

ENVIRONMENTAL PRODUCT DECLARATION FOR NUREL, S.A. NYLON 6 YARNS

Yarn 33/28/UM - Yarn 44/28/UM
Registration number: S-P-00513

Man-made Fibres-Synthetic 2013:03 Versión 1.1

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1. INFORMATION ABOUT THE PROGRAMME

This Environmental Product Declaration is developed under the PCR of the **International EPD® System**.

PCR reference document on which the EPD is based: UN CC 355. Man-made fibres-synthetic. 2013:03 Version 1.1. Valid until: 2018-04-22.

The production of the polymer which forms part of the upstream phase of the main process, is also carried out at the facilities of NUREL, S.A., so that PCR Plastics in primary forms (UN CPC 347), 2010:16, VERSION 2.11. valid until: 2017-12-15 have been used. In the manufacture of the yarns, that are the object of this EPD, no yarns recovered in the actual process are used.

Date of publication of the PCR: 2015-10-03. Valid until 2018-04-22.

Registration number: S-P-00513.

Date of publication of the EPD: 2016-12-16. Valid until 2019-12-15.

Geographical scope of application of the EPD: Global.

Year of reference of the data used in the EPD: 2015.

Reference to useful websites for obtaining further information:

www.environdec.com - <http://www.nurel.com>



2. INFORMATION ABOUT THE PRODUCT

2.1. Company information

Company name: NUREL, S.A., S.A.

Address: Ctra. Barcelona, km 329, 50016 Zaragoza (Spain).

Production centre: Ctra. Barcelona, km 329, 50016 Zaragoza (España).

Telephone: 976 465 579.

Production country: España.

Issuer and contact data: NUREL, S.A., S.A., José Carlos Martín.



NUREL, S.A. began producing polyamide fibre in 1967 and in 1999 it was purchased by the SAMCA Group. The entry of SAMCA brought successive investments in the polymerization area and new spinning facilities. Thanks to this and to the security of belonging to a solid industrial group, NUREL, S.A. has become a global lead supplier of Nylon 6 and 6.6.

NUREL, S.A. is divided into two business units: ENGINEERING POLYMERS and SYNTHETIC FIBRES, with a polymerisation capacity of 27,000 tons and a yarn production capacity of 7,500 tons. NUREL, S.A. currently employs 350 people. Thanks to the successive investments by the SAMCA Group, NUREL, S.A. has 2 polymerization lines, 3 spinning lines and several draw-warping units at its Zaragoza plant, all of which with state-of-the-art technology.

Through its continuous investments in technology and R+D+I, NUREL, S.A. is situated at the forefront of innovation in the textile industry in Europe. NUREL, S.A. has firmly consolidated its position in the European market and is capable of fully satisfying its customers' needs with a wide range of products, quality and services.

NUREL, S.A. has become a globally reputed supplier of Nylon 6 and 6.6 and its production is assigned to the most demanding markets and applications.

NUREL, S.A. is committed to continually improving all of its processes and products, with the involvement of all of its departments and employees, from the start of its projects right through to its customer support and after-sales service.

In line with its commitment to quality, NUREL, S.A. is ISO 9001 certified.

NUREL, S.A. production processes are defined in accordance with its Health, Safety and Environmental Protection policy. This is a top priority for NUREL, S.A. over and above any other objective.

NUREL, S.A. recycles and recovers most of the hazardous chemical substances generated, thus reducing the impact on the environment. Its Zaragoza plant is designed to recover and recycle a large part of the waste itself.

The operational centre of NUREL, S.A. in Zaragoza is certified according to the ISO 14001 standard. NUREL obtained ISO 50001 certification in 2015.

2.2. Product specification

Trade name:

- Yarn 33/28/UM
- Yarn 44/28/UM

Generic name according to ISO 2076:2010 standard. Polyamide – nylon. Subclass number 3.15. Code PA.

ISO Code, according to ISO 1043: PA.

Type of fibre: raw.

CAS number: 25038-54-4.

Lustre: ultra-matte.

