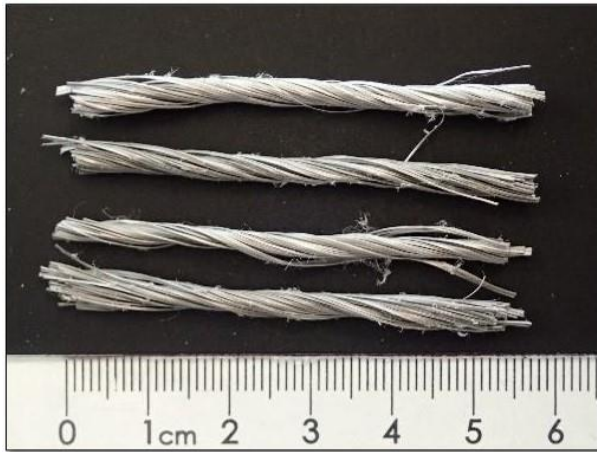


LIFE CYCLE ASSESSMENT (LCA)

In accordance with EN 15804+A2 & ISO 14025 / ISO 21930

Prepared on August 9, 2023



MasterFiber 320, Master Builders Solutions

Product name:

MasterFiber 320

Manufacturer name:

Master Builders Solutions



Program operator:

OneClick LCA



ENVIRONMENTAL DATA SUMMARY

Declared unit	1 kilogram
Declared unit mass	1 kg
GWP-fossil, A1-A3 (kgCO ₂ e)	2.54
GWP-total, A1-A3 (kgCO ₂ e)	2.41
Secondary material, inputs (%)	0.276
Secondary material, outputs (%)	0.0
Total energy use, A1-A3 (kWh)	13.2
Total water use, A1-A3 (m ³ e)	0.0275



GENERAL INFORMATION

Manufacturer:

Manufacturer name	Master Builders Solutions
Address	Dr.-Albert-Frank-Str. 32, 83308 Trostberg, Germany
Contact details	masterfiber-eu@masterbuilders.com
Website	www.master-builders-solutions.com

LCA standards, scope, and verification:

Reference standard	EN 15804+A2:2019 and ISO 14025
PCR	EPD Hub Core PCR version 1.0, 1 Feb 2022
Sector	Construction product
Category of LCA	Self-declared
Scope of the LCA	Cradle to gate
LCA author	Dr.-Ing. Shirin Fataei, Master Builders Solutions

The manufacturer has the sole ownership, liability, and responsibility for the LCA. LCAs within the same product category but from different programs may not be comparable. LCAs of construction products may not be comparable if they do not comply with EN 15804 and if they are not compared in a building context.

Product:

Product name	MasterFiber 320
Place of production	Cortegaça, Portugal
Period for data	2022
Averaging in LCA	No averaging
Variation in GWP-fossil for A1 - A3	-

PRODUCT AND MANUFACTURER

About the manufacturer:

Master Builders Solutions is one of the leading suppliers of concrete admixtures and underground construction solutions worldwide. With over a century of experience in the construction industry, we leverage cutting-edge technologies, a global community of experts at the core of our business, as well as in-depth knowledge of local building needs to provide innovative and sustainable solutions.

Product description:

MasterFiber 320 is a high-performance polyolefin synthetic macro fiber which consists of several filaments twisted to a bundle. As material a combination of Polyolefins is used, while Polypropylene is dominating. It is non-corroding and highly resistant in acidic and alkaline environment like in concrete.

According to EN 14889-2:2006-11 the fiber is supposed to be used for structural purposes in concrete, mortar, and grout. As such it reinforces cementitious based concrete and mortar.

It is successfully used, when cracking due to plastic shrinkage, internal stresses induce by drying shrinkage or temperature gradients shall be controlled in horizontal construction elements. It is there for an excellent fiber for any kind of flooring or pavement application.

Further information can be found at www.master-builders-solutions.com.

