European Communication Format – B2B

Environmental Product Declaration

POLYETHYLENE (PE) PIPE SYSTEM FOR WATER SUPPLY, USING HORIZONTAL DIRECTIONAL DRILLING (HDD)

teppfa

CONTENTS

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, TEPPFA has set up an LCA/EPD project with the Flemish Institute for Technological Research (VITO). The present EPD outlines the various environmental aspects, which accompany the Polyethylene pressure pipe systems for water supply, installed by horizontal directional drilling (HDD) technology, 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

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Website: **www.teppfa.eu**

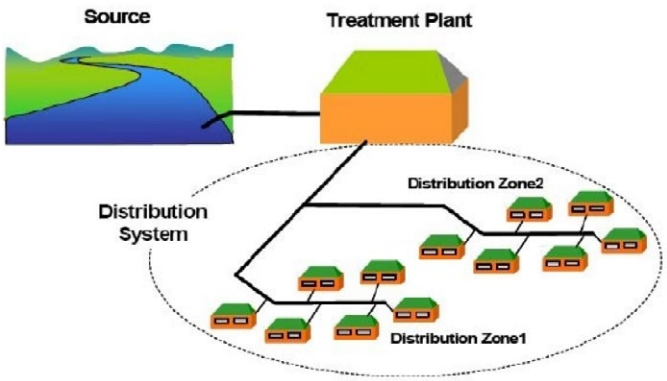
PE pipe system's use and functional unit

The EPD refers to a typical European Polyethylene (PE) pipe system for water supply, using horizontal directional drilling (HDD) installation, from the cradle to the grave, raw material extraction, transportation to converters, converting process, transport to installation location, construction, use and end of life. Environmental indicators are expressed for the complete life cycle, from the cradle to the grave, so for an average European Polyethylene (PE) pipe system for water supply, installed by horizontal directional drilling (HDD).

The functional unit is defined as **"the below ground transportation of drinking water, over a distance of 100 m by a typical public European PE pipe water supply system (DN/OD 110 mm) over its complete life cycle of 100 years, calculated per year".**

Product name & graphic display of product

Polyethylene (PE) pipe system for water supply (DN/OD 110 mm), using horizontal directional drilling (HDD) installation.



Description of the PE pipe system's components

The environmental burdens are calculated in relation to the functional unit, which resulted for the typical European PE pipe system for water supply (DN/OD 110 mm), using HDD installation in the following basic pipe system components: PE pipes; PP protecting layer; detection wire; PE fittings; metal alloy for the PE fittings.

The PE pipe material consists of black polyethylene MRS 10 MPa (PE 100) with blue stripes. The outside pipe has a diameter of 110 mm (as a representative for the average pipe diameter from the exit of the water plant to the water meter of the building). Standard dimension ratio: SDR 11 with wall thickness of 10 mm. The meter weight of the 110 mm pipe has been calculated as average of the data provider companies' products, this resulted in a meter weight of 3,8759 kg. The service life time of 100 years is taken from Schulte and Hessel (2006). 1 type of fittings has been taken into account, PE fittings. The weight of fittings was calculated from company weight/piece data. The flow capacity of a 110 mm SDR 11, PE100 pipe of average roughness is about 1,5 m per second (EN 805 advises that "in practice it will be desirable to avoid unduly high or low velocities. The range 0,5 m/s to 2,0 m/s may be considered appropriate).

The EPD is declared as the average environmental performance for a typical European PE water supply pipe system, installed by HDD, over its reference service life cycle of 100 years, calculated per year, in accordance to EN 12201-1, EN 12201-2, EN 12201-3, EN 12201-4, EN 805 and EN 1295-1.

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 T350 has not been established yet.

Date of declaration and validity

Revision 0, 15 January 2020
The EPD has a 5 year validity period (January, 2025)

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 PE pipe system EPD

The present EPD outlines various environmental aspects, which accompany a typical European PE pipe system for water supply, using HDD installation, from the primary extraction of raw materials up to and including the end of life (EoL) treatment after its reference service life time of 100 years.

