European Communication Format – B2B

Environmental Product Declaration

Polypropylene random copolymer (PP-R) pipe system for hot and cold water in the building

1 DECLARATION OF GENERAL INFORMATION

Introduction

The European Plastics Pipes and Fittings Association (TEPPFA) deems it important to have an insight into the integral environmental impacts that are encountered during the life-span of particular pipe system applications. With this framework in mind, in 2010 TEPPFA has set up an LCA/EPD project with the Flemish Institute for Technological Research (VITO) which resulted in an EPD. The present EPD is the update of the EPD issued in 2013 – foreground data remained the same, with only the datasets being updated to the latest available version (Ecoinvent 3.4 and Industry 2.0 replaced Ecoinvent 2 datasets). It outlines the various environmental aspects which accompany the Polypropylene – Random copolymer (PP-R) pipe system for hot and cold water in the building, from the primary extraction of raw materials up to and including the end of life (EoL) treatment after its reference service life time.

Name and address of manufacturers

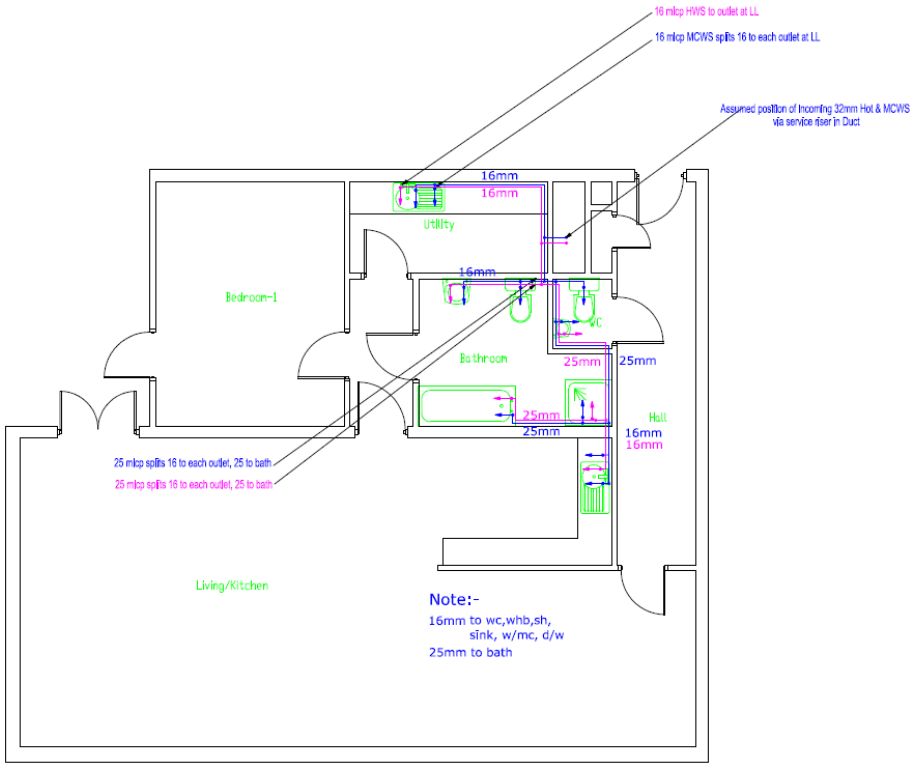
TEPPFA, Avenue de Cortenbergh, 71, B-1000 Brussels, Belgium, Tel: +32-2-736 24 06, Fax: +32-2-736 58 82, E-Mail: info@teppfa.eu, Website: www.teppfa.eu

Polypropylene random copolymer (PP-R) pipe system's use and functional unit

The EPD refers to a typical European Polypropylene random copolymer (PP-R) pipe system for hot and cold water in the building, from the cradle to the grave, including raw material extraction, transportation to converters, converting process, transport to apartment, construction, use and end of life. Environmental indicators are expressed for the complete life cycle, from the cradle to the grave, so for a typical European Polypropylene random copolymer (PP-R) Hot & Cold pipe system. The functional unit is defined as "the pressure supply and transport of hot and cold drinking water, from the entrance of a well-defined apartment to the tap, by means of a Polypropylene random copolymer (PP-R) Hot & Cold drinking water pipe system installation supplying a 100 m² apartment, incorporating a bathroom, separate WC, kitchen and washroom (considering the service life time of the pipe system to be aligned with the 50 year service life time of the apartment), calculated per year".

