European Communication Format – B2B

Environmental Product Declaration

Polyethylene (PE) DN/OD 400 mm pipe system for water distribution

1 DECLARATION OF GENERAL INFORMATION

Introduction

PE100+ deems it important to have insight into the integral environmental burdens encountered during the life span of a PE pipe system (DN/OD 400 mm) for water distribution. PE100+ wishes to get information on the entire life cycle of the systems, from the cradle-to-the grave. With this framework in mind, PE100+ 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 (PE) pipe system for water distribution, from the primary extraction of raw materials up to and including the end of life (EoL) treatment after its reference service life time.

The PE100+ Association's principal objectives are:

- guaranteeing consistent quality at the highest level in both the production and usage of PE 100+ pipe materials;
- creating a marketing platform to promote the use of polyethylene ('PE') piping in general;
- maintaining a focused communication effort towards pipe installers and end-users to promote the use of PE piping in general.

Name and address of manufacturers

PE100+ Association, P.O.Box 137, NL-7300 AC Apeldoorn, The Netherlands
Website : www.pe100plus.com

PE pipe system's use and functional unit

The EPD refers to a typical European Polyethylene (PE) pipe system for water distribution with a DN/OD 400 mm, from the cradle to the grave, raw material extraction, transportation to converters, converting process, transport to trench, 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 PE pipe system. The functional unit is defined as "***The below ground transportation of drinking water, over a distance of 100 m, by typical public European PE water distribution system (DN/OD 400 mm) over its complete life cycle of 100 years, calculated per year.***

Product name & graphic display of product

The functional unit concerns a 100 m installed pipe system. The picture below shows the pipes as pieces of the system.

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 distribution which consists of PE pipes with two types of fittings (electrofusion, butt-welding). The PE pipe material consists of PE100 marked with stripes. The pipe has a diameter of DN/OD 400 mm. Standard dimension ratio: SDR 17 with wall thickness of 23,7 mm. The service life time of 100 years is taken from: Ulrich Schulte and Joachim Hessel, 2006. 2 types of jointing have been taken into account: electro fusion, and butt welding.
The EPD is declared as the average environmental performance for a typical European PE pipe system with a DN/OD 400 mm, over its reference service life cycle of 100 years, calculated per year.

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

July, 2013
The EPD has a 5 year validity period (July, 2018)

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 with DN/OD 400 mm for water distribution, 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 (DN/OD 400 mm) for water distribution. The PE100+ member companies represent more than 50% of the European market for extruded PE pressure pipes. For an overview of all members within PE100+ we refer to the last page 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 PE100+ (contact@pe100plus.com)

2 DECLARATION OF THE MATERIAL CONTENT

The European Polyethylene (PE) pipe system for water distribution 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.

