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AQUAFIL
synthetic fibres and polymers

ENVIRONMENTAL PRODUCT DECLARATION for ECONYL® BCF REPROCESSED YARNS

EPD®

PCR 2012:01 CONSTRUCTION PRODUCTS AND CONSTRUCTION SERVICES, VERSION 2.3,
APPENDIX B TO PCR 2012:01 CONSTRUCTION PRODUCTS AND CONSTRUCTION SERVICES, VERSION 2.3
CPC: 355 & 264

Publication date: 6 October 2015
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Certification No.: S-P-00767
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COMPANY AND PRODUCT

Related information

1 THE COMPANY

Aquafil Group history began in 1969, when the Bonazzi family built the first manufacturing plant in Arco (Trentino Alto Adige region, Italy). In 1970, the Group began the polymerization and production of polyamide 6 at this facility, which started Aquafil's market share acquisition in the BCF yarn sector (polyamide yarn for textile flooring). During the '80s, significant investments allowed a consolidation and diversification of the Group's activities. The most significant diversification of the Group's operation occurred in 1995 when the Aquafil Group finalized the first privatization of a public company in the newly born Republic of Slovenia. This acquisition allowed Aquafil to start its Nylon Textile Filament (NTF) product area.

Meanwhile, the Group continued to widen its product offering by opening several production plants in Europe and entering (with its "Polyamide products priority focus" always in mind) the Engineering Plastics business to supply modified polyamide products to the automotive, electronics and construction industries.
At the same time, the Group started its internationalization process with the creation of Aquafil USA, based in Cartersville, Georgia (USA).

Between 2000 and 2010, the Group expanded its presence in all three key markets where it was operating (carpet yarn, textile yarn and engineering plastics), gradually becoming a global leader in the manufacturing of Polyamide 6 fibers. In 2013, the Group sold the Engineering Plastics division to DOMO and acquired DOMO's BCF business Xentrys.

The internationalization process continued by adding significant investments in the Asian market where, in 2005, a manufacturing facility was established in Thailand for processing and marketing BCF products for the carpet industry. In 2009, a new manufacturing facility was built in China to assist in the ever-growing Asian market.

From 2007-2011, Aquafil developed a visionary project aligned with its manufacturing and market growth focus. Driven by a genuine concern for the environment, resources and investments were dedicated to the design and construction of the **ECONYL® Regeneration System** (the recycling of pre- and post-consumer Polyamide 6 waste material), which launched in 2011.

As of 2019, the Group operates 17 manufacturing plants worldwide with more than 2,800 employees, in eight countries (Italy, Slovenia, Croatia, Germany, United Kingdom, USA, Thailand and China) on three continents (Europe, North America and Asia).

IT OPERATES 2 DIFFERENT PRODUCT AREAS:

- **BCF** *Carpet yarn for the flooring market*
- **NTF** *Special yarns for sportswear and fashion applications*

In 2008, during the engineering and design phase of Aquafil's **ECONYL® Regeneration System**, a third operating unit was created - Energy & Recycling.

This Energy & Recycling operating unit is dedicated to the promotion of sustainability and environmental issues. It has a transverse nature in respect to the other product areas, providing solutions and innovative technologies in the area of energy, recycling and the promotion of the culture of sustainability.

2 DECLARATION OF GENERAL INFORMATION

This environmental product declaration is compliant with ISO 14025 and EN15804.

2.1 PUBLISHER

• **EPD international AB;** Valhallavägen 81, SE-114 27 Stockholm Sweden; www.environdec.com

• **Institute Bauen und Umwelt e.V. (IBU);** Panoramstr.1, 10178 Berlin; www.bau-umwelt.de

2.2 OWNER OF THE DECLARATION

Aquafil S.p.A., Via Linfano 9, 38062 Arco Italy

2.3 GEOGRAPHICAL SCOPE OF THE EPD

Europe

2.4 PRODUCTION SITES INCLUDED IN EPD

- **AquafilSLO - Ljubljana** (Letališka cesta 15, 1000 Ljubljana, Slovenia)
  > process E
- **AquafilSLO - Ajdovščina** (Tovarniška cesta 15, 5270 Ajdovščina, Slovenia)
  > process I
- **AquafilSLO - Celje** (Teharje 105, 3221 Teharje, Slovenia)
  > process J
- **Aquafil S.p.A.** (Via Linfano 9, 38062 Arco, Italy)
  > process A,B
- **Tessilquattro S.p.A.** (Frazione Cares, 38071 Bleggio Inferiore, Italy)
  > process C
- **Tessilquattro - Rovereto S.p.A.** (Via del Garda 40, 38068 Rovereto, Italy)
  > process D

