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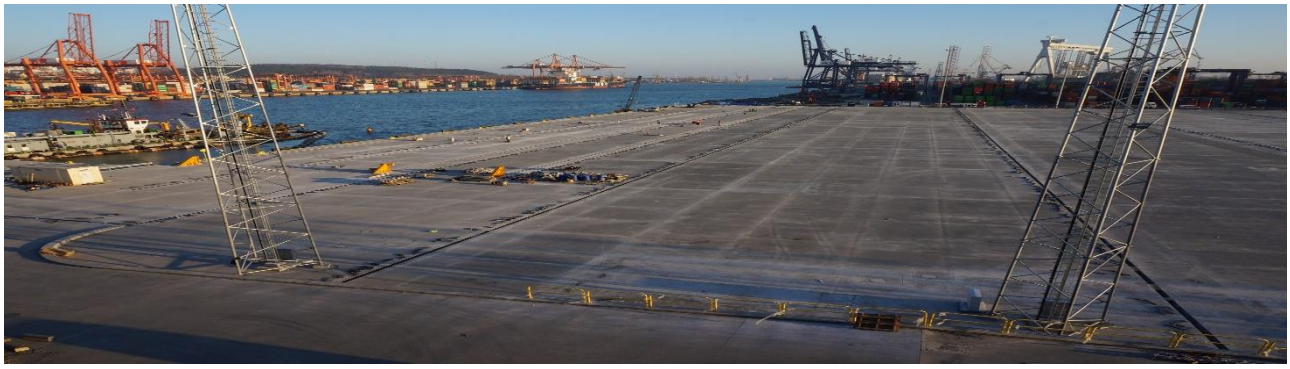
Steel fibres for concrete reinforcement



ECO EPD Ref. No. 00000616

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ITB is the verified member of The European Platform for EPD program operators and LCA practitioner www.eco-platform.org

Basic information

This declaration is the type III Environmental Product Declaration (EPD) based on EN 15804 and verified according to ISO 14025 by an external auditor. It contains the information on the impacts of the declared construction materials on the environment. Their aspects were verified by the independent body according to ISO 14025. Basically, a comparison or evaluation of EPD data is possible only if all the compared data were created according to EN 15804 (see point 5.3 of the standard).

Life cycle analysis (LCA): A1-A4 modules in accordance with EN 15804 (Cradle to Gate with options)
The year of preparing the EPD: 2017
Declared durability: 100 years for standard product
Product standard: EN 14889-1:2006
PCR: ITB-PCR A (PCR based on EN 15804)
Declared unit: 1 ton
Reasons for performing LCA: B2B
Representativeness: Polish product

Manufacturer and Product Information

ArcelorMittal is steel and mining company, present in 60 countries with an industrial footprint in 18 countries. The company supplies steel products in all major markets including automotive, construction, household appliance and packing. ArcelorMittal Syców is a part of ArcelorMittal Group and is specialized in the production of reinforcement solutions for concrete. The company offers a wide range of steel fibres for flooring, shotcrete, precast and structural applications, as a result of continuous R&D efforts to offer new and competitive products for each specific application. All fibres are made of cold drawn wire and are CE marked. ArcelorMittal is member of the French, German steel fibre producer associations.

Undulated fibre trade named TABIX has been designed such from the point of view of amplitude and wave length that the workability is good for aspect ratios up to 45 and remains satisfactory for aspect ratios up to 60. Due to the shape TABIX provides shrinkage control and pull-out resistance from the concrete matrix. These features make TABIX especially suited for jointless industrial floors and for structural applications. TABIX needs a well compacted medium - to high - strength concrete to develop its full performance. The specification of undulated fibres produced by ArceloMittal Syców Sp. z o. o. is listed in Table 1.

Fig. 1. The view of undulated fibres produced by ArcelorMittal Syców Sp. z o.o.

Table 1. Specification of undulated fibres (TABIX) produced by ArceloMittal Syców Sp. z o. o.

