Evaluating the environmental impacts of hot and cold water supply systems in a building to aid product choice: Applying your knowledge

Keywords

- PE-X, PB, PP,-R Multilayer pipes
- Hot and cold water systems
- Comparative studies
- Building Projects
- Environmental solution
- Service life

Article Highlights

Drawing on the knowledge of Environmental Product Declarations (EPDs) and Life Cycle Assessments (LCAs) presented in the first four bulletins, the environmental performance of plastic piping in hot and cold water systems is objectively evaluated and put into context against other building products.

What does the bulletin cover?

This bulletin uses the EPDs to show the environmental performance of plastic piping, how these values can be scaled up to your construction project and answers questions on the impact of packaging, transport and waste.

Introduction

Plastic piping systems for hot and cold water applications can be manufactured from cross-linked polyethylene (PE-X), polypropylene random copolymer (PP-R) or polybutene (PB), or as a polymer / aluminium / polymer (multilayer) composite.

Their performance is defined by European Standards. All pipes and fittings made by the members of the BPF Pipes Group hold a third party approval certificate against the relevant standard. This allows you to confidently select an appropriate product based on operational needs, pipe sizing requirements, jointing preference and installation demands.

However, before this and increasingly important to every building project, you will have questions about the overall environmental credentials of the products available.

In this bulletin, the real values calculated for a complete plastic piping system are presented. To help put these into context, the numbers are compared to other building products and to the overall property.

At each point, reference is made back to the first four bulletins to help you quickly find your way back to the more detailed explanations (http://bpfpipesgroup.com/sustainability-and-the-circular-economy).

Using the EPDs for real building projects

Environmental Product Declarations (Bulletin 4) for PE-X, PP-R, PB and multilayer pipes:

- Prepared against International and European Standards for Life Cycle Assessment (Bulletin 2);
- Cover all stages of life 'Cradle to Grave' from raw material supply to disposal at the end of life (Bulletin 2);
- Publicly available with values calculated for the seven impact categories included in the Life Cycle Assessment of construction products (Bulletin 3);
- Directly comparable, using the same hot and cold water supply configuration for a well-defined apartment comprising all pipes, fittings and ancillary components over a design service life of 50 years (Bulletin 2);
- Easily scaled up to real building projects by using the functional unit (100m^2 apartment) approach.

Each of the four plastic piping systems perform similarly as seen in the table below.

	Unit	Polybutene	Multilayer	Cross-linked PE	Polypropylene
ADP (non-fossil)	kg Sb eq	2.25×10^{-5}	4.47×10^{-5}	4.39×10^{-5}	$2..08 \times 10^{-5}$
Acidification	kg SO_2 eq	5.99×10^{-3}	5.62×10^{-3}	3.65×10^{-3}	2.5×10^{-3}
Eutrophication	kg PO_4 eq	1.59×10^{-3}	1.22×10^{-3}	1.18×10^{-3}	0.64×10^{-3}
POCP	kg C_2H_4	3.36×10^{-4}	5.27×10^{-4}	3.65×10^{-4}	1.50×10^{-4}
GWP	kg CO_2 eq	1.01	1.08	0.87	0.73
ADP (fossil)	MJ, net cal	2.0	1.7	1.85	1.98
Ozone depletion	kg CFC-11 eq	6.46×10^{-8}	9.09×10^{-8}	7.85×10^{-8}	4.08×10^{-8}