Technical description of product

33/28/UM Yarn	
Material	Polyamide 6 and additives
Entangled	Approx. 30 per metre
Colour	Off-white
Use	Textile
Format	Different beam formats

Technical specification	Unit	Value range	Test methodology
Type of yarn	POY, LOY, BCF, HTY...	FDY	BISFA – Terminology of man-made fibres (last available version)
Title	dTex	33,0 ±0,9	ISO 2060:1994
Elongation to break	%	35,0 ±6,0	ISO 2062:2009
Toughness or breaking load	cN/Tex	40,0 ±5,0	ISO 2062:2009
Colour strength (if applicable)	Grey scale	Not applicable	ISO 105
Number of filaments	No.	28	Not applicable

Support type and materials: Beam

44/28/UM Yarn

Material	Polyamide 6 and additives
Entangled	Approx. 35 per metre
Colour	Off white
Use	Textile
Format	Different beam formats

Technical specification	Unit	Value range	Test methodology
Type of yarn	POY, LOY, BCF, HTY...	FDY	BISFA – Terminology of man-made fibres (last available version)
Title	dTex	45,0 ±0,9	ISO 2060:1994
Elongation to break	%	35,0 ±6	ISO 2062:2009
Toughness or breaking load	cN/Tex	40,0 ±5,0	ISO 2062:2009
Colour strength (if applicable)	Grey scale	Not applicable	ISO 105
Number of filaments	No.	28	Not applicable

Support type and materials: Beam

2.3. Declared unit

This EPD includes the manufacture of two types of yarn, 33/28/UM and 44/28/UM for textile use, whose environmental impacts differ by less than 10%, thus according to PCR criteria they can be included in the same EPD. The yarns have very similar results so that the EPD presents one single result, which is the average of the two.

The declared unit is 1 kg of yarn, including the respective part of the packaging and the type of support.

Yarn humidity content when leaving the factory is less than 5%, depending on the ambient relative humidity.

2.4. Declaration of material and chemical substances content

Composition of the yarns included in this EPD is as follows:

Components	Kg / functional unit	% in total weight	Observations
Main material: Nylon 6	0,9881	98,81	
Sizing [Contains <2% of CAS No. 000067-63-0]	0,0119	1,19	The product does not have any risk phrases although it has less than 2% of an ingredient with risk phrases R11 and R36/37

The yarns do not have any type of pigment or dye.

In the manufacture of the two types of yarns no pre-consumer or post-consumer recycled or recovered material is used. Although recovered lactam is not used in the manufacture of the yarns that are the subject matter of this EPD, it is used in other factory processes with different quality requirements. Furthermore, all remains from the spin-draw process that are not used in manufacture, are re-introduced into other factory processes or they are used in manufacturing processes external to NUREL.

The yarns do not contain any materials/substances classified as hazardous to health or to the environment that are carcinogenic, mutagenic or toxic for reproduction (CMR), allergenic, PBT5 or vPvB6.

2.5. Comparison of EPDs of this product category

EPDs of different programmes may not be comparable.

2.6. Units and amounts

The units required in PCR are used. Decimals are indicated with commas, in SI style (French version); for example: 2.156,234.

