 of installed grout over a 60-year service life

The impacts of the life cycle of 1 m^2 of installed grout over a 60-year service life are presented here.

ENVIRONMENTAL IMPACTS

CML 2001 (Apr 2013)

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
GWP	kg CO_2 eq	1.44E-01	1.30E-02	2.53E-02	1.13E-02	5.16E-04	9.51E-03
ODP	kg CFC-11 eq	2.89E-10	1.07E-13	5.90E-13	3.69E-12	4.25E-15	1.82E-13
AP	kg SO_2 eq	6.17E-04	4.82E-05	4.54E-05	3.50E-05	1.91E-06	4.11E-05
EP	kg PO_4^3 eq	4.75E-05	1.24E-05	7.78E-06	2.06E-05	4.93E-07	5.25E-06
POCP	kg C_2H_4 eq	4.25E-05	5.74E-06	7.06E-06	2.47E-06	2.28E-07	4.17E-06
ADPE	kg Sb eq	1.87E-07	1.95E-09	3.88E-08	2.47E-09	7.72E-11	3.64E-09
ADPF	MJ	1.06E+00	1.83E-01	5.48E-01	1.22E-01	7.25E-03	1.44E-01

TRACI 2.1

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
GWP	kg CO_2 eq	1.44E-01	1.30E-02	2.53E-02	1.13E-02	5.16E-04	9.51E-03
ODP	kg CFC-11 eq	3.69E-10	1.14E-13	6.28E-13	3.92E-12	4.52E-15	1.93E-13
AP	kg SO_2 eq	6.13E-04	6.32E-05	4.83E-05	4.14E-05	2.51E-06	4.43E-05
EP	kg N eq	2.09E-05	5.87E-06	6.92E-06	2.51E-05	2.33E-07	2.46E-06
SP	kg O_3 eq	8.28E-03	2.01E-03	7.24E-04	3.39E-04	7.96E-05	8.62E-04

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources

RESOURCE USE

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
PERE	[MJ]	1.74E-01	3.04E-03	1.88E-02	1.18E-02	1.21E-04	9.33E-03
PERM	[MJ]	-	-	-	-	-	-
PERT	[MJ]	1.74E-01	3.04E-03	1.88E-02	1.18E-02	1.21E-04	9.33E-03
PENRE	[MJ]	1.16E+00	1.84E-01	5.66E-01	1.55E-01	7.29E-03	1.47E-01
PENRM	[MJ]	-	-	-	-	-	-
PENRT	[MJ]	1.16E+00	1.84E-01	5.66E-01	1.55E-01	7.29E-03	1.47E-01
SM	[kg]	3.07E-06	-	-	-	-	-
RSF	[MJ]	2.54E-05	-	5.85E-06	1.42E-06	-	-
NRSF	[MJ]	3.73E-04	-	6.50E-05	2.13E-05	-	-
FW	[m^3]	2.22E-04	3.72E-05	1.48E-04	7.31E-05	1.48E-06	2.27E-05

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM= Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

OUTPUT FLOWS AND WASTE CATEGORIES

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
HWD	[kg]	1.04E-07	2.33E-10	8.96E-08	4.28E-10	9.25E-12	2.82E-10
NHWD	[kg]	1.27E-03	6.46E-06	1.25E-02	1.94E-03	2.56E-07	2.13E-01
RWD	[kg]	3.04E-05	3.87E-07	7.06E-06	1.28E-05	1.53E-08	1.50E-06
CRU	[kg]	-	-	-	-	-	-
MFR	[kg]	-	-	-	-	-	-
MER	[kg]	-	-	-	-	-	-
EEE	[MJ]	-	-	-	-	-	-
EET	[MJ]	-	-	-	-	-	-

HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

NORTH AMERICAN CEMENT GROUT FOR TILE INSTALLATION
AS DEFINED BY ANSI A118.6 AND ANSI A118.7

According to ISO 14025

Results for 1 kg of installed grout over a 1-year service life

The impacts of the life cycle of 1 kg of installed grout over a 1-year service life are presented here.

