



ENVIRONMENTAL PRODUCT DECLARATION

RADIFLOOR® (PA6 and PA6.6) Bulk Continuous Filament (BCF) and Refined Yarns in Raw White and Solution-Dyed Variants

Declaration Holder: RADICIFIL S.p.A.
EPD registration number: No. S-P-00454
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Programme: The International EPD® System, www.environdec.com
Programme operator: EPD International AB

An EPD should provide current information and may be updated if conditions change.
The stated validity is therefore subject to the continued registration and publication at www.environdec.com
Document compliant with ISO 14025 and EN 15804:2012+A2:2019

1 | Company related information

RADICIGROUP - RADICIFIL

With production and sales sites in Europe, North America, South America and Asia, RadiciGroup is one of the most active Italian chemicals groups at an international level. The Group’s diversified industrial businesses focus on chemicals, plastics, synthetic fibres and nonwovens.

One of RadiciGroup’s key strengths is its vertically integrated polyamide production. The Group’s products – ranging from polymers to engineering plastics, synthetic fibres and nonwovens – are used in various industries such as apparel, furnishings, automotive, construction, household appliances and sport.

Within the synthetic fibres business area, RADICIFIL in Casnigo (Bergamo), Italy, and LOGIT, in the Czech Republic, manufacture polyamide 6 and 6.6 yarn used in textile flooring for residential, office, hotel, marine and automotive applications. The yarn is sold worldwide under the brand name Radifloor®.

INFORMATION ON ENVIRONMENTAL MANAGEMENT SYSTEM/ENVIRONMENTAL POLICY

In 2003 RadiciGroup started its journey towards sustainable development through its subsidiary Radici Chimica S.p.A., by adhering to the Responsible Care programme, a global voluntary initiative. The Group continued onward in 2004 by publishing its first corporate social report, in which the reporting scope was extended to include social responsibility aspects. In 2010 the RadiciGroup for Sustainability project kicked off with the objective of reporting on the environmental, economic and social aspects of sustainability in a unified report drawn up according to Global Reporting Initiative (GRI) guidelines.

The RadiciGroup Sustainability Report has been certified at the GRI B+ level since 2011:
<http://www.radicigroup.com/en/documentation/corporate/report>.

RADICIFIL and LOGIT, like all the other Group companies, are committed to accurate and rigorous reporting of not only environmental and economic performance indicators, but also the indicators related to product responsibility, human rights, labour practices and decent work, and stakeholder relations.

RADICIFIL and LOGIT are constantly looking for ways to improve the efficiency of their plants and reduce their energy consumption per ton of production.

RADICIFIL is working especially hard at reducing its environmental footprint by increasing the use of electric energy produced from renewable sources, such as hydroelectric power, and recycling the water used in its cooling systems. Decreasing the amount of water taken from the environment has benefited the local community where RADICIFIL is located, by increasing the availability of this precious resource.

Consistent with RadiciGroup’s path towards the integrated quality, environment and safety management system certification of all Group companies, RADICIFIL and LOGIT have undertaken their own certification process and have achieved the following objectives:

PRODUCTION SITE:	ISO 9001:2015	ISO 14001:2015	UNI ISO 45001:2018	ISO 50001:2018
RADICIFIL S.p.A.	●	●	●	●
LOGIT S.r.o.	●	●	●	●

● Certified – Not certified

2 | Product information

2.1 DECLARATION OF GENERAL INFORMATION

This environmental product declaration in accordance with ISO 14025 and EN 15804.

2.2 PUBLISHER

EPD International AB; Box 210 60, SE-100 31, Stockholm Sweden; www.environdec.com; info@environdec.com

2.3 OWNER OF THE DECLARATION

RADICIFIL S.p.A., Via Europa, 41, 24020 Casnigo (BG) Italy; flooring@radicigroup.com
The EPD owner has the sole ownership, liability and responsibility for the EPD.

2.4 GEOGRAPHICAL SCOPE OF THE EPD

Europe.

2.5 PRODUCTION SITES INCLUDED IN EPD

RADICIFIL S.p.A.	LOGIT S.r.o.
Via Europa, 41	Hlubany, 119
Italy	Czech Republic
I-24020 Casnigo (BG)	CZ-44101 Podborany

3 | Specification of products

BCF (Bulk Continuous Filament) yarn sold under the Radifloor® brand name is a bulky yarn made with polyamide 6 or polyamide 6.6 and manufactured by RADICIFIL S.p.A.

Refined BCF Radifloor® yarn is BCF yarn that has been reprocessed using various techniques in order to meet the wide spectrum of characteristics the yarn must possess for textile flooring. The yarn may be air-jet entangled at the RADICIFIL site or sent to LOGIT for single-head or multi-head twisting. Upon request, yarn with antistatic properties or heat-set yarn can be added.

Radifloor® BCF yarn is classified according to the UN CPC scheme as follows: single, entangled, heat-set or single-head twisted in Group 355, Class 3552; multiple-head twisted in Group 264, Class 2642.

PARAMETER	RADIFLOOR® BCF YARN	RADIFLOOR® REFINED YARN	TESTING METHOD
Count (dtex)	700 - 2600	1400 - 10000	ISO 2060:1994
Elongation at break (%)	≥25		ISO 2062:2009
Tenacity (cN/dtex)	≥1.8		ISO 2062:2009
Crimp (%)	8 ÷ 25		ASTM D6774
Colour	Raw white/spun-dyed	Raw white/spun-dyed	
Texturing	Textured/non-textured	Textured/non-textured	
Torsion		Without/with torsion	

RADIFLOOR®

Radifloor® BCF yarns are sold by RADICIFIL S.p.A. for further processing, such as weaving or tufting of carpets and tiles, which are then used to cover areas with pedestrian traffic. The BCF Radifloor® yarn range is very extensive. The yarns are grouped by their intended use into families, as follows:

- **Radifloor® Automotive** - polyamide 6 solution-dyed BCF yarn for the manufacture of automotive carpet; available in different counts.
- **Radifloor® Solid** - polyamide 6 solution-dyed BCF yarn mainly for contract carpet applications; available in different counts.
- **Radifloor® Residential** - raw white polyamide 6 or polyamide 6.6 BCF yarn for household carpet and rugs; available in a wide range of combinations and processing techniques.
- **Radifloor® Contract** - raw white polyamide 6 or polyamide 6.6 BCF yarn for contract carpet applications; available in a wide range of combinations and processing techniques.

3.1 CONTENT OF MATERIALS AND CHEMICAL SUBSTANCES

Radifloor® BCF yarn is made of polyamide 6 or 6.6 and contains an average of 1% spin finish. Yarn may also contain colour or titanium dioxide pigments and UV stabilizers.

RADIFLOOR® PA6 BCF	
Main component	Radipol® S100-004 polymer >98%
Chemical name	Polycaprolactam
Synonyms	Polyamide 6 - Nylon 6
Chemical formula	$[\text{NH}-(\text{CH}_2)_5-\text{CO}]_n$
CAS Number	25038 54-4
Masterbatch dye, delustering agent, pigment/additives	Active substance <1%
Lubricant oil	Lubricant, antistatic <1%
Packaging	4-5%

RADIFLOOR® PA6.6 BCF	
Main component	Radipol® A PA6.6 polymer >98%
Chemical name	Polyhexamethylene adipamide
Synonyms	Polyamide 6.6 - Nylon 6.6
Chemical formula	$[\text{NH}-(\text{CH}_2)_6-\text{NHCO}-(\text{CH}_2)_6-]_n$
CAS Number	32131-17-2
Masterbatch dye, delustering agent, pigment/additives	Active substance <1%
Lubricant oil	Lubricant, antistatic <1%
Packaging	4-5%

Radifloor® polyamide 6 and 6.6 yarns are not classified as hazardous or dangerous for the environment in accordance with Directives 67/548/EEC and 1999/45/EC. They are not substances included in the Authorisation List (Attachment XIV) or the Candidate List of Substances of Very High Concern for Authorisation issued by the European Chemicals Agency, nor do they contain such substances. Under normal storage and use conditions, these yarns can be handled with no particular precautions or special protective equipment.