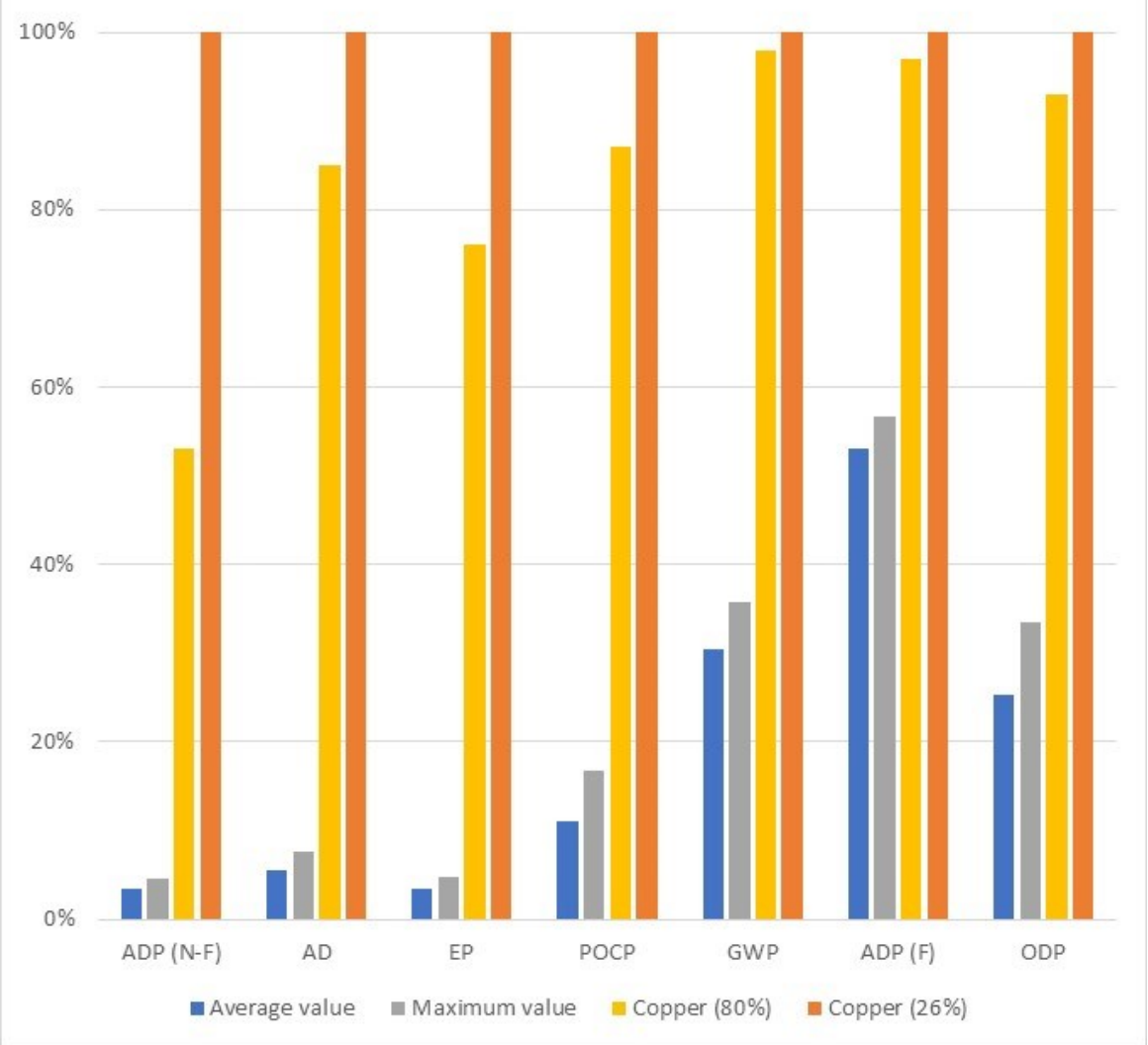
Comparing plastics to other piping systems

In the UK housing sector, most (approximately 95%) new properties are built with plastic hot and cold piping systems. The remainder use copper pipes.

Environmental Product Declarations are not publicly availably for copper pipes so to compare the products in a consistent manner, comparative studies were undertaken by the Belgian research organisation VITO using the same functional unit, hot and cold water supply configuration, design service life and life cycle stages (cradle to grave).

It is estimated that 35% of current global copper comes from recycling (Source: International Copper Study Group, www.icsg.org). The comparative studies considered the impact and benefits of recycling of copper pipes and fittings at various levels up to 80% recycled material.

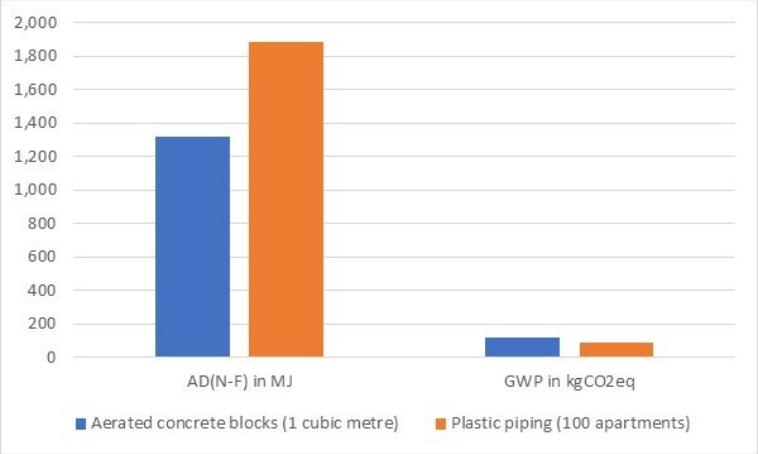
The comparison is presented graphically below. It shows the average and maximum impacts for the four plastic piping materials, copper pipe using 26% recycled material and copper pipe using 80% recycled material. The highest impact is shown as 100% and the values for other materials shown relative to this. In this case, for all categories, the copper pipe system (26% recycled content) has the highest impact.