ISO standard	AquafilSLO Ljubljana	AquafilSLO Ajdovscina	AquafilSLO Celje	Aquafil S.p.A.	Tessilquattro S.p.A.	Tessilquattro Rovereto S.p.A.
ISO 9001 : 2015	X	X	X	X	X	X
ISO 14001 : 2015	X	X	X	X	X	X
OHSAS 18001 : 2007	X	X	X	X	X	X

2.5 SPECIFICATION OF THE PRODUCT

ECONYL® BCF yarns are bulk continuous filament yarns, made from 100% recycled PA6 polymer. BCF yarns are usually reprocessed by twisting, air entangling and heat setting processes. In some cases, they may contain antistatic yarns. As such are delivered to customers for manufacturing carpet tiles and tufted or woven carpets, within the scope of construction product.

This EPD refers to three groups of Bulk Continuous Filament yarns

- **ECONYL®** Twisted & Heat-set yarns (dope dyed)
- **ECONYL®** Air entangled & Twisted yarns (dope dyed)
- **ECONYL®** Space dyed yarns

Environmental performances for each group of yarn is reported separately. Each group of yarn is consisting of several similar products, but differences in terms of parameters are not significant for the first two groups of products (Twisted & Heat-set yarns and Air entangled & Twisted yarns). Meanwhile, for the third group of products, the parameters are reported as a range of values, due to higher variation in energy consumption between one product to another in the reprocessing step.

2.6 CONTENT DECLARATION

MATERIAL	SUBSTANCE	WEIGHT (%)	CAS NUMBER
polymer	polyamide 6	92-96	25038-54-4
pigments	several	0-3	several
spin finish	several	max.1	several
water	-	3-4	7732-18-5
TOTAL		100	-

ECONYL® BCF yarns do not contain any materials / substances hazardous to health and the environment (carcinogenic, mutagenic or toxic to reproduction, allergic, PBT, vPvB). All ECONYL® BCF yarns are OEKOTEX® 100 class II certified.

2.7 PRODUCT SPECIFICATION

A. ECONYL® TWISTED & HEAT-SET YARNS (DOPE DYED)

PARAMETER	UM	VALUE	TESTING METHOD
Linear density	dtex	1.600-4.000	DIN 53830
Tenacity at break	cN/dtex	2,1-3,0	ISO 2062
Elongation at break	%	75-125	ISO 2062

B. ECONYL® AIR ENTANGLED & TWISTED YARNS (DOPE DYED)

PARAMETER	UM	VALUE	TESTING METHOD
Linear density	dtex	1.300-8.000	DIN 53830
Tenacity at break	cN/dtex	2,1-3,4	ISO 2062
Elongation at break	%	35-70	ISO 2062

C. ECONYL® SPACE DYED YARN

PARAMETER	UM	VALUE	TESTING METHOD
Linear density	dtex	1.300-4.500	DIN 53830
Tenacity at break	cN/dtex	2,1-3,4	ISO 2062
Elongation at break	%	35-70	ISO 2062

