

# Material Assessment in Methane-Hydrogen Combinations



**JOINT INDUSTRY  
PROJECT OUTLINE**

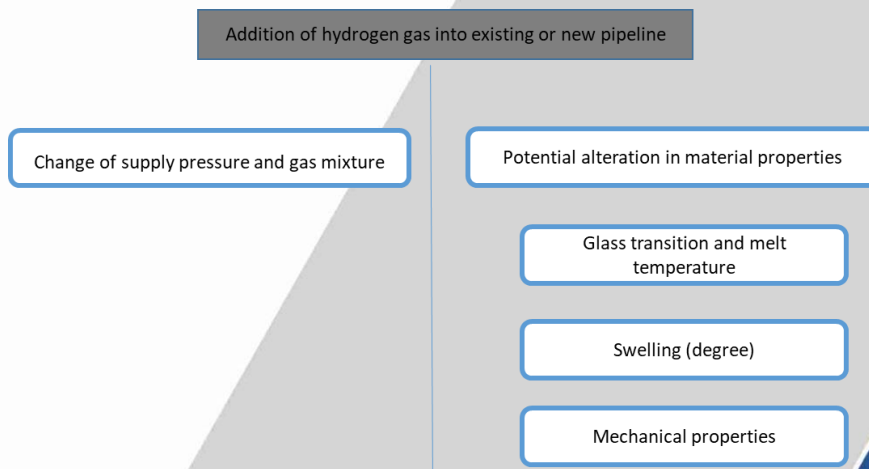
**PROP309329**

## Summary

Composite and multi-material pipe infrastructure exists for carrying natural gas and in the future there will be significant benefit if these can be used for blends of hydrogen (H<sub>2</sub>) gas. Materials containing polymers such as thermoplastics, thermosets and elastomers have been in service for decades in high methane (CH<sub>4</sub>) or carbon dioxide (CO<sub>2</sub>) fractions. In some instances, the materials are in a product that is past design life. To support their continued use when changing to hydrogen, whilst assuring integrity and continued functionality, there is a need to establish how the polymers might have altered over time.

TWI has expertise in connecting different material properties before and after exposure to gases and liquids.

In this study the properties of interest are summarised in Figure 1 with the left of the diagram describing initial exposure and the right of the diagram the alterations in properties.



**Figure 1:** Materials properties that may change on addition of hydrogen gas to existing pipelines.

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## Project Concept

An objective of this project is to summarise the potential chemical and physical alteration in a range of materials when exposed to hydrogen. Finally, to compare selected permeation rates of methane and methane-hydrogen blends with inter-dispersed rapid gas decompression events.

## Benefits

The repurposing of existing lines for use in hydrogen gas will be possible, avoiding the need for investment and disruption through new installation.

## Approach

### **WP1 – Material properties in hydrogen**

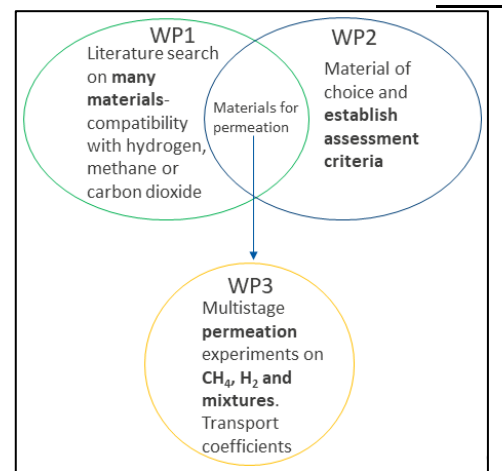
A summary of recent literature, to include previously completed reviews at TWI in order to establish the likelihood of hydrogen exposure altering the chemistry and morphology of selected materials.

### **WP2 – Assessment criteria**

In this work package the findings from WP1, that highlight the materials most likely to change and the requirements of the sponsor/s in material selection, will be combined. Based on the likely failure mechanisms of materials in products, WP2 will seek to establish agreed properties and criteria for assessment of the in service condition of laboratory specimens or pipes over a time interval.

### **WP2 – Permeation testing**

Materials selected from WP1 and WP2 will undergo permeation tests with different concentrations of CH<sub>4</sub> and H<sub>2</sub>. This will be followed up by assessment.



## Deliverables

Deliverables from the project include:

- WP1: A report containing a literature review of the impact of hydrogen exposure on selected non-metallic materials.
- WP2: A report detailing the material properties that need to be tracked and the proposed standard or non-standard methods that should be used for assessment.
- WP3: The transport coefficients (K, D and S) will be calculated for the CH<sub>4</sub> and H<sub>2</sub>. Specimens will be analysed using differential scanning calorimetry, microscopy and spectroscopy where relevant. The data will be included in a final report.

## Price and Duration

The overall estimated price for the work is £600,000 (excluding VAT), which requires £100,000 per company per annum for 3 years (£300,000 total) for 2 sponsors.

## For further information on how a Joint Industry Project (JIP) runs please visit:

<https://www.twi-global.com/what-we-do/research-and-technology/current-research-programmes/joint-industry-projects#/>

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