ENVIRONMENTAL IMPACTS

CML 2001 (Apr 2013)

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
GWP	kg CO_2 eq	6.77E-01	6.14E-02	1.19E-01	8.92E-04	2.43E-03	4.48E-02
ODP	kg CFC-11 eq	1.36E-09	5.05E-13	2.78E-12	2.90E-13	2.00E-14	8.58E-13
AP	kg SO_2 eq	2.91E-03	2.27E-04	2.14E-04	2.75E-06	9.02E-06	1.94E-04
EP	kg PO_4^3 eq	2.24E-04	5.86E-05	3.67E-05	1.62E-06	2.33E-06	2.48E-05
POCP	kg C_2H_4 eq	2.00E-04	2.71E-05	3.33E-05	1.94E-07	1.07E-06	1.97E-05
ADPE	kg Sb eq	8.84E-07	9.18E-09	1.83E-07	1.94E-10	3.64E-10	1.72E-08
ADPF	MJ	5.01E+00	8.62E-01	2.59E+00	9.61E-03	3.42E-02	6.77E-01

TRACI 2.1

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
GWP	kg CO_2 eq	6.77E-01	6.14E-02	1.19E-01	8.92E-04	2.43E-03	4.48E-02
ODP	kg CFC-11 eq	1.74E-09	5.37E-13	2.96E-12	3.08E-13	2.13E-14	9.12E-13
AP	kg SO_2 eq	2.89E-03	2.98E-04	2.28E-04	3.25E-06	1.18E-05	2.09E-04
EP	kg N eq	9.85E-05	2.77E-05	3.26E-05	1.97E-06	1.10E-06	1.16E-05
SP	kg O_3 eq	3.91E-02	9.47E-03	3.42E-03	2.66E-05	3.76E-04	4.06E-03

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources

RESOURCE USE

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
PERE	[MJ]	8.21E-01	1.43E-02	8.85E-02	9.26E-04	5.69E-04	4.40E-02
PERM	[MJ]	-	-	-	-	-	-
PERT	[MJ]	8.21E-01	1.43E-02	8.85E-02	9.26E-04	5.69E-04	4.40E-02
PENRE	[MJ]	5.49E+00	8.67E-01	2.67E+00	1.22E-02	3.44E-02	6.95E-01
PENRM	[MJ]	-	-	-	-	-	-
PENRT	[MJ]	5.49E+00	8.67E-01	2.67E+00	1.22E-02	3.44E-02	6.95E-01
SM	[kg]	1.45E-05	-	-	-	-	-
RSF	[MJ]	1.20E-04	-	2.76E-05	1.11E-07	-	-
NRSF	[MJ]	1.76E-03	-	3.07E-04	1.68E-06	-	-
FW	[m^3]	1.05E-03	1.76E-04	6.98E-04	5.74E-06	6.97E-06	1.07E-04

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM= Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

OUTPUT FLOWS AND WASTE CATEGORIES

Parameter	Unit	A1-A3	A4	A5	B2	C2	C4
HWD	[kg]	4.88E-07	1.10E-09	4.23E-07	3.36E-11	4.37E-11	1.33E-09
NHWD	[kg]	6.01E-03	3.05E-05	5.89E-02	1.53E-04	1.21E-06	1.00E+00
RWD	[kg]	1.43E-04	1.82E-06	3.33E-05	1.01E-06	7.23E-08	7.07E-06
CRU	[kg]	-	-	-	-	-	-
MFR	[kg]	-	-	-	-	-	-
MER	[kg]	-	-	-	-	-	-
EEE	[MJ]	-	-	-	-	-	-
EET	[MJ]	-	-	-	-	-	-

HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

NORTH AMERICAN CEMENT GROUT FOR TILE INSTALLATION
AS DEFINED BY ANSI A118.6 AND ANSI A118.7

According to ISO 14025

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