PERFORMANCE PLASTICS

EPD®

ENVIRONMENTAL PRODUCT DECLARATION

POLYAMIDE SCRAP RECOVERY SERVICE

Rev.	**No.3.0, 10 May 2018**
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PCR	**2013:08 vers. 2.01**
Geographical Region	**Europe**

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, from primary polyamide production to the manufacture of primary and industrial-grade engineering plastics, i.e., plastics produced from secondary PA 6/66, obtained through the plastic waste and scrap recovery service at the Radici Novacips plant in Chignolo d'Isola.

The Chignolo d'Isola plant was started in the 1980s with the objective of recovering plastic waste and scrap generated by the other Group companies. Over the years, the rising interest of target markets in recovered and reused materials has allowed the company to exploit its experience and process optimization technologies developed in the field of plastics recovery and recycling. Today Radici Novacips has the competence and technologies needed to run its plastics recovery and engineering plastics manufacturing operations simultaneously. RadiciGroup Performance Plastics is vertically integrated and has control over its entire production chain, including the recovery of plastic waste and scrap generated by the Group plants upstream. Waste and scrap are sorted, mechanically ground by qualified suppliers and extruded at the Chignolo d'Isola plant, where all the material recovered is used to manufacture the products of the HERAMID® range.

The plant is certified to ISO 14001 and OHSAS 18001, in addition to ISO 9001:2008; the entire recovery process is carried out under proper environmental, health and safety management control.

PRODUCTION SITES

RADICIGROUP PERFORMANCE PLASTICS has production sites in:

- **ITALY** RADICI NOVACIPS SpA VILLA D'OGNA, 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.

RECOVERY TECHNOLOGY

The treatment considered in this EPD is commonly applied to polyamide 6 and 66 scraps and consists of both pre-treatment – cutting and/or grinding – and a final extrusion process that outputs a product in granular form, also called "cips", suitable for use in compounding.

Grinding, outsourced to authorized companies, is often the only process performed on the material, which then ceases to be legally considered "waste" and becomes commercially available as secondary material, although still needing to undergo extrusion for its complete recovery and reuse as a final product. In this physical form (small irregular flakes of various sizes), the material may not be suitable for processing in all types of extrusion plants. Indeed, the technological characteristics of extruders do not always allow them to process materials having irregular or not perfectly homogeneous sizes and shapes.

Not only does the Radici Novacips plant at Chignolo d'Isola have the right extrusion technology, but it can also perform further processing. The plant can complete the recovery process and produce secondary raw material suitable for use as a replacement of primary polymer for the production of engineering plastics. Recovery extrusion and production compounding can also occur at the same time.

The Radici Novacips case, as described above, is typical and unique at the same time. Typical, because it uses mechanical treatment, which is the most widespread method in the field of plastics recovery, and, unique, because Radici Novacips' experience, expertise and production chain synergies allow for running its recovery operations and production process even simultaneously (as described in EPD No. S-P-00707).

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. This is an example of upstream integration in the plastics sector, which has a potentially high recovery rate and can thus be successfully extended downstream to include the recycling and re-use of plastics for the production of secondary raw materials to be used in the manufacture of second-generation engineering plastics.

The purpose of this EPD is to clarify some aspects of the process, by sharing the information and the knowledge that RadiciGroup Performance Plastics has acquired in the course of over thirty years of experience in managing the entire plastics production chain. This information is intended for whoever wants to understand the environmental contribution from the recycling and re-use of post-industrial plastic waste and scrap for the production of secondary raw materials to be used in the manufacture of second-generation engineering plastics.

SORTING CRITERIA

The recovery service covered in this EPD is concerned with polyamides (PA6 and PA66) of industrial origin. So-called post-industrial waste consists of material that has never been fully processed into a commercially available product. Post-industrial waste includes scrap from polymerization, extrusion, and processing.

On the other hand, post-consumer waste comprises goods sold commercially to consumers that have fulfilled the intended purpose for which they were manufactured and have been disposed of (automobiles, household appliances, furnishings, etc.). In the case of collected polyamide obtained from post-consumer sources, after the separation and sorting of the various components of the goods, the waste arrives for treatment in a condition comparable to that of post-industrial waste.

