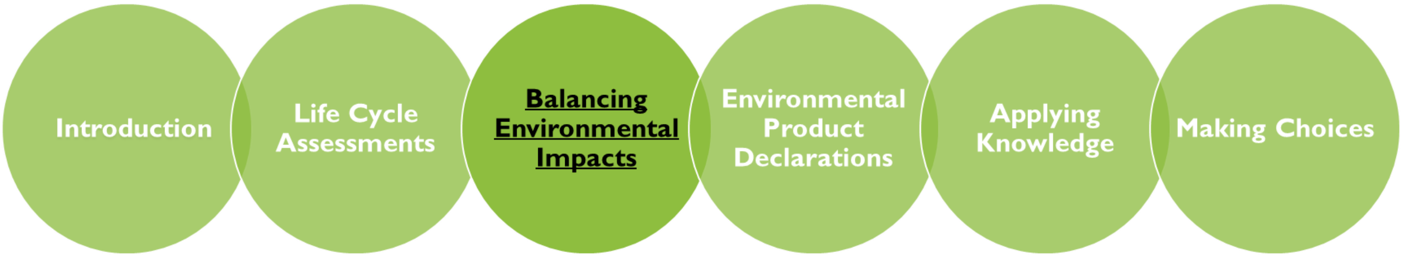
Evaluating the environmental impacts of hot and cold water supply systems in a building to aid product choice: Balancing environmental impacts



Keywords

- Environmental impact categories
- Global warming
- Ozone depletion
- Acidification
- Eutrophication
- Abiotic depletion
- Photochemical ozone creation

Article Highlights

This is the third in a series of bulletins which together describe the environmental benefits of plastic piping in hot and cold water systems. The bulletins build a resource which supports the development of knowledge of Environmental Product Declarations (EPDs) and Life Cycle Assessments (LCAs) to select the best sustainable options.

What does the bulletin cover?

This bulletin describes the environmental impacts considered when undertaking an LCA, explains how they are presented to the reader and the meaning behind the numbers.

Introduction

The production and use of construction products have the potential to impact on the environment from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance and disposal or recycling. European Standard BS EN 15804 has been used to prepare Life Cycle Assessments (LCAs) for plastic piping systems for hot and cold water inside buildings. The LCA considers the impact of all inputs (energy, raw materials and water) through all stages of life on a specified set of impact categories. This bulletin explains the significance of these impacts.

Impact Categories

	What is it?	Why is it a problem?
Depletion of Abiotic Resources ADP	Over extraction of non-living elements from an ecosystem.	Non-renewable resources are consumed (e.g. aggregates, ores, minerals) and will be unavailable for future use.
Acidification of Soil and Water AD	Reaction of acidic gases with water to form 'acid rain'.	Acid deposition, or 'acid rain', often a considerable distance from the original source of the gas, causes damage to the local ecosystem.
Eutrophication EP	Increased levels of nitrates and phosphates in water bodies.	Increased concentrations of nitrates and phosphates can encourage excessive growth of algae and reduce oxygen levels. This increases mortality in aquatic fauna and flora, leads to loss of species dependent on low-nutrient environments, reduces biodiversity and has knock-on effects on non-aquatic animals and humans.
Global Warming Potential GWP	Climate change driven by GHG emissions into the atmosphere, e.g. CO_2.	Green House Gases (GHGs) remain in the earth's atmosphere and prevent the earth losing heat gained from the sun. As global temperature rises, it is expected to cause climatic disturbance, desertification, rising sea levels and spread of disease.
Ozone Depletion Potential ODP	Breakdown of ozone (O_3) by ozone depleting gases, e.g. CFCs, HCFCs and halons.	The breakdown of ozone reduces the ability of the 'ozone layer' to prevent UV light entering the earth's atmosphere. The increase in carcinogenic UVB light results in health problems such as skin cancer, cataracts or damage to the immune system and sun-related damage to animals and crops.
Photochemical Ozone Creation POCP	Creation of ozone in the presence of sunlight, nitrogen oxides and volatile organic compounds.	Ozone in the earth's lower atmosphere creates smog with impacts as diverse as crop damage and increased incidents of asthma. The effects vary according to geography and climate and are especially problematic in heavily urbanised areas with existing pollution.

