Environmental
Product
Declaration

FORTA

FORTA-FERRO®

According to
ISO 21930
ISO 14025

1. General Information

Manufacturer Name:	FORTA – 100 Forta Drive Grove City, PA 16127-6399 USA
Program Operator:	ASTM International 100 Barr Harbor Drive West Conshohocken, PA 19428-2959, USA
Declaration Number:	EPD 345
Reference PCR:	ISO 21930: 2017
Date of Issuance:	July 28, 2022
End of Validity:	July 28, 2027
Product Name:	FORTA-FERRO®
EPD Owner:	FORTA
Declared Unit:	1000 kg of FORTA-FERRO®
EPD Scope:	Cradle-to-gate (A1, A2, and A3)
Verification:	ISO 21930 serves as the core PCR. Independent verification of the declaration according to ISO 14025 and ISO 21930. ☐ internal ☒ external
LCA Reviewer and EPD Verifier:	Timothy S. Brooke ASTM International

2. Product Information

2.1 Company Description

FORTA is an American-based company that supplies high quality synthetic reinforcement fibers to the global concrete industry. These fibers aim to reduce project costs by simultaneously extending the life of the concrete application and shortening the construction time. These reinforcement fibers are tested through research and development.

2.2 Product Description

The declared product is FORTA-FERRO® (shown in Figure 1), a fibrous reinforcement for concrete. This product is a blend of two fibers: a twisted-bundle macrosynthetic monofilament copolymer fiber; and a fibrillated microsynthetic polypropylene fiber. This heavy-duty blend yields a high-performance concrete reinforcement that reduces plastic and hardened concrete shrinkage, improves impact strength, increases fatigue resistance, toughness, load-transfer and post-crack performance, and provides maximum long-term durability and structural enhancements. FORTA-FERRO® is an easy-to-finsh color-blended fiber that is non-corrosive, non-magnetic, and 100% Alkali proof.

Figure 1: FORTA-FERRO® product visual representation.

2.2 Technical Data

Table 1 provides physical property data for FORTA-FERRO®.

Table 1: Technical Data

Property	Value	Unit
Materials	Virgin Copolymer/Polypropylene	N/A
Form	Monofilament/Fibrillated Fiber System	N/A
Specific Gravity	0.91	N/A
Tensile Strength	570-660 (83-96)	MPa (ksi)
Length	38, 54 (1.5, 2.25)	mm (inch)
Color	Gray	N/A
Acid/Alkali Resistance	Excellent	N/A

3. LCA Calculation Rules

3.1 Declared Unit

The declared unit is 1000 kg of FORTA-FERRO® produced at FORTA's manufacturing facility.

3.2 System Boundary

The system boundary for this study is limited to a cradle-to-gate focus. (see also Table 4):

- ***A1 Raw material supply***: Extraction, handling, and processing of input materials.
- ***A2 Transportation****:* Transportation of all input materials from the suppliers to the gate of the manufacturing facility.
- ***A3 Manufacturing*****:** The preparation processes of FORTA's manufacturing facility. This phase also includes the operations of the manufacturing facility and all process emissions that occur at the production facility.

3.3 Estimates and Assumptions

All significant foreground data was gathered from the manufacturer based on measured values.

3.4 Cut-off Criteria

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO 21930: 2017 Section 7.1.8. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty are included.
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle inventory.

No material or energy input or output was knowingly excluded from the system boundary.

3.5 Background Data and 3.6 Data Quality

Data was gathered for the primary material and energy inputs used in production for calendar year 2020. Table 3 describes each LCI data source for raw materials (A1), transportation (A2) and the core manufacture process (A3). Table 3 also includes a data quality assessment on the basis of the technological, temporal, and geographical representativeness.