Product name & graphic display of product

Polypropylene random copolymer (PP-R) pipe system for hot and cold water in the building



Description of the Polypropylene random copolymer (PP-R) pipe system's components

The environmental burdens are calculated in relation to the functional unit, which resulted for the typical European Polypropylene random copolymer (PP-R) pipe system for hot and cold water in the building in the following basic pipe system components: Polypropylene random copolymer (PP-R) pipes, PP-R fittings and PP-R fittings with metal (brass) insert. The system consists of polypropylene random copolymer pipes, supplied in straight length of 4 meters.

Connections to the several sanitary appliances are considered (tap connectors). Risers and joints (welded) are included in the design. Tie-ins welding fittings in PP-R type material with metal (brass) inserts are also considered in the design The building system represents 100 m² of a typical residential single family apartment in a 5-storeyed building with all the facilities clearly positioned, like bath, shower etc.

The EPD is declared as the average environmental performance for the typical European Polypropylene random copolymer (PP-R) pipe system for hot and cold water in the building, over its reference service life cycle of 50 years (being the estimated reference life time of the apartment), in accordance to EN 806, EN 806-2, EN 806-3, EN ISO 15874-1, EN ISO 15874-2 and EN ISO 15874-3.

EPD programme and programme operator

The present EPD is in line with the ongoing standardization work by CEN TC 350 (EN15804 and EN15942). A programme operator related to the CEN T 350 has not been established yet.

Date of declaration and validity

August, 2018

The EPD has a 5 year validity period (August, 2023)

Comparability
Please note that EPDs of construction products may not be comparable if they do not comply with the CEN TC 350 (EN15804 and EN15942) standards.

Typical European Polypropylene random copolymer (PP-R) pipe system EPD
The present EPD outlines various environmental aspects which accompany a representative typical European Polypropylene random copolymer (PP-R) pipe system for hot and cold water in the building, from the primary extraction of raw materials up to and including the end of life (EoL) treatment after its reference service life time of 50 years (considering the service life time of the pipe system to be aligned with the 50 year service life time of the apartment).

Group of manufacturers
The EPD for the Polypropylene random copolymer (PP-R) hot and cold pipe system is representative for an anticipated European typical Polypropylene random copolymer (PP-R) hot and cold pipe system. The TEPPFA member companies represent more than 50% of the European market for extruded plastic pipes. For an overview of all members and national associations within TEPPFA we refer to pages 11 -13 of this EPD.

Content of the product system
The product system does not contain materials or substances that can adversely affect human health and the environment in all stages of the life cycle.

Retrieve information
Explanatory material may be obtained by contacting TEPPFA (http://www.teppfa.eu)

2 DECLARATION OF THE MATERIAL CONTENT

The European Polypropylene random copolymer (PP-R) Hot & Cold pipe system does not contain any substances as such or in concentration exceeding legal limits, which can adversely affect human health and the environment in any stages of its entire life cycle.

3 DECLARATION OF THE ENVIRONMENTAL PARAMETERS DERIVED FROM LCA

3.1 Life cycle flow diagram

The EPD refers to a typical European Polypropylene random copolymer (PP-R) Hot & Cold pipe system, from the cradle to the grave, including product stage, transport to construction site and construction process stage, use stage and end of life stage.