Primary packaging material was considered, in particular paper tubes for spinning, heat set and air entangling. Secondary packaging materials was considered, in particular paper boxes & separators, wooden pallets, plastic bags and extensible film.

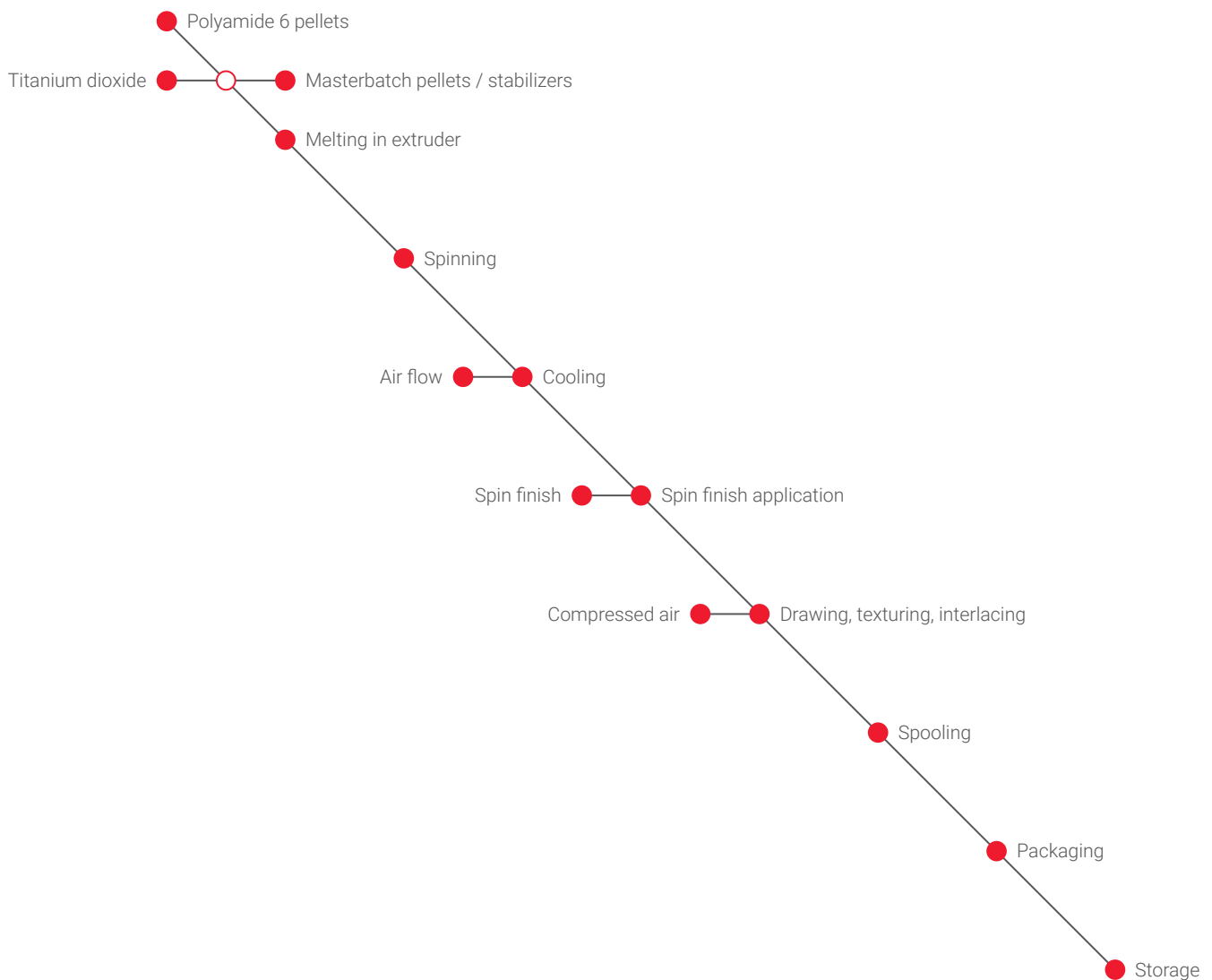
4 | Production processes

Radifloor® BCF yarn is manufactured by RADICIFIL S.p.A. using self-produced polyamide 6 or polyamide 6.6 produced by Radici Chimica S.p.A., another RadiciGroup company. During polymer extrusion, masterbatch colour pigment, titanium dioxide or UV stabilizers can be added. Radifloor® BCF yarn is wound on cardboard bobbins and can undergo other processing depending on customer specifications:

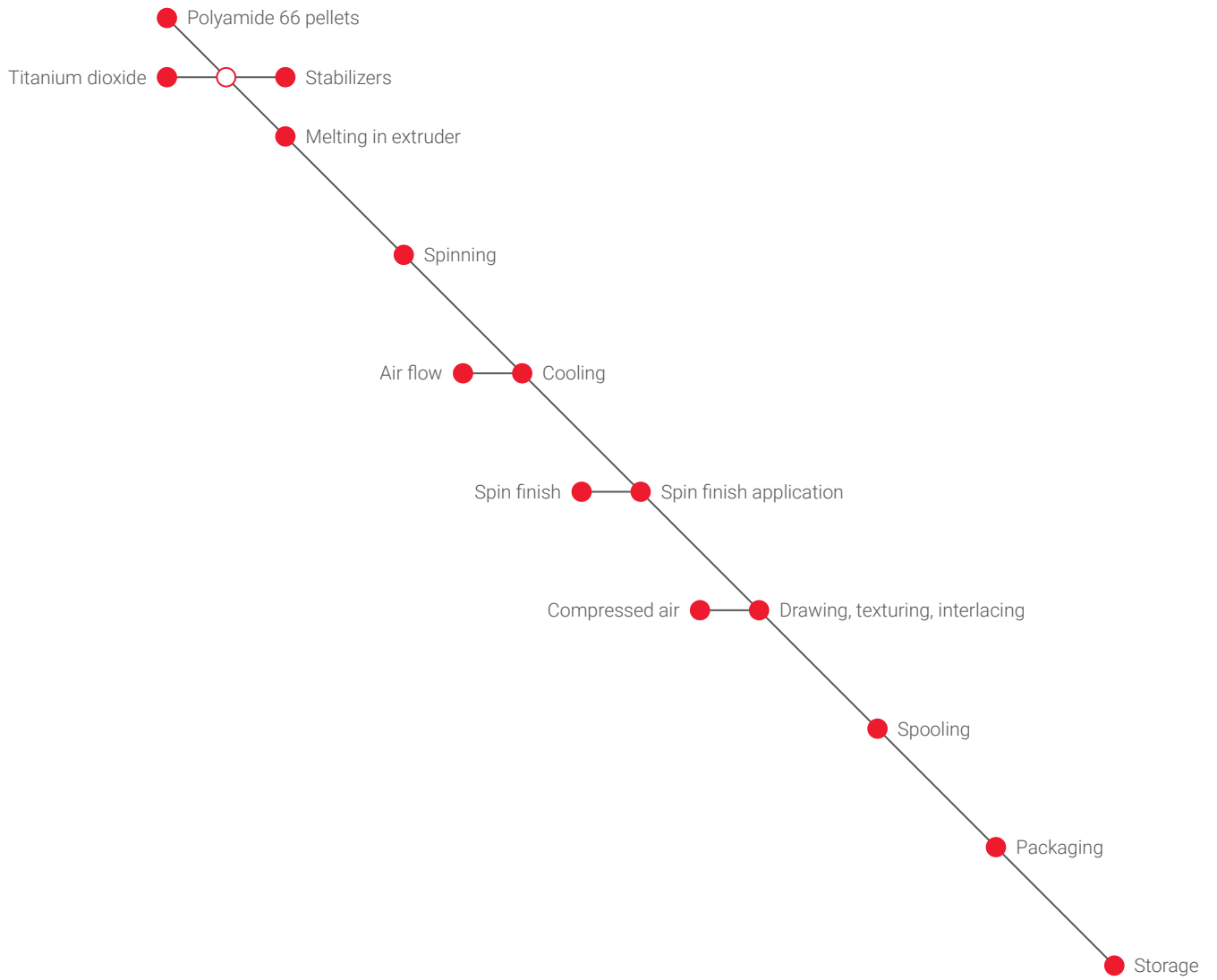
- Air-jet entangling of two or more yarns.
- Multiple-head twisting of BCF yarn with the option to insert antistatic yarn.
- Heat setting with steam.

