Environmental Product Declaration

as per ISO 14025 and EN 15804

Owner of the declaration:	Tensar International Limited
Publisher:	Kiwa BCS Öko-Garantie GmbH – Ecobility Experts
Programme operator:	Kiwa BCS Öko-Garantie GmbH – Ecobility Experts
Declaration number:	EPD-Tensar-005-EN
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Valid to:	10.07.2022

Geogrid TriAx TX 150

This EPD refers to 1m² geogrid TriAx TX150 of the product series TriAx TX100. It is produced and distributed by Tensar International Limited, located in Blackburn (United Kingdom).

1. General information

Tensar International Limited	Geogrid TriAx TX 150
Programme Operator Kiwa BCS Öko-Garantie GmbH – Ecobility Experts Marientorbogen 3-5 90402 Nürnberg Deutschland/Germany	**Owner of the Declaration** Tensar International Limited Units 2-4 Cunningham Court Shadsworth Business Park Blackburn, United Kingdom
Declaration number EPD-Tensar-005-EN	**Declared product /declared unit** **1 m² geogrid**
This declaration is based on the Product Category Rules: Anforderungen an Umweltproduktdeklaration für Geokunststoffe/-textilien (Ausgabe 2017-06) (PCR tested and approved by the independent expert committee) **Issue date:** 11.07.2017 **Valid to:** 10.07.2022	**Scope** TriAx TX150 geogrid is a product of the product series TriAx TX100. It is produced and distributed by Tensar International Limited, located in Blackburn (United Kingdom). The EPD refers to the specific product. The owner of the declaration is liable for the underlying information and evidence; the Kiwa BCS Öko-Garantie GmbH – Ecobility Experts shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.
Signature Prof. Dr.-Ing. Roland Hüttl (President of Kiwa BCS Öko-Garantie GmbH – Ecobility Experts)	**Verification** The CEN Norm EN 15804 serves as the core PCR. Independent verification of the declaration according to ISO 14025 ☐internally ✓externally

Signature
Prof. Dr. Frank Heimbecher
(Chairman of the independent expert committee)

Signature
Matthias Schulz,
(Independent verifier appointed by the independent expert committee)

2. Product

2.1 Product description

The geogrid is comprised of multiple hexagons formed by equilateral triangular apertures. These apertures are defined by a structure of monolithic, multi-directional tensile elements of defined orientation, size and shape.
The hexagonal geogrid is manufactured from an extruded polypropylene sheet, which is then punched and orientated in three equilateral directions so that the resulting ribs of the triangular apertures have a high degree of molecular orientation which continues through the mass of integral node.

2.2 Intended Use

The intended use of the geogrid is to stabilize granular layers in order to minimize deformations during trafficking, to improve the load bearing capacity and to increase the design life of the granular layer in or under a construction in roads, railways and other trafficked areas, taking into account prevailing national regulations on design methodologies.
The combination of the geogrid and the aggregate creates a mechanically stabilized composite layer with significantly improved properties and performance capabilities in response to dynamic and static loading compared with aggregate layers alone.
When installing, the manufacture's installation procedures shall be observed, as well as the respective national practices.
The geogrid is installed in five steps.

1. Site preparation
2. Placing and overlapping geogrid
3. Tensioning and pinning
4. Dumping and spreading aggregate fill
5. Compacting

More information is provided by the specific installation guide for Tensar TriAx geogrids.

2.3 Technical data

The technical data for the TriAx TX150 geogrid is shown in in the following table.
These values were determined to receive an European Technical Approval (ETA). The ETA demands, that the actual product values are above the lowest value of the tolerance range, because product specific data can vary due to operating conditions or raw material specific features. It is assumed that all product requirements are assured, if the actual product parameters are above the values which were determined for the ETA. The products are limited to a minimum but not to a maximum.