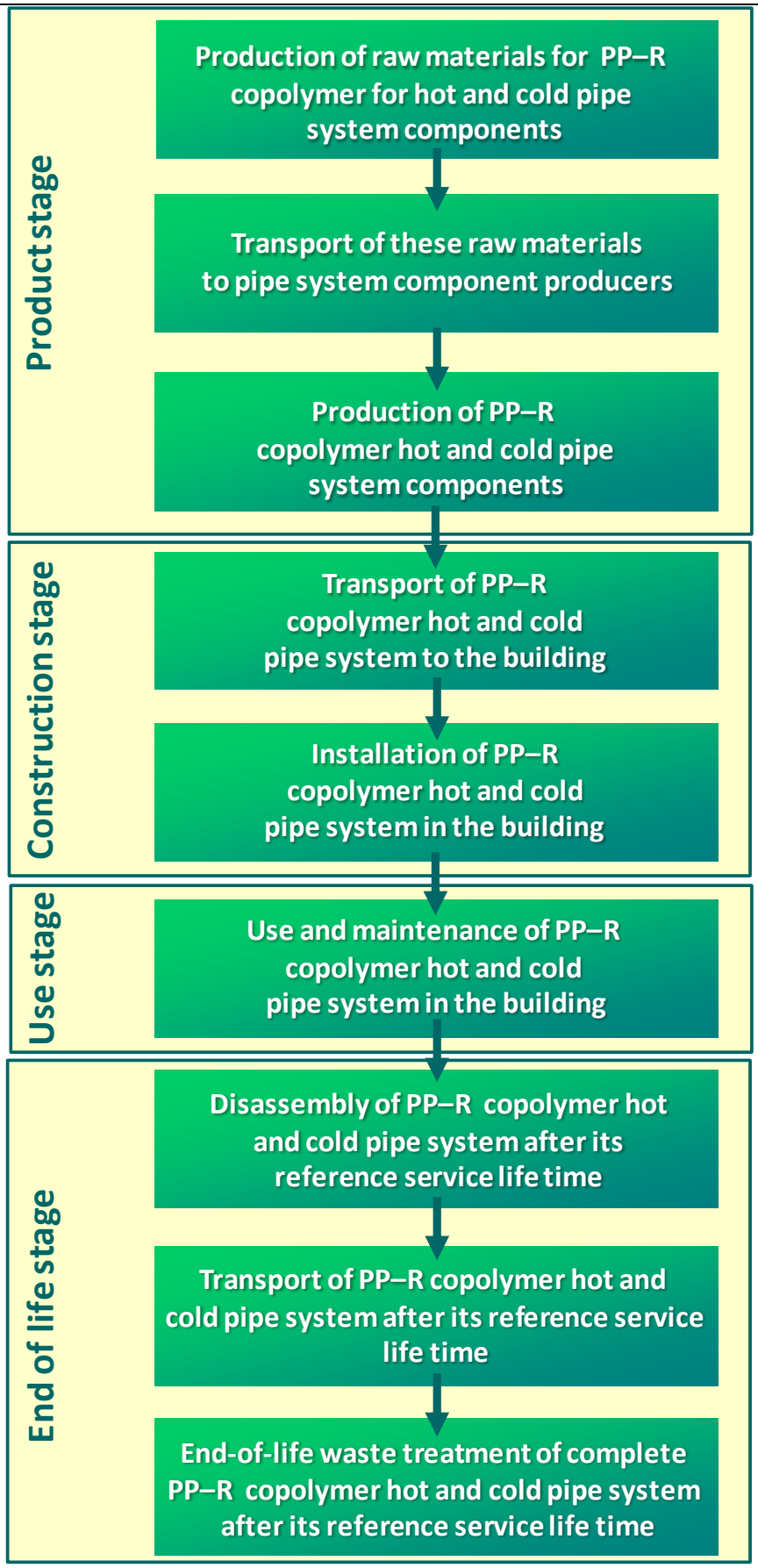
- **Product stage**: raw material extraction and processing, recycling processes for recycled material input, transport to the manufacturer, manufacturing (including all energy provisions, waste management processes during the product stage up to waste for final disposal):
  - Production of raw materials of the Polypropylene random copolymer (PP-R) pipes
  - Transport of the polymer raw materials for Polypropylene random copolymer (PP-R) pipes to converter
  - Converting process for Polypropylene random copolymer (PP-R) Hot & Cold pipes (extrusion), including packing of the pipes

- Production of the raw materials for PP-R fittings
- Transport of the polymer raw materials for Polypropylene random copolymer (PP-R) fittings to converter
- Converting process for PP-R fittings (injection moulding)
- Production of brass inserts (elements) for the PP-R fittings (raw materials and converting process)

- **Construction process stage**: including all energy provisions, waste management processes during the construction stage up to waste for final disposal
  - Transport of Polypropylene random copolymer (PP-R) Hot & Cold pipe system to the building
  - Installation of Polypropylene random copolymer (PP-R) Hot & Cold pipe system to the building