Group of manufacturers

The EPD for the PE pipe system is representative for an anticipated European typical PE pipe system for water supply, using HDD installation. 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 15-17 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 any 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

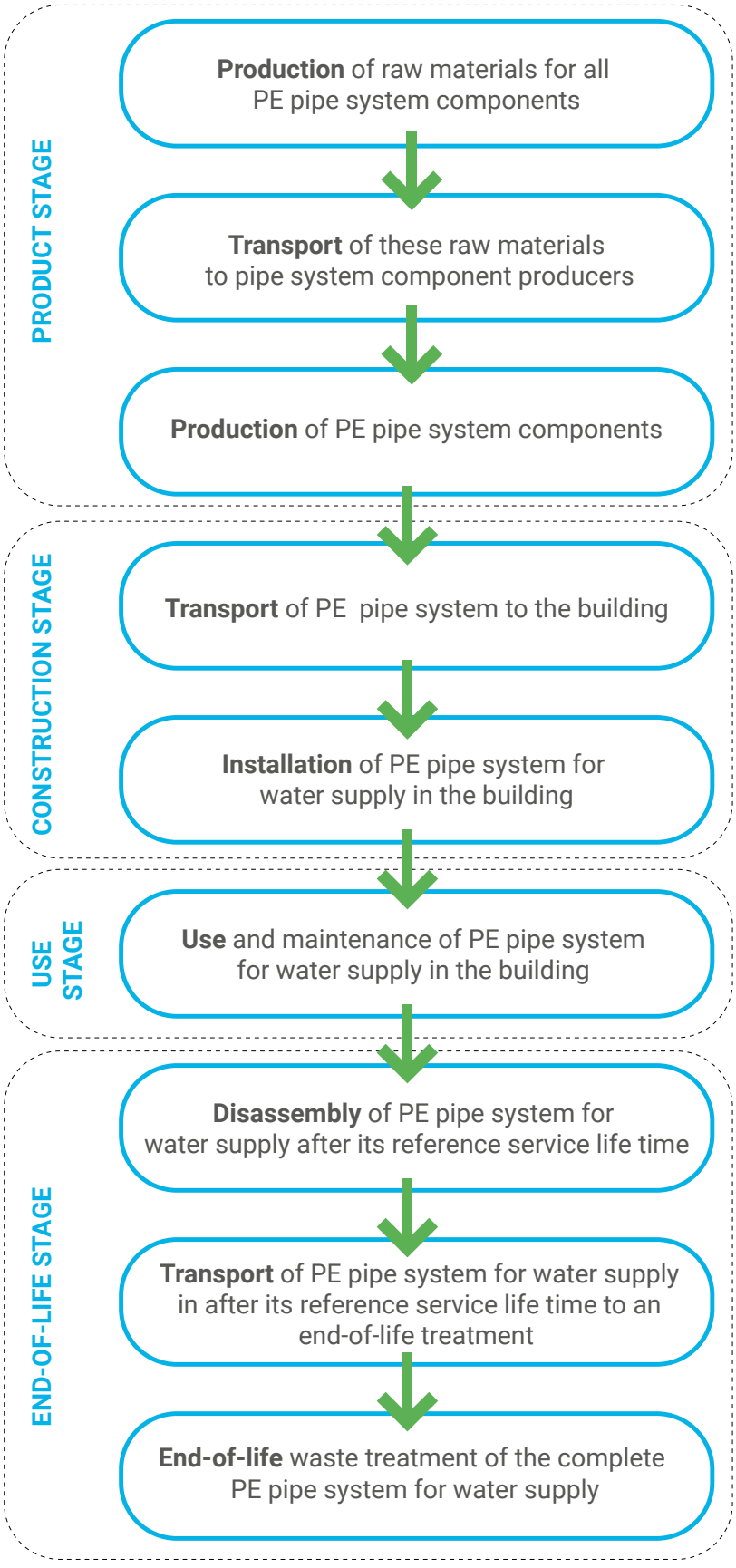
The European Polyethylene (PE) pipe system for water supply, using horizontal directional drilling (HDD) installation does not contain any substances as such or in concentration exceeding legal limits, which can adversely affect human health and the environment in any stages of its entire life cycle.