The first type of finishing is done at RADICIFIL S.p.A., while the second and third ones are performed at LOGIT S.r.o.

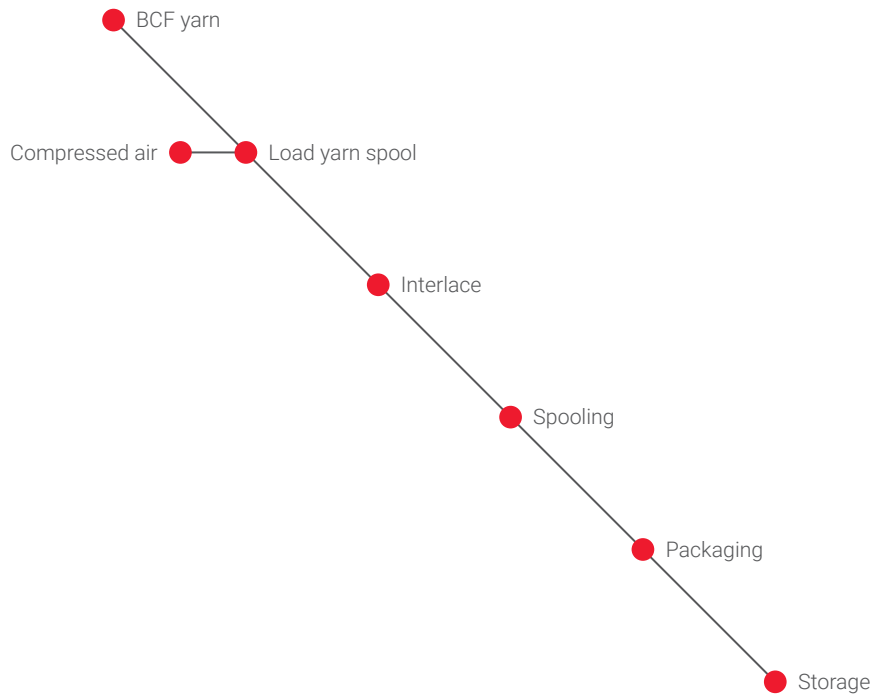
4.1 PA6 BCF SPINNING PROCESS



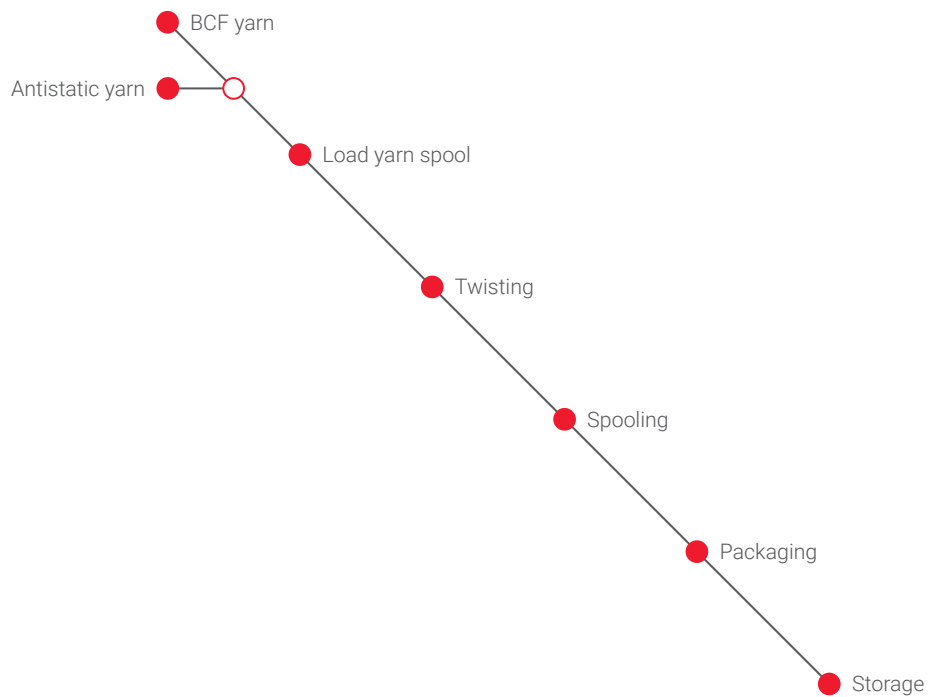
4.2 PA6.6 BCF SPINNING PROCESS



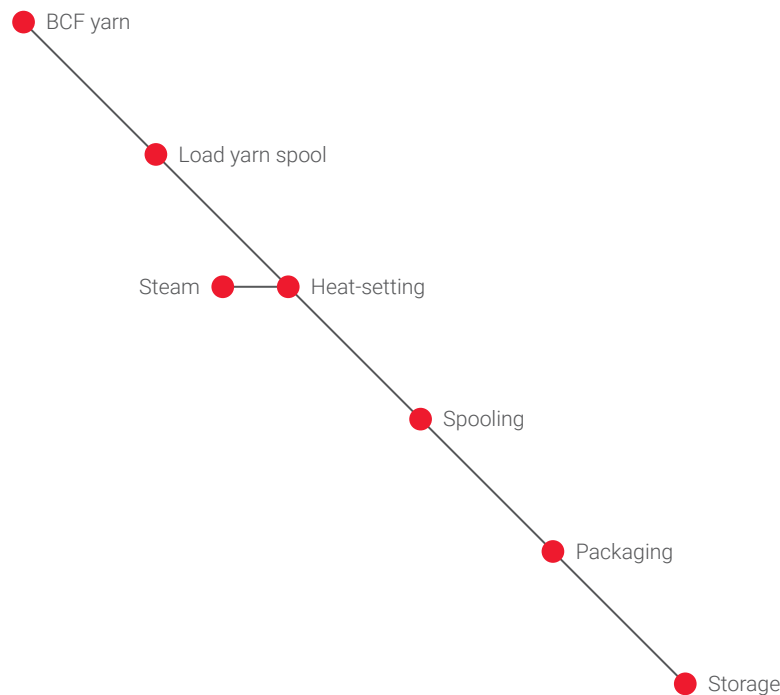
4.3 PA6 & PA6.6 BCF AIR ENTANGLING PROCESS



4.4 PA6 & PA6.6 BCF TWISTING PROCESS



4.5 PA6 & PA6.6 BCF HEAT - SETTING PROCESS



4.6 RELEASE OF DANGEROUS SUBSTANCES DURING USE

Radifloor® yarn is compliant with the voluntary Oeko-Tex® Standard 100 Class IV for decorative items and meets currently applicable human ecological requirements. Furthermore, certified Radifloor® yarn meets the requirements set forth in REACH Annex XVII (including the use of azo dyes, nickel, etc.) and complies with US legislation concerning the total lead content in children's products.

Regarding the fire behaviour of textile flooring, European Standard EN 13501-1, which governs the classification of the fire behaviour of products and construction elements, does not directly apply to yarn, as such, but to textile flooring, whose reaction to fire may depend on the type of construction and the composition of the carpet backing. Thus Radifloor® polyamide 6 and 6.6 yarns are considered low fire risk materials.

4.7 USE AND DISPOSAL

Radifloor® polyamide 6 and 6.6 yarns used to manufacture rugs and wall-to-wall carpet for interior decoration improve the acoustic and thermal insulation of the rooms where they are installed; they also improve the look and comfort of the space. Studies have proven that, if properly maintained, textile flooring can reduce the dispersion of fine dust particles in closed spaces.

Recovering Radifloor® polyamide 6 and 6.6 yarns is not always feasible. It depends on the type of textile flooring construction in which the yarn is incorporated. Extracting the yarn for reuse is not an easy task, but in those cases when it is possible (by mechanically cutting the yarn off the carpet surface), the yarn can then be recycled.

The high calorific value of the polyamide (about 30 MJ/kg) makes energy recovery through combustion plants viable.

5 | LCA information

Product environmental performance was assessed using the Life Cycle Assessment (LCA) method, in accordance with the EN ISO 14044:2021 standard, and the Life Cycle Impact assessment (LCIA) method, in accordance with CEN standard EN 15804, served as the core PCR.

