Environmental Product Declaration

In accordance with ISO 14025 and EN 15804:2019 for:

Cem-FIL MiniBars™ (1 kg)

ReforceTech / Owens Corning

Programme:	To be determined
Programme operator:	To be determined
EPD registration number:	To be determined
Issue date:	2020-10-08
Validity date:	Not validated
Geographical scope:	Europe

1. General Information

This document applies to 1kg of Cem-FIL MiniBars™ manufactured by ReforceTech in Norway. Owens Corning's supplier in Taishan FiberGlas in the Shadong region in China produces the main ingredient of the Cem-FIL MiniBars™, the Cem-FIL® AR Glass fibers, which have their own EPD.

This Environmental Product Declaration is in accordance with ISO 14040 [1], 14025 [2] and 14044 Standards [3]. Furthermore, it complies with the Dutch Norm the SBK Bepalingsmethode 3.0. The LCA tool Mobius version 0.8.367 by Ecochain has been used in the preparation of this EPD [4].

2. Company and product information

2.1 Company description

ReforceTech creates innovations in concrete. Concrete solutions made simpler, durable and greener, based on corrosion free composite reinforcement. ReforceTech products are certified to international standards.

2.2 Product specification

The Cem-FIL MiniBars™ are a high-performance composite macrofiber, engineered to provide high post- cracking strength to concrete while at the same time increasing toughness, impact and fatigue resistance of concrete. In this way, MiniBars™ macrofiber can be used as secondary and/or primary reinforcement.

- Fibers are formed in a helix shaped MiniBar™ using a resin to lock in the helix geometry so the fibers work together bonded in concrete
- Lengths tailored for concrete grade and application (Shrinkage, Flexural Tensile Strength or Average Residual Strength), 24,33 43 and 55mm lengths
- Diameter 0.65mm
- Helix and rough surface to bond with the concrete as demonstrated in concrete beam testing
- Cem-FIL MiniBars™ have a density close to the fresh concrete one, and thanks to that, the dispersion and the distribution in the concrete is homogeneous without floating or sinking effects, helping to optimize the thickness and the performances of the concrete structure.

2.3 Base materials

The base raw materials for the Cem-FIL MiniBars™ are:

- Cem-FIL® AR Glass fibers – (70-80%)
- Vinyl Ester – 20-30%
- Helix thread - < 5%

The recipe contains no hazardous substances. In accordance with current knowledge, this product contains no substances of very high concern (SVHC) on the /REACH Candidate List/ published by the European Chemicals Agency in a concentration exceeding 0.1 % (by unit weight).

2.4 Manufacturing

The manufacturing covers different production processes, which are shown in the process tree in figure 1. The process three shows the production process of the Cem-FIL MiniBars™. The MiniBar™ production process is a wet layup process where the fibers are wound and impregnated to form the desired helical shape, then cured and cut to length tailored to the concrete grade and application. The process tree is a simplified overview of the production process that are necessary for the production.

2.5 Product Application

The Cem-FIL MiniBars™ are used as reinforcement for concrete.

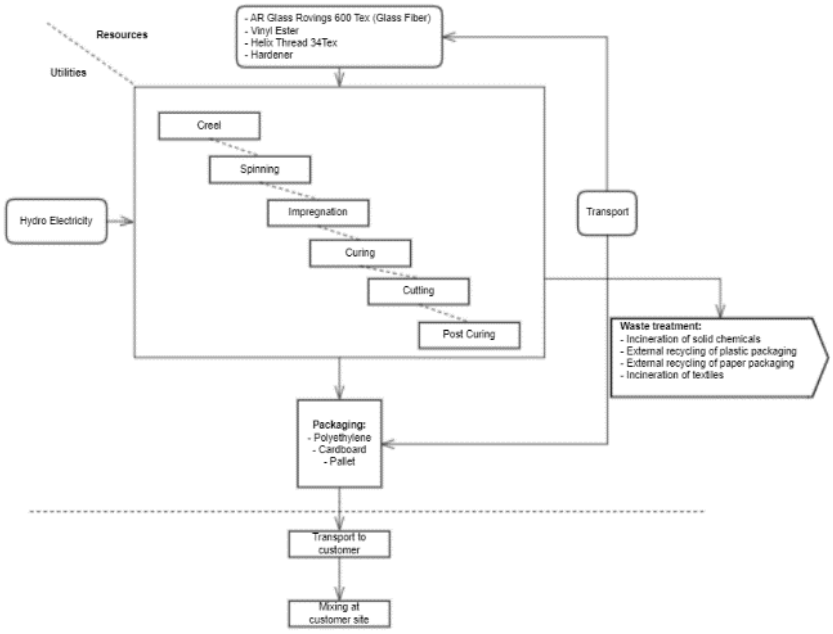

FIGURE 1: PROCESS TREE OF 1 KG OF CEM-FIL MINIBARS™.