- **Use stage** (maintenance and operational use): including transport and all energy provisions, waste management processes up to waste for final disposal during this use stage
  - Operational use is not relevant for the Polypropylene random copolymer (PP-R) Hot & Cold pipe system
  - Maintenance is not relevant for the Polypropylene random copolymer (PP-R) Hot & Cold pipe system

- **End of life stage**: including all energy provisions during the end of life stage
  - Disassembly of the Polypropylene random copolymer (PP-R) Hot & Cold pipe system after 50 years of reference service life time at the building
  - Transport of Polypropylene random copolymer (PP-R) Hot & Cold pipe system after 50 years of reference service life time at the building to an end-of-life treatment
  - End-of-life treatment of the Polypropylene random copolymer (PP-R) Hot & Cold pipe system after 50 years of reference service life time at the building.


Product stage
Production of raw materials for PP–R copolymer for hot and cold pipe system components
Transport of these raw materials to pipe system component producers
Production of PP–R copolymer hot and cold pipe system components
Construction stage
Transport of PP–R copolymer hot and cold pipe system to the building
Installation of PP–R copolymer hot and cold pipe system in the building
Use stage
Use and maintenance of PP–R copolymer hot and cold pipe system in the building
End of life stage
Disassembly of PP–R copolymer hot and cold pipe system after its reference service life time
Transport of PP–R copolymer hot and cold pipe system after its reference service life time
End-of-life waste treatment of complete PP–R copolymer hot and cold pipe system after its reference service life time

3.2 Parameters describing environmental impacts

The following environmental parameters are expressed with the impact category parameters of the life cycle impact assessment (LCIA).

Impact category	Abiotic depletion (non-fossil)	Abiotic depletion (fossil fuels)	Acidification	Eutrophication	Global warming	Ozone layer depletion	Photochemical oxidation
	kg Sb eq	MJ	kg SO2 eq	kg PO4--- eq	kg CO2 eq	kg CFC-11 eq	kg C2H4 eq
Product stage	2,01E-05	1,92E+01	2,36E-03	6,37E-04	5,80E-01	3,37E-08	1,42E-04
Construction process stage	3,50E-07	8,84E-01	2,90E-04	4,57E-05	6,28E-02	8,77E-09	1,47E-05
Use stage	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
End of life stage	6,47E-09	-2,47E-01	-1,02E-04	-6,29E-06	8,77E-02	-1,61E-09	-4,92E-06
Total	**2,05E-05**	**1,98E+01**	**2,55E-03**	**6,77E-04**	**7,31E-01**	**4,08E-08**	**1,52E-04**

3.3 Parameters describing resource input

The following environmental parameters apply data based on the life cycle inventory (LCI).

Environmental parameter	Use of renewable primary energy excluding renewable primary energy resources used as raw materials	Use of renewable primary energy resources used as raw materials	Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials	Use of non renewable primary energy resources used as raw materials	Total use of non renewable primary energy resources (primary energy and primary energy resources used as raw materials)	Use of secondary material	Use of renewable secondary fuels	Use of non renewable secondary fuels	Net use of fresh water
	MJ, net calorific value	MJ, net calorific value	MJ, net calorific value	MJ, net calorific value	MJ, net calorific value	MJ, net calorific value	kg	MJ, net calorific value	MJ, net calorific value	m3
Product stage	n.a.	n.a.	7,78E-01	n.a.	n.a.	2,17E+01	n.a.	n.a.	n.a.	1,11E-02
Construction process stage	n.a.	n.a.	1,66E-01	n.a.	n.a.	2,53E+00	n.a.	n.a.	n.a.	4,08E-03
Use stage	n.a.	n.a.	0,00E+00	n.a.	n.a.	0,00E+00	n.a.	n.a.	n.a.	0,00E+00
End of life stage	n.a.	n.a.	-1,30E-01	n.a.	n.a.	-7,42E-01	n.a.	n.a.	n.a.	-5,54E-04
Total	**n.a.**	**n.a.**	**8,14E-01**	**n.a.**	**n.a.**	**2,35E+01**	**n.a.**	**n.a.**	**n.a.**	**1,47E-02**

*** Only for foreground process from which LCI data are made available by TEPPFA - the number does not include processes and materials modeled by means of background data, e.g. transportation, electricity, ancillary materials.*

3.4 Parameters describing different waste categories and further output material flows

The parameters describing waste categories and other material flows are output flows derived from the life cycle inventory (LCI).