3. INFORMATION REGARDING ENVIRONMENTAL BEHAVIOUR

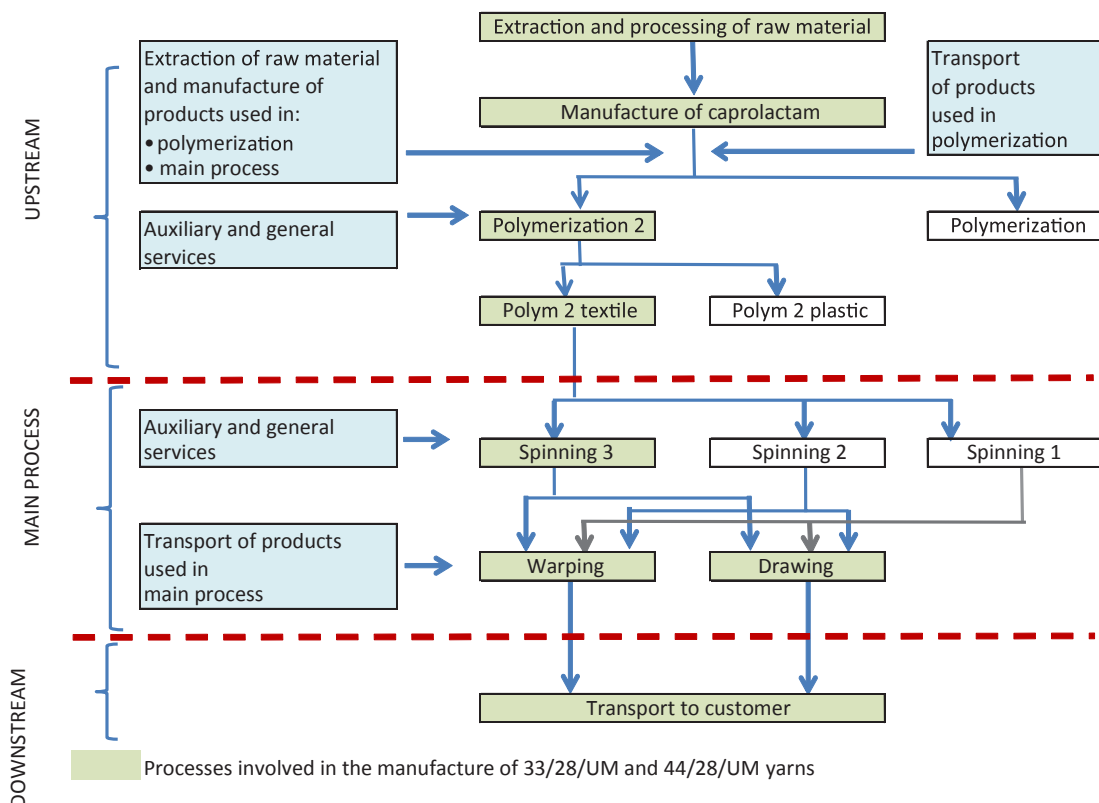
3.1. System limits

In the LCA, more than 99% by weight of the materials used in the manufacture of the yarns has been studied. The LCA does not include:

- Any equipment with a useful life of more than 3 years, nor the construction of the plant buildings, nor other capital assets.
- Business trips or journeys by personnel or journeys by personnel to and from work.

Materials and energy consumed in research activities have been included in the General Services section, assigned as a whole, in relation to total plant production.

The limits of system studied in the Life Cycle Analysis have been defined according to the following criteria established in the PCR, summarised in the following diagram:



In the downstream phase, only the transport of yarns to customers is taken into account, applying the default criterion that the transport distance is 1,000 km by road.

3.2. Use of resources

The consumption of natural resources and other types of resources by the functional unit is shown, differentiating between the main process, the upstream phase and the downstream phase.

3.2.1. Use of non-renewable resources

Non-renewable material resources used to manufacture the yarns (in g/kg yarn)				
Material resources	Upstream	Main process	Downstream	Total
Calcite	6,639	2,26	0,012	8,911
Iron	4,238	2,064	0,008	6,31
Inert rock	5.589,912	0,018	0	5589,93
Oxygen	0,741	0,793	0,007	1,54
Peat	0,109	0,125	0,007	0,241
Sodium chloride	165,844	0,092	0,003	165,939
Cadmium	0,4315	0	0,0055	0,3755
Nitrogen	1,1955	0	0,0055	1,0135
Clay, unspecified	0,803	0	0	0,1715
Lead	0,0495	0	0	0,0495
Zinc	0,2375	0	0,007	0,2445
Gravel	0,2265	0	0,007	0,2335
Others	164,455	0,346	0,001	164,801

Non-renewable resources used to manufacture the yarns				
Amounts with reference to declared unit.	Upstream	Main process	Downstream	Total
Oil (grams per kg of yarn)	2.806,521	40,389	22,434	2.869,344
Natural Gas (gram per kg of yarn)	90,313	173,37	0,736	264,416
Coal (grams per kg of yarn)	591,141	556,92	0,66	1.148,72
Uranium (grams per kg of yarn)	0,010	0,020	0,00	0,030
Uranium energy (MJ per kg of yarn)	0,000	0,022	0,00	0,022

3.2.2. Use of renewable resources

Renewable resources used to manufacture the yarns (in cm ³ /kg yarn)				
Material resources	Upstream	Main process	Downstream	Total
Coniferous wood	13,936	69,158	0,064	83,1575
Hardwood	7,831	65,667	0,064	73,562

Renewable energy sources used to manufacture the yarns					
Amounts with reference to declared unit.		Upstream	Main process	Downstream	Total
Energy resources used for the conversion of energy (Mj)	Biomass	0,295	2,418	0,001	2,713
	Wind	1,603	3,230	< 0,001	4,833
	Hydroelectric	0,757	1,763	0,001	2,521
	Solar	2,799	0,866	0	3,665
	Geothermal	0,001	0	0	0,001
Total renewable energy resources (Mj)		5,454	8,277	< 0,003	13,733

3.2.3. Use of water

Use of water to manufacture the yarns, in litres per kg of yarn.				
	Upstream	Main process	Downstream	Total
Consumptive use	68,133	20,70	0,06	88,894
Water from lakes	37,358	0,015	0	37,373
Water from rivers	1,5005	4,224	0,02	5,744
Water from nonspecific origin	4,573	15,466	0,038	20,077
Underground water	24,7015	0,996	0,002	25,700
Non-consumptive use	5.254,29	15.823,951	8,33	21.086,57
Water used for cooling	2274,798	167,379	0,216	2.442,393
Water used for turbine	2979,496	15656,572	8,114	18.644,182

