



# ENVIRONMENTAL PRODUCT DECLARATION for ECONYL® NYLON TEXTILE FILAMENT YARNS

**EPD**<sup>®</sup>

CPC263&264-TEXTILE YARN AND THREAD OF NATURAL FIBRES, MAN-MADE FILAMENTS OR STAPLE FIBRES PCR2013:12 VERS. 1.01

Revision 1, 20. November 2014 Certification No.: S-P-00278 Valid until: 20. November 2016

# **COMPANY AND PRODUCT** Related information

## Company and product Related information

### 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 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 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) business unit.

Meanwhile, the Group continued to widen its product offering by opening a number of production plants in Europe and entering the Engineering Plastics business to supply modified polyamide products to the automotive, electronic and construction industries with the 'polyamide products priority focus' always in mind.

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 3 key markets where it was operating (carpet yarn, textile yarn and engineering plastics), gradually becoming a global leader in the manufacturing of Polyamide 6 fibres. 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 evergrowing 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 preand post-consumer Polyamide 6 waste material), which launched in 2011.

As of 2014, the Group operates 15 manufacturing plants worldwide with more than 2,400 employees, in 8 countries (Italy, Slovenia, Croatia, Germany, United Kingdom, USA, Thailand and China) on 3 continents (Europe, North America and Asia).

#### **IT OPERATES 2 DIFFERENT BUSINESS UNITS:**

- 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 business unit was created - Energy & Recycling.

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

## SPECIFICATION OF MANUFACTURING COMPANY **AND PRODUCT**

### **SPECIFICATION OF MANUFACTURING COMPANY**

- Manufacturing company:
- **Production sites involved in EPD:**
- **Production country:**
- **Reference markets:**



### **SPECIFICATION OF THE PRODUCT**

#### > This EPD refers to two types of Nylon Textile Filament yarns:

Aquafil S.p.A.

Senožeče, (Slovenia) AquafilCRO (Croatia)

Slovenia, Croatia

apparel industry

Julon Ljubljana, Ajdovščina,

- ECONYL® FDY yarns on beam
- ECONYL® texturized yarns on cones •

Both types of yarns are produced out of 100 % recycled with post consumer and post industrial recycled content (DNV certificate no. 2808-2013-PC-ITA-DNV).

TECHNICAL SPECIFICATION	TEST METHOD	TEST METHOD
Commercial article description	ECONYL® FDY yarn on beams	-
Basic polymer; % of basic polymer / Generic name of synthetic fibre; % of synthetic fibre	100 % Polyamide 6	EN ISO 1043-1:2011 / ISO 2076 : 2010
Type of yarn or fibre	Filament yarn	ISO 8159:1987
Type of processing	Fully Drawn Yarn	BISFA
Intended use	See section 2.1	-
Resulting linear density	17 dtex-78 dtex	ISO 2060-1994
Filament number	various	-

**COMPANY AND PRODUCT RELATED INFORMATION** 

TECHNICAL SPECIFICATION	TEST METHOD	TEST METHOD
Commercial article description	ECONYL <sup>®</sup> textured yarn on cones	-
Basic polymer; % of basic polymer / Generic name of synthetic fibre; % of synthetic fibre	Polyamide 6	EN ISO 1043-1:2011 / ISO 2076 : 2010
Type of yarn or fibre	Textured Filament yarn	ISO 8159:1987
Type of processing	Partially Oriented Yarn / False Twist Texturizing	BISFA
Intended use	See section 2.1	-
Resulting linear density	17 dtex-120 dtex	ISO 2060-1994
Filament number	various	-



## **DECLARED UNIT**

Functional unit is 1 kg of yarn delivered.



### **CONTENT DECLARATION**

All the yarns concerned by this declaration is made by polyamide 6, pigment (in most cases titania) and spin finish. For its hydrophilic nature, polyamide yarn has a humidity content of about (3-4) %, depending on the environmental relative humidity. Its composition is:

#### A) ECONYL® FDY YARNS ON BEAM

TYPE OF PRODUCT/SERVICE	% OF MATERIAL BY WEIGHT	OF WHICH % RECYCLED
•	· · · · · · · · · · · · · · · · · · ·	
Polyamide 6	93-96	100 %
Pigments	0-1,6	
Spin Finish	1,0-1,5	
Water	3-4	
Percent of which main materials, pigments and dye stuff, and other materials is bio-based	100 %	
Of which post-consumer waste		50 %
Of which pre-consumer waste		50 %

