PERFORMANCE PLASTICS

EPD®

ENVIRONMENTAL PRODUCT DECLARATION

HERAMID® A PA66

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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

RADICI GROUP

THE GROUP

Radici Novacips SpA, headquarters of the Performance Plastics Business Area of **RadiciGroup** – a leading Italian multinational in the chemicals and synthetic fibres industries –, is one of the world's finest producers of **polyamide and polyester engineering plastics**, with production and sales sites located in Europe, Asia, North America and South America.

With eight production plants, strategically located in Italy, Germany, the Netherlands, China, Brazil, the USA and Mexico, RadiciGroup Performance Plastics offers processing, quality control, research and technical development support. A network of sales units – with a strong presence in Italy, Germany, France, Spain, the UK, China, India, the USA, Brazil and Mexico – makes Radici Novacips a truly global organization capable of meeting the needs of its customers in the worldwide plastics industry on a timely basis.

RadiciGroup Performance Plastics is a vertically integrated compounder, whose strengths range from the independent management of its whole production chain, **upstream and downstream of the product**, including the recovery of process waste and scrap from other RadiciGroup companies, to research and development activities, specifically targeted at industrial-grade products, which allow it to offer a complete range of second-generation engineering plastics **for automotive, electrical/ electronics and industrial applications.**

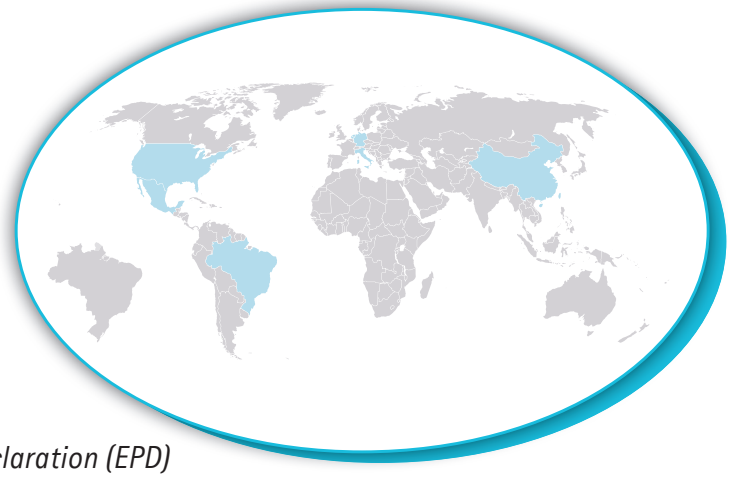
RadiciGroup Performance Plastics is an integrated organization able to offer comprehensive service, including **manufacturing, quality control, research and technological development support.** The latter is a vital component of Radici Novacips' and RadiciGroup Performance Plastics' strategy. Thus, through the use of Computer Aided Engineering services, RadiciGroup Performance Plastics can provide customers with technological support in applications development and in the design of products with greater environmental sustainability.

In the area of plastic materials, RadiciGroup offers a complete range of products including: **polyamides (Radilon®, Heramid®, Radistrong® and Torzen®), polyesters (Raditer®), polyacetals (Heraform®) and ther-moplastic elastomers (Heraflex®).**

PRODUCTION SITES

RADICIGROUP PERFORMANCE PLASTICS has production sites in:

- **ITALY** RADICI NOVACIPS SpA Villa d'Ogna and RADICI NOVACIPS SpA Chignolo d'Isola
- **GERMANY** RADICI PLASTICS GmbH
- **THE NETHERLANDS** RADICI PLASTICS BV
- **CHINA** RADICI PLASTICS (Suzhou) Co., Ltd.
- **BRAZIL** RADICI PLASTICS Ltda.
- **The USA** RADICI PLASTICS USA Inc.
- **MEXICO** RADICI PLASTICS MEXICO S. de R.L. de C.V.



The products covered in this Environmental Product Declaration (EPD) are manufactured at the RADICI NOVACIPS Chignolo d'Isola plant.