3.3 Potential environmental impacts

Potential environmental impacts of 1 kg of yarn				
Impact category	Upstream	Main proces	Downstream	Total
Acidification potential (kg SO ₂ equivalent)	0,014	0,013	< 0,001	0,027
Global warming potential (kg CO ₂ equivalent, 100 years)	10,650	1,765	0,071	12,486

Potential environmental impacts of 1 kg of yarn				
Impact category	Upstream	Main proces	Downstream	Total
Ozone depletions potential (kg CFC 11-equivalent, 20 years)	0,000	0,000	0,000	0,000
Ozone creation potential (kg of ethane, C ₂ H ₄ – equivalent)	0,001	< 0,001	0,000	< 0,002
Eutrophication potential (kg PO ₄ 3- equivalent)	0,001	0,009	0,000	0,010

Note: data obtained from the impact analysis with CML-IA baseline V3.03 / EU25 and CML-IA non-baseline V3.02 / EU25 methodology, with the SimaPro program.

3.4. Waste production

The amount of waste generated to manufacture the yarns is as follows:

Generation of waste to manufacture the yarns (in kg per kg of yarn)			
Type of waste	Upstream	Main process	Downstream
Non-hazardous	5,658	0,012	0
Hazardous	0,000	0,010	0
Radioactive	0,001	0	0

Note: data obtained from the SimaPro inventory analysis; waste flow final compartment; for each yarn.

Although recovered lactam is not used in the manufacture of the yarns that are the subject matter of this EPD, it is used in other factory processes with different quality requirements. Furthermore, all remains from the spin-draw process that are not used during manufacture, are re-introduced into other factory processes or they are used in manufacturing processes external to NUREL.

3.5. Other indicators

The yarns that are the subject matter of this EPD do not contain recycled materials.

Emissions of NOx generated in the manufacture of the yarns are as follows:

Emission of NOx in the manufacture the yarns (in g per kg of yarn)		
Upstream	Main process	Downstream
8,47	4,8	0,299

Note: data obtained from the SimaPro inventory analysis; atmospheric emission; for each yarn.

The co-products generated during the manufacturing process of the yarns and their destination are as indicated below:

Co-products generated in the manufacture of the yarns (in kg for the functional unit)		
Co-product	Amount (kg)	Destination
Yarn from warping	0,0715	Use in other manufacturing processes outside NUREL, S.A. facilities
Yarn from spinning	0,073	

Note: Values obtained from factory data and estimates.

4. VERIFICATION

Information on the verification process is indicated below:

Product Category Rules (PCR) review was conducted by:
The Technical Committee of the International EPD® System.
 Chair: Massimo Marino.
 Contact via info@environdec.com.

Independent verification of the declaration and data,
 according to ISO 14025:2006:

- EPD verification

Third party verifier: Rubén Carnerero Acosta.
 Accredited or approved by:
The International EPD® System” The International EPD System

EPD programme	The International EPD® System Valhallavägen 81 SE-114 27 Stockholm, Sweden, www.environdec.com
Registration N°	S-P-00513
Date of publication	2013-12-17
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Valid until	2019-12-16
EPD valid within the following geographical area	This EPD has Global validity
EPD type	Cradle-to-grave
Independent verification of the declaration and data, according to ISO 14025:2006	<input checked="" type="checkbox"/> EPD External verification <input type="checkbox"/> EPD Process certification
Third party verifier	Rubén Carnerero Acosta
Third party verifier accredited or approved by	The International EPD® System
Reference Product Category Rules (PCR)	Man-made fibres-synthetic. 2013:03 Version 1.1.
PCR review conducted by	The Technical Committee of the International EPD® System Contact via: info@environdec.com
PCR prepared by	PCR Moderator: Paolo Simon Ostan - QUOTA SETTE Contact via: paolo.simon.ostan@quotasette.it

5. DIFFERENCES BETWEEN THIS EPD AND THE PREVIOUS VERSIONS

NUREL drafted a first version of this EPD in December 2013, which remains valid through to December 2016. Said EPD was prepared with 2011 data given that 2012 was not a representative year from the point of view of production.

From the first version of this EPD to this current one there have been significant changes, not related to NUREL's manufacturing process, which has remained unchanged, that may affect the results obtained. These important changes are as follows:

For the EPD drafted in 2013, the Ecoinvent 2.2 database was used which was the most up to date one at that time. In the EPD drafted in 2016, **the Ecoinvent 3.2 database was used and involved significant methodological changes in the creation of processes, which, in many cases, have also been updated to 2015.**

The **caprolactam manufacturing process** is from the Gabi 6 Professional database. The caprolactam process used now was updated in 2015 and includes from cradle to gate. The details of this process have changed with respect to those used in the 2013 EPD.

