GF Piping Systems

Environmental Product Declaration

Polypropylene system

According to EN 15804+A1

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Chemical conveyance

1. Declaration of general information

1.1 Introduction

GF Piping Systems is one of the three divisions within Georg Fischer Corporation and a leading provider of plastic and metal piping systems with global market presence. The product portfolio includes pipes, fittings, valves and the corresponding automation and jointing technology for industry, building technology as well as water and gas utilities. Georg Fischer Piping Systems proactively incorporates its environmental responsibility into its everyday business activities. Because we understand environmental awareness as one of the corporation's core values, internal structures and processes are geared towards sustainability. In this context, life cycle assessments are the correct tool to gain insight in the different life cycle phases of our systems.

This EPD is based on a detailed background report written by the Flemish Institute for technological research (Vito). The report is in line with EN 15804+A1 "Sustainability of construction works – environmental product declarations – Core rules for the product category of construction products". The data of the study complies with the quality requirements set out in EN 15804+A1 (EN 15804+A1:2013, Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products). Data regarding the production of the pipe system components is company specific and was provided by GF Piping Systems.

Declaration

Declaration owner & Program operator's name	Georg Fischer Piping Systems Ltd.
Validity	26.03.2020 – 25.03.2025
Declaration Number	GFPS-EPD_2005-4_5

EPD-Type	Cradle to grave
Data calculated by	Vito NV (Flemish Institute for technological research) www.vito.be
Life Cycle Inventory (LCI) source for generic background processes	Ecoinvent 3.5 Industry 2.0 database
Software	SimaPro 9.0.0

Certified Management System SQS ISO 9001 / 14001 / OHSAS 18001

1.2 System

The analyzed case represents an exemplary system for the transport of chemicals in an aluminium pickling plant. The system is designed in the dimension d63 and installed in Leipzig (Germany). Flange connections and infrared welding are used for the jointing.

① PROGEF Standard butterfly valve type 567
② PROGEF Standard check valve type 561
③ Centrifugal pump
④ 2350 Temperature sensor
⑤ 2551 Magmeter flow sensor
⑥ PROGEF Standard ball valve type 131
⑦ PROGEF Standard ball valve type 546
⑧ 2819 Conductivity/resistivity electrode
⑨ 2724 pH/ORP electrode
⑩ 2536 Rotor-X paddlewheel flow sensor

Materials

The material of the main pipe system components (pipes and fittings) is PP. The whole system consists of the materials as listed below.

Material		Weight (kg)
PP		39.2
Plastics (other than PP)		9.0
Steel		10.8
Rubber		0.4
Other materials		0.3
Cable (metal + plastics)		0.4 + 1.4
Pump	Plastics	4.5
	Other materials	4.2
Motor	Various materials	9.0

Reference service life

25 years

Please refer to chapters 2.3 for further information on the reference service life of the system.

Functional unit (FU)

The transportation of 1.5% sulphuric acid with 250 ppm hydrofluoric acid in a 30 m long piping system (d63) in an aluminium pickling plant over the whole service life of 25 years. The transport starts from the delivery with a flange connection and ends at the process entry point.

Components of the system (number of pieces or meter)

The system mainly consists of Georg Fischer Piping Systems components. However, to complete the system also external components (Ext.) are necessary which are not produced by Georg Fischer Piping Systems. The calculation of the environmental impact of these products is based on publicly available data and assumptions.

	Product Code	Pieces or meter	Material
System components			
PROGEF Standard pipe, d63	167480716	30 m	PP-H
PROGEF Standard tee 90° equal, d63	727208511	3	PP-H
PROGEF Standard elbow 90°, d63	727108511	6	PP-H
PROGEF Standard union, d63	727518511	4	PP-H
PROGEF Standard reducer, d63/d32	727908560	1	PP-H
PROGEF Standard socket equal, d63	727910111	8	PP-H
PROGEF Standard flange adaptor, d63	727798711	10	PP-H
Backing flange, d63	727700411	10	PPGF30
O-Ring gasket, d63	748410013	6	EPDM
PROGEF Standard butterfly valve type 567, d63	167567802	2	PP-H (body) and others
PROGEF Standard check valve type 561, d63	167561087	1	PP-H (body) and others
PROGEF Standard ball valve type 131, d63	199131368	1	PP-H (body) and others
PROGEF Standard ball valve type 546, d63	167546447	2	PP-H (body) and others
2350 Temperature sensor	159000920	1	PVDF (sensor housing) and others
2551 Magmeter flow sensor	159001110	2	PP (sensor body) and others
2819 Conductivity/resistivity electrode	198844010	1	Stainless steel (electrode) and others
2724 pH/ORP electrode	159001545	1	PPS (sensor body) and others
2536 Rotor-X paddlewheel flow sensor	198840143	1	PPGF30 (sensor body) and others
8900 Multi parameter controller	159000868	1	PBT (housing) and others
PROGEF Standard gauge guard type Z700	199041003	1	PP-H (body) and others
Centrifugal pump	Ext.	1	Various metals and others
Cable	Ext.	36.2 m	Copper and others
Components for installation			
Bolts	Ext.	40	Stainless steel
Nuts	Ext.	64	Stainless steel
Washers	Ext.	64	Stainless steel
Brackets	Ext.	25	PP

1.3 Comparability

EPDs of construction products may not be comparable if they do not comply with the EN 15804+A1.

