Life Cycle Assessments of Plastic Pipe Systems in the Field of Utility and Building Technology

Summary of Life Cycle Assessments calculated on behalf of Teppfa.

1. Introduction

As a responsible company, Georg Fischer is obliged to sustainability. The development, production and marketing of environmentally friendly and therefore resource-conserving products and services is a cornerstone in the strategy of Georg Fischer Piping Systems. In the context of this commitment, GF Piping Systems strongly supported the efforts of Teppfa, the European umbrella association of the plastic pipe systems industry to analyze the environmental impact of plastic pipe systems.

On behalf of Teppfa (The European Plastic Pipes and Fittings Association), the institute Vito (Flemish Institute of Technology) conducted twelve Life Cycle Assessments (LCAs) for different plastic pipe systems and in each case a traditional material in the sector of utility and building technology . The results were summarized in so called Environmental Product Declarations (EPDs) and were furthermore critically reviewed by the company denkstatt.

The results show that plastic pipe systems have a minor effect on the environment than traditional materials.

2. Focus

Four of the twelve LCAs analyze piping systems which are in the product range of Georg Fischer. Hence, by providing relevant data, GF Piping Systems, as a member of Teppfa, contributed to the calculation of the LCAs.

Application	Material of the System	Traditional Material
Utility	PE	Ductile iron
	PVC-U	Ductile iron
Building technology	PEX	Copper
	Polymer/Al/Polymer	Copper

Tab. 1: The four systems which are in the product range of GF Piping Systems

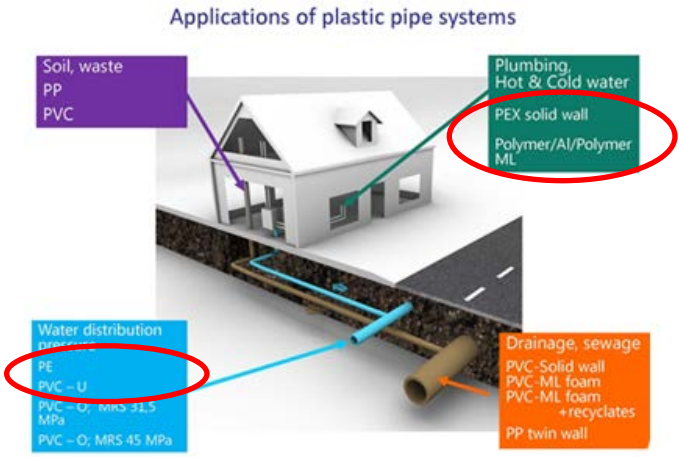

Fig. 1: Piping Systems for which Teppfa conducted LCAs. The systems offered in the product range of GF Piping Systems are accentuated (image:Teppfa).

The following table describes the characteristics of the four systems

Application and Functional Unit (FU)	Material	Selected System Characteristics
Utility FU: The underground transportation of drinking water, over a distance of 100m (from the exit of the water plant to the water meter of the building), by a typical public European PE pipe water distribution system over its complete life cycle of 100 years, calculated per year.	PE	• Material of pipes and fittings: black Polyethylene (PE 100) • Diameter of pipes: 110 mm • Minimum strength requirement (MRS) 10 MPa • Standard dimension ratio: (SDR) 17 • Wall thickness: 6,6 mm • Jointing technologies: Electro and butt welding • Flow capacity: 1,5 m/s • Service life (time) 100 years • EN 12201 und EN 805
	PVC-U	• Material of pipes: dark gray unplasticized Polyvinyl chloride • Diameter of pipes:110 mm • Minimum strength requirement (MRS): 25 MPa • Standard dimension ratio: SDR 26, SDR 41 and SDR 65 • Wall thickness: 4,2 mm • 2 kinds of fittings: PVC and ductile iron • Flow capacity:1,5 m/s • Service life (time): 100 years • EN ISO 1452 and EN 805

Application and Functional Unit (FU)	Material	Selected System Characteristics
Building technology FU: The pressure supply and transport of hot and cold drinking water, from the entrance of a well-defined apartment (bathroom, separate WC, kitchen and washroom) to the tap during 50 years, calculated per year.	PEX	• Material of pipes: PEX-A, solid wall, single layer • PPSU fittings • Brass tie-ins • Service life (time): 50 years • EN 15875 and EN 806
	Polymer/Al/Polymer	• Material of pipes: Multilayer Polymer • Fittings: PPSU and brass • Brass tie-ins • Service life (time): 50 years • EN 21003 und EN 806

Tab. 2: Overview on selected system characteristics

3. Results

In this summary, results of the impact categories „global warming" and „ozone layer depletion" are presented.