The 2015 **national electricity mix** has a different composition to that of 2011 (used in the EPD drafted in 2013). A comparison of the environmental impact assessment of both processes (carried out with CML-IA baseline V3.03 / EU25 methodology), shows that the environmental burden of both processes is very similar.

The most substantial change in NUREL's manufacturing process in 2015 with respect to 2011 is that recovered lactam has not been used in polymerization phase 2. With the use of a larger amount of new lactam a slight increase is observed in consumptions of materials and energy, as well as in some of the environmental impact categories. Although recovered lactam is not used in the manufacture of the yarns that are the subject matter of this EPD, it is used in factory processes in which the quality requirements are different. Furthermore, all remains from spinning and drawing that are not used in manufacture are reintroduced in other factory processes or they are used in manufacturing processes that are external to NUREL.

In relation to the results obtained, there are slight changes between the 2013 and 2016 versions. In general terms, the following trends are observed:

In the upstream phase, there is an increase in both renewable and non-renewable energy consumption. This is because only new lactam has been used in the manufacture of the yarns (because of quality requirements); recovered lactam has not been used so that there is an increase in the amounts used of this raw material, which is not produced by NUREL.

In the main process, there is a reduction in consumption of energy resources as a whole; with a slight increase in consumption of renewable energies and a decrease in consumption of non-renewable energies.

In the downstream phase, no significant changes in the consumption of renewable and non-renewable energy resources are observed.

A slight decrease in **electricity consumption** is observed along with a slight decrease in the percentage of non-renewable energies.

There is a decrease in water consumption in the main process, but it remains the same in the downstream phase. In the upstream phase, water consumption increases, which is again because only new lactam is used in the manufacture of the yarns.

In the five categories of **potential environmental impacts** studied, there are no significant changes in any of the three phases, with a exception of a slight increase in GGE (Greenhouse Gas Emissions) in the upstream phase due to only new lactam being used for the manufacture of the yarns, whilst there is a slight decrease in the main process , which is carried out at NUREL.

There are no significant changes in the **generation of hazardous and non-hazardous waste** in the main process.

There is a decrease in **emissions of NOx** in the main process and in the downstream phase, increasing slightly in the upstream phase due to only new lactam being used for the manufacture of the yarns.

There is a slight decrease in the **production of co-products**.

The already slight difference between the two yarns in terms of **consumption of resources** and **environmental impacts**, has been attenuated.

In general, **the environmental performance of the yarns is similar to that described in the 2013 EPD.**

6. REFERENCES

PCR reference document: UN CC 355. Man-made fibres-synthetic. 2013:03 Version 1.1.

For production of polymers the PCR Plastics in primary forms (UN CPC 347), 2010:16, VERSION 2.11. was used as the reference document.

ENVIRONDEC EPD General Programme Instructions.

Ecoinvent 3.2.

PlasticsEurope databases.

Environmental impact assessment methodology in a LCA of: CML-IA baseline V3.03 / EU25; y CML-IA non-baseline V3.02 / EU25.

IPCC 2013 methodology for Global Warming Potential (GWP) factors.

SimaPro 8.2.0 .0 and Gabi 6 databases and environmental impact methodologies.

7. VALIDITY OF THIS EPD

During the period of validity of the EPD the following indicators are used in the monitoring phase to verify that there are no substantial changes, which would make a review of the EPD necessary.

- Caprolactam consumption per kg of yarn.
- Electricity consumption per kg of yarn.

This EPD will be reviewed if there is a $\pm 10\%$ variation in these indicators or if primary data on caprolactam production become available. In any event, this EPD will be reviewed every three years.

8. ADDITIONAL INFORMATION

By way of additional information on the environmental performance of the product, the results obtained for yarns 33/28/UM and 44/28/UM, applying the ILCD 2011 Midpoint+ V1.08 / EU27 2010 equal weighting methodology, are shown below.

The results are presented according to:

- Each type of yarn.
- Life cycle phases: Upstream, Main process and Downstream.
- Characterisation in the Life Cycle Analysis phase.

All of the results refer to the declared unit, which is 1 kg of yarn. The values are shown for the 16 environmental impact categories considered in the methodology applied.