What do the numbers mean?

The numerical assessment of the product on the seven impact categories (abiotic is divided as non-fossil and fossil) are presented in an LCA for each stage in the product life cycle. This example is taken from the TEPPFA study on a polybutene piping system for hot and cold water in a building.

Impact category		Abiotic depletion - non fossil	Abiotic depletion fossil	Terrestrial acidification	Eutrophication	Climate change	Ozone layer depletion	Photochemical oxidation
		kg Sb eq	MJ, net cal	kg SO2 eq	kg PO4--- eq	kg CO2 eq	kg CFC-11 eq	kg C2H4
Product stage	A1-3	2,24E-05	1,88E+01	5,68E-03	1,53E-03	8,28E-01	5,71E-08	3,00E-04
Transport to installation	A4	4,07E-08	2,27E-01	5,98E-05	1,18E-05	1,52E-02	2,29E-09	5,02E-06
Installation	A5	1,36E-07	1,33E+00	3,01E-04	4,45E-05	1,02E-01	4,09E-09	3,51E-05
Use	B1-B7	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Disassembly	C1	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Transport to end-of-life treatment	C2	6,95E-08	2,42E-01	5,98E-05	1,20E-05	1,61E-02	2,52E-09	2,10E-06
End-of-life treatment	C3-C4	-5,39E-08	-4,95E-01	-1,10E-04	-9,59E-06	4,92E-02	-1,43E-09	-5,65E-06
Total		**2,25E-05**	**2,01E+01**	**5,99E-03**	**1,59E-03**	**1,01E+00**	**6,46E-08**	**3,36E-04**

The contributions to any one of the environmental impacts will be due to more than one item. Common sources of ozone depleting gases are refrigerants and blowing agents found in insulation foams. Interpretation of the impact would be too complex if the impact of each gas was reported separately, so a reference substance is chosen, which in the case of ozone depleting gases is chlorofluorocarbon-11 (CFC-11). The impact of each gas on the breakdown of ozone is calculated and then converted into the weight of CFC-11 needed to cause the same breakdown. The total impact for all ozone depleting gases from the product is reported as the equivalent weight of CFC-11 or "kg CFC-11 eq".

	Reference Unit
ADP	Non-fossil: Weight of antimony to be extracted to deplete the reserve within the earth's crust of the resource by the same proportion. Fossil: Calorific value of fuel being depleted.
AD	Weight of sulphur dioxide needed to provide the same acidification (SO_2 combines with water to form sulphuric acid) as the acidic gas when it reacts with water in the atmosphere.
EP	Weight of phosphate needed to cause the growth of algae in water to the same extent as the pollutant (commonly nitrates, ammonia, phosphoric acid).
GWP	Weight of carbon dioxide (CO_2) needed to have the same effect on trapping heat in the atmosphere as the GHG. This is typically based over 100 years (GWP100).
ODP	Weight of chlorofluorocarbon-11 (CFC-11) needed to breakdown the same quantity of ozone as the ozone depleting gas.
POCP	Weight of the non-methane volatile organic compound ethylene (C_2H_4) needed to produce the same quantity of ozone as the emitted gas.

The values created by the LCA can assume more or less significance when considering the impact of a product on the environment at a local rather than European level (normalization) and the relative importance of each category (weighting) to national climate change commitments. In the UK, normalization and weighting factors place a greater emphasis on GWP and fossil fuel depletion.

In the next bulletin, the presentation of an LCA in the form of an Environmental Product Declaration is illustrated using examples for hot and cold water supply inside buildings.

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

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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