3. DECLARATION OF THE ENVIRONMENTAL PARAMETERS DERIVED FROM LCA

3.1 Life cycle flow diagram

The EPD refers to a typical European PE pipe system for water supply, installed by HDD, 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 for PE pipes, incl. additives;
  - Transport of PE pipe raw materials to converter;
  - Converting process for PE pipes (extrusion);
  - Production of raw materials for PP protecting layer, incl. additives;
  - Transport of PP pipe raw materials to converter;
  - Converting process for PP protecting layers (extrusion);
  - Production of raw materials for PE fittings;
  - Transport of PE fittings raw materials to converter;
  - Converting process for PE fittings (injection moulding)
- **Construction process stage:** including all energy provisions, waste management processes during the construction stage up to waste for final disposal
  - Transport of complete PE pipe system for water supply to the construction site
  - Installation of complete PE pipe system for water supply by means of horizontal directional drilling
- **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
  - Use and maintenance of the complete PE pipe system for water supply during 100 years of reference service life time
- **End of life stage:** including all energy provisions during the end of life stage
  - Demolition/disassembly of PE pipe system for water supply after 100 years of reference service life time at the installation site
  - Transport of complete PE pipe system for water supply to end of life treatment after 100 years of reference service life time (in case the pipe system does not stay in the ground)
  - End-of-life waste treatment of complete PE pipe system for water supply after 100 years of reference service life time (in case the pipe system does not stay in the ground)


PRODUCT STAGE
Production of raw materials for all PE pipe system components
Transport of these raw materials to pipe system component producers
Production of PE pipe system components
CONSTRUCTION STAGE
Transport of PE pipe system to the building
Installation of PE pipe system for water supply in the building
USE STAGE
Use and maintenance of PE pipe system for water supply in the building
END-OF-LIFE STAGE
Disassembly of PE pipe system for water supply after its reference service life time
Transport of PE pipe system for water supply in after its reference service life time to an end-of-life treatment
End-of-life waste treatment of the complete PE pipe system for water supply

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	A1-3	7,66E-06	3,09E+02	2,34E-02	5,80E-03	8,03E+00	4,22E-07	2,52E-03
Transport to installation	A4	8,84E-07	4,74E+00	1,14E-03	2,06E-04	2,92E-01	5,44E-08	4,81E-05
Installation	A5	3,26E-06	3,32E+01	1,48E-02	3,04E-03	1,93E+00	3,67E-07	5,47E-04
Use	B1-B7	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Disassembly	C1	2,36E-08	1,08E+00	5,31E-04	1,15E-04	6,99E-02	1,27E-08	1,40E-05
Transport to end-of-life treatment	C2	2,01E-07	5,73E-01	1,38E-04	2,39E-05	3,64E-02	6,37E-09	6,34E-06
End-of-life treatment	C3-C4	-1,41E-07	-8,71E-01	-3,15E-04	-2,45E-05	2,25E-01	-6,99E-09	-1,50E-05
TOTAL		**1,19E-05**	**3,47E+02**	**3,97E-02**	**9,16E-03**	**1,06E+01**	**8,56E-07**	**3,12E-03**

3.3 Parameters describing resource input

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

Declaration of environmental paramaters derived from LCI								
Parameters describing resource use, primary energy								
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)
			MJ, net calorific value	MJ, net calorific value	MJ, net calorific value	MJ, net calorific value	MJ, net calorific value	MJ, net calorific value
Product stage	Total (of product stage)	A1-3	na	na	7,06E+00	na	na	3,12E+02
Construction process stage	Transport	A4	na	na	4,67E-02	na	na	4,57E+00
	Construction installation process	A5	na	na	6,96E-01	na	na	3,43E+01
Use stage	Use	B1	0	0	0	0	0	0
	Maintenance	B2	0	0	0	0	0	0
	Repair	B3	0	0	0	0	0	0
	Replacement	B4	0	0	0	0	0	0
	Refurbishment	B5	0	0	0	0	0	0
	Operational energy use	B6	0	0	0	0	0	0
	Operational water use	B7	0	0	0	0	0	0
End of life	De-construction, demolition	C1	na	na	5,84E-03	na	na	1,02E+00
	Transport	C2	na	na	7,32E-03	na	na	5,61E-01
	Waste processing	C3	na	na	-3,69E+00	na	na	-2,56E+01
	Disposal	C4	na	na	3,65E-03	na	na	7,28E-02
TOTAL			na	na	4,13E+00	na	na	3,27E+02