The study was conducted in keeping with Product Category Rules (PCRs) approved by the Technical Committee of the International EPD System, PCR: CONSTRUCTION PRODUCTS AND CONSTRUCTION SERVICES 2019:14 Version 1.1.

5.1 FUNCTIONAL OR DECLARED UNIT

Radifloor® yarn is supplied on bobbins with weights that vary from 0.1 to 6.0 kg depending on customer specifications. The declared/functional unit is 1 kg of BCF yarn.

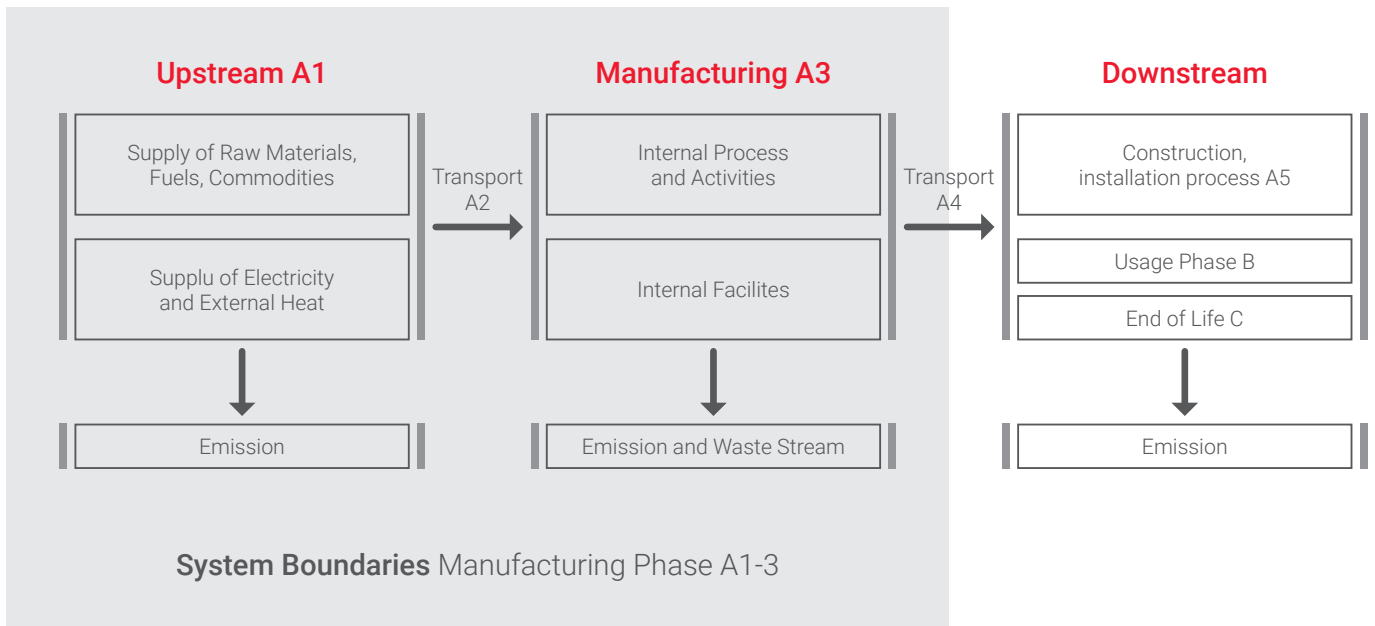
5.2 GENERAL SYSTEM BOUNDARIES

Type of EPD: cradle to factory gate. Modules A1-A3 (Manufacturing Phase) have been considered, including 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. The product life cycle starts with the production and processing of the raw materials needed for manufacturing (Upstream: Raw Materials Supply A1) and their transport to the factory gate of RADICIFIL S.p.A. (Core: Transport A2). The polyamide 6, in particular, is produced by RADICIFIL S.p.A. All the company’s internal processes and activities that contribute to the manufacture of the products covered by this EPD have been considered, including all the upstream processes related to energy and utilities (Core: Manufacturing A3). We point out that, due to the modular nature of the system, in order to include phases A4 and A5 (Construction process), an additional study of the weaving or tufting processes related to the construction of textile floorings, carpets and tiles would need to be carried out, as has been done for phase A3. Thus, manufacturing activities include the transport of the BCF yarn to the LOGIT S.r.o. plant, where the finishing processes are performed (these processes were modelled and included in the calculations), as well as the air-entangling process that take place at RADICIFIL S.p.A. All output flows (direct and indirect emissions) and waste disposal were taken into account, as shown in the following chart. The EPD is cradle to gate (A1-A3) because the following three condition are valid: the products are physically integrated with other products during installation so they cannot be physically separated from them at end of life, and the products are no longer identifiable at end of life as a result of a physical or chemical transformation process, the products do not contain biogenic carbon and the EPD shall not be used for business-to-consumer communication.¹

INFORMATION RELATED TO THE SYSTEM BOUNDARIES APPLIED IN THE STUDY								
	Upstream	Core		Downstream				Benefits and Loads Beyond the System Boundaries
	(A1-A3) Manufacturing Phase							
	Raw Material Supply	Transport	Manufacturing	Transport	Construction/ Installation	Usage stage	End-of-life stage	Resource recovery stage
Module	A1	A2	A3	A4	A5	B	C	D
Modules declared	●	●	●	ND	ND	ND	ND	ND
Geography	EU 27	EU 27	IT/CZ					
Specific data	>90%							
Variation - products	<10%							
Variation - sites	not relevant							

● Included in LCA ND Not declared

¹ The first three criteria are adapted from EN 15804, and the fourth criteria is adapted from ISO 14025. (GENERAL PROGRAMME INSTRUCTIONS FOR THE INTERNATIONAL EPD® SYSTEM VERSION 4.0 - 2021-03-29)



5.3 REFERENCE SERVICE LIFE

This EPD does not indicate Reference Service Life (RSL).

5.4 ESTIMATES AND ASSUMPTIONS

In accordance with the product category rules (PCRs), in view of the fact that LCA data for many pigments commonly used in dyeing processes are not available, the equivalent amounts of TiO₂ and soot were used as a substitute for inorganic pigments and organic pigments, respectively.

5.5 CUT-OFF CRITERIA

All the data collected during the study period were used for calculations irrespectively of their mass percentage contribution. Only processes with a mass percentage contribution less than 0.1% may have been omitted (polymerization additives and consumption of raw materials and energy for ordinary and extraordinary maintenance operations). Thus, we can assume that, for any impact category analyzed, the percentage of the total environmental impact that might have been omitted did not exceed 1%.

5.6 BACKGROUND DATA

All the background data used in this EPD were retrieved from the Ecoinvent 3.6 databank. For inventory modelling, SimaPro 9.1.1 software was used.

5.7 DATA QUALITY

Data collection included the analysis of internal production and environmental data from the RADICIFIL S.p.A. and LOGIT S.r.o. production sites, the acquisition of relevant data for all the production processes included in the LCA and the disclosure of information on the sources of energy used. Concerning the background data used, the geographical reference was Italy, or, to the greatest extent, Central Europe, while the time period spanned the last 10 years.

In order to achieve precision, consistency and representativeness and to ensure reliable results, primary industry data were used. Data quality was assessed taking into account the technological, geographical and time-related representativeness. The analysis validated that the inventory is very good.

5.8 REFERENCE TIME PERIOD FOR DATA COLLECTION

The reference time period for all the LCA data gathered by the companies engaged in the study was the year 2020.

5.9 ALLOCATION

All direct and indirect energy (heat and electric) consumption was included in the analysis.

The following procedure was adopted to handle avoided products. A preliminary mass-based allocation of the environmental impact associated with the yarn rejects from the yarn production process was used to distribute material and energy flows to the corresponding process unit. Then a cost-based substitution of the impact associated with the yarn rejects was performed taking into account the reduced value of recycled rejects compared to first-choice polymer. The correction factor applied was estimated by comparing the prices of these two products during the reference year of the study, calculated as the cost to quantity ratio of the first-choice polymer purchased by the company and the corresponding ratio for the yarn rejects. The impact associated with yarn reject production and estimated using the above procedure was taken into account in the polymer manufacturing phase, modules A1-A3.