3 LCA: Calculation rules

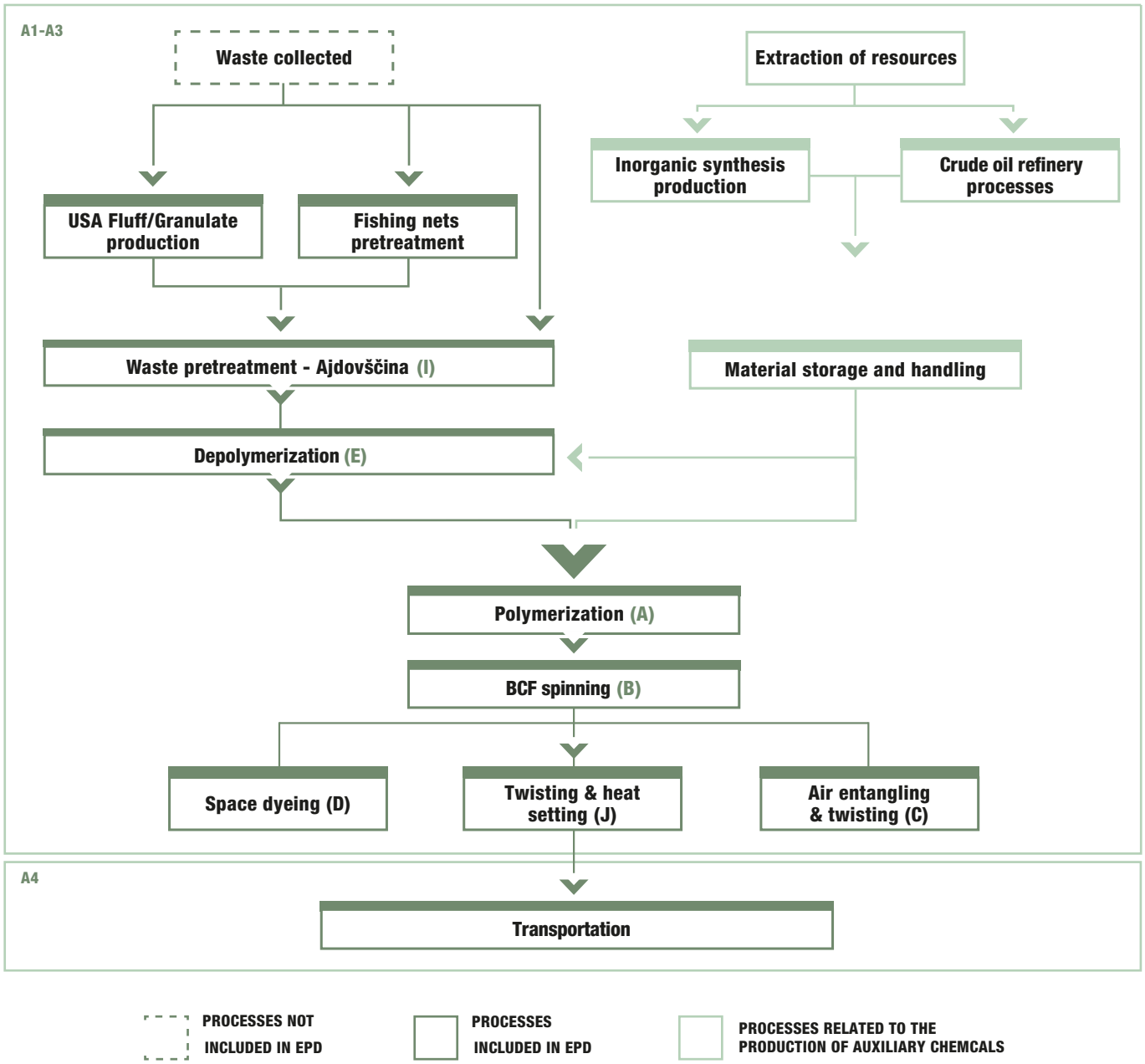
3.1 DECLARED UNIT

Declared unit is 1 kg of ECONYL® BCF reprocessed yarn delivered and including primary packaging.

3.2 SYSTEM BOUNDARIES

This is a »Cradle-to-gate« with options EPD, including modules A1-A4 and D module. Modules A1-A3 are reported as one number.

Modules A1-A3 include processes, that provide materials and energy input for the system, manufacturing and transport processes up to the factory gate, as well as the waste processing.
Module A4 includes transport to the customers.
Module D indicates credits resulting from energy recovery of output waste from depolymerization process.



3.3 CUT OFF CRITERIA

Life Cycle Inventory data for a minimum of 95% of total inflows (mass and energy) module A1-A3 are included.
All the energy inflows were considered in the study. Primary packaging material was considered:

- **polymerization process: tank truck**
- **spinning, heat set, air entangling and space dyeing: paper tubes**

Excluded secondary packaging materials: paper boxes & separators, wooden pallets, labels, plastic bags, extensible film & adhesive tape.