Name	Value	Tolerance	Unit
Weight of product /TR 041 B.1/	205	-35	g/m^2
Radial Secant Stiffness at 2% strain /TR 041 B.4/	250	-65	kN/m
Radial Secant Stiffness at 0,5% strain /TR 041 B.1/	360	-75	kN/m
Radial Secant Stiffness Ratio /TR 041 B.1/	0,8	-0,15	-
Junction Efficiency /TR 041 B.2/	100	-10	%
Static Puncture Resistance/EN ISO 12236/	n.r.	-	kN
Characteristic Opening Size	n.r.	-	mm
Water Permeability/EN ISO 11058/	n.r.	-	Velocity Index (VIH50) ms-1
Chemical Resistance	n.r.	-	-
Hexagon Pitch /TR 041 B.4/	80	±4	mm
Resistance to weathering /EN 12224/	Maximum time for exposure after installation of 1 month		
Resistance to oxidation and to acid and alkali liquids /EN ISO 13438/ and /EN 14030/	Resistant for 50 years when used in soil temperature of 25°C and 100 years when used in soil temperature of 15°C for soils with pH between 4 and 9		
Specific dimension of the finished rolls (width x length)	4 x 75		m x m

2.4 Placing on the market / Application rules

For quality assurance the geogrids TriAx TX100 series are regulated in accordance with the European Technical Assessment (ETA) 12/0530 and marked with a CE mark by the manufacture.
In the EU/EFTA (excluding Switzerland) the placing of geogrids on the market is covered by Regulation (EU) No. 305/2011 of 9 March 2011. For the product use the respective national provisions shall apply.
The product is packed and transported as roll.

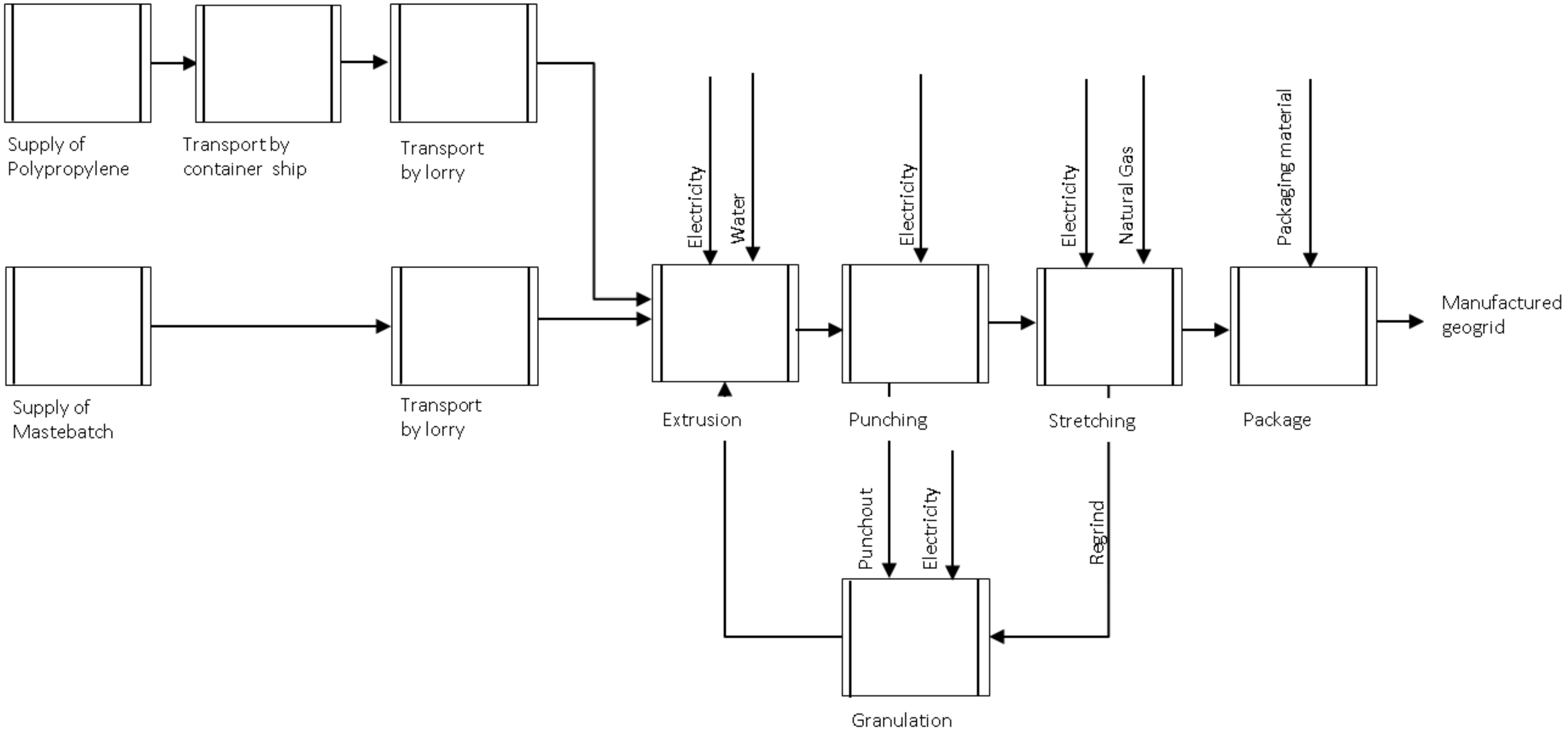
2.5 Base materials / Ancillary materials