Product raw material main composition:

Raw material category	Amount, mass- %	Material origin
Metals	0	-
Minerals	0	-
Fossil materials	100%	EU
Bio-based materials	0	-

Product raw material main composition:

Product's biogenic carbon content at the factory gate

Biogenic carbon content in product, kg C	0
Biogenic carbon content in packaging, kg C	0.0039

Functional unit and service life:

Declared unit	1 kilogram
Mass per declared unit	1 kg
Reference service life	50 years

Substances, REACH – very high concentration:

The product does not contain any REACH – substance of very high concern in amounts greater than 0.1% (1000 ppm).

PRODUCT LIFE-CYCLE

System boundary:

This LCA covers the life-cycle modules listed in the following table.

Product stage			Assembly stage		Use stage							End of life stage				Beyond the system boundaries		
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D		
x	x	x	MND	x	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	x		
Raw materials	Transport	Manufacturing	Transport	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruct./Demolish.	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling

Modules not declared = MND. Modules not relevant = MNR.

Manufacturing and packaging (A1-A3):

The environmental impacts considered for the product stage cover the manufacturing of raw materials used in the production as well as packaging materials and other ancillary materials. Also, fuels used by machines, and handling of waste formed in the production processes at the manufacturing facilities are included in this stage. The study also considers the material losses occurring during the manufacturing processes as well as losses during electricity transmission.

MasterFiber 320 are created through an extrusion process, in which molten polyolefin is formed into continuous strands. These strands then undergo a drawing process to enhance their tensile properties. Subsequently several strands are combined to a bundle, which is then twisted and cut to final length. Waste is minimized through recycling, as any production waste is molten, ground and reused as raw material, eliminating production loss. MasterFiber 320 is packed in degradable paper bags that can be directly added to concrete.

Transport and installation (A4-A5):

Transportation Impacts occurred from products delivery to the customer (A4) is not covered in this LCA.

Treatment of packaging materials is covered in A5 module.

Product use and maintenance (B1-B7):

This LCA does not cover the use phase. Air, soil, and water impacts during the use phase have not been studied.

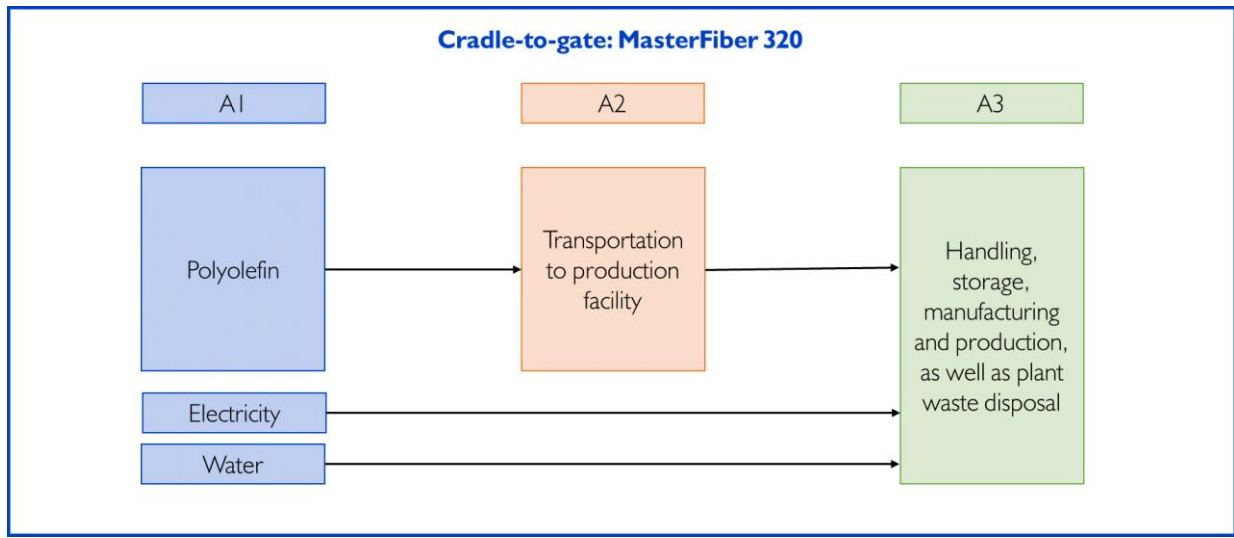
Product end of life (C1-C4, D):

The product end of life stages (C1 – C4) are not included in this LCA based on the EN 15804 standard special provision for construction products and materials which fulfil the conditions for exemption based on the product being integrated and not capable of separation from concrete at end of life, the product not being identifiable as original based on the physical change after



deconstruction and the omission of any biogenic carbon in the product. The benefits and loads of recycled and incinerated packaging (from A5) are modelled and included beyond the system boundary (D).