8.1. 33/28/UM Yarn – Upstream phase

8.1.1. Characterisation

Impact category	Unit	Total	33/28/ UM AR Yarn	Polyamide chips. Polymerization II 33/28/UM AR Yarn	Transport of Poly II additi- ves for 33/28/ UM AR Yarn
Climate change	kg CO2 eq	10,6194763	0	10,61860843	0,000867872
Ozone depletion	kg CFC-11 eq	4,04259E-08	0	4,02652E-08	1,60665E-10
Human toxicity, non-cancer effects	CTUh	2,5006E-07	0	2,49916E-07	1,43734E-10
Human toxicity, cancer effects	CTUh	9,29769E-09	0	9,2971E-09	5,90381E-13
Particulate matter	kg PM2.5 eq	0,000735417	0	0,000735052	3,65711E-07
Ionizing radiation HH	kBq U235 eq	0,151692767	0	0,151637024	5,57428E-05
Ionizing radiation E (interim)	CTUe	1,24105E-06	0	1,24066E-06	3,95843E-10
Photochemical ozone formation	kg NMVOC eq	0,011677229	0	0,011673191	4,03789E-06
Acidification	molc H+ eq	0,016911955	0	0,016908035	3,92005E-06
Terrestrial eutrophication	molc N eq	0,036462331	0	0,036446714	1,56173E-05
Freshwater eutrophication	kg P eq	2,07243E-05	0	2,0723E-05	1,25067E-09
Marine eutrophication	kg N eq	0,003298822	0	0,003297398	1,42487E-06
Freshwater ecotoxicity	CTUe	0,941340397	0	0,938392148	0,002948249
Land use	kg C deficit	-198,7227565	0	-198,7227656	9,13338E-06
Water resource depletion	m3 water eq	3,727608118	0	3,727607877	2,40999E-07
Mineral, fossil & ren resource depletion	kg Sb eq	1,9295E-05	0	1,92945E-05	4,70924E-10

8.2. 44/28/UM Yarn – Upstream phase

8.2.1. Characterisation

Impact category	Unit	Total	44/28/ UM AR Yarn	Polyamide chips Polymerization II 44/28/UM AR Yarn	Transport of Poly II additives for 44/28/UM AR Yarn
Climate change	kg CO2 eq	10,65604327	0	10,65517318	0,000870098
Ozone depletion	kg CFC-11 eq	4,05647E-08	0	4,04036E-08	1,61077E-10
Human toxicity, non-cancer effects	CTUh	2,50921E-07	0	2,50777E-07	1,44102E-10
Human toxicity, cancer effects	CTUh	9,32937E-09	0	9,32878E-09	5,91895E-13
Particulate matter	kg PM2.5 eq	0,000737948	0	0,000737582	3,66649E-07
Ionizing radiation HH	kBq U235 eq	0,152214845	0	0,152158959	5,58858E-05
Ionizing radiation E (interim)	CTUe	1,24533E-06	0	1,24493E-06	3,96859E-10
Photochemical ozone formation	kg NMVOC eq	0,011717432	0	0,011713383	4,04825E-06
Acidification	molc H+ eq	0,016970165	0	0,016966235	3,9301E-06
Terrestrial eutrophication	molc N eq	0,036587857	0	0,036572199	1,56574E-05
Freshwater eutrophication	kg P eq	2,07956E-05	0	2,07943E-05	1,25388E-09
Marine eutrophication	kg N eq	0,003310179	0	0,003308751	1,42853E-06
Freshwater ecotoxicity	CTUe	0,94456903	0	0,941613217	0,002955813
Land use	kg C deficit	-199,4070886	0	-199,4070977	9,15681E-06
Water resource depletion	m3 water eq	3,740444632	0	3,74044439	2,41617E-07
Mineral, fossil & ren resource depletion	kg Sb eq	1,93607E-05	0	1,93602E-05	4,72133E-10