3. Functional unit

3.1 Functional Unit

The functional unit has been defined as follows: *the production of 1 kg of Cem-FIL MiniBars™*

Description	Value	Unit
Declared unit	1	kg

3.2 System boundary

Type of EPD: Cradle to gate

The system boundaries of the EPD follow the modular construction system described by EN 15804. The LCA takes into account the following modules:

3.2.1 Production stage (A1-A3)

This includes three modules, A1, A2 and A3, concerning the extraction and processing of raw materials, transport and manufacturing, respectively.

3.3 Data quality and allocation

To simulate the product stage, data recorded by Owens Corning from the production year 2019. All other relevant background data sets were taken from generic data not older than 10 years.

The primary data provided by Owens Corning derive from the production plant in Norway. Within the same time frame, a coherent study has been done on the environmental impact of Owens Cornings' Cem-FIL® AR Glass fibers. This accounts for a mass percentage of 70-80% of input materials for the Cem-FIL MiniBars™. The data for the production process and input materials for the calculations of the Cem-FIL MiniBars™ came directly from the production plant in China. For other materials used in the Cem-FIL MiniBars™, MSDS sheets of most of the input materials were provided by ReforceTech through their suppliers. All background data records were retrieved from the Ecoinvent database (Version 3.5).

3.3.1 Cut-off criteria

All data was taken into account (e.g. recipe constituents, thermal energy used, electricity used). Transport expenses were considered for all inputs and outputs. The manufacturing of the production machines and systems and associated

infrastructure was not taken into account in the LCA.

3.3.2 Allocation rules

In a life cycle assessment, it is often the case that the environmental burden must be divided over multiple product systems. This can occur in four cases:

1. The production of multiple products within one production process (multi-output);
2. The treatment of multiple products/resources within one production process (multi-input);
3. The use of secondary materials;
4. Reuse of materials.

There have not been encountered any allocation issues as all four cases above do not apply for the Cem-FIL MiniBars™. Case 1 and 2 do not apply as product specific data has been retrieved from the production plant. Furthermore, there has not been any use of secondary materials or reuse of materials, which make case 3 and also not applicable in this situation.

3.3.3 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to EN 15804 and the building context, respectively the product-specific characteristics of performance, are taken into account.

4. LCA: Results

The results displayed below apply to 1 kg of Cem-FIL MiniBars™.

Description of the system boundary (X = Included in LCA; MND = Module Not declared)																
Product stage			Construction process stage		Use Stage							End of life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Manufacturing	Transport	Construction installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Impact category	A1	A2	A3	A1-A3
Environmental Cost Indicator / Milieu Kost Indicator (ECI/MKI) (Euro)	0,56	0,02	0,02	0,60
Global warming potential (GWP) (kg CO2 eq)	3,54	0,18	0,13	3,85
Total use of renewable primary energy resources (PERT) (MJ)	4,77E+00	2,94E-02	7,83E+00	1,26E+01
Radioactive waste disposed (HWD) (kg)	8,36E-05	1,89E-05	8,64E-06	1,11E-04
Abiotic depletion potential for non-fossil resources (ADPE) (kg Sb eq)	1,10E-05	5,11E-07	1,53E-07	1,17E-05
Total use of non-renewable primary energy resources (PENRT) (MJ)	6,02E+01	2,98E+00	1,43E+00	6,46E+01
Acidification potential of land and water (AP) (kg SO2 eq)	1,75E-02	7,78E-04	2,93E-04	1,86E-02
Total use of primary energy resources (PET) (MJ)	6,50E+01	3,01E+00	9,25E+00	7,73E+01
Abiotic depletion potential for fossil resources (ADPF) (kg Sb eq)	3,03E-02	1,34E-03	5,32E-04	3,22E-02
Hazardous waste disposed (HWD) (kg)	5,34E-05	1,78E-06	1,99E-06	5,72E-05
Human toxicity potential (HTP) (kg 1,4-DB eq)	2,90E+00	7,36E-02	1,14E-01	3,09E+00
Use of net fresh water (FW) (m3)	1,95E-02	4,76E-04	5,84E-02	7,84E-02
Formation potential of tropospheric ozone photochemical oxidants (POCP) (kg C2H4 eq)	3,70E-03	1,07E-04	2,48E-04	4,06E-03
Marine aquatic ecotoxicity potential (MAETP) (kg 1,4-DB eq)	1,29E+02	7,62E+00	1,16E+01	1,48E+02
Eutrophication potential (EP) (kg PO4--- eq)	2,39E-03	1,57E-04	4,82E-05	2,60E-03
Freshwater aquatic ecotoxicity potential (FAETP) (kg 1,4-DB eq)	1,94E-01	2,14E-03	9,51E-03	2,06E-01
Terrestrial ecotoxicity potential (TETP) (kg 1,4-DB eq)	5,15E-03	2,54E-04	1,55E-04	5,56E-03
Non-hazardous waste disposed (NHWD) (kg)	4,05E-01	1,71E-01	7,76E-02	6,53E-01
Depletion potential of the stratospheric ozone layer (ODP) (kg CFC-11 eq)	1,04E-06	3,35E-08	1,10E-08	1,08E-06