MANUFACTURING PROCESS



LIFE-CYCLE ASSESSMENT

Cut-off criteria:

The study does not exclude any modules or processes which are stated mandatory in the reference standard and the applied PCR. The study does not exclude any hazardous materials or substances. The study includes all major raw material and energy consumption. All inputs and outputs of the unit processes, for which data is available for, are included in the calculation. There is no neglected unit process more than 1% of total mass or energy flows. The module specific total neglected input and output flows also do not exceed 5% of energy usage or mass.

Allocation, estimates and assumptions:

Allocation is required if some material, energy, and waste data cannot be measured separately for the product under investigation. All allocations are done as per the reference standards and the applied PCR. In this study, allocation has been done in the following ways:

Data type	Allocation
Raw materials	No allocation
Packaging materials	No allocation
Ancillary materials	No allocation
Manufacturing energy and waste	Allocated by mass or volume

The manufacturing energy is allocated by mass considering the annual total production. The plant produces similar other products, which allows for mass allocation. The following assumptions were made in this LCA: 1) 0% production loss (module A1) due to reuse of PP waste; 2) Treatment of degradable paper bags are not necessary as they become part of the concrete structure; 3) Waste processing ratios for plastic packaging: 34.6% recycling and reuse as plastic, 42.0% incineration with 73% efficiency, 23.4% sanitary landfill (A5) [Sources: [The Circular Economy for Plastics, A European Overview.](#)], 4) Waste processing ratios for wooden pallet: 100% incineration with 73% efficiency after 10 times reuse (A5) [Source: Eriksson O., Finnveden G. (2017)]; 5) Waste processing ratios for cardboard box: 81.5% recycling, 9.1% incineration with 73% efficiency, 9.4% sanitary landfill (A5) [Sources: eurostat - [Packaging waste by waste management operations](#)]; 6) Transport distance for waste (A5) is considered 100 km.

Averages and variability:

Type of average	No averaging
Averaging methos	Not applicable
Variation in GWP-fossil for A1 -A3	-

This LCA is product and factory specific and does not contain average calculations.

LCA software and bibliography:

This LCA has been created using One Click LCA EPD Generator. The LCA have been prepared according to the reference standards and ISO 14040/14044. Ecoinvent version 3.8 data and One Click LCA databases were used as sources of environmental data.

ENVIRONMENTAL IMPACT DATA

Core environmental impact indicators – EN 15804+A2, PEF:

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP – total ¹⁾	kg CO ₂ e	1.99E0	6.64E-2	3.61E-1	2.41E0	MND	1.46E-1	MND	MND	MND	MND	-3.49E-2
GWP – fossil	kg CO ₂ e	1.98E0	6.63E-2	4.95E-1	2.54E0	MND	5.64E-3	MND	MND	MND	MND	-2.73E-2
GWP – biogenic	kg CO ₂ e	3.43E-3	1.95E-5	-1.4E-1	-1.36E-1	MND	1.41E-1	MND	MND	MND	MND	-7.84E-3
GWP – LULUC	kg CO ₂ e	5.06E-4	5.97E-5	5.49E-3	6.05E-3	MND	1.85E-6	MND	MND	MND	MND	2.56E-4
Ozone depletion pot.	kg CFC-11e	3.04E-8	1.3E-8	3.18E-8	7.53E-8	MND	2.6E-10	MND	MND	MND	MND	-7.73E-10
Acidification potential	mol H ⁺ e	6.87E-3	1.92E-3	3.65E-3	1.24E-2	MND	1.42E-5	MND	MND	MND	MND	-1.31E-4
EP-freshwater ²⁾	kg Pe	2.63E-5	2.74E-7	2.46E-5	5.12E-5	MND	5.56E-8	MND	MND	MND	MND	-1.11E-6
EP-marine	kg Ne	1.17E-3	4.34E-4	6.41E-4	2.24E-3	MND	1.52E-5	MND	MND	MND	MND	-2.58E-5
EP-terrestrial	mol Ne	1.27E-2	4.83E-3	6.21E-3	2.38E-2	MND	4.4E-5	MND	MND	MND	MND	-2.87E-4
POCP (“smog”) ³⁾	kg NMVOCe	6.19E-3	1.27E-3	1.66E-3	9.12E-3	MND	1.66E-5	MND	MND	MND	MND	-7.91E-5
ADP-minerals & metals ⁴⁾	kg Sbe	1.32E-5	1.12E-7	1.46E-6	1.48E-5	MND	2.41E-8	MND	MND	MND	MND	-3.2E-8
ADP-fossil resources	MJ	7.07E1	8.31E-1	6.73E0	7.82E1	MND	2.61E-2	MND	MND	MND	MND	-3.87E-1
Water use ⁵⁾	m ³ e depr.	8.46E-1	2.84E-3	2.09E-1	1.06E0	MND	1.27E-3	MND	MND	MND	MND	1.91E-2