SOCIAL AND ENVIRONMENTAL RESPONSIBILITY

In 2003 RadiciGroup and Radici Novacips started their journey towards process and product sustainability by join-ing the **voluntary Responsible Care® initiative**. In 2004 RadiciGroup published its first Social Report prepared along the guidelines of the Study Group for Social Reporting Standards (Gruppo di Studio del Bilancio Sociale, or GBS).

In 2010 RadiciGroup sustainability efforts accelerated with the launch of "RadiciGroup for Sustainability", a project encompassing initiatives targeted at the development and **continual improvement of Group products based on the Life Cycle Assessment method**, as well as the improvement of Group information quality with the adoption of the Global Reporting Initiative (GRI) framework for the preparation of the RadiciGroup Sustainability Report. The first Sustainability Report was published in 2011 and received external assurance.

As Radici Novacips is equipped with strong systems for Environmental Management (ISO 14001- certified since 2006), Safety Management (OHSAS 18001-certified since 2010) and Quality Management (ISO 9001:2001-certified since 1993, and IATF 16949-certified) and is supported by strong Research and Development and Application Marketing departments with a high rate of product innovation, the company has decided to charge its best staff with the task of formulating products with the highest sustainability and designing ways to measure the environmental impact of the products. Methods, people, training, research and transparent communication are the cornerstones of the Radici Novacips sustainability project.

Radici Novacips' decision to use LCAs to develop and prepare **EPDs** for its products, including the most innovative ones, reflects its commitment to support collaborative endeavours with its customers in order to develop products more in tune with the most recent trends in international markets, all the while keeping an eye on the **sustainability of the economic development** through recyclable products, the measurement of environmental impact and the use of renewable energy.

Of all the Group's business areas, RadiciGroup Performance Plastics is the one that has best realized the RadiciGroup approach to materials, technology and the environment.

Radici Novacips Chignolo d'Isola started operating in 1980 as a very small plant, which RadiciGroup had de-cided to create to make the best use of all the waste and scrap generated by upstream processes, such as polymerization and spinning. The Group began waste recovery in the firm belief that even polyamide scrap could and should be used in a useful way and in the spirit of the zero-kilometre philosophy. Moreover, Radici Novacips could exercise maximum control over all process stages, even when work was outsourced to external qualified suppliers. Radici Novacips Chignolo d'Isola began its waste recovery activity in a market that knew little of, and appreciated even less, recycled polymers.

Over the years the Group has constantly increased its investments in recovery competence, materials selection and in the research and development of specific solutions for engineering plastics. The efforts have been directed at adopting the best technologies for the treatment of materials, while at the same time, staying committed to the environmental adequacy of the facilities and the safety of the plants. Radici Novacips takes full advantage of convenient access to the quality post-industrial waste and scrap produced by RadiciGroup's upstream processes. These materials are accurately sorted and then pre-treated using "simple", high yield additive-free technologies such as mechanical recycling. RadiciGroup Performance Plastics' production activities are part of a vertically integrated production chain, in which polymer 66 from Radici Chimica and polymer 6 from Radici Fil and Radici Yarn are the inputs for the production of the Radilon product range, while waste and scrap from polymerization, spinning and compounding are used to manufacture the Heramid® range.

Replacing primary with secondary raw materials is a challenge, as well as a declared objective promoted by European authorities, which Radici Novacips is ready to pursue with the utmost transparency. Indeed, it has certified the EPD relating to its Polyamide Scrap Recovery Service (EPD No. S-P-00708) to provide greater disclosure on its activities by supplying quantifiable and credible information both on its recovery process and its products, which are realized using its flexible and versatile technologies and taking advantage of its specific expertise.

THE PRODUCT

Heramid® is the trade name for a range of **post-industrial PA6 and PA66** products manufactured using secondary raw materials and intended for **injection moulding and extrusion** for automotive, electrical/ electronics and industrial applications.