The results of the LCAs show the good environmental performance of plastic pipe systems compared to traditional materials, in the area of utility and building technology.

- In the impact category „global warming", the plastic pipe systems of the utility application perform around 80% better than the competing system, the warm-/coldwater application coming up to about 65%.
- The same pattern can be seen for the impact category „ozone layer depletion": In the area of utility the performance is as well around 80% better. In the area of building technology the performance is 60% better than the traditional material.
- In the impact category "global warming" the product stage (production of raw material, production of the system components) for all piping systems, is the one with the highest contribution.
- In the impact category "ozone layer depletion" the biggest contribution for the PE and the PVC-U systems comes from the installation phase. This is due to the installation of the system in the trench.
- Production of fittings: The contribution of injection moulding, which is a main process at GF Piping Systems, is around 1.2 – 2.2% for both impact categories.
- Production of pipes: The contribution of the extrusion process is up to 21% (impact category "global warming" PEX system) and therefore clearly higher than the injection moulding.
- Also in the conducted sensitivity analysis the pipe system performs significantly better than the competing material.
- The following tables show which life cycle stages render the most relevant contribution for the impact categories **„global warming" (Tab.3)** and **„ozone layer depletion" (Tab.4)**. Not listed life cycle stages show a contribution of less than 10% to the total environmental performance.

Piping System	PE	PVC	Ductile Iron	PEX	Polymer/Al /Polymer	Copper
Significant influence (Contribution›50%)			Production of the ductile iron pipes 6)			
Relevant influence (25%‹Contribution‹50%)	- Production of the PE raw material for the PE pipes (granulate production) - Installation of the PE piping system in the trench 3)	- Production of the raw material for PVC pipes - Installation of the PVC piping systems in the trench 3)		Production of the raw material for the PEX pipes 1)	Production of the raw material for the Polymer/Al/Polymer-pipes 1)	- Production of the raw material for the copper pipes - Production of the copper pipes 7)
Some influence (10%‹Contribution‹25%)				- Production of pipes 5) - Production of PPSU fittings 4) - Transport of the PEX system to the construction site - Installation of the PEX system	- Production of the Al-layer of the pipes - Extrusion 5) - Production of the PPSU fittings 4) - Installation of the system	

Tab. 3 : Relevant life cycle stages for the impact category „global warming".

Piping System	PE	PVC	Ductile Iron	PEX	Polymer/Al /Polymer	Copper
Significant influence (Contribution›50%)	Installation of the PE pipe system 3)	Installation of the PVC pipe systems 3)	Production of the ductile iron pipes 6)	Production of the PPSU fittings 4)	Production of the PPSU fittings 4)	
Relevant influence (25%‹Contribution‹50%)						- Production of the raw material for copper pipes - Production of the copper pipes 7)
Some influence (10%‹Contribution‹25%)	Production of the raw material for the PE pipes (granulate production)	Transport of the PVC pipe system to the trench	Installation of the ductile iron pipe system 3)	- Production of the pipes 5) - Transport of the PEX systems to the construction site		Transport of the copper pipe systems to the construction site

Tab. 4 : Relevant life cycle stages for the impact category „ozone layer depletion".

1) Production of the Polyethylene granulate; 2) Production of the carbon black for the colour; 3) Energy need for the excavating and refilling (of) the trench; Mining of the raw sand; 4) Production of Polyphenylenesulfid; 5) Energy need for extrusion; 6) Production of pig iron; 7) Energy need for melting the copper

Environmental impacts during the operation of the systems were not considered in the LCAs. Possible influences on the use stage are outside the defined system boundary. Furthermore, it was assumed that no maintenance work on the system is carried out during the whole life cycle.

The following figures illustrate the good performance of the plastic pipe systems contrary to the traditional material for the impact categories „global warming" and „ozone layer depletion".