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EPD for Aquafil Econyl

#### **B) ECONYL® TEXTURIZED YARNS ON CONES**

TYPE OF PRODUCT/SERVICE	% OF MATERIAL BY WEIGHT	OF WHICH % RECYCLED
	· · · · · · · · · · · · · · · · · · ·	
Polyamide 6	93-96	100 %
Pigments	0-1,4	
Spin Finish	1,5-2,0	
Water	3-4	
Percent of which main materials, pigments and dye stuff, and other materials is bio-based	100 %	
Of which post-consumer waste		50 %
Of which pre-consumer waste		50 %



## UNITS AND QUANTITIES

SI units are used.

COMPANY AND PRODUCT RELATED INFORMATION



- - - PROCESS

**COMPANY AND PRODUCT RELATED INFORMATION** 



#### **UPSTREAM PROCESSES**

Upstream processes include:

- Extraction of non-renewable resource
- Additives and auxiliaries production
- All relevant transportation
- Secondary raw materials, that are entering into pretreatment plant and are constituted of three main types of waste:
  - A) PA6 fishnets collection: they are collected worldwide
  - B) PA6 carpet are collected, after shaved to obtain PA6 fluff. The
  - fluff is later pelletised to simplify the handling of the material.
  - *C)* Oligomers are waste generated by polymer industries to produce PA6 and collected and partly grinded to get suitable dimension.

All of them are characterized with the specific feedstock energy entering the system, and the process are described by means of energy use (according to the local energy mix) and emissions.

- Polymer production
- ECONYL® plant operation

A) depolymerisation step (where specific mix of waste is transformed back into secondary raw material - caprolactam)
B) purification step of caprolactam

Polymer production

All energetic input flows (electricity, heating fuels, steam...) and water consumption to the upstream processes are considered. All emissions to air, water and soil and treatment of waste and wastewater generated are considered as well.

# **6.2** CORE PROCESSES

Core Process takes into account:

- Spinning process (POY or FDY)
- Post spinning processes; texturizing or warping
- Transportation of materials into the core processes

All energetic input flows (electricity, heating fuels, steam....) and water consumption to the upstream processes are considered. All emissions to air, water and soil and treatment of waste and wastewater generated are considered as well.

COMPANY AND PRODUCT RELATED INFORMATION



### **DOWNSTREAM PROCESSES**

Downstream processes include transportation to average retailer / distribution platform:

• 300 km by truck

Use phase and end of life of product is not included.

# ENVIRONMENTAL PERFORMANCE Related information

**ENVIRONMENTAL PERFORMANCE - RELATED INFORMATION** 

# **T**ENVIRONMENTAL PERFORMANCE RELATED INFORMATION

The environmental burden of the product has been calculated according to the general rules of the EPD (Environmental Product Declaration) International Programme and PCR 263&264 (Textile yarn and thread of natural fibres, manmade filaments or staple fibres).

This declaration is based on the application of Life Cycle Assessment (LCA) methodology to the Econyl<sup>®</sup> yarns life-cycle system. The LCA report constitutes the most important background document to support environmental communication about ECONYL<sup>®</sup> and its environmental life-cycle burden.

To assess the burden of ECONYL<sup>®</sup> yarn production at the **plant level**, detailed data and information were collected from several manufacturing facilities:

- Julon-Ajdovščina Slovenia (for ECONYL® waste pretreatment)
- **Julon- Ljubljana** Slovenia (for ECONYL® depolymerisation, polymer manufacturing and spinning of yarns)
- **Julon-Senožeče** *Slovenia (for post spinning processing-warping)*
- **AquafilCRO** Croatia (for post spinning processing-texturizing)

Customized LCA questionnaires were used to gather in-depth information about all aspects of the production system (for example, raw materials specifications, pre-treatments, process efficiencies, air emissions, waste management), ultimately providing a complete picture of the environmental burden of the system.

The use phase and end of life is not included in the study, while distribution scenario is set to 300 km via truck to distribution platform.

**ENVIRONMENTAL PERFORMANCE - RELATED INFORMATION** 

The detailed environmental performance of the ECONYL<sup>®</sup> yarns is presented for the three phases, Upstream, Core and Downstream.