Parameters describing different waste categories

Environmental parameter	Hazardous waste	Non-hazardous waste	Nuclear waste
	kg	kg	kg
Product stage	2,98E-03	1,14E-01	2,22E-05
Construction stage	9,92E-06	6,33E-02	9,70E-06
Use stage	0,00E+00	1,00E+00	2,00E+00
End of life stage	-9,49E-07	1,98E-01	-4,11E-06
Total	**2,99E-03**	**1,38E+00**	**2,00E+00**

Parameters describing further output material flows

Parameter	Unit	Total
Components for re-use**	kg	0
Materials for recycling**	kg	0,03296
Materials for energy recovery**	kg	0,03922
Exported energy**	MJ per energy carrier	0

*** Only for foreground process from which LCI data are made available by TEPPFA - the number does not include processes and materials modeled by means of background data, e.g. transportation, electricity, ancillary materials.*

4 SCENARIOS AND TECHNICAL INFORMATION

4.1 Construction process stage

Transport from the production gate to the construction site (apartment)

Parameter	Parameter unit expressed per functional unit
Fuel type consumption of vehicle or vehicle type used for transport e.g. long distance truck, boat etc.	The Polypropylene random copolymer (PP-R) Hot & Cold pipe system is transported over an average distance of 450 km with a truck (about 16 ton) and 30 km by means of a van (< 3,5 ton) from the producers of the different pipe system components via customers to the building. Environmental burdens associated with this kind of transport are calculated by means of the Ecoinvent V3.4 datarecords "Transport, freight, lorry 16-32 metric ton, EURO4 {RER}| transport, freight, lorry 16-32 metric ton, EURO4 | Cut-off, U" and "Transport, freight, light commercial vehicle {Europe without Switzerland}| processing | Cut-off, U".
Capacity utilisation (including empty returns)	
Bulk density	
Volume capacity utilisation factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaged product)	

Construction (installation in building/apartment)

Parameter	Parameter unit expressed per functional unit
Ancillary materials for installation	**3 liter of water** for testing, flushing and cleaning. **0,04 kg fast fixing cement** (ratio water/cement 0,3) of which 0,028 kg cement and 0,012 kg water

<table>
<tr><td></td><td>0,03 kg of wall fixing metals, considered to be made out of galvanised steel
Environmental burdens associated with this kind of input flows are calculated by means of the Ecoinvent V3.4 datarecord "Tap water {RER}| market group for | Cut-off, U", "Cement, unspecified {Europe without Switzerland}| cement, Portland to generic market for cement, unspecified | Cut-off, U" and "Steel, unalloyed {RER}| steel production, converter, unalloyed | Cut-off, U", in combination with "Metal working, average for steel product manufacturing {RER}| processing | Cut-off, U"</td></tr>
<tr><td>Other resource consumption</td><td>Not relevant</td></tr>
<tr><td>Quantitative description of energy type (regional mix) and consumption during the installation process</td><td>0,01 kWh of electrical energy is needed for the installation (screw driver)
Environmental burdens associated with this kind of energy are calculated by means of the Ecoinvent V3.4 datarecord "Electricity, low voltage {RER}| market group for | Cut-off, U (European average mix of production)"</td></tr>
<tr><td>Waste on the building site, generated by the product's installation

Output materials as result of waste management processes at the building site e.g. of collection for recycling, for energy recovery, final disposal</td><td>0,006 kg of Polypropylene random copolymer (PP-R) pipe left left over during installation: 80% to landfill, 15% to incineration and 5% to mechanical recycling. Transportation of Polypropylene random copolymer (PP-R) pipe left over to waste management treatment facilities is included: 150 km to incineration with energy recovery and 50 km to landfill. Environmental burdens are calculated by means of the Ecoinvent v3.4 datarecord "Transport, freight, lorry 3.5-7.5 metric ton, EURO4 {RER}| transport, freight, lorry 3.5-7.5 metric ton, EURO4 | Cut-off, U".
0,00878 kg of packaging waste: treated according to European average packaging waste scenarios (Eurostat, 2006):