Name	Diameter, mm	Length, mm
AFT +1,0 mm / 60 mm	1.00	60
AFT 0,80 mm / 55 mm	0.80	55
TABIX Faser 1,0 mm / 50 mm	1.00	50
TABIX Faser 90 mm / 35 mm	0.90	35

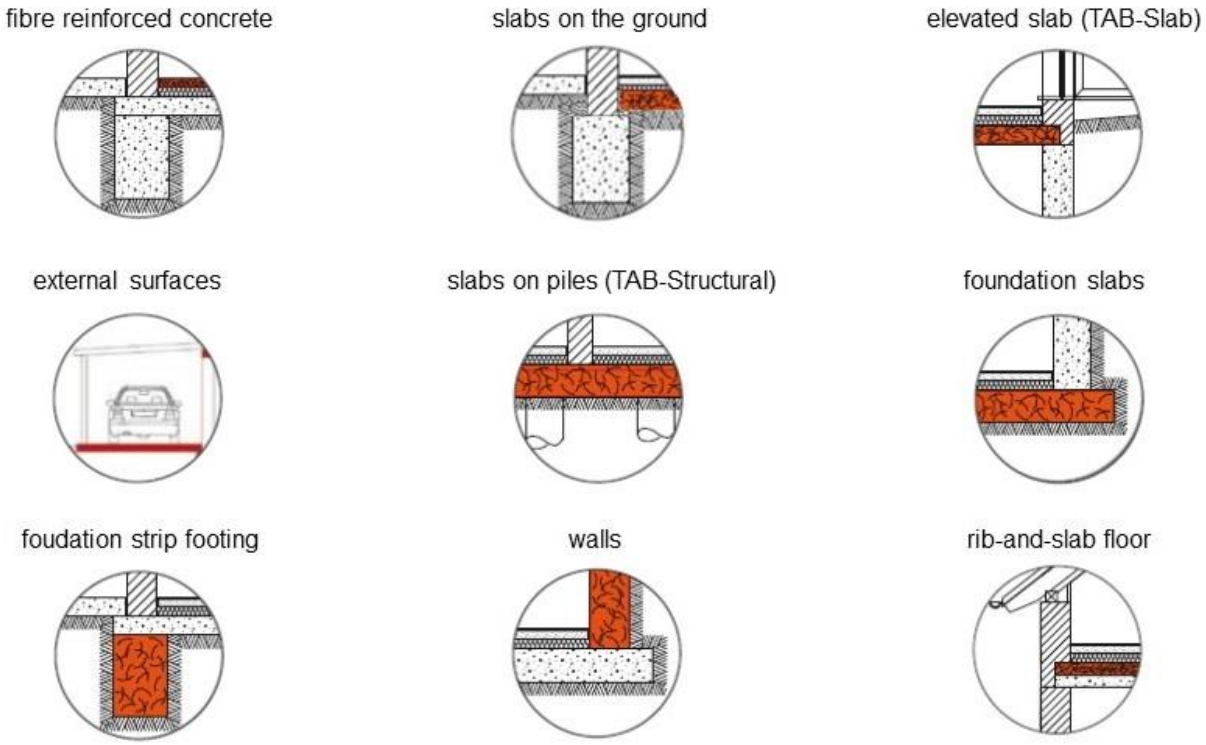
Hooked end fibre (HE) depicted in Fig. 2 has been in the market for over 25 years. The product can be used in almost any known application for steel fibre reinforced concrete. It does not perform as well as undulated fibres with regard to shrinkage control but shows better performances for high deformations of the concrete element, and it provides a good workability when using fibres with up to an aspect ratio of 60. HE can be used with any concrete mix and high concrete density is less mandatory then for undulated or for flat-end fibres. According to producer, load transfer in the crack is very good with this fibre shape. Thus after the appearance of the first crack the loss of load-bearing capacity occurs quickly but then stabilizes and in some cases even begins to increase again after large cracks have developed. The specification of hooked end fibres produced by ArceloMittal Syców Sp. z o. o. is listed in Table 2.

Fig. 2. The view of hooked end fibres produced by ArcelorMittal Syców Sp. z o.o.