na: not available

Declaration of environmental paramaters derived from LCI						
Parameters describing resource use, secondary materials and fuels, and use of water						
Environmental parameter			Use of secondary material*	Use of renewable secondary fuels*	Use of non renewable secondary fuels*	Net use of fresh water
			kg	MJ, net calorific value	MJ, net calorific value	m3
Product stage	Total (of product stage)	A1-3	0	0	0	1,66E-01
Construction process stage	Transport	A4	na	na	na	7,15E-04
	Construction installation process	A5	na	na	na	4,17E-02
Use stage	Use	B1	0	0	0	0
	Maintenance	B2	0	0	0	0
	Repair	B3	0	0	0	0
	Replacement	B4	0	0	0	0
	Refurbishment	B5	0	0	0	0
	Operational energy use	B6	0	0	0	0
	Operational water use	B7	0	0	0	0
End of life	De-construction, demolition	C1	0	0	0	1,30E-04
	Transport	C2	0	0	0	8,76E-05
	Waste processing	C3	0	0	0	-1,49E-02
	Disposal	C4	0	0	0	1,96E-05
TOTAL			0	0	0	1,94E-01

*only for foreground process from which LCI data are made available by TEPPFA - the number does not include processes and materials modelled by means of background data, eg 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

Declaration of environmental paramaters derived from LCI					
Other environmental information describing waste categories					
Environmental parameter			Hazardous waste	Non-hazardous waste	Radioactive waste
			kg	kg	kg
Product stage	Total (of product stage)	A1-3	3,85E-02	3,42E-01	2,31E-04
Construction process stage	Transport	A4	2,86E-06	2,14E-01	3,07E-05
	Construction installation process	A5	1,06E-02	1,86E-01	1,78E-04
Use stage	Use	B1	0	0	0
	Maintenance	B2	0	0	0
	Repair	B3	0	0	0
	Replacement	B4	0	0	0
	Refurbishment	B5	0	0	0
	Operational energy use	B6	0	0	0
	Operational water use	B7	0	0	0
End of life	De-construction, demolition	C1	4,56E-07	1,12E-03	7,11E-06
	Transport	C2	4,66E-07	1,66E-02	3,58E-06
	Waste processing	C3	-2,82E-05	-6,74E-02	-1,56E-04
	Disposal	C4	3,38E-08	1,00E+00	5,54E-07
TOTAL			4,91E-02	1,69E+00	2,95E-04

Parameters describing further output material flows

Other environmental information describing output flows	
Components for re-use*	9,68E-02 kg
Materials for recycling*	1,53E-01 kg
Materials for energy recovery**	0 kg
Exported energy**	0 MJ per energy carrier

*only for foreground process from which LCI data are made available by TEPPFA - the number does not include processes and materials modelled by means of background data, eg transportation, electricity, ancillary materials...
**the benefits from waste incineration are accounted for within the system boundaries. Therefore no energy nor materials for energy recovery are leaving the system boundaries

4. SCENARIOS AND TECHNICAL INFORMATION

4.1 Construction process stage

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

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 PE pipe system is transported over an average distance of 460 km by means of a truck from the producers of the different pipe system components to the construction site. The loading factor for PE pipes is limited by volume. Environmental burdens associated with this kind of transport are calculated by means of the Ecoinvent V3.5 datarecord “Transport, freight, lorry 16-32 metric ton, EURO4 {RER}| transport, freight, lorry 16-32 metric ton, EURO4	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 products)	

Construction (installation at construction site)