8.3. 33/28/UM Yarn - Main process

8.3.1. Characterisation

Impact category	Unit	Total	33/28/ UM Yarn spinning	Transp. of mat., Gen. Serv., Auxill. Serv., Treatment plant, waste	33/28/UM EU PP Yarn warping	General services PP	33/28/ UM COPS PP Yarn drawing
Climate change	kg CO2 eq	1,759635	0,783566	3,67E-05	0,939247	0,022257	0,014529
Ozone depletion	kg CFC-11 eq	2,04E-07	9,14E-08	6,79E-12	1,09E-07	2,63E-09	1,68E-09
Human toxicity, non-cancer effects	CTUh	4,41E-08	-8,4E-09	6,07E-12	5,05E-08	1,15E-09	7,82E-10
Human toxicity, cancer effects	CTUh	1,15E-09	3,09E-10	2,49E-14	8,14E-10	1,14E-11	1,26E-11
Particulate matter	kg PM2.5 eq	0,000861	0,000377	1,54E-08	0,000467	9,66E-06	7,23E-06
Ionizing radiation HH	kBq U235 eq	0,20585	0,039797	2,35E-06	0,159639	0,003942	0,00247
Ionizing radiation E (interim)	CTUe	1,03E-06	-2,3E-07	1,67E-11	1,21E-06	3E-08	1,88E-08
Photochemical ozone formation	kg NMVOC eq	0,005795	0,002567	1,71E-07	0,003114	6,57E-05	4,82E-05
Acidification	molc H+ eq	0,015409	0,006807	1,66E-07	0,008281	0,000192	0,000128
Terrestrial eutrophication	molc N eq	0,021026	0,009297	6,6E-07	0,011298	0,000256	0,000175
Freshwater eutrophication	kg P eq	5,28E-05	2,1E-05	5,28E-11	3,05E-05	7,47E-07	4,72E-07
Marine eutrophication	kg N eq	0,001911	0,000845	6,02E-08	0,001025	2,52E-05	1,59E-05
Freshwater ecotoxicity	CTUe	0,161076	0,044542	0,000125	0,112064	0,002611	0,001734
Land use	kg C deficit	0,651412	0,24847	3,86E-07	0,388115	0,008821	0,006005
Water resource depletion	m3 water eq	0,033852	0,00978	1,02E-08	0,00576	0,018235	7,74E-05
Mineral, fossil & ren resource depletion	kg Sb eq	-0,00062	-0,00063	1,99E-11	1,08E-05	2,62E-07	1,68E-07

8.4. 44/28/UM Yarn - Main process

The results obtained for 44/28/UM yarn in the main process are similar to those of 33/28/UM yarn.

8.4.1. Characterisation

Impact category	Unit	Total	44/28/ UM Yarn spinning	Transp. of mat., Gen. Serv., Auxill. Serv. Treatment plant, waste	44/28/UM PP Yarn warping	General services PP
Climate change	kg CO2 eq	1,752064	0,78492	3,67E-05	0,94485	0,022257
Ozone depletion	kg CFC-11 eq	2,03E-07	9,15E-08	6,79E-12	1,09E-07	2,63E-09
Human toxicity, non-cancer effects	CTUh	4,36E-08	-8,4E-09	6,07E-12	5,08E-08	1,15E-09
Human toxicity, cancer effects	CTUh	1,14E-09	3,1E-10	2,49E-14	8,18E-10	1,14E-11
Particulate matter	kg PM2.5 eq	0,000857	0,000378	1,54E-08	0,00047	9,66E-06
Ionizing radiation HH	kBq U235 eq	0,204402	0,039866	2,35E-06	0,160591	0,003942
Ionizing radiation E (interim)	CTUe	1,02E-06	-2,3E-07	1,67E-11	1,22E-06	3E-08
Photochemical ozone formation	kg NMVOC eq	0,00577	0,002571	1,71E-07	0,003133	6,57E-05
Acidification	molc H+ eq	0,015342	0,006819	1,66E-07	0,008331	0,000192
Terrestrial eutrophication	molc N eq	0,020935	0,009313	6,6E-07	0,011365	0,000256
Freshwater eutrophication	kg P eq	5,25E-05	2,11E-05	5,28E-11	3,07E-05	7,47E-07
Marine eutrophication	kg N eq	0,001903	0,000847	6,02E-08	0,001031	2,52E-05
Freshwater ecotoxicity	CTUe	0,160132	0,044664	0,000125	0,112732	0,002611
Land use	kg C deficit	0,648147	0,248895	3,86E-07	0,390431	0,008821
Water resource depletion	m3 water eq	0,033826	0,009796	1,02E-08	0,005795	0,018235
Mineral, fossil & ren resource depletion	kg Sb eq	-0,00062	-0,00063	1,99E-11	1,09E-05	2,62E-07

8.5. 33/28/UM Yarn and 44/28/UM Yarn – Downstream phase

The downstream phase is identical for the 33/28/UM and 44/28/UM yarns, so that the data tables are only shown once.