Heramids® are PA6 and PA66 plastic compounds made mostly from secondary raw materials selected from the industrial waste and scrap that are produced by RadiciGroup polymerization and compounding plants. Thus, they are engineering plastics that aim at **optimizing the technical performance to environmental impact ratio**. The testing performed in the R&D and Quality Labs ensures that all the required technical and safety documentation can be provided for all the products.

The Heramid® product range is proof that it is possible to integrate environmental commitment in the **manufacture of PA6 and PA66 thermoplastic compounds**. Each Heramid® product possesses unique characteristics that make it suitable for the **manufacture of plastic components** for use in a variety of different industries, from electronics to automotive. Furthermore, **Heramid®** thermoplastic compounds are processable by **injection moulding or extrusion**, thus meeting the needs of the diverse production processes used for the manufacture of components for automotive, electrical and technical industrial applications.

The product versions covered by this Environmental Product Declaration (EPD) are Heramid® A NER GF030/1K, a 30% glass-fibre reinforced, heat stabilized, black PA 66 compound and Heramid® A NER MP/ 1K, a toughened, heat stabilized PA 66 compound. Both versions are injection moulding grade products.

The geographical scope of the EPD is Europe.

INFORMATION ON USE AND END OF LIFE MANAGEMENT

The products are used in industries such as automotive, furnishings, electrical, electronics and are recyclable at end of life.

ENVIRONMENTAL PERFORMANCE ASSESSMENT

Product environmental performance was assessed using the Life Cycle Assessment (LCA) method, from the extraction of the raw materials to the distribution of the finished product. The study was conducted in accordance with the ISO 14040 standard and the product category rules set forth in PCR 2010:16 PLASTICS IN PRIMARY FORM, approved by The International EPD® System technical committee.

DECLARED UNIT

The declared unit is 1 kg of compound in granular form.

GENERAL SYSTEM BOUNDARIES

The system boundaries shown in Figure 2,1 include the pre-production phase (upstream processes) and the production phase (core processes) of the compound, from cradle to gate. The finished product distribution phase is included as part of the post-production phase (downstream processes).

The system boundaries are defined following the rules set forth in the relevant PCR document.

The pre-production phase (upstream processes) comprises:

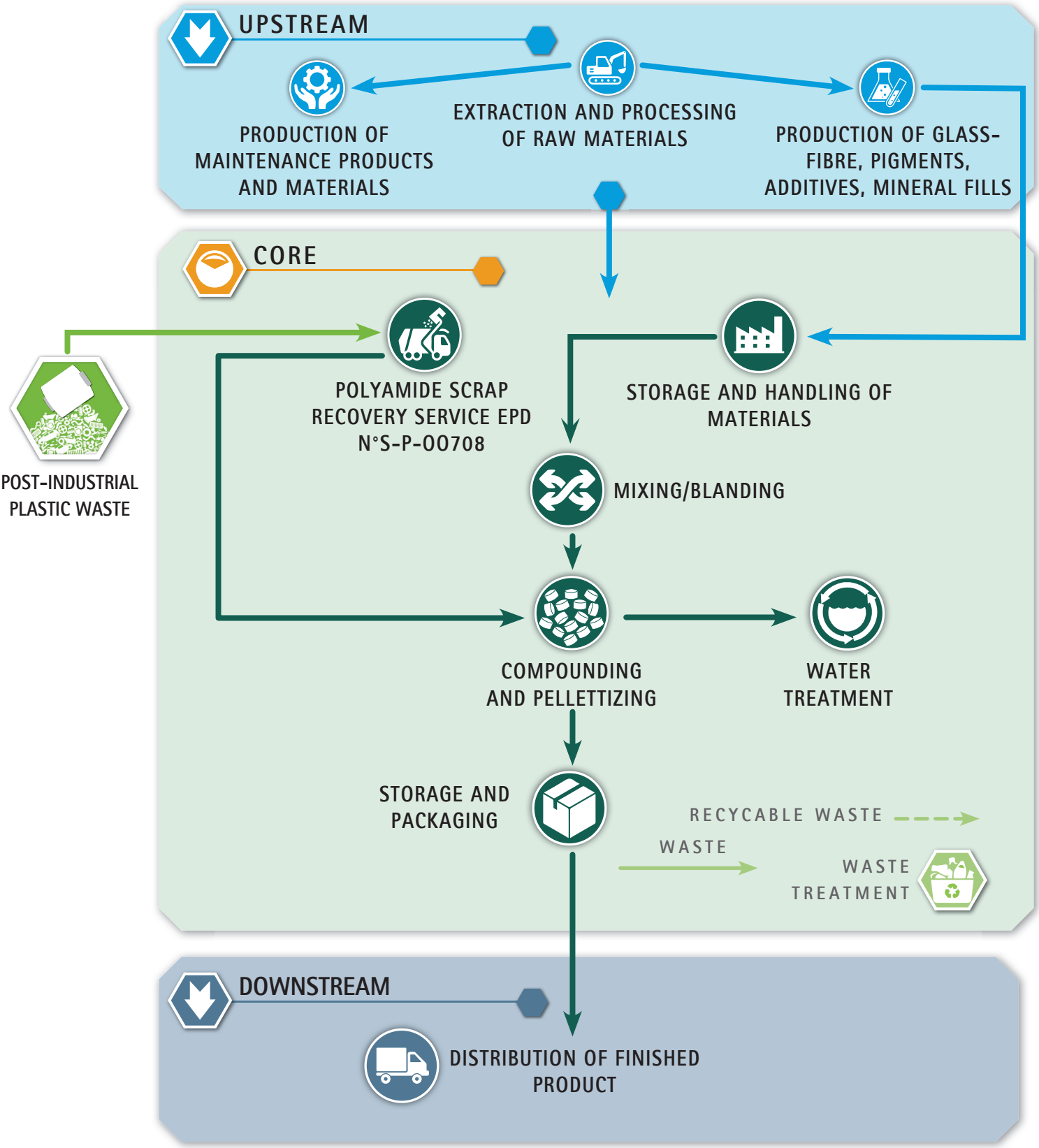
- Extraction and processing of virgin raw materials
- Polymer production
- Production of additives and other input materials (glass fibre, mineral fills, pigments, etc.)
- Maintenance materials and products production

The production phase (core processes) comprises:

- Transportation of all input virgin raw materials to the production plant for the production phase
- Plastic waste and scrap recovery processes
- Storage and internal handling of materials
- Compounding and pelletizing
- Storage and packaging
- Production of primary and secondary packaging for finished products
- Treatment of process waters
- Transportation and treatment of waste generated in the various phases

Post-production processes (downstream processes) comprise finished product distribution to the main European and international destinations. The product use, product end-of-life and packaging phases have been excluded. Process water treatment and production waste treatment have been included within the system boundaries.

FIG. 2.1 SYSTEM BOUNDERIES



CUT-OFF RULES

In compliance with the provisions of the relevant PCR, 99% of the input flows were considered.

DATA QUALITY

The data quality rules followed for this EPD are those defined in the relevant PCR document. In accordance with said rules, use was made of both specific data gathered directly from the production sites during the year 2017 and generic data extracted from the Ecoinvent 3.3 database.

PRODUCT ENVIRONMENTAL PROFILE

Below are reported the product characteristics and product environmental profile for **Heramid® A NER GF 030 /1k and Heramid ® A NER MP/ 1k.** The data reported are for 1 kg of compound and are broken down into the following phases: pre-production (upstream processes), production (core processes) and post-production (downstream processes).

ENVIRONMENTAL PROFILE
HERAMID® A NER GF030/1K

COMPOSITION OF THE PRODUCT

Heramid® A 30% glass-fibre reinforced injection moulding grade PA 66. Heat stabilized. Black colour. Post-industrial grade produced with selected polymers coming from polymerization, fibres and compounding plants.