ECONYL<sup>®</sup> production process is continuously improved and this analysis took into consideration the most representative and specific data available.

From a general point of view all production are described using data year 2013.

ECONYL<sup>®</sup> depolymerisation process (in Julon-Ljubljana) was technically upgraded at the end of the year 2013, therefore that part of primary data are considering the period from January to July 2014.

**ENVIRONMENTAL PERFORMANCE - RELATED INFORMATION** 

# **7.1** RESOURCES

#### **RESULTS ABOUT THE USE OF RESOURCES ARE SPLIT INTO FOUR SECTIONS:**

•	1. Renewable resources	Table 1
•	2. Non-renewable resources	Table 2
•	3. Secondary resources	Table 3
•	3. Direct electricity consumption	Table 4
•	4. Water use	Table 5

#### >TABLE 1.A. TOTAL RENEWABLE RESOURCES FOR PRODUCTION OF 1 kg OF ECONYL® FDY YARN ON BEAMS

(rounded values).

RENEWABLE RES	OURCES				
		UPSTREAM	CORE	DOWSTREAM	TOTAL
TOTAL RR MATERIAL RES	OURCES [g]	-	_	-	-
	Solar	2	<0,3	<0,02	2
Energy resources	Hydropower	5	20	2,32E-04	25
for energy conversion	Wind	<0,1	<0,007	1,23E-04	<0,1
purpose [MJ]	Biomass	<1	5,64E-04	7,15E-15	<1
	Other	<0,02	3,85E-04	8,55E-06	<0,02
TOTAL RR ENERGY RESO	URCES [MJ]	7	21	<0,02	28

totals may not match, because of rounded data.

#### >TABLE 1.B. TOTAL RENEWABLE RESOURCES FOR PRODUCTION OF 1 kg OF ECONYL® TEXTURIZED YARN ON CONES

(rounded values).

RENEWABLE RES	DURCES				
		UPSTREAM	CORE	DOWSTREAM	TOTAL
TOTAL RR MATERIAL RES	OURCES [g]	-	_	-	-
	Solar	3	<0,3	<0,02	4
Energy resources	Hydropower	5	22	2,32E-04	26
for energy conversion	Wind	<0,07	<0,009	1,23E-04	<0,09
purpose [MJ]	Biomass	2	<0,02	7,69E-15	2
	Other	<0,02	5,44E-04	8,55E-06	<0,02
TOTAL RR ENERGY RESOL	JRCES [MJ]	9	22	<0,02	31

totals may not match, because of rounded data.

**ENVIRONMENTAL PERFORMANCE - RELATED INFORMATION** 

#### >TABLE 2.A. TOTAL NONRENEWABLE RESOURCES FOR PRODUCTION OF 1 kg OF ECONYL® FDY YARN ON BEAMS

(rounded values).

~	UPSTREAM	CORE	DOWSTREAM	TOTAL
NR MATERIAL RESOURCES [g]		Ť		
Inert rock*	4,74E+03	924	<1	5,66E+03
Limestone (CaCo <sub>3</sub> )	135	27	<0,1	162
Sodium Chloride	24	2	<0,01	25
Soil	71	262	<0,01	333
Natural aggregate	100	121	<0,003	221
Clay	12	1	<0,002	13
Others	9	1	<0,2	11
TOTAL NR MATERIAL RESOURCES [g]	5,09E+03	1,34E+03	1	6,43E+03
NR ENERGY RESOURCES - FOR ENERGY CONVERSION PURPOSE [a]		Ĭ		
Hard coal	506	87	<0,03	593
Hard coal Crude oil	506 149	87 14	<0,03 6	593 169
Hard coal Crude oil Lignite	506 149 39	87 14 4	<0,03 6 <0,4	593 169 43
Hard coal Crude oil Lignite Natural gas	506 149 39 93	87 14 4 24	<0,03 6 <0,4 <0,5	593 169 43 117
Hard coal Crude oil Lignite Natural gas Uranium	506 149 39 93 <0,003	87 14 4 24 9,24E-05	<0,03 6 <0,4 <0,5 1,95E-06	593 169 43 117 <0,003
Hard coal Crude oil Lignite Natural gas Uranium Other	506 149 39 93 <0,003 <0,05	87 14 4 24 9,24E-05 <0,006	<0,03 6 <0,4 <0,5 1,95E-06 6,87E-04	593 169 43 117 <0,003 <0,06

totals may not match, because of rounded data.