8.5.1. Characterisation

Impact category	Unit	Total	Transport of 33/28/UM yarn to standard customers
Climate change	kg CO2 eq	0,070962	0,070962
Ozone depletion	kg CFC-11 eq	1,31E-08	1,31E-08
Human toxicity, non-cancer effects	CTUh	1,18E-08	1,18E-08
Human toxicity, cancer effects	CTUh	4,83E-11	4,83E-11
Particulate matter	kg PM2.5 eq	2,99E-05	2,99E-05
Ionizing radiation HH	kBq U235 eq	0,004558	0,004558
Ionizing radiation E (interim)	CTUe	3,24E-08	3,24E-08
Photochemical ozone formation	kg NMVOC eq	0,00033	0,00033
Acidification	molc H+ eq	0,000321	0,000321
Terrestrial eutrophication	molc N eq	0,001277	0,001277
Freshwater eutrophication	kg P eq	1,02E-07	1,02E-07
Marine eutrophication	kg N eq	0,000117	0,000117
Freshwater ecotoxicity	CTUe	0,241066	0,241066
Land use	kg C deficit	0,000747	0,000747
Water resource depletion	m3 water eq	1,97E-05	1,97E-05
Mineral, fossil & ren resource depletion	kg Sb eq	3,85E-08	3,85E-08

8.6. Complete 33/28/UM yarn

8.6.1. Characterisation

33/28/UM Yarn					
Impact category	Unit	Total	Upstream	Main process	Downstream
Climate change	kg CO2 eq	12,45007	10,61948	1,759635	0,070962
Ozone depletion	kg CFC-11 eq	2,58E-07	4,04E-08	2,04E-07	1,31E-08
Human toxicity, non-cancer effects	CTUh	3,06E-07	2,5E-07	4,41E-08	1,18E-08
Human toxicity, cancer effects	CTUh	1,05E-08	9,3E-09	1,15E-09	4,83E-11
Particulate matter	kg PM2.5 eq	0,001626	0,000735	0,000861	2,99E-05
Ionizing radiation HH	kBq U235 eq	0,362101	0,151693	0,20585	0,004558
Ionizing radiation E (interim)	CTUe	2,3E-06	1,24E-06	1,03E-06	3,24E-08
Photochemical ozone formation	kg NMVOC eq	0,017802	0,011677	0,005795	0,00033
Acidification	molc H+ eq	0,032641	0,016912	0,015409	0,000321
Terrestrial eutrophication	molc N eq	0,058766	0,036462	0,021026	0,001277
Freshwater eutrophication	kg P eq	7,36E-05	2,07E-05	5,28E-05	1,02E-07
Marine eutrophication	kg N eq	0,005326	0,003299	0,001911	0,000117
Freshwater ecotoxicity	CTUe	1,343482	0,94134	0,161076	0,241066
Land use	kg C deficit	-198,071	-198,723	0,651412	0,000747
Water resource depletion	m3 water eq	3,76148	3,727608	0,033852	1,97E-05
Mineral, fossil & ren resource depletion	kg Sb eq	-0,0006	1,93E-05	-0,00062	3,85E-08

8.7. Complete 44/28/UM yarn

The results obtained for complete 44/28/UM yarn are similar to those of 33/28/UM yarn.

8.7.1. Characterisation

44/28/UM Yarn					
Impact category	Unit	Total	Upstream	Main process	Downstream
Climate change	kg CO2 eq	12,47907	10,65604	1,752064	0,070962
Ozone depletion	kg CFC-11 eq	2,57E-07	4,06E-08	2,03E-07	1,31E-08
Human toxicity, non-cancer effects	CTUh	3,06E-07	2,51E-07	4,36E-08	1,18E-08
Human toxicity, cancer effects	CTUh	1,05E-08	9,33E-09	1,14E-09	4,83E-11
Particulate matter	kg PM2.5 eq	0,001625	0,000738	0,000857	2,99E-05
Ionizing radiation HH	kBq U235 eq	0,361174	0,152215	0,204402	0,004558
Ionizing radiation E (interim)	CTUe	2,29E-06	1,25E-06	1,02E-06	3,24E-08
Photochemical ozone formation	kg NMVOC eq	0,017817	0,011717	0,00577	0,00033
Acidification	molc H+ eq	0,032633	0,01697	0,015342	0,000321
Terrestrial eutrophication	molc N eq	0,0588	0,036588	0,020935	0,001277
Freshwater eutrophication	kg P eq	7,34E-05	2,08E-05	5,25E-05	1,02E-07
Marine eutrophication	kg N eq	0,00533	0,00331	0,001903	0,000117
Freshwater ecotoxicity	CTUe	1,345768	0,944569	0,160132	0,241066
Land use	kg C deficit	-198,758	-199,407	0,648147	0,000747
Water resource depletion	m3 water eq	3,77429	3,740445	0,033826	1,97E-05
Mineral, fossil & ren resource depletion	kg Sb eq	-0,0006	1,94E-05	-0,00062	3,85E-08

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