TriAx geogrids are manufactured from a homopolymer or a copolymer of Polypropylene.
Polypropylene (PP) is a thermoplastic polymer. It belongs to the group of polyolefins and is partially crystalline and nonpolar. PP is prepared by polymerization of propene. It is rugged and unusually resistant to many chemical solvents, bases and acids.

Name	Quantity	Unit
Polypropylene (PP)	95	%
Masterbatch	5	%

2.6 Manufacturing

The manufacturing is located in Blackburn, United Kingdom. The geogrids are made from polypropylene granulate. In the first step granulate is melted and then extruded. After this the extruded sheet passes the punching process. Depending on the specific product the punches differ in size. The punched sheet is then stretched. The result is the specific triangular structure of each geogrid. The products are rolled and then packaged. The manufacturing process is shown in the following figure.


Supply of Polypropylene
Transport by container ship
Transport by lorry
Supply of Mastebatch
Transport by lorry
Electricity
Water
Extrusion
Electricity
Punching
Electricity
Natural Gas
Stretching
Packaging material
Package
Manufactured geogrid
Punchout
Electricity
Regrind
Granulation

2.7 Reference service life

A reference service life does not have to be declared, because this LCA does not declare the entire life cycle. Therefore it is a voluntary statement. According to the manufacturer the reference service lifetime of TriAx TX100 series is about 100 years.

3. LCA: Calculation rules

3.1 Declared unit

This declaration of the product TriAx TX150 refers to 1 m² geo grid with a mass per unit area of 189 g/m². The declared unit of TriAx TX150 is within the tolerance range of the ETA. All calculations refer to this declared unit.

Name	Quantity	Unit
Declared unit	1	m^2
Conversion factor to 1 kg	5,29	-
Mass per unit area	0,189	kg/m^2

3.2 System boundary

The Environmental Product Declaration is a cradle-to-gate EPD. It contains all the potential environmental impacts caused in the production stage. According to EN 15804 these are the production phases A1 to A3.

The environmental impacts caused by the infrastructure are neglected because of the high mass flow. Furthermore only the use of energy related to the production processes is considered (excluding offices, social rooms etc.).

The production stage includes:

- A1: Extraction and processing of the raw materials (Polypropylene, Masterbatch)
- A2: Transport to the production site
- A3: Processing of the geogrids (Extrusion, Punching, Stretching) and Packaging (including packaging material)

The production does not contain secondary materials or fuels.

The system boundaries, including the modules A1 to A3, were made in accordance with the PCR. The study does not contain any information about the modules A4, A5, B1 to B7, C1 to C4 and D.

3.3 Estimates and assumptions

If it was not possible to choose data sets with the geographic reference of the United Kingdom, a data set with a similar geographic reference was used.