5.10 COMPARABILITY

For all the products included in the study, all the LCA data and results were collected and obtained based on the EN 15804 standard, in the context of their final use in the carpet manufacturing system. Thus, the environmental impacts associated with the products in question are comparable with the environmental impacts of other similar products calculated according to the same EN 15804 standard. Environmental product declarations within the same product category from different programs may not be comparable.

EPD of construction products may not be comparable if they do not comply with EN 15804.

6 | Environmental profiles

Below are reported the environmental profiles of the products covered by this EPD using the LCA method.

- BCF yarn
- Refined yarn - Twisted and heat-set
- Refined yarn - Air-entangled

6.1 ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS

Information about additional environmental impact indicators for each module was calculated and reported in the LCA study.

Impact Category	Particulate Matter	Ionising radiation**	Ecotoxicity freshwater*	Cancer human health effects*	Non-cancer human health effects*	Land Use*
Unit	Disease incidence	kBq U235 eq	CTUe	CTUh	CTUh	Dimensionless

* The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

** This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

6.2 BCF YARN

RADIFLOOR® BCF YARN		(A1-3) MANUFACTURING PHASE			
PARAMETER	UNIT	BCF PA6 (1C) [1kg]	BCF PA6 (2E+2F) [1kg]	BCF PA6.6 (3C) [1kg]	
USE OF RESOURCES					
Primary energy resources - Renewable	Use as energy carrier	[MJ]	5,92E+00	6,72E+00	7,51E+00
	Used as raw materials	[MJ]	1,10E-02	1,08E-02	6,51E-02
	TOTAL	[MJ]	5,93E+00	6,73E+00	7,57E+00
Primary energy resources - Non-renewable	Use as energy carrier	[MJ]	1,12E+02	1,18E+02	1,36E+02
	Used as raw materials	[MJ]	4,24E+01	4,16E+01	3,77E+01
	TOTAL	[MJ]	1,55E+02	1,59E+02	1,74E+02
Use of secondary material (SM)		[kg]	0,00E+00	0,00E+00	0,00E+00
Use of renewable secondary fuels (RSF)		[MJ]	0,00E+00	0,00E+00	0,00E+00
Use of non renewable secondary fuels (NRSF)		[MJ]	0,00E+00	0,00E+00	0,00E+00
Use of net fresh water		[m³]	3,28E-01	3,52E-01	1,08E+00
ENVIRONMENTAL IMPACT CATEGORIES					
Global Warming Potential (GWP₁₀₀)	Fossil	[kg CO ₂ eq]	8,58E+00	8,87E+00	7,90E+00
	Biogenic	[kg CO ₂ eq]	7,53E-02	1,43E-01	9,56E-02
	Land use & transformation	[kg CO ₂ eq]	2,72E-03	2,44E-03	4,18E-03
	TOTAL	[kg CO₂ eq]	8,65E+00	9,02E+00	8,00E+00
GWP-GHG *		[kg CO ₂ eq]	8,58E+00	8,88E+00	7,90E+00
Ozone Depletion Potential (ODP)		[kg CFC-11 eq]	3,84E-07	4,37E-07	1,41E-06
Photochemical Oxidation Potential (POCP)		[kg NMVOC eq]	6,02E-02	6,06E-02	1,91E-02
Acidification Potential (AP)		[mol H ⁺ eq]	2,46E-02	2,61E-02	2,24E-02
Eutrophication Potential (EP) Freshwater		[kg PO ₄ ³⁻ eq]	5,68E-03	5,89E-03	5,87E-03
Eutrophication Potential Marine (EP-marine)		[kg N eq]	3,04E-02	3,04E-02	4,50E-03
Eutrophication Terrestrial		[mol N eq]	9,59E-02	9,76E-02	4,57E-02
ADPE **		[kg Sb eq]	9,11E-06	1,04E-05	3,30E-05
ADPF **		[MJ]	1,55E+02	1,59E+02	1,74E+02
Water Scarcity **		[m³ eq]	1,01E+01	1,03E+01	3,72E+01

* The indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. This indicator is thus equal to the GWP indicator originally defined in EN 15804:2012+A1:2013.

**The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

RADIFLOOR® BCF YARN		(A1-3) MANUFACTURING PHASE		
PARAMETER	UNIT	BCF PA6 (1C) [1kg]	BCF PA6 (2E+2F) [1kg]	BCF PA6.6 (3C) [1kg]
OUTPUT FLOWS AND WASTE CATEGORIES				
Hazardous waste disposal	[kg]	4,92E-03	4,88E-03	1,52E-04
Non-Hazardous waste disposal	[kg]	4,94E-02	4,90E-02	2,42E-03
Radioactive Waste Disposal (RWD) ***	[kg]	0,00E+00	0,00E+00	0,00E+00
Components for Re-Use (CRU)	[kg]	0,00E+00	0,00E+00	0,00E+00
Material For Recycling (MFR)	[kg]	7,39E-02	7,36E-02	3,58E-02
Material for Energy Recovery (MER)	[kg]	4,11E-03	4,08E-03	7,70E-04
Exported energy [electricity]	[MJ]	0,00E+00	0,00E+00	0,00E+00
Exported energy [thermal energy]	[MJ]	0,00E+00	0,00E+00	0,00E+00

*** A cut-off of 1% has been applied since Radioactive Waste Disposal (RWD) account less than 1% with reference to the overall waste flows, as illustrated in LCA study report. This component refers to nuclear energy in the energy mix.

YARN CODE	TYPE OF YARN
1C	BCF PA6 (1C) raw white yarn
2E+2F ****	BCF PA6 (2E) solution dyed yarn and BCF PA6 (2F) solution dyed yarn
3C	BCF PA6.6 raw white yarn

**** BCF PA6 (2E) and BCF PA6 (2F) are the same products but with different applications, thus are characterized by the same environmental impacts.

6.3 REFINED YARN - TWISTED AND HEAT-SET

RADIFLOOR® REFINED YARN - TWISTED AND HEAT SET		(A1-3) MANUFACTURING PHASE			
PARAMETER	UNIT	BCF PA6 (1C) T-HS [1kg]	BCF PA6 (2E+2F) T-HS [1kg]	BCF PA6.6 (3C) T-HS [1kg]	
USE OF RESOURCES					
Primary energy resources - Renewable	Use as energy carrier	[MJ]	7,62E+00	8,46E+00	9,29E+00
	Used as raw materials	[MJ]	1,15E-02	1,13E-02	6,82E-02
	TOTAL	[MJ]	7,63E+00	8,47E+00	9,35E+00
Primary energy resources - Non-renewable	Use as energy carrier	[MJ]	1,46E+02	1,51E+02	1,70E+02
	Used as raw materials	[MJ]	4,44E+01	4,35E+01	3,95E+01
	TOTAL	[MJ]	1,90E+02	1,95E+02	2,10E+02
Use of secondary material (SM)	[kg]	0,00E+00	0,00E+00	0,00E+00	
Use of renewable secondary fuels (RSF)	[MJ]	0,00E+00	0,00E+00	0,00E+00	
Use of non renewable secondary fuels (NRSF)	[MJ]	0,00E+00	0,00E+00	0,00E+00	
Use of net fresh water	[m³]	1,47E+00	1,50E+00	2,26E+00	
ENVIRONMENTAL IMPACT CATEGORIES					
Global Warming Potential (GWP₁₀₀)	Fossil	[kg CO ₂ eq]	1,12E+01	1,15E+01	1,04E+01
	Biogenic	[kg CO ₂ eq]	7,94E-02	1,51E-01	1,01E-01
	Land use & transformation	[kg CO ₂ eq]	5,20E-03	4,91E-03	6,72E-03
	TOTAL	[kg CO₂ eq]	1,12E+01	1,16E+01	1,06E+01
GWP-GHG *	[kg CO ₂ eq]	1,12E+01	1,15E+01	1,15E+01	
Ozone Depletion Potential (ODP)	[kg CFC-11 eq]	5,45E-07	6,01E-07	1,62E-06	
Photochemical Oxidation Potential (POCP)	[kg NMVOC eq]	6,57E-02	6,61E-02	2,27E-02	
Acidification Potential (AP)	[mol H ⁺ eq]	3,46E-02	3,61E-02	3,23E-02	
Eutrophication Potential (EP) Freshwater	[kg PO ₄ ³⁻ eq]	1,58E-02	1,60E-02	1,60E-02	
Eutrophication Potential Marine (EP-marine)	[kg N eq]	3,29E-02	3,29E-02	5,76E-03	
Eutrophication Terrestrial	[mol N eq]	1,15E-01	1,17E-01	6,28E-02	
ADPE **	[kg Sb eq]	2,69E-05	2,82E-05	5,19E-05	
ADPF **	[MJ]	1,90E+02	1,95E+02	2,10E+02	
Water Scarcity **	[m³ eq]	1,06E+01	1,08E+01	3,90E+01	

* The indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. This indicator is thus equal to the GWP indicator originally defined in EN 15804:2012+A1:2013.