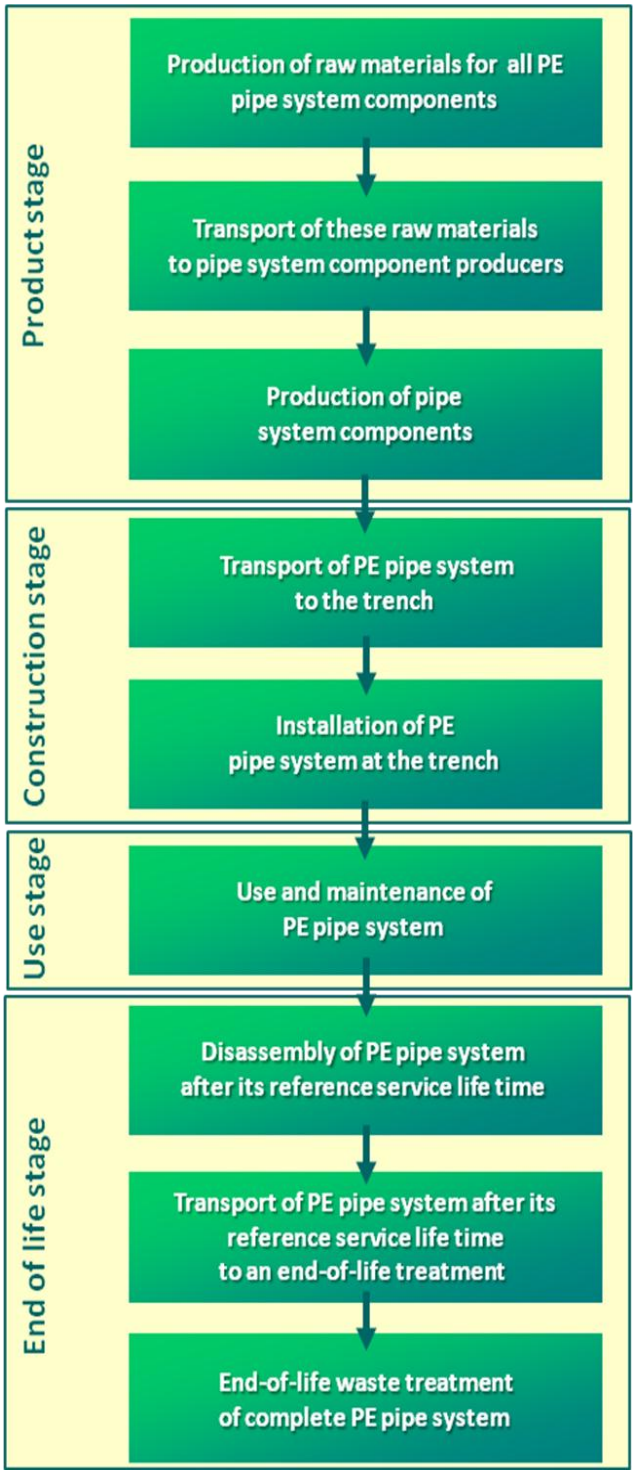
3 DECLARATION OF THE ENVIRONMENTAL PARAMETERS DERIVED FROM LCA

Life cycle flow diagram

The EPD refers to a typical European PE pipe system for water distribution, from the cradle to the grave, including product stage, transport to construction site and construction process stage, use stage and end of life stage (in line with the EN 15804 prepared by Technical Committee CEN/TC 350 (CEN TC 350, 2012):

- **Product stage**:
  - Production of raw materials for PE pipes, incl. additives;
  - Transport of PE pipe raw materials to converter;
  - Converting process for PE pipes (extrusion);
- **Construction process stage**:
  - Transport of complete PE pipe system to the trench;
  - Installation of complete PE pipe system at the trench, including generation of fittings by means of butt-welding and electrofusion;
- **Use stage:**
  - Maintenance of the complete PE pipe system during 100 years;
  - Operational use of the complete PE pipe system during 100 years;

- **End of life stage**:
  - Disassembly of complete PE pipe system after 100 years reference service life time (in case the PE pipe system does not stay in the ground);
  - Transport of complete PE pipe system after 100 years reference service life time to an end-of-life treatment (in case the PE pipe system does not stay in the ground);
  - End-of-life treatment of complete PE pipe system (in case the PE pipe system does not stay in the ground).