Table 2. Specification of hooked end fibres produced by ArcelorMittal Syców Sp. z o. o.

Name	Diameter, mm	Length, mm
HE Faser ++0,75 mm / 50 mm	0.75	50
HE Faser +0,75 mm / 50 mm	0.75	50
HE Faser 0,75 mm / 50 mm	0.75	50
HE Faser +0,75 mm / 60 mm	0.75	60
HE Faser ++0,70 mm / 50 mm	0.70	50
HE Faser 0,80 mm / 50 mm	0.80	50
HE Faser ++0,90 mm / 60 mm	0.90	60
HE Faser 0,90 mm / 60 mm	0.90	60
HE Faser +1,0 mm / 60 mm	1.00	60
HE Faser 1,0 mm / 50 mm	1.00	50
HE Faser 1,0 mm / 60 mm	1.00	60
HE Faser +0,55 mm / 35 mm	0.55	35
HE Faser 0,55 mm / 35 mm	0.55	35
HE Faser 0,75 mm / 35 mm	0.75	35

Potential applications of the steel fibres:



LIFE CYCLE ASSESSMENT (LCA) – general rules applied

Allocation

The allocation rules used for this EPD are based on general ITB-PCR A. Steel fibres for concrete reinforcement production is a line process with reinforcing steel mesh in one factory in ArcelorMittal Syców Sp. z o.o. Allocation was done on product mass basis. All impacts from raw materials extraction are allocated in A1 module of EPD**.** 85% of impacts from line production were inventoried and allocated to all steel fibres production. Municipal waste and waste water of whole factory were allocated to module A3. Energy supply was inventoried for whole production process. Emissions in ArcelorMittal Syców Sp. z o.o. are measured and were allocated to module A3.

System limits

The life cycle analysis of the examined products covers "Product Stage", A1-A4 modules (Cradle to Gate with options) in accordance with EN 15804+A1 and ITB-PCR A. The details of systems limits are provided in product technical report. All materials and energy consumption inventoried in factory were included in calculation. Office impacts were also taken into consideration. In the assessment, all significant parameters from gathered production data are considered, i.e. all material used per formulation, utilised thermal energy, internal fuel and electric power consumption, direct production waste, and all available emission measurements. It can be assumed that the total sum of omitted processes does not exceed 5% of all impact categories. In accordance with EN 15804, machines and facilities (capital goods) required for and during production are excluded, as is transportation of employees.

A1 and A2 Modules: Raw materials supply and transport

Raw materials such as rolled steel wires come from Arcelor Mittal Sosnowiec, lubricant agent and dies are imported from Germany whereas other ancillary items come from local suppliers. Data on transportation of the raw material, additives and packaging materials to the manufacturing plants was collected and modelled for by assessor. Means of transport include trucks with load: <10t, 10 – 16t and >16. For calculation purposes Polish and European fuel averages are applied.

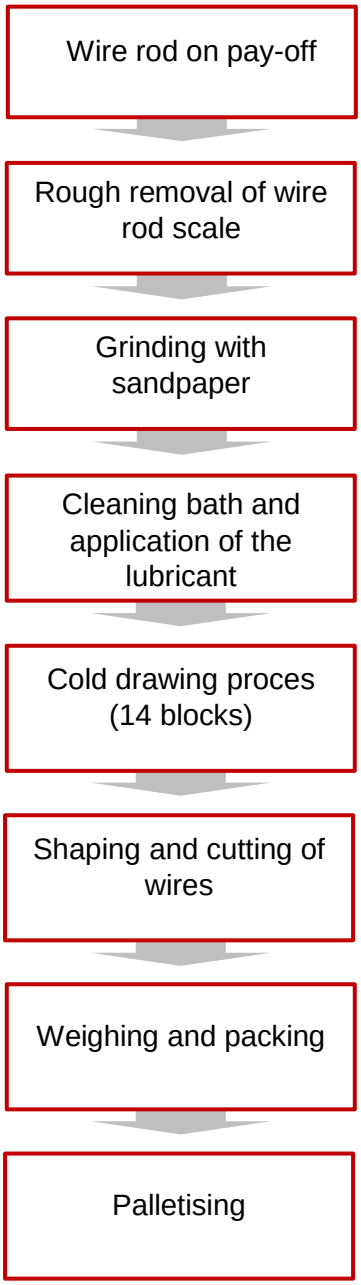


Fig. 3. A production scheme of the steel fibress produced by ArcelorMittal Syców.

