

European Communication Format – B2B

Environmental Product Declaration

POLYVINYLCHLORIDE (PVC-U) SOLID WALL
SEWER PIPE SYSTEM



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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 lifespan 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 2012 – foreground data remained the same, with only the datasets being updated to the latest available version (Ecoinvent 3.3 and Industry 2.0 replaced Ecoinvent 2 datasets).

It outlines the various environmental aspects, which accompany the polyvinylchloride (PVC-U) solid wall sewer pipe system, from the primary extraction of raw materials up to and including the end of life (EoL) treatment after its reference service lifetime.

Name and address of manufacturers

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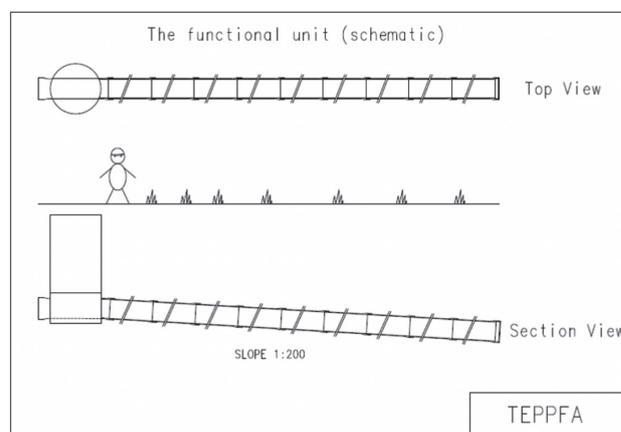
PVC-U pipe system's use and functional unit

The EPD refers to a typical European PVC-U solid wall sewer pipe system, from the cradle to the grave, including raw material extraction, transportation to converters, converting process, transportation 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 PVC-U solid wall sewer pipe system.

The functional unit is defined as "The below ground gravity transportation of sewage over a distance of 100 m by a typical public European PVC solid wall pipe system (Ø 250mm) from the entrance of a public sewer system to the entrance of the waste water treatment plant, over its complete service life cycle of 100 years, calculated per year".

Product name & graphic display of product

PVC-U solid wall sewer pipe system (civil applications)



Description of the PVC-U solid wall sewer pipe system components

The environmental burdens are calculated in relation to the functional unit, which resulted for the typical European PVC-U solid wall sewer pipe system in the following basic pipe system components: PVC pipes, PVC fittings, PP manholes and SBR sealing rings.

The system consists of PVC solid wall pipes and fittings, red brown, SN 4, diameter 250 mm, 5 m length, socketed (representative for the typical pipe diameter from the entrance of a public sewer system to the entrance of the waste water treatment plant).

Manhole roughly every 45 metres (630 mm shaft – SMP report, 2005). The manhole covers are not included in the LCA study. Volume of fittings including seals (approximately 5%) are calculated based on actual sales data. The pipe system has a reference length of 100 metres; slope 1/200 and filling rate 100%. Service lifetime of 100 years (TNO report, 2008).

The EPD is declared as the average environmental performance for a typical European PVC-U solid wall sewer pipe system, over its reference service life cycle of 100 years, calculated per year, in accordance to EN 1401-1, EN 1401-2, EN 1295-1 and EN 1610.

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 TC 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 PVC-U solid wall sewer pipe system EPD

The present EPD outlines various environmental aspects, which accompany a representative average European PVC-U solid wall sewer pipe system, from the primary extraction of raw materials up to and including the end of life (EoL) treatment after its reference service lifetime of 100 years.

Group of manufacturers

The EPD for the PVC-U solid wall sewer pipe system is representative for an anticipated European typical PVC-U solid wall sewer 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 12-14 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 Polyvinylchloride (PVC-U) solid wall sewer 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 PVC-U solid wall sewer pipe system, from the cradle to the grave, including product stage, transportation 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 PVC-U pipes
- Transportation of PVC-U pipe raw materials to converter
- Converting process for PVC-U solid wall pipes (extrusion), including packing of the pipes
- Production of raw materials for PVC-U fittings
- Transportation of PVC-U fittings raw materials to converter
- Converting process for PVC-U fittings (injection moulding), including packing of the fittings
- Production raw materials for PP manholes
- Converting process for PP manholes (injection moulding), including packing of the manholes
- Production raw materials for SBR rings
- Converting process for SBR rings, including packing of the SBR rings

■ **Construction process stage:** including all energy provisions, waste management processes during the construction stage up to waste for final disposal:

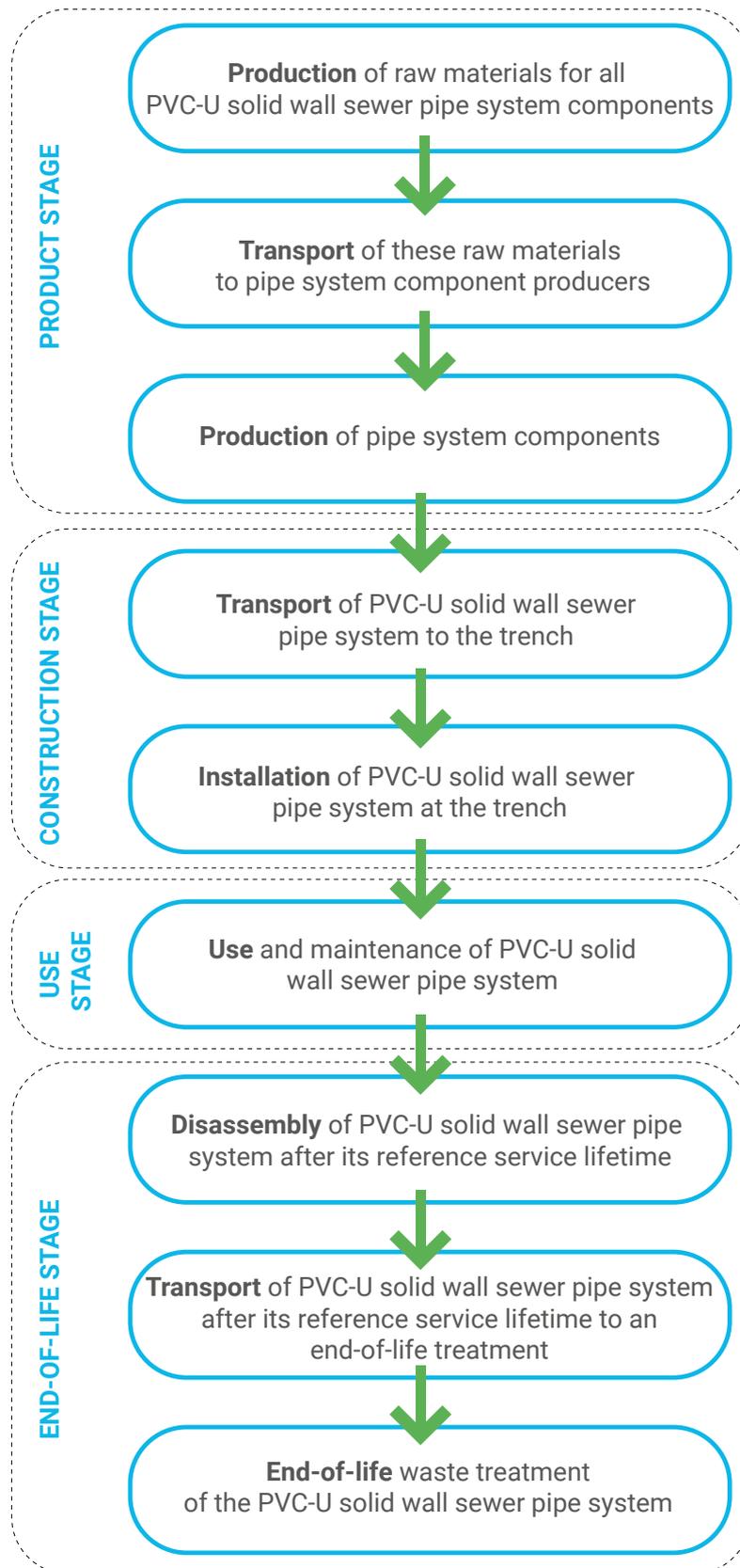
- Transportation of PVC-U solid wall sewer pipe system to the trench
- Installation of PVC-U solid wall pipe system in the trench

■ **Use stage (maintenance and operational use):** including transportation and all energy provisions, waste management processes up to waste for final disposal during this use stage

- Operational use is not relevant for the PVC-U solid wall sewer pipe system
- Maintenance of the PVC-U solid wall sewer pipe system during 100 years of reference service lifetime in the trench

■ **End of life stage:** including all energy provisions during the end of life stage

- Disassembly of PVC-U solid wall sewer pipe system after 100 years of reference service lifetime at the trench
- Transportation of PVC-U solid wall sewer pipe system after 100 years of reference service lifetime at the trench to an end-of-life treatment
- End-of-life treatment of PVC-U solid wall pipe system after 100 years of reference service lifetime at the trench to an end-of-life treatment