The distance for the transport of raw materials as well as the types of transport could be determined. For the transport by road a truck with a payload of 27 tons, total weight 40 tons from generation EURO 4 was assumed. As utilization factor 85% was selected.

3.4 Cut-off criteria

All flows whose influence is higher than 1% on the total mass, energy or environmental impact are included in the Life Cycle Assessment. It is assumed, that the total neglected input flows are much less than 5% of energy usage and mass.

All process specific data could be determined and modelled by the use of generic data (GaBi-database). The polypropylene is bulk delivered in 24 tons batches – the pellet is blown into to silo. Therefore there is no packaging waste for the polypropylene.

The masterbatch is delivered in octabins made of cardboard and a thin polythene liner. Cardboard and liner are recycled afterwards. As the amounts for the masterbatch packaging are quite small referred to the overall mass flow this packaging was neglected. It is assumed that the residues of the extrusion, punching and stretching processes are less than 1% of the total mass, energy or environmental impact. Therefore these residues are within the cut-off criteria and were neglected.

3.5 Background data and data quality

For all processes primary data was collected and provided by Tensar International Limited. The primary data refers to year 2014. For the data, which is not influenced by the manufacturer, generic data is used. The GaBi-database was used for the generic data. This database is updated regularly. The power sources were chosen from data for the UK in 2011, in accordance with the geographical and time representativeness. The study does not consider any other energy sources due to the fact, that just conventional power mix is used.
The modelling was made by using the LCA software GaBi 6, which was developed by thinkstep AG. Due to the comparability of the results all used data sets are consistent and documented. The documentation is available online (GaBi-documentation). Therefore the process specific and the generic data meet requirements of EN 15804.

3.6 Period under review

All process specific data were collected in 2014. The data is based on 1 year of averaged data.

3.7 Allocation

Allocations were avoided as far as possible. Tensar uses polypropylene (PP) for several products as a raw material and all PP residues, which occur during the manufacturing, are recycled. The residues are not mandatorily used again for the product from which they occurred. The material can also be used for products from another series.
For Example: 5 % residues of polypropylene occur during the manufacturing of geogrid A. These 5 % are recycled, but due to operating conditions, it can be that 4 % is reused for geogrid A and 1 % for geogrid B.
For this calculation it was assumed, that the generated punchout and the regrind material of a specific geogrid is reused in a closed loop recycling for the analysed geogrid. This was done to avoid product specific shifts of potential environmental impacts. It was also assumed that the recycled PP substitutes virgin PP after a regranulation without any quality losses during the process.

3.8 Comparability

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. The used background database has to be mentioned.

4. LCA: Scenarios and additional technical information

No other scenarios were considered in this EPD.

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5. LCA: Results

The next tables show the environmental impact potentials for the different parameters, for the material flows as well as for the waste and other outputs. The results refer to the declared unit of 1 m^2 geogrid.

Description of the system boundary (X = included in LCA)																
Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport	Installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-, Recovery-, Recyclingpotential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Results of the LCA – Environmental impact: 1 m² geogrid TriAx TX150		
Parameter	unit	A1 – A3
Global warming potential	[kg CO2-Eq.]	5,12E-01
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	3,91E-11
Acidification potential of land and water	[kg SO2-Eq.]	1,30E-03
Eutrophication potential	[kg (PO4)³-Eq.]	1,27E-04
Photochemical Ozone Creation Potential	[kg Ethen-Eq.]	1,78E-04
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	1,01E-07
Abiotic depletion potential for fossil resources	[MJ]	1,52E+01

Results of the LCA – Resource use: 1 m² geogrid TriAx TX150		
Parameter	unit	A1 – A3
Renewable primary energy as energy carrier	[MJ]	4,02E-01
Renewable primary energy resources as material utilization	[MJ]	IND
Total use of renewable primary energy resources	[MJ]	4,02E-01
Non-renewable primary energy as energy carrier	[MJ]	7,87E+00
Non-renewable primary energy as material utilization	[MJ]	8,13E+00
Total use of non-renewable primary energy resources	[MJ]	1,60E+01
Use of secondary material	[kg]	IND
Use of renewable secondary fuels	[MJ]	IND
Use of non-renewable secondary fuels	[MJ]	IND
Use of net fresh water	[m³]	2,01E-03