<table>
<tr><th>Parameter</th><th>Parameter unit expressed per functional unit</th></tr>
<tr><td>Ancillary materials for installation</td><td>4,30E-02 m³ of drilling fluid is necessary, which consists of 96,3% of water and 3,7% of bentonite. Thus 41,41 kg of water are necessary for the functional unit, and 9,39E-01 kg of bentonite.
Environmental burdens associated with these ancillary materialsare calculated by means of the Ecoinvent V3.5 datarecord “Tap water {RER}| market group for | Cut-off, U” “Activated bentonite {DE}| production | 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>A total of 14,88 MJ of diesel consumption related to drilling process are necessary, as follows: for drilling unit (drilling): 6,65 MJ, for drilling fluid pumping system: 3,50 MJ and for drilling unit (pull in): 4,73 MJ. Environmental burdens associated with this kind of energy are calculated by means of the Ecoinvent V3.5 datarecords modelled with ecoinvent record “Diesel, burned in building machine {GLO}| processing | Cut-off, U”:
A total of 7,46E-03 kWh electricity was used for butt welding and 1,39E-02 kWh for electrofusion for the functional unit. Environmental burdens associated with this kind of energy are calculated by means of the Ecoinvent V3.5 datarecords “Electricity, low voltage {RER}| market group for | Cut-off, U”.
1,05 MJ of mechanical energy is needed for excavating the soil (dig up), for excavating the backfilling soil and sand, for the stamping process (compaction next pipe) and for the vibration plate (compaction top). Environmental burdens associated with this kind of energy are calculated by means of the Ecoinvent V3.5 datarecords “Diesel, burned in building machine {GLO}| processing | Cut-off, U”</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>A total of 1,93E-02 kg of PE pipe and PP protective layer is released as left over waste during installation: 80% to landfill, 15% to incineration and 5% to mechanical recycling. Transportation of PE pipe and PP protective layer left over to waste management treatment facilities is included: 600 km to recycling plant, 150 km to incineration with energy recovery and 50 km to landfill. Environmental burdens are calculated by means of the Ecoinvent v3.5 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”.
3,00E-02 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 installation site. Emissions are related to the upstream processes (mining of sand, 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 PE pipe system for water supply.

4.3 End of life

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

- Estimated reference service life time of 100 years (Schulte and Hessel, 2006)
- EoL approach for landfill, 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</td><td>After a reference service life time of 100 years the PE pipe system for water supply might be replaced. In most cases (95%) the pipe system will be left in the ground. In some cases (5%) the pipe system is taken out and treated (recycled, incinerated or landfilled).

<table>
<tr><th colspan="2">EOL scenario PE HDD pipes</th></tr>
<tr><td>Mechanical recycling</td><td>2,5%</td></tr>
<tr><td>Incineration</td><td>2,5%</td></tr>
<tr><td>Left in ground</td><td>95%</td></tr>
</table>

The transportation distance of the PE pipe system from the installation site to a waste treatment facility depends on the treatment option. For mechanical recycling we assumed an average transportation distance of 600 km and for incineration an average distance of 150 km. Environmental burdens associated with transportation are calculated by means of the following Ecoinvent v3.5 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”</td></tr>
</table>

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

Emissions to indoor air:

Since the PE pipe system for water supply is a buried system we can confirm that emissions to indoor air are not relevant.

Emissions to soil and water:

Since the PE pipe system for water supply is a buried system we can confirm that emissions to indoor air are not relevant.

6. OTHER ADDITIONAL INFORMATION

Product certification, conformity, marking

EN 805, Water supply. Requirements for systems and components outside buildings

EN 1295-1, Structural design of buried pipelines under various conditions of loading. Part 1: General requirements

EN 12201-1, Plastics piping systems for water supply. Polyethylene (PE). Part 1: General

EN 12201-2, Plastics piping systems for water supply. Polyethylene (PE). Part 2: Pipes

EN 12201-3, Plastics piping systems for water supply. Polyethylene (PE). Part 3 Fittings

EN 12201-4, Plastics piping systems for water supply. Polyethylene (PE). Part 4: Valves

Other technical product performances

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

List of names and logos of TEPPFA member companies

Aliaxis

DYKA

Geberit International

Georg Fischer Piping Systems

LK

Nupi

Pipelife International

Polypipe

Rehau

Radius Systems

Uponor

Wavin

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
Essenscia PolyMatters	Belgian Federation for Chemistry and Life Sciences industries
FIPIF	Finnish Plastics Industries Federation
IPPMA	Irish Plastic Pipe Manufacturers Association
KRV	Kunstoffrohrverband e.V.- Fachverband der Kunstoffrohr-Industrie
MCsSz	Műanyag Csőgyártók Szövetsége
NPG Sweden	Swedish Plastic Pipe Association
PRIK	Polish Association of Pipes and Fittings
STR	Syndicat des Tubes et Raccords
VKR	Verband Kunststoffrohre und Rohrleitungstelle