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 SO ₂ eq | kg PO ₄ --- eq | kg CO ₂ eq | kg CFC-11 eq | kg C ₂ H ₄ eq |
| Product stage | 9,23E-05 | 4,65E+02 | 5,31E-02 | 9,01E-03 | 1,90E+01 | 6,46E-06 | 3,86E-03 |
| Construction process stage | 1,03E-05 | 1,02E+02 | 4,36E-02 | 9,13E-03 | 6,66E+00 | 1,27E-06 | 1,34E-03 |
| Use stage | 3,13E-07 | 8,49E+00 | 4,17E-03 | 8,69E-04 | 5,62E-01 | 9,90E-08 | 1,20E-04 |
| End of life stage | 3,50E-07 | 1,10E+00 | 3,44E-04 | 9,70E-05 | 3,45E-01 | 1,59E-08 | 1,26E-05 |
| TOTAL | 1,03E-04 | 5,77E+02 | 1,01E-01 | 1,91E-02 | 2,65E+01 | 7,83E-07 | 5,34E-03 |

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 | m ³ |
| Product stage | na | na | 4,26E+01 | na | na | 5,22E+02 | na | na | na | 1,35E+00 |
| Construction process stage | na | na | 3,66E+00 | na | na | 1,09E+02 | na | na | na | 7,65E-01 |
| Use stage | na | na | 1,30E-01 | na | na | 8,42E+00 | na | na | na | 1,22E-01 |
| End of life stage | na | na | -1,92E-01 | na | na | 1,45E-01 | na | na | na | -7,18E-04 |
| TOTAL | na | na | 4,62E+01 | na | na | 6,39E+02 | na | na | na | 2,24E+00 |

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 | 2,88E+00 | 6,83E-01 | 4,29E-04 |
| Construction stage | 5,54E-05 | 1,92E+00 | 8,25E-04 |
| Use stage | 5,02E-06 | 1,43E-02 | 5,73E-05 |
| End of life stage | -6,00E-07 | 8,45E+00 | 4,00E-06 |
| TOTAL | 2,88E+00 | 1,11E+01 | 1,32E-03 |

Parameters describing further output material flows

| Parameter | Parameter unit expressed per functional unit |
|-------------------------------|--|
| Components for re-use | 8,063 kg |
| Materials for recycling | 0,219 kg |
| Materials for energy recovery | 0,233 kg |

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 PVC-U solid wall sewer 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 trench. The average loading capacity is 26% with an average actual load of 7 tons. The loading factor for PVC-U pipes is limited by volume. Environmental burdens associated with this kind of transport are calculated by means of the Ecoinvent V3.3 datarecord "Transport, freight, lorry 16-32 metric ton, EURO4 {RER} transport, freight, lorry 16-32 metric ton, EURO4 Alloc Rec, 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 trench)

| Parameter | Parameter unit expressed per functional unit | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|-----------------|------------|-----------------|----------|---------|-----|-----|-----|-----------------|-----|-----|-----|------|-----|-----|-----|--------|-----|--|-----|--------------|------------|------------|------------|
| Ancillary materials for installation | 0,31 m³ of backfilling sand trucked to trench over an average distance of 10 km. Environmental burdens associated with this kind of energy are calculated by means of the Ecoinvent V3.3 datarecords "Sand {CH} gravel and quarry operation Alloc Rec, U" and "Transport, freight, lorry >32 metric ton, EURO4 {RER} transport, freight, lorry >32 metric ton, EURO4 Alloc Rec, U" Building hall is excluded from the background dataset for sand due to irregularities related to the impact on abiotic depletion (non-fossil). | | | | | | | | | | | | | | | | | | | | | | | | |
| Other resource consumption | Not relevant | | | | | | | | | | | | | | | | | | | | | | | | |
| Quantitative description of energy type (regional mix) and consumption during the installation process | 44,5 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 V3.3 datarecord "Diesel, burned in building machine {GLO} processing Alloc Rec, U" | | | | | | | | | | | | | | | | | | | | | | | | |
| Waste on the building site, generated by the product's installation | 0,14 kg of PVC pipe left over during installation: 80% to landfill, 15% to incineration and 5% to mechanical recycling. Transportation of PVC 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 V3.3 datarecord "Transport, freight, lorry 3.5-7.5 metric ton, EURO4 {RER} transport, freight, lorry 3.5-7.5 metric ton, EURO4 Alloc Rec, U". | | | | | | | | | | | | | | | | | | | | | | | | |
| Output materials as result of waste management processes at the building site e.g. of collection for recycling, for energy recovery, final disposal | <p>0,2 kg of packaging waste: treated according to European average packaging waste scenarios (EU27, 2006):</p> <table border="1"> <thead> <tr> <th></th> <th>Recycling</th> <th>Energy Recovery</th> <th>Landfill</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>0,36 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 V3.3 datarecord "Transport, freight, lorry 3.5-7.5 metric ton, EURO4 {RER} transport, freight, lorry 3.5-7.5 metric ton, EURO4 Alloc Rec, U".</p> | | 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% |
| | 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% | | | | | | | | | | | | | | | | | | | | | | |
| 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. | | | | | | | | | | | | | | | | | | | | | | | | |

4.2 Use stage: operation and maintenance

Operation:

Operational use is not relevant for the EPD, since it falls outside the system boundaries of the LCA project. Moreover, the PVC-U solid wall sewer pipe system is a gravity pipe system.