Table 2: Secondary Data Sources and Data Quality Assessment				
A1: Raw Material Inputs				
Inputs	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
FORTA-FERRO Polypropylene	US LCI: Polypropylene, resin, at plant, CTR/kg/RNA	US	2014	**Technology:** good **Time:** good Data is <10 years old **Geography:** very good
FORTA-FERRO Polyethylene	US LCI: Polyethylene, high density, resin, at plant, CTR /kg/RNA	US	2014	**Technology:** good **Time:** good Data is <10 years old **Geography:** very good
FORTA-FERRO Color	Ecoinvent 3.7: Chemicals inorganic, at plant/GLO with US electricity U	Global	2018	**Technology:** fair **Time:** very good Data is <5 years old **Geography:** good Data is representative of global conditions.
A2: Transportation				
Inputs	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Trucking	USLCI: Transport, single unit truck, short-haul, diesel powered, Northwest/tkm/RNA	Global	2014	**Technology:** very good **Time:** good Data is <10 years old **Geography:** very good
Rail	USLCI: Transport, train, diesel powered/US	Global	2014	**Technology:** very good **Time:** good Data is <10 years old **Geography:** very good
A3: Manufacturing				
Energy	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Electricity	Ecoinvent 3: Electricity, low voltage {RFC}| market for | Cut-off, U	Global	2018	**Technology:** very good **Time:** very good Data is <5 years old **Geography:** very good
Natural Gas	USLCI: Natural gas, combusted in industrial boiler/US	Global	2014	**Technology:** very good **Time:** good Data is <10 years old **Geography:** very good.

Cardboard Sheets	USLCI: Paper board, packing, average, at plant/CN U	Global	2014	**Technology:** very good **Time:** good Data is <10 years old **Geography:** very good.
Pallets	USLCI: Dry rough lumber, at kiln, US SE NREL /US Packaging	Global	2014	**Technology:** very good **Time:** good Data is <10 years old **Geography:** very good.

3.7 Period under Review

Data was gathered for the primary material and energy inputs used in the production for calendar year 2020.

3.8 Allocation

FORTA produces multiple products. Since the primary data for manufacturing was only available on a facility level, the environmental load among the products produced is allocated according to its mass. For waste that is recycled, the 'recycled content approach' was chosen. The recycling of waste generated by the product system is cut off.

3.9 Comparability

This LCA was created using industry average data for upstream materials. Data variation can result from differences in supplier locations, manufacturing processes, manufacturing efficiency and fuel types used.

4. LCA Results

Life cycle impact assessment (LCIA) is the phase in which the set of results of the inventory analysis – the inventory flow table – is further processed and interpreted in terms of environmental impacts and resource use inventory metrics.Tables 4 and 5 below summmarize the LCA results for the cradle-to-gate (A1-A3) product system.

Table 3: Description of the System Boundary (x: included in LCA; mnd: module not declared; mnr: module not reported)

Product			Construction Installation		Use							End-of-Life				Benefits Beyond the System Boundary		
Raw Material Supply	Transport	Manufacturing	Transport	Construction / Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/ Demolition	Transport	Waste Processing	Disposal	Reuse	Recovery	Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
x	x	x	mnd	mnd	mnd	mnd	mnr	mnr	mnr	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd

Table 4. LCIA Results for 1000 kg FORTA-FERRO®						
Environmental Indicator	**Abbreviation**	**Units**	**Total**	**A1**	**A2**	**A3**
Core Mandatory Impact Indicator						
Global warming potential	**GWP**	kg CO_2-eq	2.94E+03	1.72E+03	1.02E+01	1.21E+03
Depletion potential of the stratospheric ozone layer	**ODP**	kg CFC-11-eq	1.03E-04	1.02E-05	3.89E-10	9.28E-05
Acidification potential of land and water	**AP**	kg SO_2-eq	1.17E+01	6.53E+00	1.80E-01	5.03E+00
Eutrophication potential	**EP**	kg PO_4-eq	1.12E+01	1.74E-01	1.09E-02	1.10E+01
Formation of tropospheric ozone	**SFP**	kg O_3-eq	1.09E+02	6.57E+01	5.86E+00	3.75E+01
Abiotic depletion potential for fossil resources	**ADPf**	MJ Surplus	7.91E+04	6.73E+04	1.31E+02	1.17E+04
Fossil fuel depletion	**FFD**	MJ Surplus	1.03E+04	9.59E+03	2.25E+02	5.20E+02
Use of Primary Resources						
Renewable primary energy carrier used as energy	**RPRE**	MJ	4.82E+02	1.30E+02	0.00E+00	3.52E+02
Renewable primary energy carrier used as material	**RPRM**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable primary energy used as energy	**NRPRE**	MJ	8.66E+04	6.73E+04	1.32E+02	1.91E+04
Non-renewable primary energy used as material	**NRPRM**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Secondary Material, Secondary Fuel and Recovered Energy						
Use of secondary materials	**SM**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels	**RSF**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels	**NRSF**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Recovered energy	**RE**	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mandatory Inventory Parameters						
Use of freshwater resources	**FW**	m^3	4.32E+01	7.65E+00	0.00E+00	3.55E+01
Indicators Describing Waste						
Disposed of hazardous waste	**HWD**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of non-hazardous waste	**NHWD**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of high-level radioactive waste	**HLRW**	m^3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Disposed of low-level radioactive waste	**LLRW**	m^3	3.30E-05	9.34E-08	2.53E-06	3.04E-05
Components for reuse	**CRU**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	**MFR**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery	**MER**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported electrical energy (waste to energy)	**EEE**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported thermal energy (waste to energy)	**ETE**	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00