A3: Production

The Fig. 3 shows the production process of steel fibres for concrete reinforcement in ArcelorMittal Syców factory. In first step a coil of wire rod is loaded on pay off by means of forklift. Next wire rod is mechanically cleaned. After cleaning process a drawing lubricant is put on it to ensure smooth drawing process. In cold wire drawing process wire rod diameter is reduced from 6.5 mm or 5.5 mm to diameter in range from 0.55 mm to 1.3 mm. In next step wire is formed and cut. Ready product is automatically packed in carton boxes or Big Bags, labelled and palletised.

A4: Transport to construction sites

The steel fibres manufactured by ArcelorMittal Syców Sp. z o.o. in 2018 were distributed among 13 European countries (more than 80% was sold to Poland, Germany and Czech Republic). An average distance between Syców and the construction sites, taken to the LCA calculation, constitutes weighted arithmetic mean of 600 km, estimated based on sales data provided by ArcelorMittal Syców Sp. z o.o. Means of transport include trucks with load >16t and fuel consumption of 35 L per 100 km.

Data collection period

The data for manufacture of the examined products refer to period between January – December 2016. The life cycle assessments were prepared for Poland as reference area.

Data quality

The values determined to calculate the LCA originate from verified ArcelorMittal Syców Sp. z o.o. inventory data and specific EPDs.

Assumptions and estimates

The impacts of the representative steel fibres for concrete reinforcement were aggregated using weighted average. Impacts were inventoried and calculated for all products of steel fibres product group.

Calculation rules

LCA was done in accordance with ITB PCR A document.

Databases

The data for the processes come from the following databases: Ecoinvent, ELCD, Ullmann's, ITB-Data. Specific data quality analysis was a part of external ISO 14001 audit. Characterization factors are CML ver. 4.2 based on EN 15804:2013+A1 version. (PN EN 15804+A1:2014-04).

LIFE CYCLE ASSESSMENT (LCA) – Results

Declared unit

The declaration refers to functional unit (FU) - 1 ton of the steel fibres for concrete reinforcement.

Table 3. System boundaries for environmental characteristic of the steel fibres for concrete reinforcement.

Environmental assessment information (MNA – Module not assessed, MD – Module Declared, INA – Indicator Not Assessed)																
Product stage			Construction process		Use stage							End of life				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport to construction site	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction 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
MD	MD	MD	MD	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA

Steel fibres for concrete reinforcement

Environmental impacts: (FU) 1 ton						
Indicator	**Unit**	**A1**	**A2**	**A3**	**A1-A3**	**A4**
Global warming potential	kg CO_2 eq.	1.26E+03	1.52E+01	1.16E+00	1.28E+03	4.51E+01
Depletion potential of the stratospheric ozone layer	kg CFC 11 eq.	1.15E-06	0.00E+00	0.00E+00	1.15E-06	0.00E+00
Acidification potential of soil and water	kg SO_2 eq.	8.62E+00	1.02E-01	2.73E-05	8.72E+00	3.29E-01
Formation potential of tropospheric ozone	kg Ethene eq.	5.88E-01	7.89E-03	0.00E+00	5.96E-01	2.40E-02
Eutrophication potential	kg $(PO_4)^{3-}$ eq.	4.44E-01	1.78E-02	5.07E-06	4.62E-01	5.81E-02
Abiotic depletion potential (ADP-elements) for non-fossil resources	kg Sb eq.	6.63E-03	0.00E+00	4.28E-06	6.63E-03	0.00E+00
Abiotic depletion potential (ADP-fossil fuels) for fossil resources	MJ	1.47E+03	1.07E+02	9.27E+00	1.59E+03	3.45E+02
Environmental aspects on resource use: (FU) 1 ton						
Indicator	**Unit**	**A1**	**A2**	**A3**	**A1-A3**	**A4**
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA
Use of renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	8.94E+02	7.49E+00	1.62E-01	9.02E+02	2.42E+01
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA
Use of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA	INA
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	1.39E+04	1.18E+02	1.40E+01	1.40E+04	3.80E+02
Use of secondary material	kg	8.44E+02	0.00E+00	0.00E+00	8.44E+02	0.00E+00
Use of renewable secondary fuels	MJ	3.08E-01	5.88E+00	0.00E+00	6.19E+00	1.90E+01
Use of non-renewable secondary fuels	MJ	INA	INA	INA	INA	INA
Net use of fresh water	m^3	INA	INA	INA	INA	INA
Other environmental information describing waste categories: (FU) 1 ton						
Indicator	**Unit**	**A1**	**A2**	**A3**	**A1-A3**	**A4**
Hazardous waste disposed	kg	1.43E-02	1.08E-04	6.63E-02	8.07E-02	2.47E-04
Non-hazardous waste disposed	kg	9.08E+00	1.00E-01	1.68E+01	2.60E+01	2.29E-01
Radioactive waste disposed	kg	1.43E-01	0.00E+00	0.00E+00	1.43E-01	0.00E+00
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E-00	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	1.53E+01	1.53E+01	0.00E+00
Materials for energy recover	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy	MJ per energy carrier	INA	INA	INA	INA	INA

Verification

The process of verification of this EPD is in accordance with ISO 14025 and ISO 21930. After verification, this EPD is valid for a 5-year-period. EPD does not have to be recalculated after 5 years, if the underlying data have not changed significantly.

The basis for LCA analysis was EN 15804 and ITB PCR A
Independent verification corresponding to ISO 14025 & 8.3.1. [x] external [ ] internal
External verification of EPD: PhD. Eng. Halina Prejzner LCA, LCI audit and input data verification: PhD. Eng. Justyna Tomaszewska, j.tomaszewska@itb.pl Verification of LCA: PhD. Eng. Michał Piasecki, m.piasecki@itb.pl

Normative references

- ITB PCR A, General Product Category Rules for Construction Products
- EN 14889-1:2006, Fibres for concrete – Part 1: Steel fibres – Definitions, specifications and conformity
- ISO 14025:2006, Environmental labels and declarations – Type III environmental declarations – Principles and procedure
- ISO 21930:2017, Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services
- ISO 14044:2006, Environmental management – Life cycle assessment – Requirements and guidelines
- ISO 15686-1:2011, Buildings and constructed assets – Service life planning – Part 1: General principles and framework
- ISO 15686-8:2008, Buildings and constructed assets – Service life planning – Part 8: Reference service life and service-life estimation
- EN 15804+A1:2013, Sustainability in construction works – Environmental product declarations – Core rules for the product category of construction products.
- EN 15942:2011, Sustainability of construction works – Environmental product declarations – Communication format business-to-business

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Thermal Physics, Acoustics and Environment Department
02-656 Warsaw, Ksawerów 21

CERTIFICATE № 064/2017
of TYPE III ENVIRONMENTAL DECLARATION

Product:

Steel Fibres

for concrete reinforcement

Manufacturer:

ArcelorMittal Syców Sp. z o.o.

Wioska 28D, 56-500 Syców, Poland

confirms the correctness of the data included in the development of
Type III Environmental Declaration and accordance with the requirements of the standard

PN-EN 15804+A1:2014-04

Sustainability of construction works.
Environmental product declarations.
Core rules for the product category of construction products.

This certificate, issued for the first time on 1st December 2017 is valid for 5 years
or until amendment of mentioned Environmental Declaration

Head of the Thermal Physic, Acoustics and Environment Department
Michał Piasecki, PhD

INSTYTUT TECHNIKI BUDOWLANEJ

Deputy Director for Research and Innovation
Krzysztof Kuczyński, PhD

Warsaw, December 2017