**The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

RADIFLOOR® REFINED YARN - TWISTED AND HEAT SET		(A1-3) MANUFACTURING PHASE		
PARAMETER	UNIT	BCF PA6 (1C) T-HS [1kg]	BCF PA6 (2E+2F) T-HS [1kg]	BCF PA6.6 (3C) T-HS [1kg]
OUTPUT FLOWS AND WASTE CATEGORIES				
Hazardous waste disposal	[kg]	8,97E-03	8,97E-03	4,15E-03
Non-Hazardous waste disposal	[kg]	7,25E-02	7,25E-02	2,36E-02
Radioactive Waste Disposal (RWD) ***	[kg]	0,00E+00	0,00E+00	0,00E+00
Components for Re-Use (CRU)	[kg]	4,32E-03	4,32E-03	4,32E-03
Material For Recycling (MFR)	[kg]	8,89E-02	8,89E-02	4,86E-02
Material for Energy Recovery (MER)	[kg]	1,05E-02	1,05E-02	6,96E-03
Exported energy [electricity]	[MJ]	0,00E+00	0,00E+00	0,00E+00
Exported energy [thermal energy]	[MJ]	0,00E+00	0,00E+00	0,00E+00

*** A cut-off of 1% has been applied since Radioactive Waste Disposal (RWD) account less than 1% with reference to the overall waste flows, as illustrated in LCA study report. This component refers to nuclear energy in the energy mix.

YARN CODE	TYPE OF YARN
1C T-HS	Heat-set BCF PA6 raw white yarn
2E+2F T-HS ****	Heat-set BCF PA6 solution-dyed yarn
3C T-HS	Heat-set BCF PA6.6 raw white yarn

**** BCF PA6 (2E) T-HS and BCF PA6 (2F) T-HS are the same products but with different applications, thus are characterized by the same environmental impacts.

6.4 REFINED YARN - AIR ENTANGLED

RADIFLOOR® REFINED YARN - AIR ENTANGLED			(A1-3) MANUFACTURING PHASE			
PARAMETER		UNIT	RY (1H) [1kg]	RY (2H) [1kg]	RY (3H) [1kg]	RY (5H) [1kg]
USE OF RESOURCES						
Primary energy resources - Renewable	Use as energy carrier	[MJ]	8,95E+00	9,75E+00	1,05E+01	1,04E+01
	Used as raw materials	[MJ]	1,10E-02	1,10E-02	6,51E-02	6,05E-03
	TOTAL	[MJ]	8,96E+00	9,76E+00	1,06E+01	1,04E+01
Primary energy resources - Non-renewable	Use as energy carrier	[MJ]	1,64E+02	1,25E+02	1,45E+02	1,20E+02
	Used as raw materials	[MJ]	1,10E-02	4,24E+01	3,77E+01	2,33E+01
	TOTAL	[MJ]	1,64E+02	1,68E+02	1,82E+02	1,43E+02
Use of secondary material (SM)		[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of renewable secondary fuels (RSF)		[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of non renewable secondary fuels (NRSF)		[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Use of net fresh water		[m³]	3,91E-01	4,15E-01	1,15E+00	4,85E-01
ENVIRONMENTAL IMPACT CATEGORIES						
Global Warming Potential (GWP₁₀₀)	Fossil	[kg CO ₂ eq]	9,18E+00	9,48E+00	8,50E+00	6,98E+00
	Biogenic	[kg CO ₂ eq]	1,14E-01	1,82E-01	1,34E-01	-6,33E-02
	Land use & transformation	[kg CO ₂ eq]	4,23E-03	3,95E-03	5,68E-03	5,62E-03
	TOTAL	[kg CO₂ eq]	9,30E+00	9,66E+00	8,64E+00	6,92E+00
GWP-GHG *		[kg CO ₂ eq]	9,18E+00	9,48E+00	8,51E+00	6,98E+00
Ozone Depletion Potential (ODP)		[kg CFC-11 eq]	4,76E-07	5,30E-07	1,50E-06	4,15E-07
Photochemical Oxidation Potential (POCP)		[kg NMVOC eq]	6,14E-02	6,18E-02	2,04E-02	3,98E-02
Acidification Potential (AP)		[mol H ⁺ eq]	2,68E-02	2,82E-02	2,46E-02	2,31E-02
Eutrophication Potential (EP) Freshwater		[kg PO ₄ ³⁻ -eq]	6,31E-03	6,51E-03	6,50E-03	6,03E-03
Eutrophication Potential Marine (EP-marine)		[kg N eq]	3,09E-02	3,09E-02	4,97E-03	1,87E-02
Eutrophication Terrestrial		[mol N eq]	1,01E-01	1,03E-01	5,09E-02	7,30E-02
ADPE **		[kg Sb eq]	1,15E-05	1,28E-05	3,54E-05	2,26E-05
ADPF **		[MJ]	1,64E+02	1,68E+02	1,82E+02	1,43E+02
Water Scarcity **		[m³ eq]	1,09E+01	1,10E+01	3,80E+01	1,15E+01

* The indicator includes all greenhouse gases included in GWP-total but excludes biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. This indicator is thus equal to the GWP indicator originally defined in EN 15804:2012+A1:2013.

**The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

RADIFLOOR® REFINED YARN - AIR ENTANGLED		(A1-3) MANUFACTURING PHASE			
PARAMETER	UNIT	RY (1H) [1kg]	RY (2H) [1kg]	RY (3H) [1kg]	RY (5H) [1kg]
OUTPUT FLOWS AND WASTE CATEGORIES					
Hazardous waste disposal	[kg]	5,27E-03	5,24E-03	5,07E-04	3,05E-03
Non-Hazardous waste disposal	[kg]	5,25E-02	5,22E-02	5,59E-03	3,03E-02
Radioactive Waste Disposal (RWD) ***	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Components for Re-Use (CRU)	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Material For Recycling (MFR)	[kg]	8,48E-02	8,45E-02	4,67E-02	5,15E-02
Material for Energy Recovery (MER)	[kg]	4,32E-03	4,30E-03	9,86E-04	2,47E-03
Exported energy [electricity]	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Exported energy [thermal energy]	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00

*** A cut-off of 1% has been applied since Radioactive Waste Disposal (RWD) account less than 1% with reference to the overall waste flows, as illustrated in LCA study report. This component refers to nuclear energy in the energy mix.