3.4 BACKGROUND DATA AND METHOD

All the background data relevant for modelling were taken from Gabi database – service pack 38, (update 2019).
CML 2001, January 2016 assessment method is used for calculating impacts.

3.5 DATA COLLECTION

Life cycle assessment primary data of processes owned by Aquafil group were collected from period of January 2018 to December 2018 .

3.6 COMPARABILITY

EPDs of construction products may not be comparable if they do not comply with EN15804.

4 LCA: SCENARIOS AND OTHER TECHNICAL INFORMATION

4.1 TRANSPORT TO SITE (A4)

Means of transport: truck
Transport distance: average distance to customers 500 km
Capacity utilization: 85%
Fuel type: diesel

4.2 REFERENCE SERVICE LIFE

This EPD does not indicate RSL.

4.3 MODULE D

Waste sludge generated in module A3 is an input to energy recovery plant located outside Aquafil group. Burdens of waste combustion are considered in module A, while credits for avoiding production of electrical and thermal energy, in module D.

5 LCA: RESULTS

Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
Raw materials	Transport	Manufacturing	Transport	Construction installation	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	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X

(X = included in the LCA; MND = module not declared)

5.1 USE OF RESOURCES

A. ECONYL® TWISTED & HEAT-SET YARNS

PARAMETER	UNIT	A1-A3	A4	TOTAL	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ	31,36	0,03	31,38	-0,84
Use of renewable primary energy resources used as raw materials	MJ	0	0	0	0
Total use of renewable primary energy resources; primary energy and primary energy resources used as raw materials	MJ	**31,36**	**0,03**	**31,38**	**-0,84**
Use of non-renewable primary energy excluding non -renewable primary energy resources used as raw materials	MJ	31,56	0,44	32,00	-3,02
Use of non-renewable primary energy resources used as raw materials	MJ	33,91	0	33,91	0
Total use of non- renewable primary energy resources; primary energy and primary energy resources used as raw materials	MJ	**65,47**	**0,44**	**65,91**	**-3,02**
Use of secondary material	Kg	**2,01**	**0**	**2,01**	**0**
Use of renewable secondary fuels	MJ	**0**	**0**	**0**	**0**
Use of non - renewable secondary fuels	MJ	**0**	**0**	**0**	**0**
Use of net fresh water	m3	**0,10**	**4,30E-05**	**0,10**	**-3,00E-03**

Totals may not match, because of rounded data

B. ECONYL® AIR ENTANGLED & TWISTED YARNS

PARAMETER	UNIT	A1-A3	A4	TOTAL	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ	30,49	0,03	30,52	-0,83
Use of renewable primary energy resources used as raw materials	MJ	0	0	0	0
Total use of renewable primary energy resources; primary energy and primary energy resources used as raw materials	MJ	**30,49**	**0,03**	**30,52**	**-0,83**
Use of non-renewable primary energy excluding non -renewable primary energy resources used as raw materials	MJ	27,65	0,44	28,09	-2,99
Use of non-renewable primary energy resources used as raw materials	MJ	33,59	0	33,59	0
Total use of non- renewable primary energy resources; primary energy and primary energy resources used as raw materials	MJ	**61,24**	**0,44**	**61,68**	**-2,99**
Use of secondary material	Kg	**1,98**	**0**	**1,98**	**0**
Use of renewable secondary fuels	MJ	**0**	**0**	**0**	**0**
Use of non - renewable secondary fuels	MJ	**0**	**0**	**0**	**0**
Use of net fresh water	m3	**0,12**	**4,30E-05**	**0,12**	**-2,97E-03**

Totals may not match, because of rounded data

C. ECONYL® SPACE DYED YARNS

PARAMETER	UNIT	A1-A3	A4	TOTAL	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ	29,23-29,25	0,03	29,18-29,20	-0,81
Use of renewable primary energy resources used as raw materials	MJ	0	0	0	0
Total use of renewable primary energy resources; primary energy and primary energy resources used as raw materials	MJ	**29,23-29,25**	**0,03**	**29,25-29,27**	**-0,81**
Use of non-renewable primary energy excluding non -renewable primary energy resources used as raw materials	MJ	56,61-73,93	0,44	57,05 - 74,37	-2,93
Use of non-renewable primary energy resources used as raw materials	MJ	32,93	0	32,93	0
Total use of non- renewable primary energy resources; primary energy and primary energy resources used as raw materials	MJ	**89,54-106,86**	**0,44**	**89,97-107,29**	**-2,93**
Use of secondary material	Kg	**1,91**	**0**	**1,91**	**0**
Use of renewable secondary fuels	MJ	**0**	**0**	**0**	**0**
Use of non - renewable secondary fuels	MJ	**0**	**0**	**0**	**0**
Use of net fresh water	m3	**0,12**	**4,30E-05**	**0,13**	**-2,91E-03**