5. Interpretation

Figure 2 shows the relative contribution to the cumulative impacts of the A1 through A3 phases of the cradle-to-gate life cycle. For all the major impact categories (GWP, ODP, AP, EP, SFP, ADPf), the biggest contributor is A1 – Raw material supply. There are some contributions from A3 – Manufacturing data, and very little from A2 – Transportation.

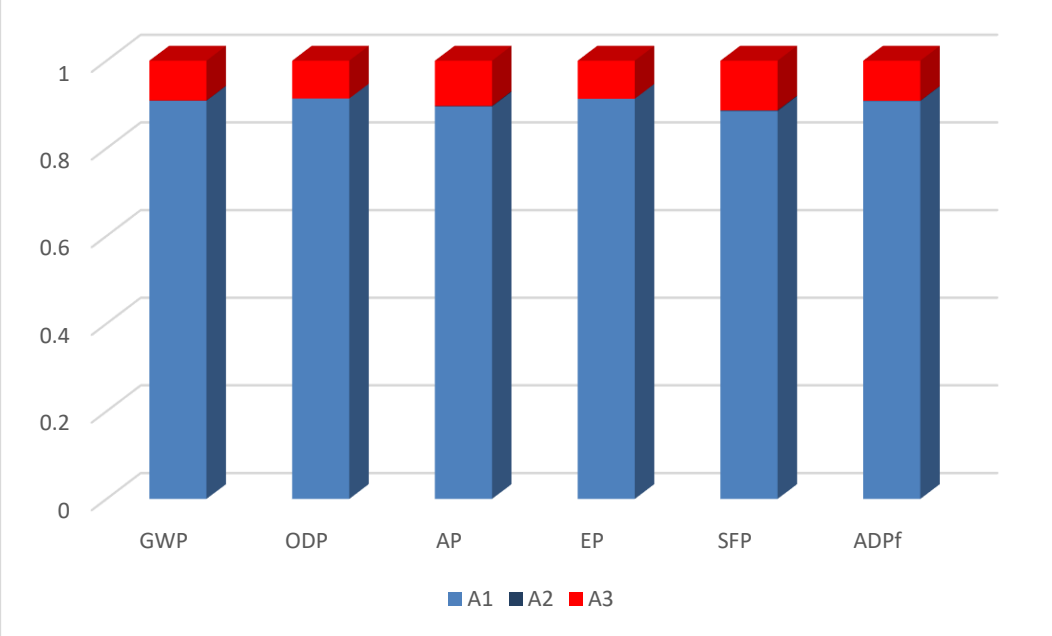

Figure 2. Contribution analysis for FORTA-FERRO®.

6. References

1. ASTM 2020 - ASTM Program Operator for Product Category Rules (PCR) and Environmental Product Declarations (EPDs) General Program Instructions v8, April 29th.

2. Athena Institute: 2021 - A Cradle-to-Gate Life Cycle Assessment of FORTA-FERRO® Manufactured by FORTA.

3. ISO 21930: 2017 Building construction – Sustainability in building construction – Environmental declaration of building products.

4. ISO 14025: 2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.

5. ISO 14044:2006/AMD 1:2017/ AMD 2:2020 - Environmental management - Life cycle assessment - Requirements and guidelines.

6. 14040:2006/AMD 1:2020 - Environmental management - Life cycle assessment - Principles and framework.