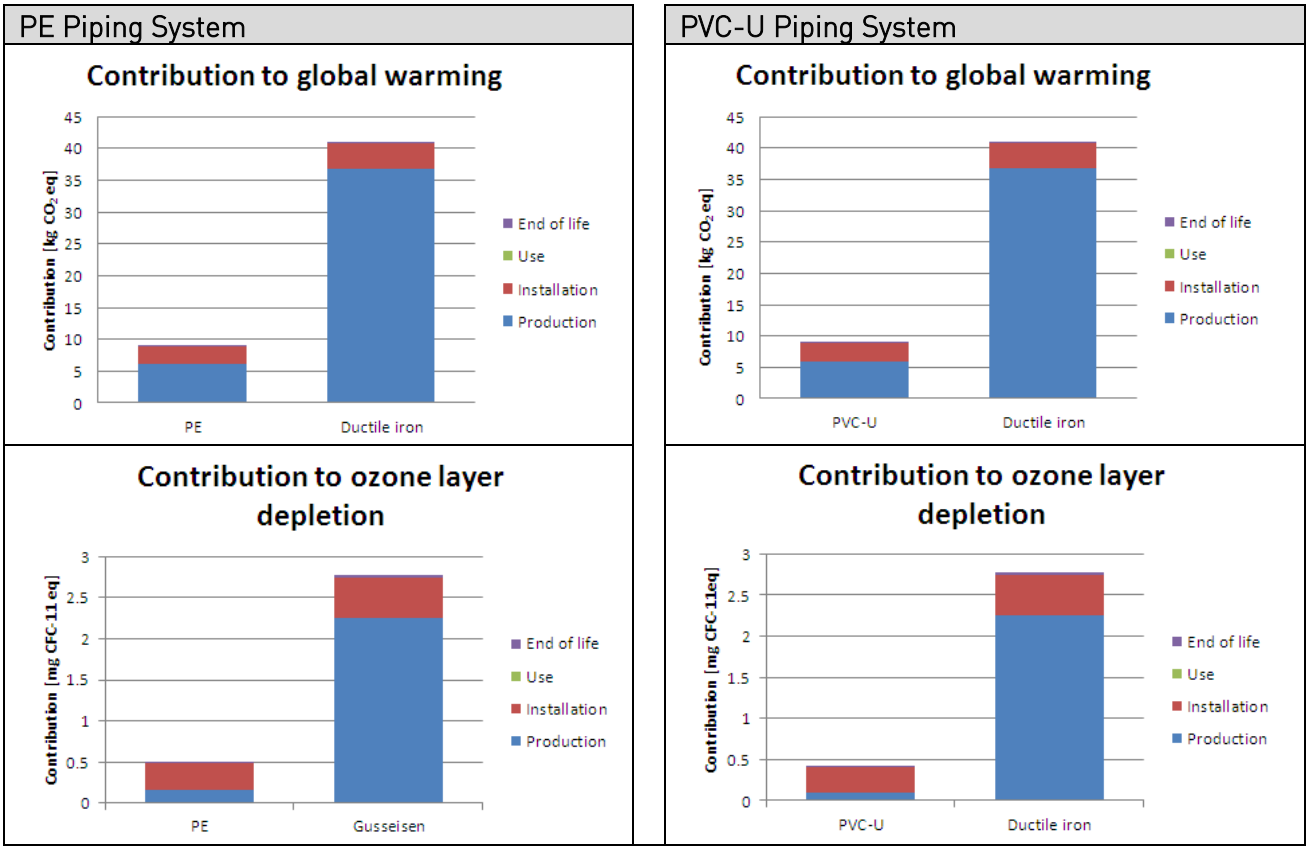

Fig. 2: Contribution to the impact categories „global warming" and „ozone layer depletion" for the PE and the PVC-U pipe system. CO_2eq = Carbon dioxide equivalents, CFC-11eq= Trichlorofluormethane equivalents.