1.4 Demonstration of verification

CEN standard EN 15804 serves as the core PCR

Independent verification of the declaration and data, according to EN ISO 14025:2010

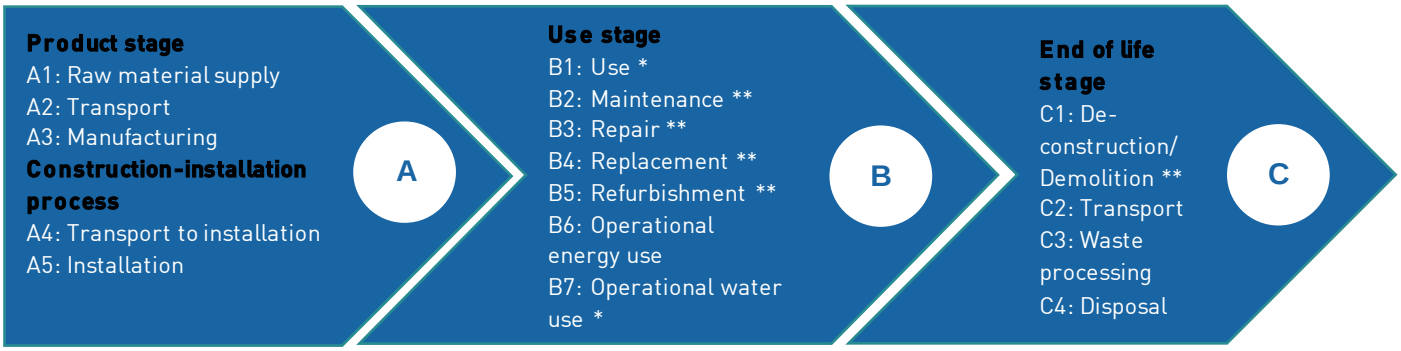
☐ internal ☒ external

Dr. Frank Werner

Company: Dr. Frank Werner Umwelt & Entwicklung, Zürich (Switzerland)

2. Declaration of environmental parameters derived from LCA

2.1 Flow diagram of the processes included in the LCA



* Stage not relevant, ** Environmental impact below cut-off criteria. Please refer to chapter 2.3 for details.

2.2 Parameters describing environmental impacts

	Impact category	Global warming	Ozone depletion	Acidification of soil and water	Eutro-phication	Photo-chemical ozone creation	Abiotic depletion - non fossil	Abiotic depletion - fossil
		kg CO_2 eq	kg CFC-11 eq	kg SO_2 eq	kg PO_4^{3-} eq	kg C_2H_4 eq	kg Sb eq	MJ
A1-3	Product stage	3.86E+02	9.58E-04	3.57E+00	5.42E-01	1.85E-01	8.99E-03	6.69E+03
A4	Transport to installation	3.30E+01	6.10E-06	1.20E-01	2. 04E-02	5.29E-03	2.48E-05	4.81E+02
A5	Installation	4.24E+00	3.44E-07	1.27E-02	3.00E-03	1.41E-01	1.17E-05	6.42E+01
B1-5	Use, Maintenance, Repair, Replace-ment, Refurbish-ment	0	0	0	0	0	0	0
B6	Operational energy use	5.19E+04	5.58E-03	3.13E+02	4.68E+01	1.05E+01	7.81E-02	5.63E+05
B7	Operational water use	0	0	0	0	0	0	0
C1	De-construction/ Demolition	0	0	0	0	0	0	0
C2	Transport to end-of-life treatment	9.08E+00	1.57E-06	2.86E-02	4.55E-03	1.57E-03	4.97E-05	1.33E+02
C3	Waste processing	2.57E+02	3.82E-07	2.59E-02	6.50E-03	1.06E-03	4.11E-06	1.61E+01
C4	Disposal	0	0	0	0	0	0	0

2.3 Scenarios and additional technical information

The analyzed case represents an exemplary system for the transport of chemicals in an aluminium pickling plant.