<table>
<tr><th></th><th>Recycling</th><th>Energy Recovery</th><th>Landfill</th></tr>
<tr><td>Plastic</td><td>27%</td><td>26%</td><td>47%</td></tr>
<tr><td>Paper and board</td><td>75%</td><td>10%</td><td>15%</td></tr>
<tr><td>Wood</td><td>38%</td><td>23%</td><td>39%</td></tr>
<tr><td>Metals</td><td>66%</td><td></td><td>34%</td></tr>
<tr><td>Total</td><td>57%</td><td>12%</td><td>31%</td></tr>
</table>
</td></tr>
<tr><td>Emissions to ambient air, soil and water</td><td>No direct emissions at the building site. Emissions are related to the upstream processes (transportation processes and mechanical energy) and downstream processes (waste management and treatment) and are included in the Ecoinvent datarecords that are used for modelling the environmental impacts.</td></tr>
</table>

4.2 Use stage: operation and maintenance

Operation and maintenance:

Operational use (pumping energy) is not relevant for the EPD, since it falls outside the system boundaries of the LCA project. Maintenance is not needed for the Polypropylene random copolymer (PP-R) Hot & Cold pipe system.

4.3 End of life

The following end of life scenarios have been taken into account:

- Estimated reference service life time of 50 years, being the service life time of the apartment until the first refurbishment
- EoL approach for recycling, landfill and incineration with energy recovery (impacts and credits are assigned to the life cycle that generates the waste flows)
- Recycled content approach for recycling and use of recyclates (= impact of recycling and credits for recyclates, because less virgin materials are needed is assigned to the life cycle that uses the recyclates)

<table>
<tr><th>Processes</th><th>Parameter unit expressed per functional unit</th></tr>
<tr><td>Collection process
Recycling system
Final deposition</td><td>After a reference service life time of 50 years the Polypropylene random copolymer (PP-R) Hot & Cold pipe system might be stripped for recoverable materials and products, and the remaining construction subsequently demolished. The Polypropylene random copolymer (PP-R) Hot & Cold pipe system is demolished together with the total construction. So for the functional unit 0,255 kg of pipe system components are available at the apartment. The brass inserts (0,015 kg) are for 75% recycled (0,011 kg is transported over average distance of 600 km) and for 25% disposed to a landfill (0,004 kg transported over average distance of 50 km). The PP-R pipes and fittings (0,240 kg) follow the following scenario: 5 % (0,012 kg) is transported over a distance of 600 km for mechanical recycling, 15% (0,036 kg) is transported over an average distance of 150 km to an incinerator and 80% (0,192 kg) is transported over an average distance of 50 km to a landfill.
<table>
<tr><th colspan="2">EOL scenario PP-R copolymer pipes</th></tr>
<tr><td>Mechanical recycling</td><td>5,0%</td></tr>
<tr><td>Incineration</td><td>15,0%</td></tr>
<tr><td>Landfill</td><td>80,0%</td></tr>
<tr><th colspan="2">EOL brass inserts of fittings</th></tr>
<tr><td>Recycling</td><td>75,0%</td></tr>
<tr><td>Landfill</td><td>25,0%</td></tr>
</table>
</td></tr>
</table>

	Environmental burdens associated with transportation are calculated by means of the following Ecoinvent v3.4 datarecord "Transport, freight, lorry 3.5-7.5 metric ton, EURO4 {RER}| transport, freight, lorry 3.5-7.5 metric ton, EURO4 | Cut-off, U"

5 ADDITIONAL INFORMATION ON EMISSIONS TO INDOOR AIR, SOIL AND WATER DURING USE STAGE

Emissions to indoor air:
Despite there is no approved European measurement method available, we can confirm that the Polypropylene random copolymer (PP-R) Hot & Cold pipe system does not contain any substances mentioned on the REACH-list.

Emissions to soil and water:
Since the Polypropylene random copolymer (PP-R) Hot & Cold system is installed in the apartment we can confirm that emissions to soil and water are not relevant.