Results of the LCA – Waste and output flows: 1 m² geogrid TriAx TX150		
Parameter	unit	A1 – A3
Hazardous waste disposed	[kg]	1,83E-06
Non-hazardous waste disposed	[kg]	4,84E-01
Radioactive waste disposed	[kg]	3,32E-04
Components for re-use	[kg]	IND
Materials for recycling	[kg]	IND
Materials for energy recovery	[kg]	IND
Exported electrical energy	[MJ]	IND
Exported thermal energy	[MJ]	IND

6. LCA: Interpretation

The table "LCA: Interpretation" shows the influence of the phases A1, A2 and A3 on the production stage and it can be seen that the analysed impact categories are mainly influenced by the raw material supply (A1). The share varies from 50-96% depending on the impact category. The supply of polypropylene is identified as the most significant parameter for the raw material supply in all analysed impact categories. Another significant parameter results from the emissions which occur through the use of energy.

The manufacturing phase (A3) is identified as another influential phase of the production stage, whereas the influence varies from 4 to 35% The share of this stage on the total Global warming potential (GWP), Acidification (AP) and Eutrophication potential (EP) of the production stage is between 34 - 35% and for the categories Depletion potential of the Stratospheric ozone layer (ODP), Photochemical Ozone Creation Potential (POCP) and Abiotic depletion potential for fossil resources (ADP_f) the share is between 16 - 17%.

The emissions based on the transport are marginal for all impact categories, except for the Eutrophication (EP) and Acidification potential (AP) with 14 and 16%.

LCA: Interpretation			
Parameter	A1	A2	A3
Global warming potential	64%	2%	34%
Depletion potential of the stratospheric ozone layer	83%	0%	17%
Acidification potential of land and water	51%	14%	35%
Eutrophication potential	50%	16%	34%
Photochemical Ozone Creation Potential	79%	4%	17%
Abiotic depletion potential for non-fossil resources	96%	0%	4%
Abiotic depletion potential for fossil resources	83%	1%	16%

7. Requisite evidence

In 2008 TriAx TX 160 was tested concerning its leaching behaviour using the trough method. Due to this method the institute "Prüftechnik CDL" could determine the direct environmental impacts to the local environment (soil and groundwater). No parameters from the Bundes-Bodenschutz- und Altlastenverordnung (BBodSchV) were found in the 5. eluate, except from phenol. The analysed phenol concentrations are with 12 µg below the threshold value of the BBodSchV.

In accordance to the criteria of the BBodSchV the environmental soundness of the geogrid could be confirmed. This result can be transferred to all the other types of geogrids referring to the product series TX100, so as well to TriAx TX150.

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	Publisher Kiwa BCS Öko-Garantie GmbH – Ecobility Experts Marientorbogen 3-5 90402 Nürnberg Deutschland/Germany	E-Mail Web	ecobility@bcs-oeko.de www.kiwabcs.com/ecobility
	Programme operator Kiwa BCS Öko-Garantie GmbH – Ecobility Experts Marientorbogen 3-5 90402 Nürnberg Deutschland/Germany	E-Mail Web	ecobility@bcs-oeko.de www.kiwabcs.com/ecobility
	Author of the Life Cycle Assessment Kiwa GmbH Voltastr. 5 13355 Berlin Germany	Tel. Fax. E-Mail Web	+49(0)30/467761-43 +49(0)30/467761-10 info@kiwa.de www.kiwa.de
	Owner of Declaration Tensar International Limited Units 2-4 Cunningham Court Shadsworth Business Park Blackburn, United Kingdom	Tel. Fax. E-Mail Web	+44(0)1254 262431 +44(0)1254 266868 info@tensar-international.com www.tensar.co.uk