¹⁾GWP = Global Warming Potential; ²⁾EP = Eutrophication potential; ³⁾POCP = Photochemical ozone formation; ⁴⁾ADP = Abiotic depletion potential

For EP-freshwater, the required characterization method and data are in kg P-eq. Multiply by 3,07 to get PO4e

^{4,5)}EN 15804+A2 disclaimer for Abiotic depletion and Water use and optional indicators except Particulate matter and Ionizing radiation, human health: The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator

Additional environmental impact indicators – EN 15804+A2, PEF:

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Particulate matter	Incidence	7.16E-8	2.06E-9	1.44E-8	8.81E-8	MND	6.35E-10	MND	MND	MND	MND	-9.83E-10
Ionizing radiation ⁶⁾	kBq U235e	1.09E-1	3.83E-3	4.14E-2	1.54E-1	MND	1.42E-4	MND	MND	MND	MND	-2.35E-3
Ecotoxicity (freshwater)	CTUe	9.58E0	5.5E-1	7.8E0	1.79E1	MND	3.21E-1	MND	MND	MND	MND	-2.87E-1
Human toxicity, cancer	CTUh	5.13E-10	4.63E-11	1.74E-10	7.33E-10	MND	6.75E-12	MND	MND	MND	MND	-1.05E-11
Human tox. non-cancer	CTUh	1.22E-8	3.58E-10	5.33E-9	1.78E-8	MND	1.16E-10	MND	MND	MND	MND	-1.81E-10
SQP ⁷⁾	-	1.64E0	1.19E-1	8.7E0	1.05E1	MND	2.56E-2	MND	MND	MND	MND	-2.3E0

⁶⁾EN 15804+A2 disclaimer for Ionizing radiation, human health: This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator

⁷⁾SQP = Land use related impacts/soil quality

Use of natural resources:

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Renew. PER as energy ⁸⁾	MJ	1.04E0	6.6E-3	3.44E0	4.49E0	MND	1.38E-3	MND	MND	MND	MND	-6.05E-2
Renew. PER as material	MJ	0E0	0E0	1.25E0	1.25E0	MND	-1.25E0	MND	MND	MND	MND	-4.65E-3
Total use of renew. PER	MJ	1.04E0	6.6E-3	4.69E0	5.74E0	MND	-1.24E0	MND	MND	MND	MND	-6.51E-2
Non-re. PER as energy	MJ	3.56E1	8.31E-1	6.58E0	4.3E1	MND	2.61E-2	MND	MND	MND	MND	-3.57E-1
Non-re. PER as material	MJ	3.51E1	0E0	1.27E-1	3.52E1	MND	-1.27E-1	MND	MND	MND	MND	4.65E-3
Total use of non-re. PER	MJ	7.07E1	8.31E-1	6.71E0	7.82E1	MND	-1.01E-1	MND	MND	MND	MND	-3.52E-1
Secondary materials	kg	2.76E-3	4.62E-4	7.01E-2	7.34E-2	MND	4.05E-5	MND	MND	MND	MND	1.9E-2
Renew. secondary fuels	MJ	2.69E-5	1.17E-6	7.92E-3	7.94E-3	MND	2.35E-7	MND	MND	MND	MND	-5.11E-7
Non-ren. secondary fuels	MJ	0E0	0E0	0E0	0E0	MND	0E0	MND	MND	MND	MND	0E0
Use of net fresh water	m ³	2.19E-2	6.07E-5	5.57E-3	2.75E-2	MND	1.45E-5	MND	MND	MND	MND	-8.22E-5

