

POLYETHYLENE PIPES FOR BELOW GROUND WATER APPLICATIONS IN BROWNFIELD SITES

Guidance Notes



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Introduction

The following guide has been prepared to provide information on the use of polyethylene pipes and joints in brownfield sites.

Planning, designing and constructing water mains and services

In preparing to develop a brownfield site, a developer will consider the risks to humans living or working on the site posed by its former use as well as the risks of ingress to the water or wastewater systems. The assessment of brownfield sites typically identifies chemicals which remain because of the former use of the site. In the UK, there are a wide variety of brownfield sites used for redevelopment e.g. chemical, pharmaceutical, and pesticide manufacture; foundries, engineering and printing works; gas works, filling stations and food processing.

In preparing this note, it is assumed that a preliminary and, if required a more detailed quantitative, risk assessment has been completed and that an options appraisal has been carried out to identify solutions which meet regulatory and planning requirements. The site assessment report and options appraisal might conclude that there is no contamination on site; that nothing needs to be done about contamination found as it does not pose an ongoing risk to health or environment; or that the contamination needs to be managed, sometimes involving preventing or cleaning up contamination on part or all of the site, known as remediation.

For planning, designing and constructing water mains and services detailed guidance is given in UKWIR Report ref. No 10/WM/03/21 (Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites). Developers and their consultants are referred to this best practice.

Polyethylene Pipes

Polyethylene pipes (20mm - 1200mm) and polyethylene barrier pipes (20mm - 630mm) are used for drinking water systems in the UK. Information on current specifications can be found in the BPF Guidance document 'Specifications for polyethylene pipe and fittings for water supply, drainage and sewerage under pressure' https://www.bfppipesgroup.com/media/34047/Specifications-for-polyethylene-pipe-and-fittings-for-water-supply-drainage-and-sewerage-under-pressure_v3.pdf

Polyethylene pipes are naturally resistant to inorganic compounds such as acids and alkalis, sulphides, chlorides, sulphates or cyanide. Their properties will not be affected by the presence of metals in the soil.

Some organic compounds e.g. polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), BTEX and phenols, have the potential to permeate polyethylene pipes, as other plastic pipes and elastomeric sealing rings. The process by which this occurs is complex and difficult to predict, so testing of products in conditions which reflect brownfield sites is essential.

Importantly, even where these organic compounds are present on the site and not removed during the remedial works, they may exist at low levels which means that polyethylene pressure pipe without any barrier layer can still be used.

BPF Pipes Group members manufacture polyethylene pressure pipe with an aluminium barrier layer. This is used as part of a system of compatible pipes and fittings which work in combination to act as a barrier to organic contaminants, ensuring that concentrations remain below a threshold to protect drinking water quality. The entire system is tested to BS 8588 - Polyethylene pressure pipe with an aluminium barrier layer and associated fittings for potable water supply in contaminated land – Size 20 mm to 630 mm.

Testing of products in conditions which reflect Brownfield Sites

The pipe manufacturers together with UK water companies developed and evaluated a permeation test to assess systems in conditions which reflect worst case hydrocarbon contamination in brownfield sites. The test was included in WIS 4-32-19: 2007 and is now in BS 8588: 2017.

The permeation test uses a saturated liquid hydrocarbon environment to provide a high concentration of low molecular weight substances to provide an accelerated test. Concentrations are 1000 times greater than typical ground contamination.

The test liquid is a synthetic petroleum (gasoline) blend of 50% toluene and 50% iso-octane. This is equivalent to ASTM D471 Fuel C and is considered the most aggressive contaminant reflecting former petrol forecourt locations. This ASTM standard is widely recognised and in the absence of a UK or European Standard, Fuel C best represents likely contamination in brownfield sites. Additionally, whilst care needs to be taken concerning health and safety, storage, handling and disposal of petroleum liquids, laboratories are familiar with using Fuel C to test plastics and rubbers.

The molecular size of the organic compound (carbon chain length) and the concentration of the test liquid will impact on the diffusion coefficient (and therefore time to permeate) through the pipe material. Analysis of site survey report shows contaminants to be low concentration, high molecular weight substances which will permeate more slowly than the high concentration of low molecular weight substances used in the BS 8588 test.

In addition, the BS 8588 test is design around service pipes with the thinnest wall and smallest diameter in the pipe range.

What is suitable for use in Brownfield Sites?

Where hydrocarbons are shown to be present and a barrier system is selected, the complete system needs to meet the requirements of BS 8588. This means a barrier pipe with joints which are compatible and tested in conjunction with the pipe to BS 8588. This provides assurance of the long-term system performance and gives confidence in the future reliability of the barrier pipe system.

Suitable joints:

- Mechanical. Metal fittings are naturally a barrier to organic compounds, but contaminants may come in contact with the elastomeric seal. A suitable sealing material is incorporated into the fitting and tested as part of the BS 8588 assessment.
- Electrofusion fittings. Unlike the pipe, these do not include a barrier layer. Electrofusion fittings supplied as part of a barrier system have been tested with the pipe to BS 8588 and provide acceptable performance without additional wrapping.
- Butt fusion. Butt fusion joints on pipes greater than 90mm diameter have been successfully tested to BS 8588 in both the wrapped and unwrapped conditions. Where butt fusion jointing is carried out on site, the manufacturer's instructions must be followed.

Further guidance on selection of joints is given in the BPF Guidance document - Joining of polyethylene pressure pipes for below ground water applications

<https://www.bfppipesgroup.com/media/34200/Joining-of-PE-pipes-for-below-ground-water-applications-v2.pdf>