YARN CODE	TYPE OF YARN
RY (1H)	Air entangled BCF PA6 raw white yarn
RY (2H)	Air entangled BCF PA6 solution dyed yarn
RY (3H)	Air entangled BCF PA6.6 raw white yarn
RY (5H)	Air entangled BCF PA6/PP raw white yarns

7 | Interpretation of results

Life Cycle Impact Assessment (LCIA)

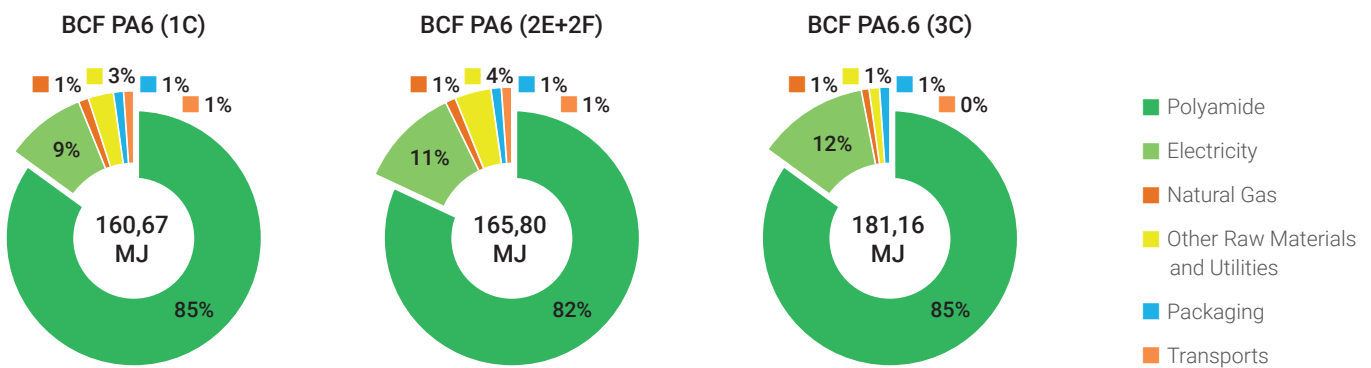
Two different types of products obtained as a result of two consecutive processes were analysed (BCF yarn served as the basis for both types of refined yarns).

7.1 INTERPRETATION OF RESULTS - BCF YARN

Use of resources

The major contributors to energy usage associated with the production of 1 kg of BCF yarn are the upstream polyamide production processes (about 82% to 85% of total consumption). Renewable primary energy makes up about 5% of the total energy used. The upstream processes, taking place before reaching the company gate, are also the major contributors to water consumption.

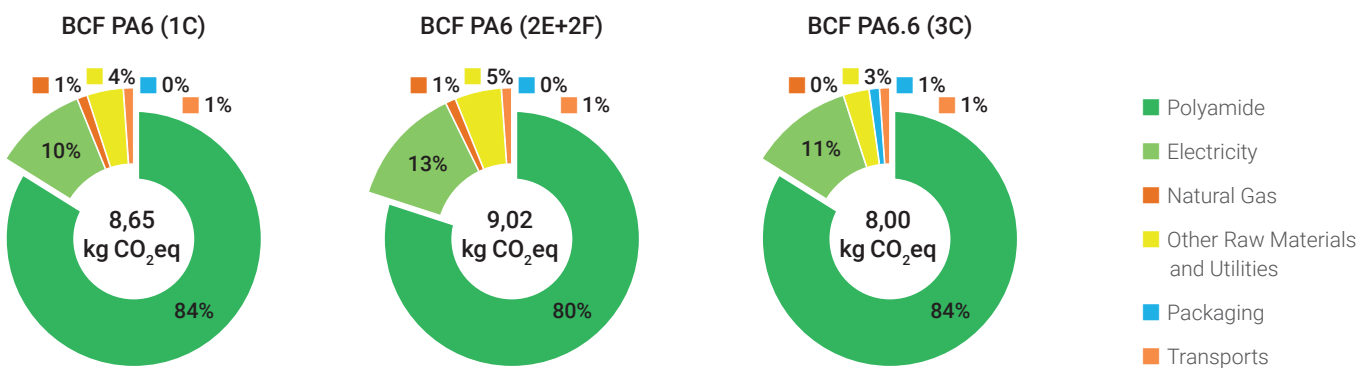
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Environmental impact

The major contributors to the environmental impact of BCF yarn are the processes associated with polyamide production, which account for over 80-84% of the total for all the parameters considered. ODP and ADPE are exceptions, in that the polyamide contribution to these two parameters is actually less. The remaining contribution to the environmental impact comes from the BCF yarn spinning processes and is mostly due to heat and electricity usage. It is worth noting that a considerable amount (about 46%) of the electricity used by the RADICIFIL S.p.A. plant in Casnigo is produced from renewable resources. Thus, the processes at RADICIFIL S.p.A. give a lower percentage contribution to the total environmental impact for the products included in the assessment.

GWP_{100a}



Output flows and waste

Non-hazardous waste makes up about 90% of the total amount of waste generated by the production processes at RADICIFIL S.p.A. The waste that is classified as subject to recycling and reuse comprises wooden pallets, which are used again as is in the production cycle.

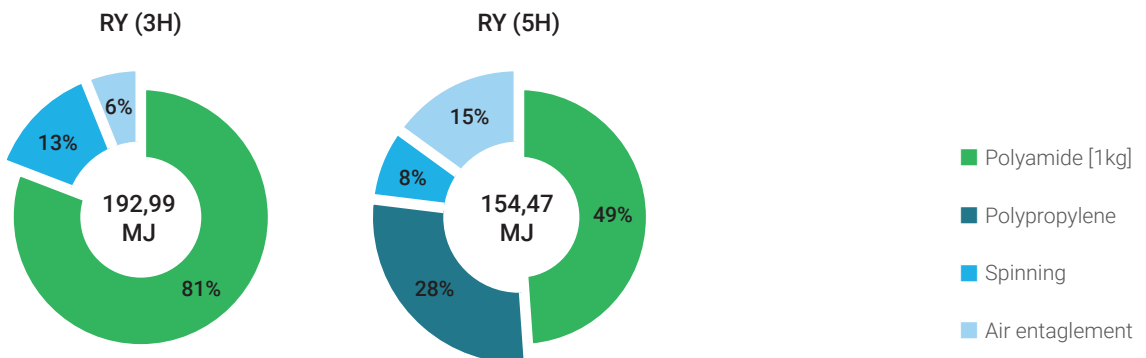
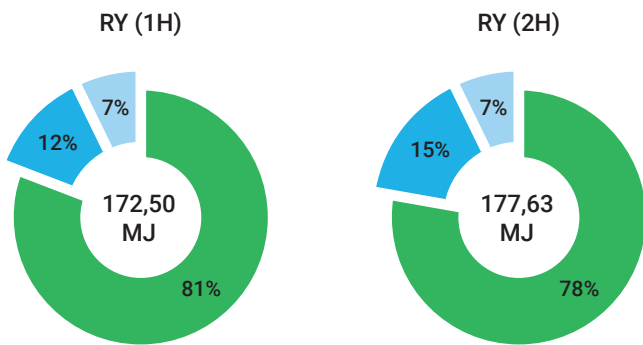
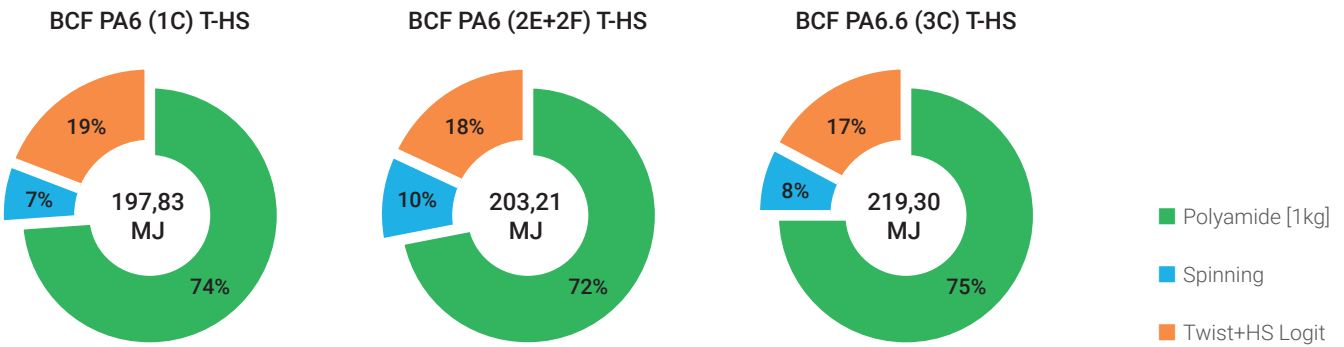
7.2 INTERPRETATION OF RESULTS - REFINED YARN

Use of resources

The contribution of BCF yarn to total energy consumption per 1 kg of refined yarn amounts to about 80% to 85% for each type of product analysed. Energy consumption associated with the BCF yarn spinning processes at the RADICIFIL S.p.A. plant represents 8% to 15% of the total energy used for refined yarns.

