## Position statement:

## Plastic piping systems for hydrogen fuel gas networks

**This position statement has been issued by the BPF Pipes Group (June 2023) on behalf of its members**
**https://www.bpfpipesgroup.com/members/member-listings/**

The UK government plans to deliver its Net Zero emissions target by 2050. Hydrogen gas is a clean fuel that can be produced from renewable power like solar and wind and a variety of domestic resources, such as natural gas, nuclear power and biomass – the latter coupled with carbon capture and sequestration.

Hydrogen was present in 'town' gas produced from the early 1800's in the UK, for example by the Gas Light and Coke Company. Later it as superseded by 'natural gas' in the 1950's when the then British Gas Corporation undertook a nationwide conversion programme to this newer 'clean natural gas' of the future.

Plastic pipes, predominantly derived from and made of polyethylene were introduced to the UK distribution system in 1969, rapidly gaining widespread acceptance due to their predictable performance as a buried asset. One consequence in the UK experience is that such pipes have not been operated with hydrogen, or hydrogen-methane blends, coming as they do after conversion to natural gas. The materials are though made to standards that do cover dry gas blends in their scope, for example ISO 4437 and BS EN 1555. And the same materials used to construct networks in the UK are used around the world where there is relevant experience with hydrogen.

A relevant example can be found by reference to The Hong Kong & China Gas Company. This company in Hong Kong supplies gas made from naphtha, natural and landfill gas sources. Hydrogen forms 46.3% to 51.8% of the gas supplied by volume. Hong Kong started using polyethylene pipe systems in 1987 and has an extensive network from 32 to 400mm, operating at pressures to 4bar. This in the fourth most densely populated country on the planet with extensive underground building levels with pipes buried in close proximity. It has an exemplary safety record.

The UK is taking the first steps to reintroduce hydrogen, as a blend with methane, to reduce carbon emissions. Initially this will be at low concentrations of hydrogen so that appliances operated by end users will not need modification of the combustion systems - not due to safety considerations with the pipeline. This allows partial introduction of hydrogen fuel prior to eventual full conversion to 100% hydrogen gas supply. It will

deliver an initial incremental benefit but be largely invisible and without impact to wider society, whilst regaining confidence in moving to a new fuel gas source.

The 'HyDeploy'[i] project is a UK case study that converted the Keele University estate to run on a hydrogen-methane blend. The network features all types of polyethylene pipe laid from the early 1970's onwards, covering both medium and high density materials. It also features the range of jointing systems employed including hot iron, butt and electro-fusion welding techniques. A safety case was successfully developed with the national regulator for conversion of the polyethylene network to start using hydrogen in the gas supply.

The next step considers conversion of existing networks, or construction of new networks, for the distribution of hydrogen gas alone. An early study by the Danish Gas Technology Institute[ii], removed polyethylene pipes up to 20 years old from existing methane based natural gas installations. These pipes, along with new pipes, were then installed to a test network running with 100% hydrogen gas volumes. The evidence showed that after monitoring for a period in excess of 10 years, even with increased concentrations of hydrogen, no new failure modes were created, and no acceleration of wear out characteristics was seen.

Validation of new materials can be performed prior to building networks. In the Groningen region of Netherlands, the development of green hydrogen refuelling infrastructure for vehicles is underway. A published study on the properties and suitability of polyethylene materials[iii] concluded that risk is no higher than with methane gas and evidence from other studies such as the H100 project in the UK[iv] is that some risks actually reduce with hydrogen.

Many countries are considering the longer-term goal of converting existing gas distribution networks to either a hydrogen-methane blend, or a pure hydrogen option. Whether the hydrogen comes from so called blue or green sources, then in principle, existing and new polyethylene pipe material networks will be suitable for the distribution of these gases.

There has been much work performed on the suitability of hydrogen for use with plastic piping systems. Whilst polyethylene materials are the first consideration due to their extensive use in gas networks, PVC pipes have also been assessed[v]. Pan European collaborative research has been completed to develop evidence on the genuine concerns and issues that could exist. An example is the 'NaturalHy'[vi, vii] project, an evidential approach demonstrating the suitability of materials for hydrogen. One which helps differentiate economic issues (i.e. permeability of materials) from genuine safety concerns.

It is clear, and the informed position of the BPF Pipes Group, that plastic pipe systems can be considered for use with hydrogen-methane blends, and with pure hydrogen

gases. For modern materials the industry standards such as ISO 4437 and EN 1555 already anticipate this in their scope for compatible fuel gases for polymer piping systems. Older generation materials subjected to classification and characterisation of their properties can also be considered. The final decision on suitability will be determined by asset owners who understand the construction and operating conditions of their pipelines. This reflects the approach being taken through all of the European markets in which BPF Pipe Group member companies are working. The national or local application of plastic piping networks must be taken into consideration so that factors like construction quality and operating characteristics are assessed prior to building or converting networks, to ensure safe systems result.

**References:**


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[iii] Hermkens R et al; KIWA; "The suitability of PE pipes for transport of hydrogen", AMI Conference Proceedings

[iv] Muckle D et al; "Integrity of PE Pipe Systems – 100% Hydrogen Fuel Gas Source", May 2020, OFGEM NIA, UK

[v] Hermkens R et al; KIWA; "Can PE and PVC gas distribution pipes withstand the impact of sustainable gases?", Sep-16, Plastic Pipes Conference, Germany

[vi] Foulc MP et al; "Durability and transport properties of polyethylene pipes for distributing mixtures of hydrogen and natural gas", NaturalHy Project, WHEC June 2006, France

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