Product composition: PA 66 68-70%
Glass fibre reinforce 30%
Additives and master 1-2%

TRADE NAME	NORM	HERAMID® A NER GF030/1K
ISO code	**ISO 1043**	**PA66T – GF30**
IUPAC name		Poly(hexamethylene adipamide)
CAS number		32131-17-2
GHS classification		N.A.
TECHNICAL DESCRIPTION		
Density	ISO 1183	1360 kg/m3
MFR	ISO 1133	20 g/10'
Tensile strength at break	ISO 527	2.5%
Melting T	ISO 11357	260°C
HDT @ 1.8 MPa	ISO 75f	220°C
Charpy Impact Notched	ISO 179: 2010	6.5 kJ/m2 (+23°C)
Flame behaviour	UL 94	HB (0.8 mm thickness)

Environmental impacts

IMPACT CATEGORY		UNIT	TOTAL	UPSTREAM	CORE	DOWNSTREAM
Global warming (GWP100a)	Fossil	kg CO2 eq	6,41E-01	4,54E-01	6,32E-02	1,24E-01
	Biogenic	kg CO2 eq	8,98E-04	5,37E-04	3,23E-04	3,80E-05
	Land use/transformation	kg CO2 eq	8,51E-04	6,43E-04	1,67E-04	4,13E-05
	TOTAL	kg CO2 eq	6,43E-01	4,55E-01	6,37E-02	1,24E-01
Acidification		kg SO2 eq	4,02E-03	3,19E-03	2,62E-04	5,62E-04
Eutrophication		kg PO4--- eq	8,83E-04	6,68E-04	1,06E-04	1,09E-04
Photochemical oxidant formation		kg NMVOC	2,92E-03	2,02E-03	2,33E-04	6,69E-04
Ozone layer depletion (ODP)		kg CFC-11 eq	6,90E-08	3,82E-08	7,35E-09	2,34E-08
Abiotic depletion		kg Sb eq	2,60E-06	2,08E-06	1,42E-07	3,77E-07
Abiotic depletion, fossil fuels		MJ	9,06E+00	6,23E+00	8,45E-01	1,99E+00
Water scarcity potential (AWARE)		m3	1,54E-01	1,25E-01	2,08E-02	7,98E-03

Use of resources and other indicators

PARAMETER		UNIT	TOTAL	UPSTREAM	CORE	DOWNSTREAM
Primary Energy Resources - Non Renewable	Used as energy carrier	MJ	9,60E+00	6,61E+00	9,47E-01	2,04E+00
	Used as raw material	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00
	TOTAL	MJ	9,60E+00	6,61E+00	9,47E-01	2,04E+00
Primary Energy Resources - Renewable	Used as energy carrier	MJ	3,61E+00	3,42E-01	3,24E+00	2,64E-02
	Used as raw material	MJ	1,08E+00	9,25E-02	9,76E-01	1,11E-02
	TOTAL	MJ	4,69E+00	4,34E-01	4,22E+00	3,74E-02
Secondary Material		kg	8,74E-01	0,00E+1	8,74E-01	0,00E+1
Renewable secondary fuels		MJ	0	0	0	0
Non-renewable secondary fuels		MJ	0	0	0	0
Water consumption		m3	5,39E-03	3,56E-03	1,44E-03	3,92E-04
Agricultural land use for renewable material production*		m2	0	0	0	0

**The product doesn't contain renewable raw materials; the renewable materials listed above refer to the packaging.*

Content of recycled material per declared unit

The content of recycled materials is 87,4%, 100% obtained from post-industrial waste and scrap.

Information on the recovery process

Technology used: mechanical volume reduction, extrusion.
Recovery process yield (process upstream of compounding): 98%.
Destination of non-recovered waste fraction: recycling/energy recovery.