The greatest difference in the values between copper and plastic pipe is caused by the impact of production. So although recycling of copper (from off-cuts from site and at end of life) would save on extraction of raw materials, the environmental impact would still be much higher than any of the four plastic piping systems.

Putting plastic piping systems into context

The impact of plastic piping systems can be compared to those of other construction materials. The EPD for aerated concrete blocks used for internal and external masonry in most houses and other buildings (published by the British Precast Concrete Federation) covers the same life cycle stages as those for plastic piping systems and is also independently verified. The impacts from one block (440mm x 225mm x 100mm) is similar to those from the plastic piping system in one 100m^2 apartment.



Abiotic depletion of fossil fuels

- One concrete block 12.5 MJ
- Plastic piping system for one 100m^2 apartment 18.9 MJ

Global Warming Potential

- One concrete block 1.13 kg$C0_2$e
- Plastic piping system for one 100m^2 apartment 0.92 kg$C0_2$e

Scaling this up to the shell of one family home, with a footprint of 8m x 8m, 6m high walls and concrete ground and first floors, the Global Warming Potential is calculated to be:

- 6834 kg$C0_2$e: Brick walls,
- 4186 kg$C0_2$e: Ready mixed concrete floors
- 6376 kg$C0_2$e: Hollow core concrete floors
- 1 kg$C0_2$e: Plastic piping system

In summary

The Environmental Product Declarations for PE-X, PP-R, PB and multilayer pipes show that piping systems contribute very little to the overall impact of a construction project. Nevertheless, in seeking to meet the UK's commitment to bring all greenhouse gas emissions to net zero by 2050, every bit counts.

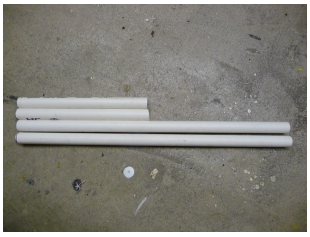
Plastic pipes are widely used in the UK for hot and cold water supply for domestic purposes (in homes and other buildings with water and sanitary provisions) and heating installations. The service life of these systems matches that of buildings in which they are installed. For more information on the extensive performance testing undertaken by manufacturers, see our technical guidance "*Testing the lifetime of plastic piping systems for domestic applications*", available from http://bpfpipesgroup.com/application-groups/building-services.

The comparative Life Cycle Assessment studies with traditional copper systems clearly demonstrate that, in addition to offering excellent technical performance, plastic piping systems for hot and cold water supply systems in a building are the best environmental choice.

Your questions answered

With the focus on reducing single use plastics and increasing use of recycled materials, you may have questions on handling of waste from construction sites.

Is packaging included in the impact? Yes, all plumbing products use packaging for hygienic and convenient delivery. For the plastic piping system EPDs, it is included at two stages: (a) manufacture of the pipe from polymer and (b) installation in the apartment. The independent life cycle inventory database 'Ecoinvent' was used to determine how much and what type (paper, board, plastic and wood) of packaging to include.



How are off-cuts (waste) from installation included? Realistically, off-cuts are not collected on site. So, the EPDs calculate the impact of sending these to landfill or incineration and therefore represent the worst case. Moving forward, separation of pre-consumer waste will improve this situation as plastics can be recycled into pipes or other products.

How do the calculations deal with removal at the end-of-life? Construction practices vary widely and some products are harder to recycle due to their material or multi-layer construction. With the exception of the brass fittings included in the typical configuration, the EPDs assume the building contractor would skip and send the waste to landfill or incineration.

Finding more detail

The Environmental Product Declarations for PE-X, PP-R, PB and multilayer pipes can be accessed from the BPF Pipes Group website, select TEPPFA Environmental Product Declarations (EPDs).

Comparative studies between each of the four plastic piping systems and copper pipe can also be accessed from our website, select TEPPFA Life Cycle Assessments (LCAs).

http://bpfpipesgroup.com/sustainability-and-the-circular-economy/overview/

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About the BPF Pipes Group

Part of the British Plastics Federation, the BPF Pipes Group is a trade association representing manufacturers and material suppliers of plastic piping systems across the UK.

Committed to sustainable construction, its aims are to provide a forum for the exchange of technical expertise between member companies and to promote the importance of plastic as a pipework material, for the full spectrum of above and below ground, pressure and non-pressure applications. It also plays a key role in initiating and disseminating research and informing and influencing the standards bodies pertaining to plastic pipe systems. It works closely with TEPPFA, The European Plastic Pipes and Fittings Association.

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