Parameters describing environmental impacts

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

Parameters describing environmental impacts								
		Abiotic depletion non-fossil resources	Abiotic depletion fossil resources	Acidification	Eutrophication	Global warming (GWP100)	Ozone layer depletion (ODP)	Photochemical oxidation
		kg Sb eq	MJ primary	kg SO2 eq	kg PO4--- eq	kg CO2 eq	kg CFC-11 eq	kg C2H4
Product stage								
Total of product stage	A1-3	4,25E-05	2,31E+03	2,41E-01	4,57E-02	6,73E+01	1,69E-06	2,00E-02
Construction process stage								
Transport of complete pipe system to the trench	A4	8,47E-06	27,59310	5,34E-03	1,41E-03	1,72839	2,81E-07	2,16E-04
Installation of PE pipe system	A5	2,80E-05	125,19710	5,41E-02	1,39E-02	8,90363	1,07E-06	1,65E-03
Use stage								
Use	B1	0	0	0	0	0	0	0
Maintenance	B2	0	0	0	0	0	0	0
Repair	B3	0	0	0	0	0	0	0
Replacement	B4	0	0	0	0	0	0	0
Refurbishment	B5	0	0	0	0	0	0	0
Operational energy use	B6	not considered						
Operational water use	B7	not considered						
End of life stage								
Disassembly	C1	1,44E-07	0,97257	4,75E-04	1,14E-04	0,06408	7,96E-09	1,32E-05
Transport of complete pipe system to EoL treatment	C2	2,02E-06	3,84333	7,30E-04	2,05E-04	0,25114	3,81E-08	3,18E-05
Waste processing	C3	0	0	0	0	0	0	0
EoL of PE pipe system	C4	-2,41E-06	-11,22810	-3,15E-03	-2,54E-03	1,32685	-3,67E-08	-1,60E-04
Total		**7,88E-05**	**2451,59058**	**0,29895**	**0,05876**	**79,5898829**	**3,05E-06**	**0,02180**

Parameters describing resource input

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

Parameters describing resource use, primary energy							
		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, gross calorific value*	MJ, gross calorific value*	MJ, gross calorific value*	MJ, gross calorific value*	MJ, gross calorific value*	MJ, gross calorific value*
Product stage							
Total (of product stage)	A1-3	na	na	5,65E+01	na	na	2,52E+03
Construction process stage							
Transport	A4	na	na	3,28E-01	na	na	2,91E+01
Construction installation process	A5	na	na	3,95E+00	na	na	1,44E+02
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	not considered					
Operational water use	B7	not considered					
End of life							
De-construction, demolition	C1	na	na	6,95E-03	na	na	1,00E+00
Transport	C2	na	na	8,27E-02	na	na	4,23E+00
Waste processing	C3	na	na	0	na	na	0
Disposal	C4	na	na	-1,68E+00	na	na	-1,85E+01

*Energy use is expressed in MJ, gross calorific value. According to EN15804 these categories should be expressed in MJ, net calorific value. There is no method available to calculate the net calorific value.

Parameters describing resource use, secondary materials and fuels, and use of water					
		Use of secondary material**	Use of renewable secondary fuels**	Use of non renewable	Net use of fresh water
		kg	MJ, gross calorific value*	MJ, gross calorific value*	m3
Product stage					
Total (of product stage)	A1-3	1,39E+00	0	0	2,02E-01
Construction process stage					
Transport	A4	na	na	na	6,94E-03
Construction installation process	A5	na	na	na	1,07E+00
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	not considered			
Operational water use	B7	not considered			
End of life					
De-construction, demolition	C1	0	0	0	1,22E-04
Transport	C2	0	0	0	1,03E-03
Waste processing	C3	0	0	0	0
Disposal	C4	0	0	0	-7,32E-03

*Energy use is expressed in MJ, gross calorific value. According to EN15804 these categories should be expressed in MJ, net calorific value. There is no method available to calculate the net calorific value.

**only for foreground process from which LCI data are made available by the insulation producing company - the number does not include processes and materials modelled by means of background data, eg transportation, electricity, ancillary materials...

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

Other environmental information describing waste categories				
		Hazardous waste disposed	Non hazardous waste disposed	Radioactive waste disposed
		kg	kg	kg
Product stage				
Total (of product stage)	A1-3	1,93E-01	1,46E+00	1,03E-03
Construction process stage				
Transport	A4	2,77E-05	2,05E-01	1,97E-05
Construction installation process	A5	1,24E-04	1,68E+00	2,47E-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	not considered		
Operational water use	B7	not considered		
End of life				
De-construction, demolition	C1	6,18E-07	1,59E-03	3,84E-07
Transport	C2	4,58E-06	2,11E-02	5,17E-06
Waste processing	C3	0	0	0
Disposal	C4	-2,18E-05	-2,30E-02	-1,02E-04

Parameters describing further output material flows

Other environmental information describing output flows		
Components for re-use**	2,70E+01	kg
Materials for recycling**	1,31E+00	kg
Materials for energy recovery**	8,97E-01	kg
Exported energy**	7,18E-01	MJ

**only for foreground process from which LCI data are made available by the insulation producing company - the number does not include processes and materials modelled by means of background data, eg transportation, electricity, ancillary materials...