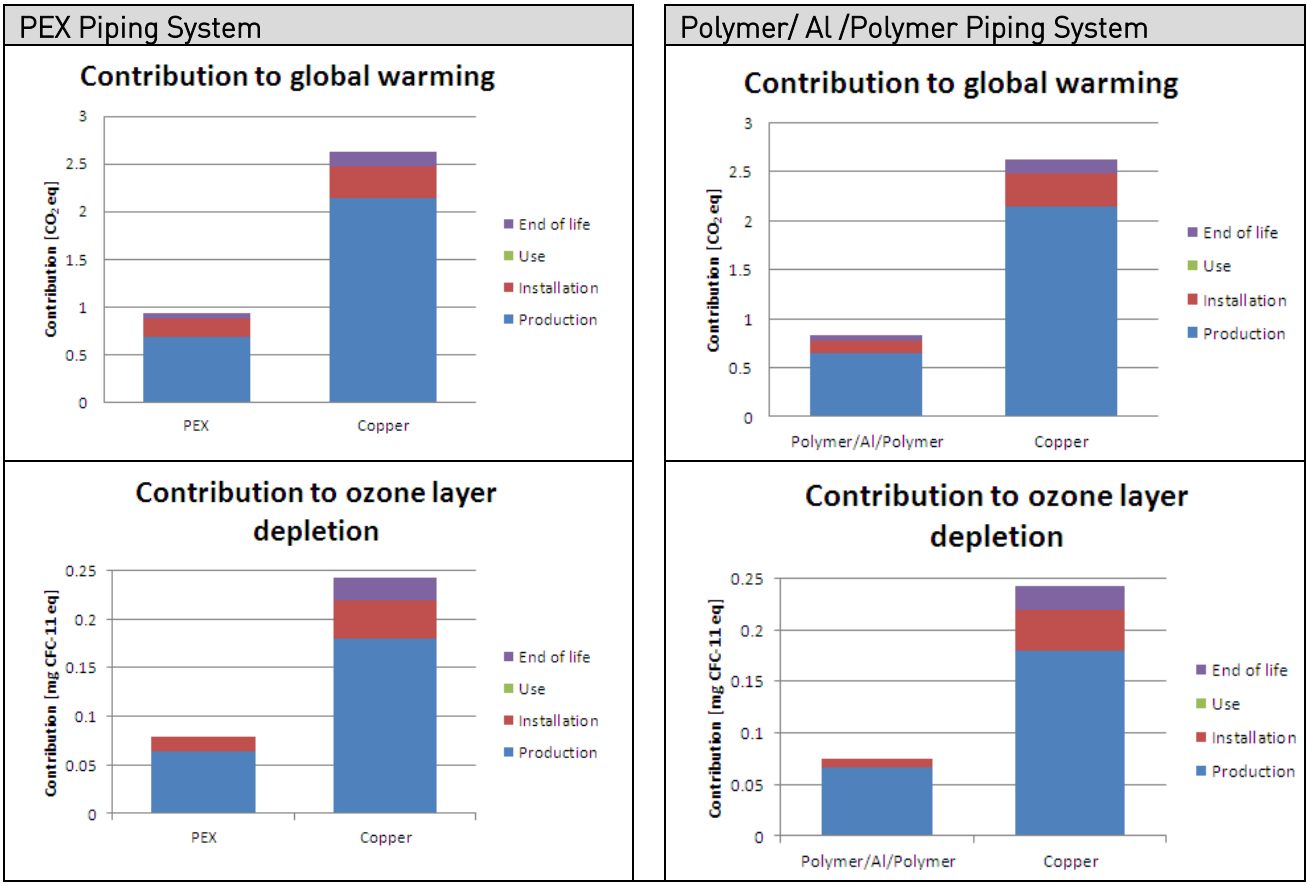

Fig. 3: Contribution to the impact categories „global warming" and „ozone layer depletion" for the PEX and the Polymer / Al/ Polymer pipe system. CO_2eq = Carbon dioxide equivalents, CFC-11eq= Trichlorofluormethane equivalents.

4. Comparability

As a member of Teppfa, GF Piping Systems provided data for the LCA studies. Therefore, the comparability of the systems defined by Teppfa with systems in the product range of GF Piping Systems is good. The results of the Teppfa studies can therefore be transferred to systems of GF Piping Systems.

5. Conclusion

The LCAs conducted by Vito show the better environmental performance of plastic pipe systems compared to traditional materials. They hereby confirm results of other studies and underline the important status of plastic in an ecological awareness pipeline construction.

6. Further information

Further information including the Environmental Product Declarations, the third party reports and the critical review conducted by Vito are available on the Teppfa website:
http://teppfa.eu/sustainability-a-environment/-epd.html

Information on the activities of GF Piping Systems in the field of sustainability can be found on the internet: www.gfps.com› about GF Piping Systems › Sustainability and www.georgfischer.com/sustainability.

Life Cycle Assessment
A Life Cycle Assessment lists all environmental burdens caused by a product over its entire life cycle. It is a tool to make life cycle thinking regarding environmental impacts manageable and comprehensible in terms of numbers. The methodology includes all relevant environmental impacts starting from the production of the raw material over the production and the use of the product through to the end of life (cradle-to-grave).

Environmental Product Declaration
An Environmental Product Declaration (EPD) is a standardized form to communicate the results of Life Cycle Assessments. Interested parties can use it to assess the environmental impacts of products.

Impact category
An impact category can be seen as an anthropogenic caused harmful effect to the environment.