Totals may not match, because of rounded data

5.2 POTENTIAL ENVIRONMENTAL IMPACTS

A. ECONYL® TWISTED & HEAT-SET YARNS

PARAMETER	UNIT	A1 - A3	A4	TOTAL	D
GWP100*	kg CO_2 eq	2,49	3,19E-02	2,52	-0,21
Ozone depletion potential	kg CFC-11 eq	1,29E-08	5,33E-18	1,29E-08	-5,06E-15
Acidification potential	kg SO_2 eq	7,16E-03	1,48E-04	7,31E-03	-2,38E-04
Photochemical ozone creation potential	kg ethene eq	5,78E-04	1,38E-05	5,92E-04	-1,95E-05
Eutrophication potential	kg phosphate- eq	1,96E-03	3,69E-05	2,00E-03	-4,00E-05
Abiotic depletion potential (elements)	kg Sb eq	9,60E-07	2,51E-09	9,63E-07	-5,56E-08
Abiotic depletion potential (fossil)	MJ	30,76	0,44	31,20	-2,64

Totals may not match, because of rounded data
**emissions and removal of fossil and biogenic carbon are considered*

B. ECONYL® AIR ENTANGLED & TWISTED YARNS

PARAMETER	UNIT	A1 - A3	A4	TOTAL	D
GWP100*	kg CO_2 eq	2,23	0,03	2,26	-0,21
Ozone depletion potential	kg CFC-11 eq	1,29E-08	5,33E-18	1,29E-08	-5,01E-15
Acidification potential	kg SO_2 eq	6,78E-03	1,48E-04	6,93E-03	-2,36E-04
Photochemical ozone creation potential	kg ethene eq	5,29E-04	1,38E-05	5,43E-04	-1,93E-05
Eutrophication potential	kg phosphate- eq	1,88E-03	3,69E-05	1,92E-03	-3,97E-05
Abiotic depletion potential (elements)	kg Sb eq	8,17E-07	2,51E-09	8,20E-07	-5,51E-08
Abiotic depletion potential (fossil)	MJ	26,86	0,44	27,30	-2,62

Totals may not match, because of rounded data
**emissions and removal of fossil and biogenic carbon are considered*

C. ECONYL® SPACE DYED YARNS

PARAMETER	UNIT	A1-A3	A4	TOTAL	D
GWP100*	kg CO_2 eq	4,22-5,29	0,03	4,25-5,32	-0,21
Ozone depletion potential	CFC-11eq	1,10E-08	5,33E-18	1,10E-08	-4,91E-15
Acidification potential	kg SO_2 eq	8,25E-03-8,87E-03	1,48E-04	8,40E-03-9,02E-03	-2,31E-04
Photochemical ozone creation potential	kg ethene eq	7,55E-04-8,71E-04	1,38E-05	7,69E-04-8,85E-04	-1,90E-05
Eutrophication potential materials	kg phosphate eq	2,41E-03-2,51E-03	3,69E-05	2,45E-03-2,55E-03	-3,89E-05
Abiotic depletion potential (elements)	kg Sb eq	1,03E-06-1,09E-06	2,51E-09	1,03E-06-1,09E-06	-5,40E-08
Abiotic depletion potential (fossil)	MJ	55,66-72,96	0,44	56,10-73,40	-2,56

Totals may not match, because of rounded data
**emissions and removal of fossil and biogenic carbon are considered*

5.3 OTHER INDICATORS

A. ECONYL® TWISTED & HEAT-SET YARNS

PARAMETER	UNIT	A1 - A3	A4	TOTAL	D
Hazardous waste disposed	kg	4,36E-03	2,45E-08	4,36E-03	- 1,78E-09
Non-Hazardous waste disposed	kg	9,63E-01	3,57E-05	9,63E-01	- 1,80E-03
Radioactive waste disposed	kg	2,23E-04	5,95E-07	2,23E-04	- 1,46E-04