6 OTHER ADDITIONAL INFORMATION

Product certification, conformity, marking

EN 806-1, Specifications for installations inside buildings conveying water for human consumption. Part 1: General

EN 806-2, Specification for installations inside buildings conveying water for human consumption. Part 2: Design

EN 806-3, Specifications for installations inside buildings conveying water for human consumption. Part 3: Pipe sizing. Simplified method

EN ISO 15874-1, Plastics piping systems for hot and cold water installations. Polypropylene (PP). Part 1: General

EN ISO 15874-2, Plastics piping systems for hot and cold water installations. Polypropylene (PP). Part 2: Pipes

EN ISO 15874-3, Plastics piping systems for hot and cold water installations. Polypropylene (PP). Part 3: Fittings In compliance with European Construction Products Directive (89/106/EEC)

Other technical product performances

For the full overview of the environmental benefits of plastic pipe systems we will refer to the TEPPFA website: http://www.teppfa.eu

List of names and logos of TEPPFA member companies

Aliaxis	**Aliaxis**
GEBERIT	**Geberit International**
+GF+	**Georg Fischer Piping Systems**
PIPELIFE	**Pipelife International**
Polypipe	**Polypipe**
REHAU Unlimited Polymer Solutions	**Rehau**
RADIUS Systems	**Radius Systems**
Tessenderlo Group EVERY MOLECULE COUNTS	**Tessenderlo Group**
uponor	**Uponor**
wavin CONNECT TO BETTER	**Wavin**

List of National Associations of TEPPFA

ADPP	-	Czech Republic plastic pipes association
ASETUB	-	Asociación Española de Fabricantes de Tubos y Accesorios Plásticos
BPF	-	Plastic Pipes Group
BureauLeiding	-	Dutch Plastic Pipes Association
DPF	-	Danish Plastics Federation
FCIO	-	Fachverband der Chemischen Industrie Österreich
Federplast.be	-	Belgische Vereniging van Producenten van Kunststof- en Rubberartikelen bij Agoria en Essenscia
FIPIF	-	Finnish Plastics Industries Federation
KRV	-	Kunstoffrohrverband e.V.- Fachverband der Kunstoffrohr-Industrie
MCsSz	-	Műanyag Csőgyártók Szövetsége
IKEM	-	Swedish Plastics and Chemical Federation
PRIK	-	Polish Association of Pipes and Fittings
STR	-	Syndicat des Tubes et Raccords
VKR	-	Verband Kunststoffrohre und Rohrleitungstelle
Unionplast	-	Federazione Gomma Plastica – Pipes Sector Group

List of names and logos of TEPPFA Associated Members

Borealis

LyondellBasell

Vynova

Lubrizol

List of names and logos of TEPPFA Supporting Members

Rollepaal

Molecor

REFERENCES

Ecoinvent, 2018. Ecoinvent database v3.4, Swiss Centre for Life Cycle Inventories, Switzerland. From: www.ecoinvent.org

EN 806-1, Specifications for installations inside buildings conveying water for human consumption. Part 1: General

EN 806-2, Specification for installations inside buildings conveying water for human consumption. Part 2: Design

EN 806-3, Specifications for installations inside buildings conveying water for human consumption. Part 3: Pipe sizing. Simplified method

EN ISO 15874-1, Plastics piping systems for hot and cold water installations. Polypropylene (PP). Part 1: General

EN ISO 15874-2, Plastics piping systems for hot and cold water installations. Polypropylene (PP). Part 2: Pipes

EN ISO 15874-3, Plastics piping systems for hot and cold water installations. Polypropylene (PP). Part 3: Fittings

EN 15804:2012+A1:2013: Sustainability of construction works – Environmental product declarations – core rules for the product category of construction products (2013)

EN 15942: Sustainability of construction works – Environmental product declarations – Communication format – Business to Business

Eurostat, 2006. Packaging waste scenarios (EU27, 2006). From: http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/data/wastestreams/packaging_waste

ISO 14025: Environmental Labels and Declarations Type III

ISO 14040: Environmental management – Life cycle assessment – Principles and framework

ISO 14044: Environmental management – Life cycle assessment – Requirements and guidelines

Background LCA report (ISO 14040 and ISO 14044) prepared by

VITO – Flemish Institute for Technological Research, Boeretang 200, B-2400 Mol, Belgium, Tel.: +32-14-33 55 11, Email: vito@vito.be

External critical review of underlying LCA by

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