Waste production

WASTE	UNIT	TOTAL	UPSTREAM	CORE	DOWNSTREAM
Not-hazardous waste disposed	kg	1,79E-01	5,34E-02	3,49E-02	9,05E-02
Hazardous waste disposed	kg	3,94E-03	6,01E-06	3,94E-03	1,08E-06
Radioactive waste* disposed	kg	3,58E-05	1,88E-05	3,54E-06	1,35E-05

**RadiciGroup DOESN'T use radioactive materials or additives, and DOESN'T manage processes that could, directly or undirectly, produce radioactivity or radioactive leftovers. The item reported is attributable EXCLUSIVELY to the share of waste allocated to the nuclear part of national electricity energy mix, used for absolutely independent processes from RadiciGroup production and its suppliers.*

Output flows

PARAMETER	UNIT	TOTAL	UPSTREAM	CORE	DOWNSTREAM
Components for reuse	kg	0	0	0	0
Materials for recycling	kg	9,03E-02	0,00E+00	9,03E-02	0,00E+00
Materials for energy recovery	kg	0	0	0	0
Exported energy, electricity	MJ	0	0	0	0
Exported energy, thermal	MJ	0	0	0	0

ENVIRONMENTAL PROFILE
HERAMID® A NER MP/1K

COMPOSITION OF THE PRODUCT

Heramid® A PA66 injection moulding grade. Toughened, heat stabilized. Black colour. Post-industrial grade produced with selected polymers coming from polymerization, fibres and compounding plants.

Product composition: PA 66 91 %
Additives and master: 8%, Other 1%

TRADE NAME	NORM	HERAMID® A NER MP/1K
ISO code	**ISO 1043**	**PA66 – IT**
IUPAC name		Poly(hexamethylene adipamide)
CAS number		32131-17-2
GHS classification		N.A.

TECHNICAL DESCRIPTION		
Density	ISO 1183	1120 kg/m3
MFR	ISO 1133	~10 g/10'
Tensile strength at break	ISO 527	30%
Melting T	ISO 11357	260°C
HDT @ 1.8 MPa	ISO 75f	66°C (@1.8 MPa)
Charpy Impact Notched	ISO 179: 2010	13 kJ/m2 (+23°C)
Flame behaviour	UL 94	HB (0.8 mm thickness)

Environmental impacts

IMPACT CATEGORY		UNIT	TOTAL	UPSTREAM	CORE	DOWNSTREAM
Global warming (GWP100a)	Fossil	kg CO2 eq	3,69E-01	1,98E-01	4,75E-02	1,24E-01
	Biogenic	kg CO2 eq	4,21E-04	2,20E-04	1,64E-04	3,80E-05
	Land use/transformation	kg CO2 eq	2,00E-04	2,13E-05	1,38E-04	4,13E-05
	TOTAL	kg CO2 eq	3,70E-01	1,98E-01	4,78E-02	1,24E-01
Acidification		kg SO2 eq	1,38E-03	6,41E-04	1,78E-04	5,62E-04
Eutrophication		kg PO4--- eq	2,80E-04	8,00E-05	9,11E-05	1,09E-04
Photochemical oxidant formation		kg NMVOC	1,56E-03	7,15E-04	1,74E-04	6,69E-04
Ozone layer depletion (ODP)		kg CFC-11 eq	4,05E-08	1,25E-08	4,60E-09	2,34E-08
Abiotic depletion		kg Sb eq	6,99E-07	2,26E-07	9,65E-08	3,77E-07
Abiotic depletion, fossil fuels		MJ	9,38E+00	6,75E+00	6,40E-01	1,99E+00
Water scarcity potential (AWARE)		m3	2,90E-01	2,74E-01	7,80E-03	7,98E-03