The additional energy used in the twist and heat setting processes at LOGIT S.r.o. accounts for about 17-19% of the total, while the air-entangling process at the RADICIFIL plant in Casnigo is lower in terms of energy consumption (about 6-15% of the total). Water consumption is mainly related to raw materials. The percentage contribution to the total water consumption of the finishing processes at LOGIT S.r.o. and of the air-entangling process is mainly due to indirect water consumption related to energy production.

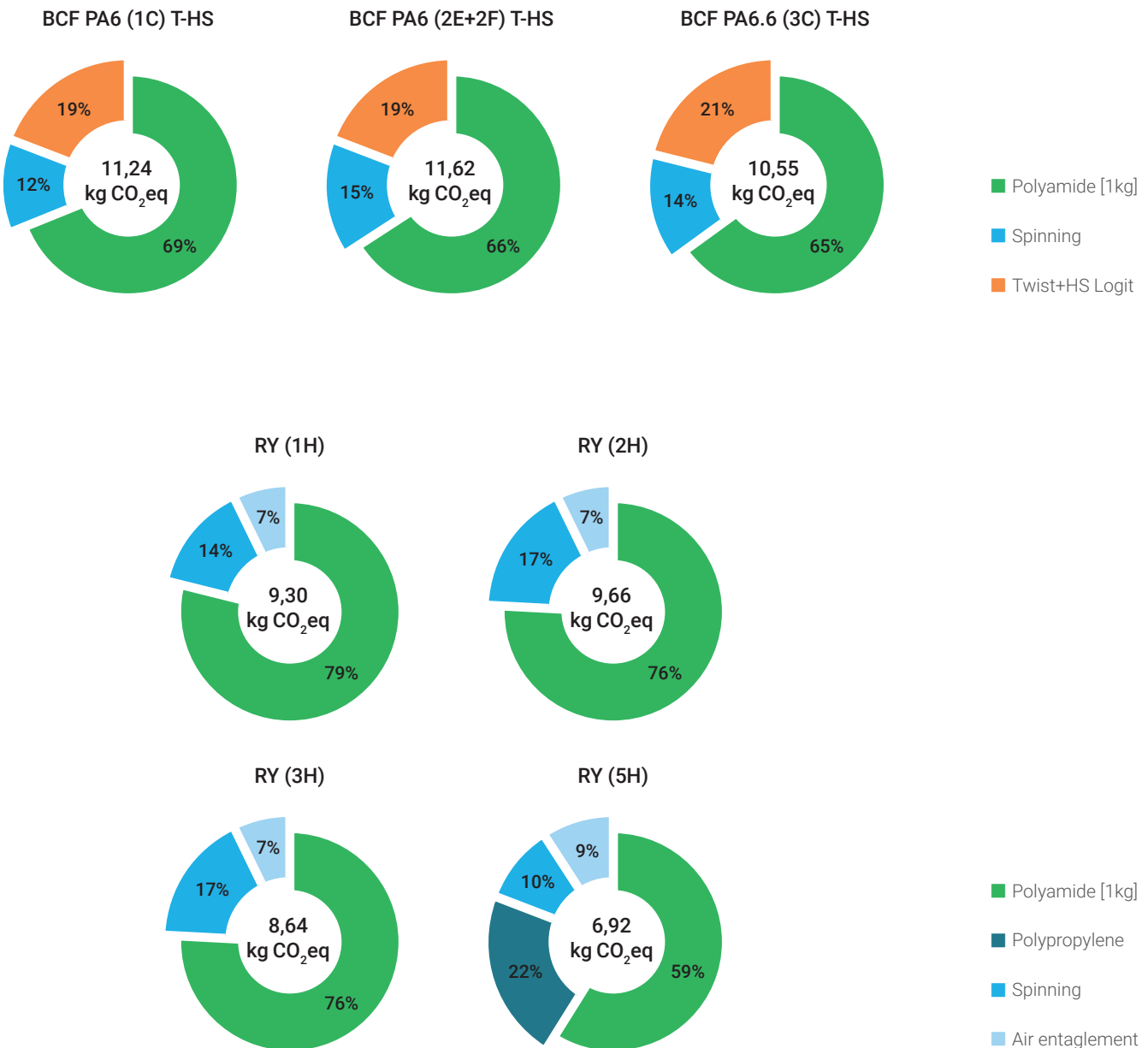
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Environmental impact

The major contributors to the environmental impact indicators are the raw materials. The finishing processes at LOGIT S.r.o. also make a significant contribution to the total values of the impact indicators. Indeed, the finishing processes contribute about 20% to global warming potential (GWP), ozone depletion potential (ODP), abiotic depletion potential - fossil fuels (ADPF). This phase is more relevant photochemical ozone creation potential (POCP), acidification potential (AP), with a peak at 85% for eutrophication potential (EP). This impact is related to the energy used for the heat-setting and twisting processes, in particular is due to the Czech Republic energy mix. Less significant is the contribution of the air-entangling process, which does not exceed 7-10% for most of the environmental impact indicators.

GWP_{100a}



7.3 DIFFERENCES VERSUS PREVIOUS VERSIONS OF THE EPD

The environmental performance in EPD compared with previous version are < ±10%. The main causes of changes are mainly due to a different allocation approach of energy consumption between polymerization and spinning, which resulted in a lower contribution of the spinning process (-7%/-10%). During 2020, the process was more efficient with a lower consumption of raw/auxiliaries materials and waste production. These reductions are not significant and are less than 10%. The environmental profiles of products are updated with the new impact indicators as defined in EN 15804:2012+A2:2019: GWP-GHG, Eutrophication Marine and Eutrophication Terrestrial.

Additional information

Issuer and contacts



RADICIFIL S.p.A.

Via Europa, 41

IT - 24020 CASNIGO (BG)

Tel. +39 035 736000

Fax +39 035 736350

www.radicigroup.com - flooring@radicigroup.com

Verification and registration

TECHNICAL SUPPORT: ICA - Società di Ingegneria Chimica per l'Ambiente S.r.l. - Bergamo, Italy

For further information on this Environmental Product Declaration (EPD), contact: arturo.andreoni@radicigroup.com

PRODUCT CATEGORY RULES (PCR):

Construction Products And Construction Services 2019:14
Version 1.1 - 2021-02-05

PCR REVIEW CONDUCTED BY:

The International EPD® System Technical Committee
Chair: Claudia A. Peña, University of Concepción, Chile
Secretariat contact: info@environdec.com

PROCEDURE FOR FOLLOW-UP OF DATA DURING EPD®

VALIDITY INVOLVES THIRD-PARTY VERIFIER:

Yes No

INDEPENDENT VERIFICATION OF THE DECLARATION AND DATA, ACCORDING TO ISO 14025:2006:

External EPD Process Certification

THIRD PARTY VERIFIER:

CERTIQUALITY S.r.l. - Istituto di Certificazione della qualità
Milan, Italy

ACCREDITED BY: ACCREDIA

ACCREDITATION No.: 003H14

PROGRAMME:

The International EPD® System

EPD international AB
Box 210 60, SE-100 31,
Stockholm Sweden
www.environdec.com
e-mail: info@environdec.com

EPDs within the same product category but from different programs may not be comparable.

EPDs of construction products may not be comparable if they do not comply with EN 15804.

References

- THE INTERNATIONAL EPD® SYSTEM PCR: Construction Products And Construction Services 2019:14 Version 1.1 - 2021-02-05
- EPD International General Programme Instructions of the International EPD® System. Version 4.0, dated 2021-03-29.
- EN 15804:2012+A2:2019: Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.
- UNI EN ISO 14044, 2021: Environmental management - Life cycle assessment - Requirements and guidelines.
- UNI EN ISO 14025, 2010: Environmental labels and declarations - Type III environmental declarations - Principles and procedures.
- PlasticsEurope (2014): Eco-profiles and environmental product declarations of the European Plastics Manufacturers - Polyamide 6 (PA6).
- Relazione ICA - Società di Ingegneria Chimica per l'Ambiente S.r.l. - Bergamo (Italy): RADICIFIL SpA, May 2021 "Valutazione del ciclo di vita (LCA) Produzione di polimero PA6, filati BCF grezzi e elaborati".