List of names and logos of TEPPFA Associated Members

Borealis

ECVM

LyondellBasell

Lubrizol

Molecor

List of names and logos of TEPPFA Supporting Members

Rollepaal

7. REFERENCES

CEN TC 350 Sustainability of construction works – Environmental product declarations – core rules for the product category of construction products (2013)

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 Busiess (2011)

Ecoinvent, 2018. Ecoinvent database v3.5, Swiss Centre for Life Cycle Inventories, Switzerland. From: www.ecoinvent.org

ISO, 2006
*ISO 14025, (2006), Environmental labels and declarations -- General principles.
*ISO 14040, (2006), Environmental management – Life cycle assessment – Principles and framework.
*ISO 14044, (2006) Environmental management – Life cycle assessment – Requirements and guidelines.

EN 12201-1, Plastics piping systems for water supply. Polyethylene (PE). Part 1: General

EN 12201-2, Plastics piping systems for water supply. Polyethylene (PE). Part 2: Pipes

EN 12201-3, Plastics piping systems for water supply. Polyethylene (PE). Part 3 Fittings

EN 12201-4, Plastics piping systems for water supply. Polyethylene (PE). Part 4: Valves

EN 805, Water supply. Requirements for systems and components outside buildings

EN 1295-1, Structural design of buried pipelines under various conditions of loading. Part 1: General requirements

Schulte U. and Hessel J., 2006. Remaining service life of plastic pipes after 41 years in service

Fachberichte, 3R International (45), Heft 9/2006 (5 pages)

SimaPro, 2019. SimaPro LCA Software 9.0.0.30, PRé consultants bv, Amersfoort, The Netherlands

Spirinckx C., Vanderreydt I., Vercalsteren A. and Boonen K., 2011. Life Cycle Assessment of a PE pipe system for water distribution (according to EN 12201) Spirinckx.

Final LCA background report

Reference: 2010/TEM/R/227

Life Cycle Assessment of a PP pipe system for soil and waste removal in the building (according to EN 1451)

Spirinckx C., Vanderreydt I., Vercalsteren A., and Boonen K., 2011

Final LCA background report

Reference: 2010/TEM/R/231

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

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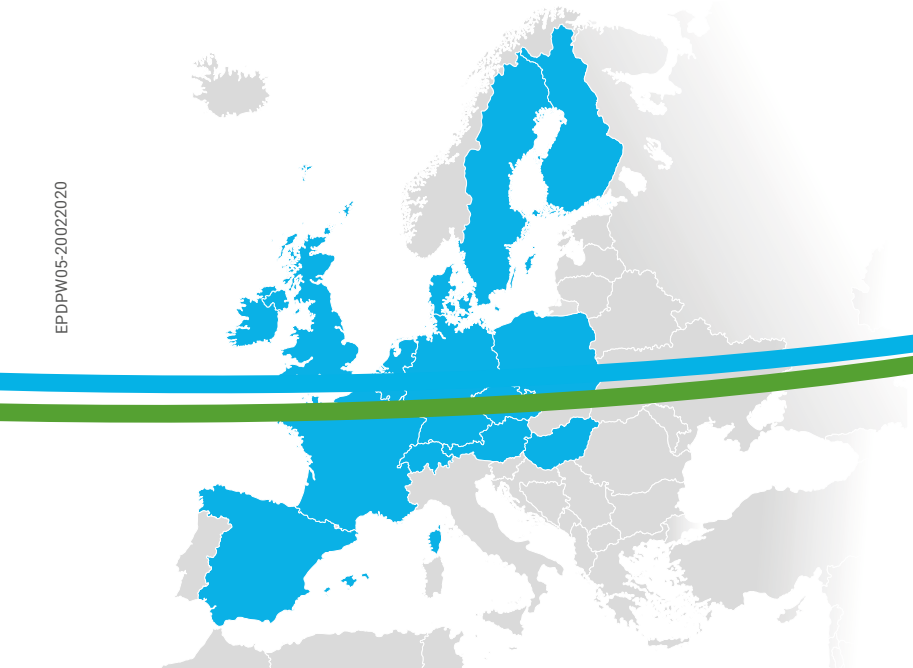

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