SORTING CRITERIA (continue)

For over thirty years, waste material (scrap and by-products) generated by other Group companies and associated companies has been recovered and used for the production of engineering plastics at the Radici Novacips Chignolo d'Isola plant.

At Radici Novacips, the available extrusion technology, the acquired experience and know-how, and the availability of waste through the Group production chain create an opportunity for the best use of a "simple" and widely recognized technology to obtain secondary raw materials suitable for use in the manufacture of materials with consistent performance characteristics. These materials are usually targeted at industries, such as automotive, which require exacting performance characteristics. These performance characteristics are described in EPD No. S- P-00707, concerning the final output of the entire RadiciGroup process for the production of polymer, recovery, and regenerated compounds obtained from recyclate.

PRODUCT TECHNICAL SPECIFICATIONS AND RECYCLED CONTENT

The recovery service produces a semi-finished product, which is solely used at the Chignolo d'Isola plant for the production of compounds in the Heramid family. Technical characteristics are not evaluated at this stage, but only at the completion of the production cycle for the commercially available item. Likewise, the recycled content is disclosed in the specifications of the commercially available product, the last stage of the production cycle.

Recycling yield: 98%. The environmental performance of the recovery service will be expressed in declared units, as required by the PCR, and also per kilogram of secondary material obtained.

The feedstock energy , in in the case of material subject to end-of-life energy recovery, is 38,5 MJ per kg of PA6 and 31 MJ per kg of PA66 (source: Plastics Europe).

ENVIRONMENTAL PERFORMANCE ASSESSMENT OF THE SERVICE

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 2013:08 v.2,01 PLASTIC WASTE AND SCRAP RECOVERY (RECYCLING) SERVICES, approved by the International EPD® System technical committee.

DECLARED UNIT

The declared unit is the recovery/recycling of 1,000 kg of plastic waste and/or scrap in bulk form as collected, before any treatment.

GENERAL SYSTEM BOUNDARIES

The system boundaries are illustrated in Figure 2,1 and comprise the waste collection processes (upstream processes) and the pre-treatment and advanced treatment processes (core processes) of the material. Storage and packaging of the final product have been excluded from the post-production processes (down-stream processes), as the material obtained is used entirely for the production of engineering plastics at the plant.

The definition of the system boundaries follows the rules established in the relevant PCR document.

Upstream processes include:

- Maintenance materials production

The other upstream processes defined in the PCR (such as virgin raw material production and additive production) do not apply to the process under consideration, because they are not directly involved in the plastic scrap recovery service.