Maintenance:

Energy consumption for jetting: 5,4 kWh per FU

Water consumption for jetting: 0,12 m³ per FU

Maintenance in case of the PVC-U solid wall sewer pipe systems is specifically related to jetting. Jetting happens 4 times in a 100 year service lifetime. One jetting operation needs an energy consumption of 4 litres of gasoline and 3 m³ of water per 100 metres of pipe system.

4.3 End of life

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

- Estimated reference service lifetime of 100 years (Source: TNO report, 2008, Quality of PVC sewage pipes in the Netherlands service lifetime PVC).
- 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 | <p>After a reference service lifetime of 100 years the PVC-U solid wall sewer pipe system 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).</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="background-color: #cccccc;">EOL scenario PVC-U pipes</th> </tr> </thead> <tbody> <tr> <td>Mechanical recycling</td> <td style="text-align: center;">2,5%</td> </tr> <tr> <td>Incineration</td> <td style="text-align: center;">2,5%</td> </tr> <tr> <td>Left in ground</td> <td style="text-align: center;">95%</td> </tr> </tbody> </table> <p>The transportation distance of the PVC-U 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 V3.3 data record "Transport, freight, lorry 3.5-7.5 metric ton, EURO4 {RER} transport, freight, lorry 3.5-7.5 metric ton, EURO4 Alloc Rec, U"</p> | EOL scenario PVC-U pipes | | Mechanical recycling | 2,5% | Incineration | 2,5% | Left in ground | 95% |
| EOL scenario PVC-U pipes | | | | | | | | | |
| Mechanical recycling | | 2,5% | | | | | | | |
| Incineration | | 2,5% | | | | | | | |
| Left in ground | 95% | | | | | | | | |
| Recycling system | | | | | | | | | |
| Final deposition | | | | | | | | | |

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

Emissions to indoor air:

Since the PVC-U solid wall sewer pipe system 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 PVC-U solid wall sewer pipe system does not contain any substances mentioned on the REACH-list.

6. OTHER ADDITIONAL INFORMATION

Product certification, conformity, marking

EN 1401-1, Plastics piping systems for non-pressure underground drainage and sewerage. Unplasticized poly (vinyl chloride) (PVC-U). Part 1: Specifications for pipes, fittings and the system

EN 1401-2, Plastics piping systems for non-pressure underground drainage and sewerage. Unplasticized poly (vinyl chloride) (PVC-U). Part 2: Guidance for assessment of conformity

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

EN 1610, Construction and testing of drains and sewers

ENV 1046, Plastics piping and ducting systems - Systems outside building structures for the conveyance of water or sewage - Practices for installation above and below ground

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 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

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 |
| Essencia PolyMatters | Belgian Federation for Chemistry and Life Sciences industries |
| FIPIF | Finnish Plastics Industries Federation |
| IPPMA | Irish Plastic Pipe Manufacturers Association |
| KRV | Kunststoffrohrverband e.V.- Fachverband der Kunststoffrohr-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

Ecoinvent, 2016. Ecoinvent database v3.3, Swiss Centre for Life Cycle Inventories, Switzerland.

From: www.ecoinvent.org

EN 1401-1, Plastics piping systems for non-pressure underground drainage and sewerage. Unplasticized poly (vinyl chloride) (PVC-U). Part 1: Specifications for pipes, fittings and the system

ENV 1401-2, Plastics piping systems for non-pressure underground drainage and sewerage. Unplasticized poly (vinyl chloride) (PVC-U). Part 2: Guidance for assessment of conformity

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

EN 1610, Construction and testing of drains and sewers

ENV 1046, Plastics piping and ducting systems - Systems outside building structures for the conveyance of water or sewage - Practices for installation above and below ground

Eurostat, 2006, Packaging waste scenarios (EU27, 2006)

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

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

Simapro 7.3.0 – LCA Software, 2011, PRé consultants bv, Amersfoort, The Netherlands

TNO report, 2008: Quality of PVC sewage pipes in the Netherlands, MT-RAP-2008-01066/mso / 2 / April 2, 2008
- Author(s) J. Breen - Assignor BureauLeiding

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

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