Use of resources and other indicators

PARAMETER		UNIT	TOTAL	UPSTREAM	CORE	DOWNSTREAM
Primary Energy Resources - Non Renewable	Used as energy carrier	MJ	7,43E+00	4,67E+00	7,09E-01	2,04E+00
	Used as raw material	MJ	2,22E+00	2,22E+00	0,00E+00	0,00E+00
	TOTAL	MJ	9,64E+00	6,89E+00	7,09E-01	2,04E+00
Primary Energy Resources - Renewable	Used as energy carrier	MJ	4,13E+00	4,02E+00	2,64E-02	0,00E+00
	Used as raw material	MJ	8,77E-01	7,99E-03	8,58E-01	1,11E-02
	TOTAL	MJ	5,01E+00	4,03E+00	8,84E-01	1,11E-02
Secondary Material		kg	9,36E-01	0,00E+00	9,36E-01	0,00E+00
Renewable secondary fuels		MJ	0	0	0	0
Non-renewable secondary fuels		MJ	0	0	0	0
Water consumption		m3	8,14E-03	6,56E-03	1,18E-03	3,92E-04
Agricultural land use for renewable material production*		m2	0	0	0	0

**The product doesn't contain renewable raw materials; the renewable materials listed above refer to the packaging.*

Content of recycled material per declared unit

The content of recycled materials is 93,6%, 100% obtained from post-industrial waste and scrap.

Information on the recovery process

Technology used: mechanical volume reduction, extrusion.
Recovery process yield (process upstream of compounding): 98%.
Destination of non-recovered waste fraction: recycling/energy recovery.

Waste production

WASTE	UNIT	TOTAL	UPSTREAM	CORE	DOWNSTREAM
Not-hazardous waste disposed	kg	1,31E-01	7,82E-03	3,30E-02	9,05E-02
Hazardous waste disposed	kg	4,46E-03	5,03E-07	4,45E-03	1,08E-06
Radioactive waste* disposed	kg	2,24E-05	6,90E-06	1,99E-06	1,35E-05

**RadiciGroup DOESN'T use radioactive materials or additives, and DOESN'T manage processes that could, directly or undirectly, produce radioactivity or radioactive leftovers. The item reported is attributable EXCLUSIVELY to the share of waste allocated to the nuclear part of national electricity energy mix, used for absolutely independent processes from RadiciGroup production and its suppliers.*

Output flows

PARAMETER	UNIT	TOTAL	UPSTREAM	CORE	DOWNSTREAM
Components for reuse	kg	0	0	0	0
Materials for recycling	kg	9,29E-02	0,00E+00	9,29E-02	0,00E+00
Materials for energy recovery	kg	0	0	0	0
Exported energy, electricity	MJ	0	0	0	0
Exported energy, thermal	MJ	0	0	0	0

DIFFERENCES COMPARED TO THE PREVIOUS VERSION

This version of the EPD includes products obtained from different types of plastic scrap, reflecting changes in materials procurement made by the production plant in 2017.

There is an overall reduction in the main impact categories compared with the previous year; this reduction is mainly due to the different distribution scenario of the products.

ADDITIONAL INFORMATION

CONTACTS

REGISTERED OFFICE, ADMINISTRATION AND PRODUCTION UNIT:
Via Bedeschi, 20
IT - 24040 CHIGNOLO D'ISOLA (BG)
Tel. +39 035 4991311
Fax +39 035 994386

RADICI NOVACIPS SpA PRODUCTION UNIT:
Via Provinciale, 1331
IT - 24020 VILLA D'OGNA (BG)
Tel. +39 0346 22453
Fax +39 0346 23730

www.radicigroup.com info.plastics@radicigroup.com

TECHNICAL SUPPORT:

Quota Sette S.r.l. – Milano, Italy
For further information on this EPD®, please contact:
susanna.caprotti@radicigroup.com

PCR review conducted by:
The International EPD® System Technical Committee
Chair: Paola Borla
Contact at info@environdec.com

PPCR Moderator:
Maurizio Fieschi - Paolo Simon-Ostan

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

Accredited by:
ACCREDIA

Accreditation No.:
003H

Programme:
The International EPD® System

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

EPDs within this product category that come from different programmes may not be comparable.

Radici Novacips SpA has the sole ownership, liability and responsibility of the EPD

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EPD/Performance Plastics/graphic review: 31th July 2018

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