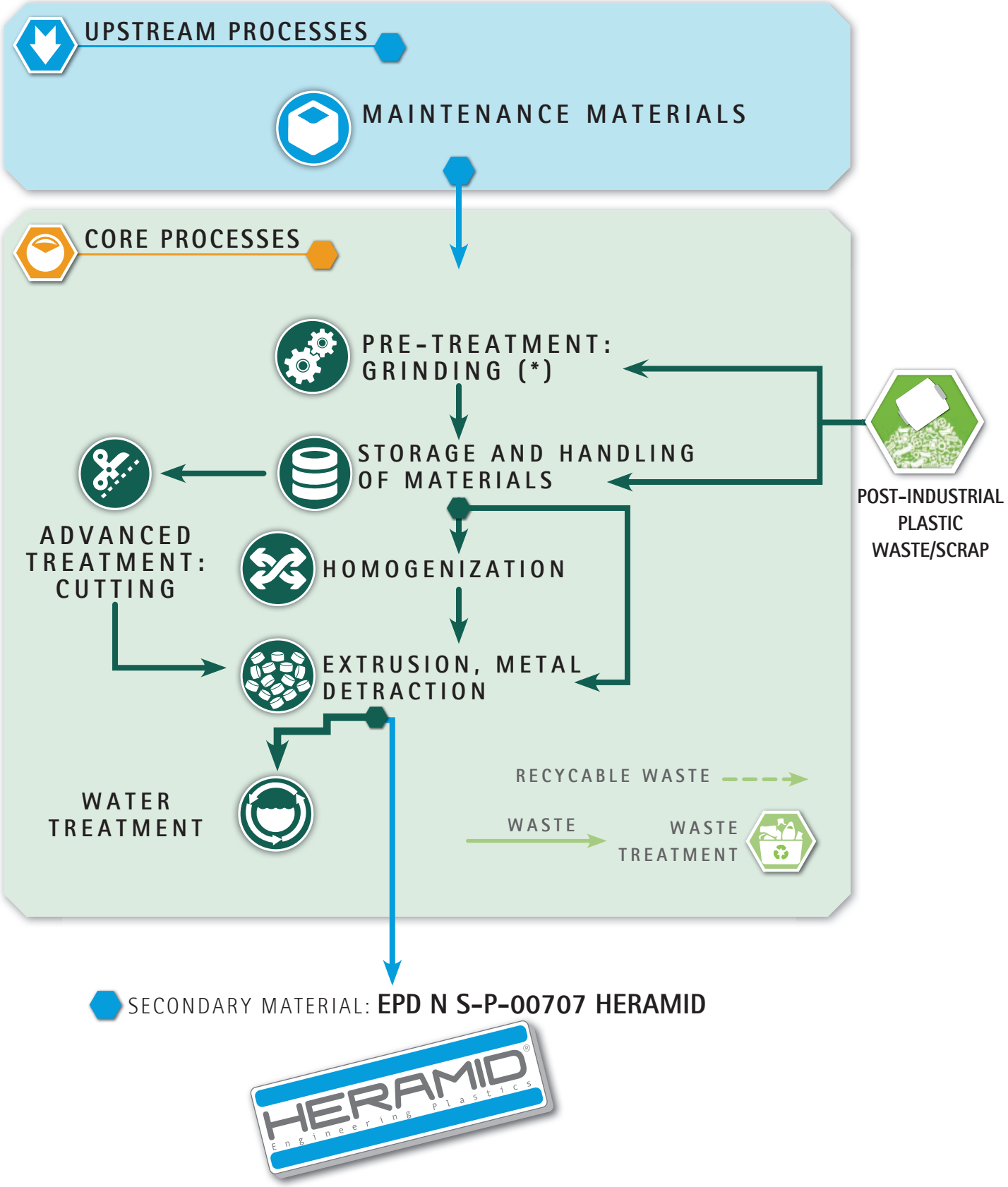
Production processes (core processes) include:

- Grinding * (outsourced) or cutting
- Transportation of materials from the pre-treatment site (if needed)
- Internal storage and handling of materials
- Homogenization (if needed)
- Extrusion and pelletizing
- Auxiliary extrusion processes (e.g., water treatment)

Product packaging does not apply to the service under consideration, because the material is entirely and solely used at the Radici Novacips Chignolo d'Isola plant as secondary raw material for the manufacture of engineering plastics, and thus packaging is not required

Likewise, the system boundaries do not include post-production processes (downstream processes), and in particular do not include the recycled material distribution phase, since the material is entirely used as secondary raw material for the production of the engineering plastics in the Heramid® family.

FIG. 2.1 SYSTEM BOUNDARIES



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 (par. 7,4 and 8,2 of the PCR document). In accordance with such rules, use was made of both specific data gathered directly from the plastic treatment and recovery sites during the year 2017 and generic data extracted from the commercial database (Ecoinvent 3.3).

SERVICE ENVIRONMENTAL PROFILE

Below is reported the product environmental profile of the scrap recovery service. The data reported relate to the process for the recovery of 1.000 kg of waste and scrap as collected, prior to any treatment, broken down into the pre-treatment phase (upstream processes) and the treatment phase (core processes).

Use of non-renewable energy resources

RESOURCES	UNIT	TOTAL	UPSTREAM	CORE
Coal	kg	6,54E+00	1,85E+00	4,69E+00
Natural gas	kg	2,38E+00	2,67E-01	2,11E+00
Oil	kg	5,07E+00	2,04E-01	4,86E+00
Other	kg	1,05E-02	3,66E-03	6,89E-03

Use of non-renewable material resources

RESOURCES	UNIT	TOTAL	UPSTREAM	CORE
Gravel	kg	2,81E+01	1,39E+00	2,67E+01
Calcite	kg	3,60E+00	3,82E-01	3,22E+00
Iron	kg	1,76E+00	9,56E-01	8,07E-01
Gangue, bauxite	kg	7,28E-01	1,29E-01	6,00E-01
Clay	kg	7,26E-01	7,72E-02	6,48E-01
Other	kg	1,26E+00	3,58E-01	8,99E-01