PARAMETER	UNIT	A1 - A3	A4	TOTAL	D
Components for re-use	kg	0	0	0	0
Materials for recycling	kg	0	0	0	0
Materials for energy recovery	kg	0	0	0	0
Exported energy	MJ	2,18	0	2,18	0

Totals may not match, because of rounded data

B. ECONYL® AIR ENTANGLED & TWISTED YARNS

PARAMETER	UNIT	A1 - A3	A4	TOTAL	D
Hazardous waste disposed	kg	4,48E-03	2,45E-08	4,48E-03	-1,77E-09
Non-Hazardous waste disposed	kg	9,51E-01	3,57E-05	9,51E-01	-1,78E-03
Radioactive waste disposed	kg	2,19E-04	5,95E-07	2,19E-04	-1,44E-04

PARAMETER	UNIT	A1 - A3	A4	TOTAL	D
Components for re-use	kg	0	0	0	0
Materials for recycling	kg	0	0	0	0
Materials for energy recovery	kg	0	0	0	0
Exported energy	MJ	2,15	0	2,15	0

Totals may not match, because of rounded data

C. ECONYL® SPACE DYED YARNS

PARAMETER	UNIT	A1 - A3	A4	TOTAL	D
Hazardous waste disposed	kg	2,85E-02	2,45E-08	2,85E-02	-1,73E-09
Non-Hazardous waste disposed	kg	1,00	3,57E-05	1,00	-1,75E-03
Radioactive waste disposed	kg	3,10E-04-3,12E-04	5,95E-07	3,10E-04-3,12E-04	-1,41E-04

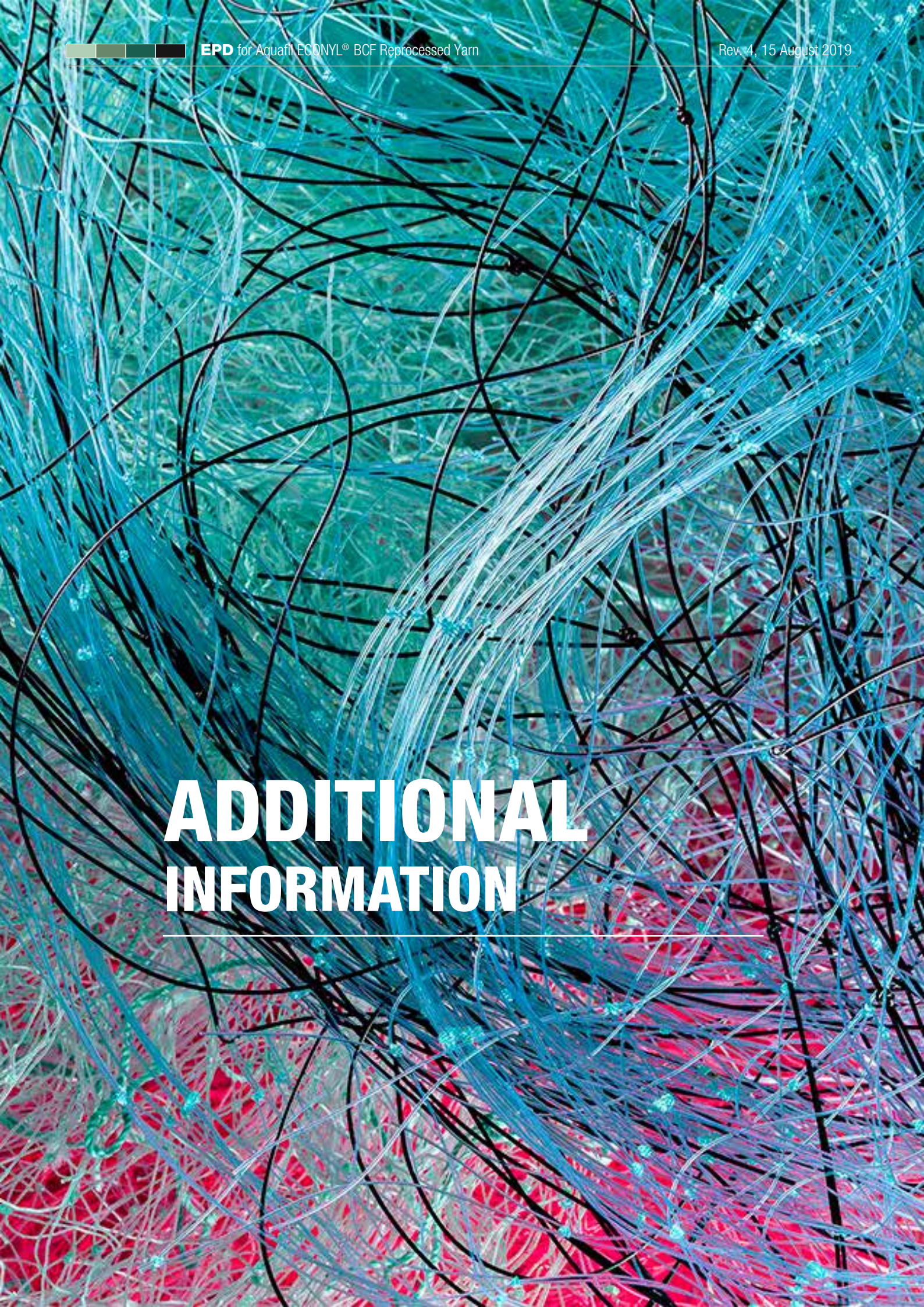
PARAMETER	UNIT	A1 - A3	A4	TOTAL	D
Components for re-use	kg	0	0	0	0
Materials for recycling	kg	0	0	0	0
Materials for energy recovery	kg	0	0	0	0
Exported energy	MJ	2,06	0	2,06	0

