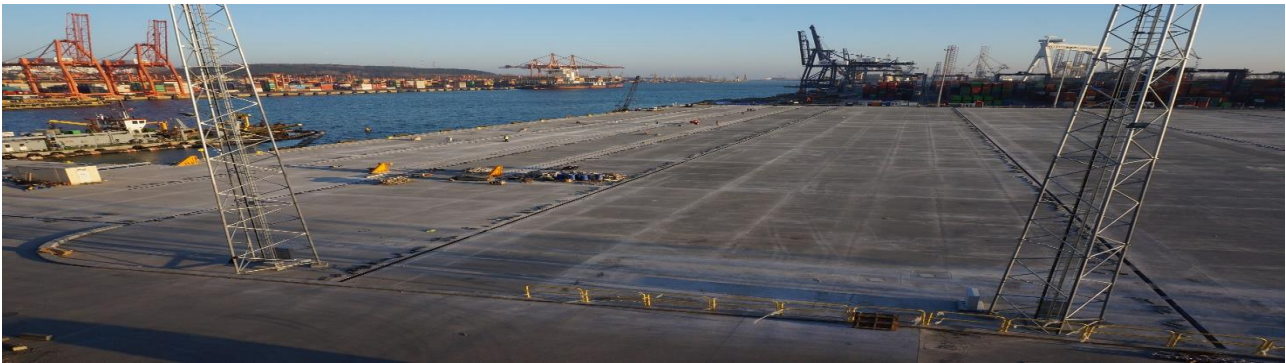




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## Steel fibres for concrete reinforcement



ECO EPD Ref. No. 00000616

### EPD program operator:

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ITB is the verified member of The European Platform for EPD program operators and LCA practitioner, [www.eco-platform.org](http://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-A3 modules in accordance with EN 15804 (Cradle to Gate)

**The year of preparing the EPD:** 2017

**Declared durability:** for standard product – 100 years

**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 ArceloMittal Syców Sp. z o. o.

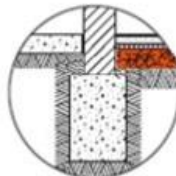
Name	Diameter, mm	Length, mm
HE Faser ++0,75 mm / 50 mm	0.75	50
HE Faser +0,75 mm / 50 mm	0.75	50
HE Faser 0,75 mm / 50 mm	0.75	50
HE Faser +0,75 mm / 60 mm	0.75	60
HE Faser ++0,70 mm / 50 mm	0.70	50
HE Faser 0,80 mm / 50 mm	0.80	50
HE Faser ++0,90 mm / 60 mm	0.90	60
HE Faser 0,90 mm / 60 mm	0.90	60
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:

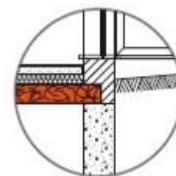
fibre reinforced concrete



slabs on the ground



elevated slab (TAB-Slab)



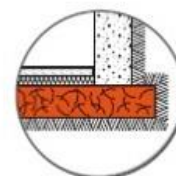
external surfaces



slabs on piles (TAB-Structural)



foundation slabs



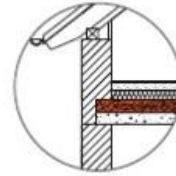
foudation strip footing



walls



rib-and-slab floor



## 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-A3 modules (Cradle to Gate) 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 transport of the different products to the manufacturing plants is collected and modelled for factory by assessor. Means of transport include trucks and Polish and European fuel averages are applied.

### A3: Production

The Fig. 3 shows the process of production of steel fibres for concrete reinforcement in ArcelorMittal Syców factory. In first step of production process a coil of wire rod is loaded on pay off by means of

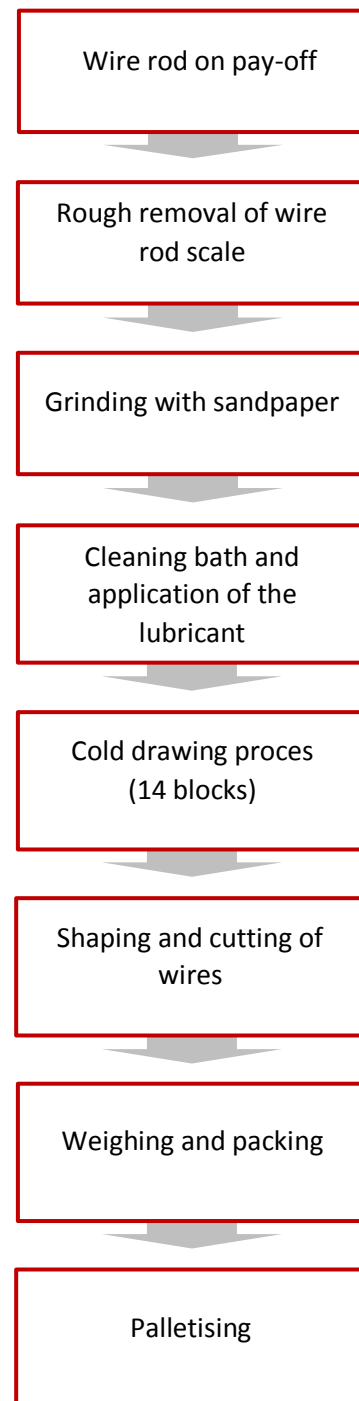


Fig. 3. A production scheme of undulated fibres and hooked end fibres in ArcelorMittal Syców factory.