5. LCA: Interpretation

A contribution analysis shows the 'hot spots' within a LCA study. The following figures show the contribution analysis of separate inputs in the Cem-FIL MiniBars™. Figure 2 provides information on how separate items contribute to the overall impact of 1 kg of Cem-FIL MiniBars™. Figure 3 provides information of the impact of the different phases A1 – A3. The share the contribution of each item within the MKI/ECI (in €) is shown here.

The material input (A1) account for the biggest share (93%) of the impact of Cem-FIL MiniBars™. This consists mainly of the use of Cem-FIL® AR Glass fibers (46%) and Vinyl Ester (45%). After materials, the transport (A2) accounts for 4% of the MKI/ECI (in€). The electricity use, waste and emissions (A3) account for 3% of the MKI/ECI (in €). The waste of solid chemicals (1%), the use of electricity (1%) and the emission of dust from cured thermoset plastic (1%) have the biggest contribution to the A3 phase.

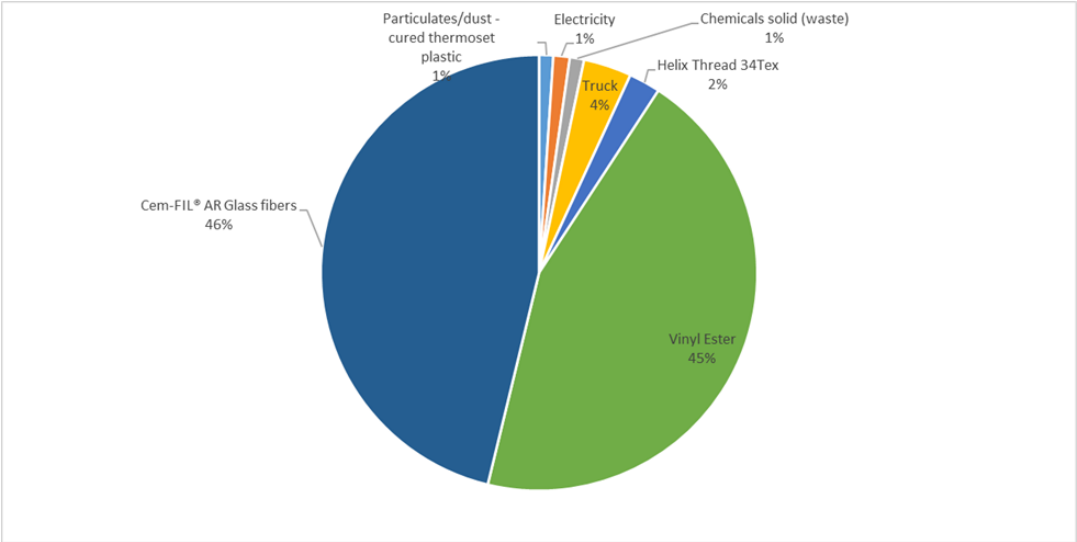

FIGURE 2: HOTSPOT ANALYSIS OF 1 KG CEM-FIL MINIBARS™

6. Programme-related information and verification

Product category rules (PCR): • EN 15804: A2:2019 (*Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products*).
Independent verification of the declaration and data, according to ISO 14025:2006:

☐ EPD Process Certification (internal)	☑ EPD Verification (external)
Third party verifier: to be determined	

7. Contact information

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LCA author:	EcoChain Technologies B.V. H.J.E. Wenckebachweg 123 1096 AM Amsterdam The Netherlands	
Programme operator:	To be determined	

8. References

[1] 'Environmental management - Life cycle assessment – Principles and Framework', International Organization for Standardization, ISO14040:2006.

[2] 'Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures', International Organization for Standardization, ISO14025:2006.

[3] 'Environmental management - Life cycle assessment - Requirements and guidelines', International Organization for Standardization, ISO14044:2006.

[4] Mobius 0.8.367 – 2020, web: http://mobius.ecochain.com.