Product stage	
A1	The production of the plastic raw material was modeled by generic European data (source: ecoinvent) and complemented by specific data from GF Piping Systems to consider the company specific formulation of the raw material.
A2	Wherever possible, the specific transport distances were taken into account. Data from ecoinvent with the respective parameters was used to model the transportation.
A3	The use of energy is the most important input for this process step. Pipes are extruded while fittings and valve parts are injection moulded. Each of GF Piping Systems' worldwide production sites is certified according to ISO 14001 (Environmental management systems) and to OHSAS 18001 (Occupational health and safety management systems) or is currently in the certification process. For the production of GF Piping Systems components, electricity mixes for the respective country/continent was used. The production of external products was modeled using generic ecoinvent data records for the process.

Construction process	
A4	The system is installed in Leipzig (Germany). Pipes are transported over a distance of 350 km by means of a truck. Valves and measuring instruments are first transported to storage: measuring instruments via air freight (ecoinvent data record: Transport, freight, aircraft {RER}| intercontinental | Cut-off, U over 5 000 km; valves via truck over 150 km. Afterwards these components as well as fittings, bolts, nuts, washers and brackets are transported to the installation site by truck over 600 km. The pump and the gauge guard are also transported by truck over 480 km and 540 km respectively to the installation site. For all transportations via truck the ecoinvent data record 'Transport, freight, lorry 16-32 metric ton, EURO5 {RER}| transport, freight, lorry 16-32 metric ton, EURO5 | Cut-off, U' was used. Loading capacity is 60%.
A5	For the installation of the whole system 1.8 kWh welding energy is needed Electricity, low voltage {DE}| market for | Cut-off, U. Outputs of the complete installation of the system are PP pipe cut-off (0.2 kg/FU) and packaging waste (3.9 kg/FU) whereof 88% is cardboard. Wood and cardboard are recycled; PE film, nylon belts and PP straps are incinerated. Transport distance to recycling is assumed to be 600 km, transport to incineration is 150 km. Transport is carried out by truck.

Use stage	
B1	There are no further environmental impacts arising from the use of the systems. This stage is considered as not relevant.
B2-B5	The system is designed to be operated without repair, maintenance, replacement or refurbishment during the reference service life. This is subject to the condition that the system is operated according to the specifications given by GF Piping Systems. The lifetime of a valve is mainly influenced by the actuation cycles. The number of actuation cycles the valves are tested for is not reached during the life time of the evaluated system. It is possible that in individual cases components of the valve (e.g. seals) must be replaced. In this case the environmental impact is negligible compared to the impact of the whole system and below the cut-off criteria defined in EN 15804+A1.
B6	The operational use of the system is an important stage mainly because of the long reference service life of 25 years. 117 000 kWh of energy (ecoinvent dataset: Electricity, low voltage {RER}| market group for | Cut-off, U) per functional unit is necessary to run the pump.
B7	No operational water use is necessary for the system. This stage is considered as not relevant.

End of life stage	
C1	A small energy input is needed to cut the pipe into smaller pieces. The environmental impact is negligible compared to the impact of the whole system and below the cut-off criteria defined in EN 15804+A1.
C2	Transportation to the end of life treatment facilities is carried out by truck. Distances are 600 km for recycling and 150 km for incineration.
C3	It is assumed that all metal parts are recycled and all other parts are incinerated with energy recovery. The exported energy is in the form of electricity and thermal energy. Approximately 11.5% of the net energy content of the incinerated waste is converted to electricity and 23.4% is converted to heat. Both are sold to external consumers. These values reflect the situation in Swiss municipal waste incinerators about 10 years ago, as reported in ecoinvent documentation.
C4	It is assumed that all metal parts are recycled and all other parts are incinerated with energy recovery. Therefore module C4 is not relevant.

Reference service life data

Parameter	Data
Reference service life	25 years
Declared product properties	System components are compliant with relevant international standards, e.g. • EN (European Standards) • ISO (International Organization for Standardization) • DVS (German Welding Society) • DIN (German Institute for Standardization) Most relevant standards are: ISO 15494 Plastics piping systems for industrial applications - Polybutene (PB), Polyethylene (PE) and Polypropylene (PP) - Specifications for components and the system ISO 16138 Industrial valves -- Diaphragm valves of thermoplastics materials ISO 16135 Industrial valves -- Ball valves of thermoplastics materials
Design application parameters	See table below
Assumed quality of work	• Wide operating temperature range • High chemical resistance • No corrosion and no incrustation reduces maintenance to a minimum
Indoor environment	The system is installed in Leipzig, Germany. Standard indoor conditions apply.
Usage conditions	• SDR 11 • PN 10 • Flow rate 2 m/s
Maintenance	The system is designed to be operated without repair, maintenance, replacement or refurbishment. This is subject to the condition that the system is installed and operated according to the specifications given by GF Piping Systems.