4 SCENARIOS AND TECHNICAL INFORMATION

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 500 km by means of a truck from the producers of the pipes to the trench. The average loading capacity is 36% with an average actual load of 8,7 tons. 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 V2.2 datarecord "Transport, lorry >32t, EURO5, RER".
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 trench)

Parameter	Parameter unit expressed per functional unit
Ancillary materials for installation	**0,4395 m³ of backfilling sand** trucked to trench over an average distance of 10 km. Environmental burdens are calculated by means of the Ecoinvent V2.2 datarecord "Sand, at mine/CH + Transport, lorry >32t, EURO5, RER"
Other resource consumption	Not relevant
Quantitative description of energy type (regional mix) and consumption during the installation process	**53 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 V2.2 datarecords "Diesel, burned in building machine,GLO" and "Diesel, burned in chopper, RER" are used.
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**	**0,568 kg of PE pipe left left over** during installation: 80% to landfill, 15% to incineration and 5% to mechanical recycling. Transportation of PE pipe 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 v2.2 datarecord "Transport, lorry 3.5-7.5t, EURO5, RER". **0,780602 kg of packaging waste**: treated according to European average packaging waste scenarios (EU27, 2006): **0,5652 m³ of soil** that has to be transported over an average distance of 5 km to the nearest depot. Environmental burdens are calculated by means of the Ecoinvent v2.2 datarecord "Transport, lorry 3.5-7.5t, EURO4/tkm/RER".
Emissions to ambient air, soil and water	No direct emissions at the trench. 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.

	Recycling	Energy Recovery	Landfill
Plastic	27%	26%	47%
Paper and board	75%	10%	15%
Wood	38%	23%	39%
Metals	66%		34%
Total	**57%**	**12%**	**31%**

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 distribution.

End of life

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

- Estimated reference service life time of 100 years (Ulrich Schulte and Joachim 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)

Processes	Parameter unit expressed per functional unit
Collection process	After a reference service life time of 100 years the PE pipe system for water distribution 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 (landfilled or incinerated).

EOL scenario PE pipes	*Present*
Mechanical recycling	2,5%
Incineration	2,5%
Left in ground	95%

The transportation distance of the PE pipe system from the trench 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 v2.2 datarecord "Transport, lorry 3.5-7.5t, EURO5/RER U"

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 distribution is a buried system (in trench) we can confirm that emissions to indoor air are not relevant.

Emissions to soil and water:
Despite there is no approved European measurement method available, we can confirm that the PE pipe system for water distribution does not contain any substances mentioned on the REACH-list.

6 OTHER ADDITIONAL INFORMATION

Product certification, conformity, marking

The PE100+ Association ensures the very highest quality of PE 100 products by continuously monitoring three fundamental properties:

- Creep Rupture Strength
- Stress Crack Resistance
- Resistance to Rapid Crack Propagation

On behalf of the PE100+ Association, Kiwa Gastec Certification B.V., an independent testing authority in the Netherlands repeats those test rounds together with various independent and internationally respected laboratories every nine months.

For PE100+ Quality Materials, see www.pe100plus.com/PE-Pipes/materials/high-quality,i239.html

Other technical product performances

For the full overview of the environmental benefits of plastic pipe systems one can refer to the TEPPFA website: http://www.teppfa.org

List of names and logos of PE100+ member companies

Borealis

Borouge

Ineos

LyondellBasell

Prime Polymer

SABIC

SCG Plastics

Tasnee Marketing

Total

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VITO, Mol, Belgium

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