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.

**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.

**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 steel fibres for concrete reinforcement.

Table 2. System boundaries for environmental characteristic for 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	MNA	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
Global warming potential	[kg CO <sub>2</sub> eq.] (100 years)	7.56E+02	1.51E+01	4.56E-09	7.71E+02
Depletion potential of the stratospheric ozone layer	[kg CFC 11 eq.]	1.00E-01	0.00E+00	0.00E+00	1.00E-01
Acidification potential of soil and water	[kg SO <sub>2</sub> eq.]	9.44E-01	1.05E-01	1.06E-09	1.05E+00
Formation potential of tropospheric ozone	[kg Ethene eq.]	3.17E-01	7.93E-03	0.00E+00	3.24E-01
Eutrophication potential	[kg (PO <sub>4</sub> ) <sup>3-</sup> eq.]	3.17E-01	1.84E-02	1.98E-10	3.35E-01
Abiotic depletion potential (ADP-elements) for non-fossil resources	[kg Sb eq.]	1.11E-01	0.00E+00	1.69E-14	1.11E-01
Abiotic depletion potential (ADP-fossil fuels) for fossil resources	[MJ]	1.00E+04	2.38E-01	9.27E+00	1.01E+04
Environmental aspects on resource use: (FU) 1 ton					
Indicator	Unit	A1	A2	A3	A1-A3
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	[MJ]	INA	INA	INA	INA
Use of renewable primary energy resources used as raw materials	[MJ]	INA	INA	INA	INA
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	[MJ]	7.84E+02	9.75E+00	1.62E-01	7.94E+02
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	[MJ]	INA	INA	INA	INA
Use of non-renewable primary energy resources used as raw materials	[MJ]	INA	INA	INA	INA
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	[MJ]	1.10E+04	2.61E-01	1.40E+01	1.10E+04
Use of secondary material	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels	[MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water	[dm <sup>3</sup> ]	5.00E+00	8.81E-08	4.60E-01	5.46E+00
Other environmental information describing waste categories: (FU) 1 ton					
Indicator	Unit	A1	A2	A3	A1-A3
Hazardous waste disposed	[kg]	1.90E+01	2.80E-04	6.63E-02	1.91E+01
Non-hazardous waste disposed	[kg]	2.17E+02	2.60E-01	1.68E+01	2.34E+02
Radioactive waste disposed	[kg]	5.30E-02	0.00E+00	0.00E+00	5.30E-02
Components for re-use	[kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	[kg]	6.90E+00	0.00E+00	1.53E+01	2.22E+01
Materials for energy recover	[kg]	INA	INA	INA	INA
Exported energy	[MJ per energy carrier]	INA	INA	INA	INA

## Verification

The process of verification of this EPD is in accordance with EN 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. <input checked="" type="checkbox"/> external <input type="checkbox"/> internal
External verification of EPD: PhD. Eng. Halina Prejzner LCA, LCI audit and input data verification: PhD. Eng. Justyna Tomaszewska, <a href="mailto:j.tomaszewska@itb.pl">j.tomaszewska@itb.pl</a> Verification of LCA: PhD. Eng. Michał Piasecki, <a href="mailto:m.piasecki@itb.pl">m.piasecki@itb.pl</a>

## Normative references

- ITB PCR A, General Product Category Rules for Construction Products
- EN 14889-1:2006, Włókna do betonu - Część 1: Włókna stalowe -- Definicje, wymagania i zgodność
- ISO 14025:2006, Environmental management – Type III environmental declarations – Principles and procedure
- ISO 21930:2007, Sustainability in building and construction – Environmental declaration of building products
- ISO 14044:2006, Environmental management – Life cycle assessment – Requirements and guidelines
- ISO 15686-1:2000, Buildings and constructed assets — Service life planning — Part 1: General principles
- ISO 15686-8:2008, Buildings and constructed assets – Service life planning – Part 8: Reference service life
- EN 15804:2012+A1:2013, Sustainability in construction works – Environmental product declarations – Core rules for the product category of construction products.
- EN15942:2011, Sustainability of construction- Environmental product declarations. Communication format business-to-business



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**Thermal Physics, Acoustics and Environment Department**

02-656 Warsaw, Ksawerów 21

# **CERTIFICATE No 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 1<sup>st</sup> 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



Deputy Director  
for Research and Innovation

Krzysztof Kuczyński, PhD

Warsaw, December 2017