\*more than 89% of inert rock consumption is related to coal extraction

MATERIAL RESOURCES [g]				
	UPSTREAM	CORE	DOWSTREAM	TOTAL
NR MATERIAL RESOURCES [g]		Ĭ		
Inert rock*	4,77E+03	828	<1	5,60E+03
Limestone (CaCo <sub>3</sub> )	131	29	<0,07	161
Sodium Chloride	26	3	<0,007	29
Soil	69	263	<0,009	331
Natural aggregate	101	129	<0,003	230
Clay	12	2	<0,001	14
Others	7	5	<0,2	12
TOTAL NR MATERIAL RESOURCES [g]	5,11E+03	1,26E+03	1	6,37E+03
NR ENERGY RESOURCES - For Energy Conversion Purpose [g]		Ĭ		
Hard coal	502	78	<0,03	580
Crude oil	181	15	6	202
Lignite	55	6	<0,04	61
Natural gas	128	6	<0,5	134
Uranium	< 0.003	1,86E-04	1,95E-06	<0,004
Uranium				
Other	<0,05	<0,006	6,87E-04	<0,06

>TABLE 2 B TOTAL NONRENEWARI E RESOURCES FOR PRODUCTION OF 1 kg OF ECONVI ® TEXTURIZED VARN ON CONES (rounded values)

totals may not match, because of rounded data.

\*more than 86 % of inert rock consumption is related to coal extraction

The figures in the tables above, referring to the resources consumption, are mainly related to depolymerisation phase and are strongly influencing the data.

**ENVIRONMENTAL PERFORMANCE - RELATED INFORMATION** 

#### >TABLE 3. TOTAL SECONDARY RESOURCES FOR PRODUCTION OF 1 kg OF ECONYL® YARN

(recycled waste)

	Units	UPSTREAM	CORE	DOWSTREAM	TOTAL
FCONYL® FDY varn	n	1623	0	0	1623
ECONYL® texturised yarn	g	1599	0	0	1599

#### >TABLE 4. TOTAL DIRECT ELECTRICITY USED FOR PRODUCTION OF 1 kg OF ECONYL® YARN

	Units	UPSTREAM	CORE	DOWSTREAM	TOTAL
ECONYL® FDY yarn	kWh	1,0	4,8	0	5,8
ECONYL® texturised yarn	kWh	1,0	5,1	0	6,1

Direct electricity used is consisting of 100% renewable energy

#### >TABLE 5. TOTAL WATER USED FOR PRODUCTION OF 1 kg OF ECONYL® YARN

	Units	UPSTREAM	CORE	DOWSTREAM	TOTAL
ECONYL® FDY yarn	L	8	3	<0,005	11
ECONYL® texturised yarn	L	8	6	<0,005	14

totals may not match, because of rounded data.

## **7 2** POTENTIAL ENVIRONMENTAL IMPACT

#### >TABLE 6.A. TOTAL ENVIRONMENTAL IMPACT FOR PRODUCTION OF 1 kg OF ECONYL® FDY YARN ON BEAMS

	Units	UPSTREAM	CORE	DOWSTREAM	TOTAL
Global Warming Potential (GWP) from fossil fuels	g CO <sub>2</sub> eq	2875	374	19	3268
Acidification Potentials	g SO <sub>2</sub> eq	12	1	<0,2	13
Photochemical Ozone Creation P.	$g C_2 H_4$	<1	<0,1	<0,02	<1
Eutrophication Potentials	g PO <sub>4</sub> eq	3	<0,5	<0,03	4

totals may not match, because of rounded data.

#### >TABLE 6.B. TOTAL ENVIRONMENTAL IMPACT FOR PRODUCTION OF 1 kg OF ECONYL® TEXTURIZED YARN ON CONES

	Units	UPSTREAM	CORE	DOWSTREAM	TOTAL
Global Warming Potential (GWP) from fossil fuels	g CO <sub>2</sub> eq	3020	330	19	3369
Acidification Potentials	$g SO_2 eq$	12	1	<0,2	14
Photochemical Ozone Creation P.	$g C_2 H_4$	1	<0,09	<0,02	1
Eutrophication Potentials	g PO <sub>4</sub> eq	3	<0,5	<0,03	4

totals may not match, because of rounded data.