PP characteristics	Value	Test standard
Operating temperature range	-10 °C to + 95 °C	
Density	0.90 - 0.91 g/cm^3	EN ISO 1183 - 1
Yield Stress at 23 °C	31 N/mm^2	EN ISO 527 - 1
Tensile e-modulus at 23 °C	1300 N/mm^2	EN ISO 527 - 1
Charpy notched impact strength at 23 °C	85 kJ/m^2	EN ISO 179 – 1/1eA
Charpy notched impact strength at 0 °C	4.8 kJ/m^2	EN ISO 179 – 1/1eA
Ball indentation hardness (132N)	58 MPa	EN ISO 2039 - 1
Heat distortion temperature HDT B 0.45 MPa	95 °C	EN ISO 75 - 2
Crystallite melting point	150 °C - 167 °C	DIN 51007
Heat conductivity at 23 °C	0.23 W/m K	EN 12664
Water absorption at 23 °C	0.1%	EN ISO 62
Limited oxygen index (LOI)	19%	ISO 4589 - 1

For more information, please refer to the planning fundamentals which are available at:
gfps.com › Support & Services › Planning Assistance › Planning Fundamentals › Industrial Piping Systems

2.4 Parameters describing resource use

Parameters describing resource use, primary energy		Product stage	Construction process stage		Use stage			End of life			
		Total (of product stage)	Transport	Construction installation process	Use, Maintenance, Repair, Replacement, Refurbishment	Operational energy use	Operational water use	De-construction / Demolition	Transport	Waste processing	Disposal
		A1-3	A4	A5	B1-B5	B6	B7	C1	C2	C3	C4
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	5.48E+02	3.00E+00	3.03E+00	0	1.86E+05	0	0	1.81E+00	1.61E+00	0
Use of renewable primary energy resources used as raw materials		6.24E+01	0	8.92E-02	0	0	0	0	0	0	0
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)		6.10E+02	3.00E+00	3.12E+00	0	1.86E+05	0	0	1.81E+00	1.61E+00	0
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials		5.80E+03	4.88E+02	6.36E+01	0	1.09E+06	0	0	1.36E+02	1.94E+01	0
Use of non-renewable primary energy resources used as raw materials		1.79E+03	0	7.22E+00	0	0	0	0	0	0	0
Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)		7.58E+03	4.88E+02	7.09E+01	0	1.09E+06	0	0	1.36E+02	1.94E+01	0

Parameters describing resource use, secondary materials and fuels, and use of water		Product stage	Construction process stage		Use stage			End of life			
		Total (of product stage)	Transport	Construction installation process	Use , Maintenance, Repair, Replacement, Refurbishment	Operational energy use	Operational water use	De-construction / Demolition	Transport	Waste processing	Disposal
		A1-3	A4	A5	B1-B5	B6	B7	C1	C2	C3	C4
Use of secondary material*	kg	7.44E+00	0	0	0	0	0	0	0	0	0
Use of renewable secondary fuels*	MJ, net calorific value	0	0	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels*	MJ, net calorific value	0	0	0	0	0	0	0	0	0	0
Net use of fresh water	m^3	5.02E+00	6.00E-02	2.09E-02	0	7.64E+02	0	0	2.17E-02	6.21E-02	0

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

2.5 Environmental information describing output flows

Other environmental information describing output flows		Product stage	Construction process stage		Use stage			End of life			
		Total (of product stage)	Transport	Construction installation process	Use, Maintenance, Repair, Replacement, Refurbishment	Operational energy use	Operational water use	De-construction / Demolition	Transport	Waste processing	Disposal
		A1-3	A4	A5	B1-B5	B6	B7	C1	C2	C3	C4
Components for re-use*	kg	0	0	0	0	0	0	0	0	0	0
Materials for recycling*	kg	4.09E+00	0	3.87E+00	0	0	0	0	0	2.24E+01	0
Materials for energy recovery*	kg	0	0	0	0	0	0	0	0	0	0
Exported energy - electricity*	MJ per energy carrier	1.53E+00	0	1.14E+00	0	0	0	0	0	2.03E+02	0
Exported energy - thermal energy*	MJ per energy carrier	3.23E+00	0	2.22E+00	0	0	0	0	0	1.26E+01	0

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

Other environmental information describing waste categories		Product stage	Construction process stage		Use stage			End of life			
		Total (of product stage)	Transport	Construction installation process	Use , Maintenance, Repair, Replacement, Refurbishment	Operational energy use	Operational water use	De-construction / Demolition	Transport	Waste processing	Disposal
		A1-3	A4	A5	B1-B5	B6	B7	C1	C2	C3	C4
Hazardous waste disposed	kg	1.54E-01	1.87E-04	8.96E-05	0	1.43E+00	0	0	1.15E-04	1.01E-04	0
Non-hazardous waste disposed		9.97E+1	5.53E-00	8.06E-01	0	3.66E+03	0	0	4.10E+00	4.93E+00	0
Radioactive waste disposed		1.47E-02	3.44E-03	2.30E-04	0	7.98E+00	0	0	8.85E-04	8.10E-05	0

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