Use of renewable energy resources

RESOURCES	UNIT	TOTALE	UPSTREAM	CORE
Geothermal	MJ	3,15E+00	6,40E-02	3,09E+00
Biomass	MJ	1,33E+01	2,48E+00	1,08E+01
Wind	MJ	5,14E+00	2,99E-01	4,84E+00
Hydropower	MJ	2,19E+03	9,28E+00	2,18E+03
Solar	MJ	1,81E-01	2,87E-02	1,52E-01

Use of renewable material resources

RESOURCES	UNIT	TOTAL	UPSTREAM	CORE
Wood	kg	0,84	0,16	0,68

Environmental impact categories

IMPACT CATEGORY	UNIT	TOTAL	UPSTREAM	CORE
Acidification	kg SO_2 eq	1,67E-01	3,03E-02	1,37E-01
Eutrophication	kg PO_4--- eq	6,37E-02	9,71E-03	5,40E-02
Global warming (GWP 100a)	kg CO_2 eq	4,19E+01	5,34E+00	3,66E+01
Photochemical oxidant formation	kg NMVOC	1,35E-01	1,89E-02	1,16E-01

OTHER ENVIRONMENTAL INFORMATION

Waste production per ton processed

WASTE	UNIT	TOTAL	UPSTREAM	CORE
Non hazardous waste to recovery	kg	4,82E+01	0,00E+00	4,82E+01
Non hazardous waste	kg	3,28E+01	4,42E+00	2,83E+01
Hazardous waste	kg	3,25E+00	1,23E-04	3,25E+00

*Below are given the environmental impact categories for **1 kg of 100% recycled material**, obtained from processing post-industrial scarp and waste.*

Environmental impact categories per kg produced

IMPACT CATEGORY	UNIT	TOTAL	UPSTREAM	CORE
Acidification	kg SO_2 eq	1,70E-04	3,09E-05	1,39E-04
Eutrophication	kg PO_4--- eq	6,50E-05	9,90E-06	5,51E-05
Global warming (GWP100a)	kg CO_2 eq	4,28E-02	5,45E-03	3,73E-02
Photochemical oxidant formation	kg NMVOC	1,38E-04	1,93E-05	1,18E-04

*The above table shows the environmental impact category values for **1 kilogram of secondary material produced**, considering the recovery service yield.*

DIFFERENCES COMPARED TO THE PREVIOUS VERSION

All the primary data used refer to the year 2017.

There is an overall reduction in the contribution to global warming due mainly to the change in the supply mix and the consequent lower impact determined by the transport inherent to the process; the typical process activities remain essentially constant.

ADDITIONAL INFORMATION

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PCR review conducted by:
International EPD® System Technical Committee
Chair: Lars-Gunnar Lindfors
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PCR Moderator(s):
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

Program:
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EPD within this product category that come from different programs may not be comparable.

REFERENCES

- Caprotti S. 2018, Life Cycle Assessment del Servizio di Recupero Scarti e Rifiuti Plastici, Rev2, 2 Maggio 2018
- PCR 2013-08, plastic waste and srap recovery (recycling) services, version 2.01, www.environdec.com.
- General Programme Instructions for the International EPD System, version 3.0, dated 2017-12-11, www.environdec.com.
- ISO 14025:2006, Environmental labels and declarations - Type III environmental declarations - Principles and procedures, International Organization for Standardization, Geneve, Switzerland.
- JPTS- JRC: end-of-waste criteria for waste plastic for conversion. Technical proposals.

  Final Draft Report. March 2013 – Seville, Spain
- Decreto Legislativo 3 aprile 2006 n° 152, Norme in materia ambientale e ss.mm.ii
- PlasticsEurope: Eco-profiles and environmental product declaration of European Plastics Manufactures Polyamide 6 (PA6) February 2014
- PlasticsEurope: Eco-profiles and environmental product declaration of European Plastics Manufactures Polyamide 66 (PA66) - February 2014

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