Totals may not match, because of rounded data

6 DIFFERENCES VERSUS PREVIOUS VERSION OF EPD

Efficiency of the power plant, which is feeding AquafilSLO Ljubljana has increased from 71,7% to 78%, however at the same time energy mix of steam supplied has changed to less appreciated; from 60% of coal + 40% of biomass origin to 85% of coal + 15% of biomass origin.
Furthermore, increased share of renewable energy is implemented in the process of ECONYL® spinning. Also, better separation of input waste components, before being depolymerized in ECONYL® plant was implemented. This consequently decreased impacts of sludge waste management generated by depolymerization stage; thus, energy and material efficiency are increased.

As a summary of all changes described above, GWP impact, as one of the most important parameters, is reduced compared to previous version of EPD.



ADDITIONAL INFORMATION

7 ADDITIONAL INFORMATION

This chapter is intended to provide specific additional information about the ECONYL® Regeneration System as well as some comments of its environmental benefit.

In 2009 we set ourselves the challenge of collecting waste material all over the world and turning it into recycled polymers. It is possible to mention other environmental benefits, besides those appreciated from the impact categories investigated in the present study. In fact, part of virgin raw materials extraction and natural resources exploitation is prevented by the use of waste otherwise disposed of.

The European Commission has estimated that the EU discards 5.8 million tons of textiles and apparel every year, 75% of this is sent to landfill or incinerated, but the vast bulk is destined for landfill. The USA generates 12.7 million tons of textile waste; of this only 14.9% is recycled (US Environmental Protection Agency, 2009), which means more than 85% is waste, again largely being sent to landfill.

To put this number in context, in 2009 a total of 71.6 million tons of fiber was used around the world. This means that the EU and the USA in one year alone discarded 18.5 million tons which is equal to 26% of annual global fiber usage.

Another aspect not directly emerging from the present study, which is worth a mention, is the contribution to the prevention of oceans pollution from the collection of fishing nets in their end-of-life.

References

> Bibliography

LCA report, REV.1, 1 August 2019
ISO 14025:2006
EN 15804:2012
General Programme instructions 2.5
PCR 2012:01 Construction products and Construction services, Version 2.3,
Appendix B to PCR 2012:01 Construction products and construction services, Version 2.3

For data elaboration, the following tools are used:
Software: Gabi 9.1.0.53
Database: Gabi professional database – pack 38

This declaration and further information about it are available at www.environdec.com

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> Independent verification

Independent verification of the declaration and data, according to ISO 14025:
☐ INTERNAL X EXTERNAL

Third party verifier:
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