Waste raw materials have very little influence on the indicators above, depolymerisation (with specific concern to coal based steam production) is primary contributor to GWP. Polymerisation, spinning, texturizing and warping are still important, but the contribution is of lower grade, mostly because of the renewable mix for specific direct electricity.

Also use of auxiliary chemical used for depolymerisation process is significantly contributing to Eutrophication Potential.

# **7.3** OTHER INDICATORS

>TABLE 7.A. RECYCLED MATERIAL CONTENT FOR PRODUCTION OF 1 kg OF ECONYL® FDY YARN ON BEAMS

	Units	UPSTREAM	CORE	DOWSTREAM	TOTAL
POST CONSUMER	%	-	min 50	_	min 50
POST INDUSTRIAL	%	-	max.50	-	max.50

>TABLE 7.B. RECYCLED MATERIAL CONTENT FOR PRODUCTION OF 1 kg OF ECONYL® TEXTURIZED YARN ON CONES

	Units	UPSTREAM	CORE	DOWSTREAM	TOTAL
POST CONSUMER	%	-	min.50	-	min. 50
POST INDUSTRIAL	%	-	max.50	-	max.50

#### >TABLE 8.A. WASTE AT PRODUCTION OF 1 kg OF ECONYL® FDY YARN ON BEAMS

	Units	UPSTREAM	CORE	DOWSTREAM	TOTAL
Hazardous waste	g	-	15	-	15
Non hazardous	g	-	1,27E+03*	-	1,27E+03

\*almost 84 % of the waste is generated by extraction of coal and lignite-stockpile goods deposited.

#### >TABLE 8.B. WASTE AT PRODUCTION OF 1 kg OF ECONYL® TEXTURIZED YARN ON CONES

	Units	UPSTREAM	CORE	DOWSTREAM	TOTAL
Hazardous waste	q	-	15	-	15
Non hazardous	g	-	1,23E+03*	-	1,23E+03

\*more than 80 % of the waste is generated by extraction of coal and lignite-stockpile goods deposited.

The impacts related to the management of the waste all along the life cycle are included in the impact assessment reported in chapter 7.2. Waste generation in table 8 includes:

- all waste that is subject to recycling, landfilling and incineration
- waste deposited without further treatment all along the life cycle stages; sourcing from commercial database
- all waste whose end of life is unknown all along the life cycle stages; sourcing from commercial database

#### >TABLE 9.A. WASTE AT PRODUCTION OF 1 kg OF ECONYL® FDY YARN ON BEAMS

(waste subject to recycling)

	Units	UPSTREAM	CORE	DOWSTREAM	TOTAL
Hazardous waste	g	-	2	-	2
Non hazardous	g	-	92	-	92

#### >TABLE 9.B. WASTE AT PRODUCTION OF 1 kg OF AVERAGE ECONYL® TEXTURIZED YARN ON CONES

(waste subject to recycling)

	Units	UPSTREAM	CORE	DOWSTREAM	TOTAL
Hazardous waste	g	-	2	-	2
Non hazardous	g	-	146	-	146
					1

#### >TABLE 10. NOX AIR EMISSIONS

	Units	UPSTREAM	CORE	DOWSTREAM	TOTAL
ECONYL <sup>®</sup> FDY yarn	g	7	<0,8	<0,2	8
ECONYL <sup>®</sup> texturized yarn	g	7	<0,7	<0,2	8

# ADDITIONAL INFORMATION

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## **Additional information**

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

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

The European Commission has estimated that the EU discards 5.8 million tonnes 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 tonnes 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 tonnes of fibre was used around the world. This means that the EU and the USA in one year alone discarded 18.5 million tonnes = 26 % of annual global fibre 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 fishnets in their end-of-life.

## References

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

#### > Specific requirements

The calculation of the environmental impact of the product was conducted according to the general EPD<sup>®</sup> requirements.

#### > Contacts

To get more information about this environmental declaration or about Aquafil activities please contact:

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#### > Independent verification CPC263&264/PCR2013:12 vers. 1.01

Independent verification of the declaration and data, according to ISO 14025:□ INTERNALX EXTERNAL

Third party verifier: Bureau Veritas Group www.bureauveritas.com

Accredited by: SWEDAC

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