⁸⁾PER = Primary energy resources

End of life – waste:

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste	kg	4.58E-2	1.33E-3	4.62E-2	9.33E-2	MND	1.64E-4	MND	MND	MND	MND	1.21E-5
Non-hazardous waste	kg	1.12E0	1.08E-2	8.47E-1	1.98E0	MND	2.28E-2	MND	MND	MND	MND	-4.49E-2
Radioactive waste	kg	3.3E-5	5.84E-6	1.49E-5	5.37E-5	MND	9.92E-8	MND	MND	MND	MND	-6.8E-7

End of life – output flows:

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Components for re-use	kg	0E0	0E0	0E0	0E0	MND	0E0	MND	MND	MND	MND	0E0
Materials for recycling	kg	0E0	0E0	0E0	0E0	MND	5.79E-2	MND	MND	MND	MND	0E0
Materials for energy rec	kg	0E0	0E0	0E0	0E0	MND	0E0	MND	MND	MND	MND	0E0
Exported energy	MJ	0E0	0E0	0E0	0E0	MND	1.26E-1	MND	MND	MND	MND	0E0

Environmental impacts – EN 15804+AI, CML / ISO 21930:

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Global Warming Pot.	kg CO ₂ e	1.88E0	6.59E-2	4.96E-1	2.44E0	MND	1.68E-2	MND	MND	MND	MND	-2.63E-2
Ozone depletion Pot.	kg CFC ₁₁ e	2.65E-8	1.03E-8	2.71E-8	6.4E-8	MND	2.11E-10	MND	MND	MND	MND	-6.16E-10
Acidification	kg SO ₂ e	5.75E-3	1.56E-3	3.04E-3	1.03E-2	MND	1.1E-5	MND	MND	MND	MND	-1.08E-4
Eutrophication	kg PO ₄ ³ e	1.32E-3	1.61E-4	9.28E-4	2.41E-3	MND	3.89E-5	MND	MND	MND	MND	-3.91E-5
POCP ("smog")	kg C ₂ H ₄ e	4.29E-4	4.28E-5	1.25E-4	5.97E-4	MND	3.38E-6	MND	MND	MND	MND	-3.94E-6
ADP-elements	kg Sbe	1.31E-5	1.1E-7	1.38E-6	1.46E-5	MND	2.37E-8	MND	MND	MND	MND	-3.55E-8
ADP-fossil	MJ	7.07E1	8.31E-1	6.72E0	7.82E1	MND	2.61E-2	MND	MND	MND	MND	-3.87E-1

Environmental impacts – TRACI 2.1. / ISO 21930:

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Global Warming Pot.	kg CO ₂ e	1.82E0	6.59E-2	4.85E-1	2.37E0	MND	1.48E-2	MND	MND	MND	MND	-2.62E-2
Ozone Depletion	kg CFC ₁₁ e	2.63E-8	1.03E-8	2.69E-8	6.35E-8	MND	2.11E-10	MND	MND	MND	MND	-6.01E-10
Acidification	kg SO ₂ e	3.02E-1	8.72E-2	1.57E-1	5.45E-1	MND	7.28E-4	MND	MND	MND	MND	-6.04E-3
Eutrophication	kg Ne	2.05E-4	6.59E-5	2.14E-4	4.85E-4	MND	1.38E-5	MND	MND	MND	MND	-6.61E-6
POCP ("smog")	kg O ₃ e	3.22E-3	1.11E-3	1.34E-3	5.67E-3	MND	1.13E-5	MND	MND	MND	MND	-6.65E-5
ADP-fossil	MJ	9.8E0	1.17E-1	5.44E-1	1.05E1	MND	2.76E-3	MND	MND	MND	MND	-3.18E-2