

OZPIPE 2024

SUSTAINABLE INFRASTRUCTURE

PUBLISHED HYDROGEN PERMEATION STUDY ON 4 DIFFERENT TYPES OF PE PIPES

Andrew Wedgner – PE100+ Association

Co-authors Norbert Jansen and Rainer Kloth

Content

- Target of the study
- Materials and test set-up
- Specific permeation coefficient determination
 - PE80 MDPE yellow
 - PE100 Black
 - PE100-RC Black (C4 based)
 - PE100-RC Black (C6 based)
- Summary of results at the target temperatures
- Example from standardization

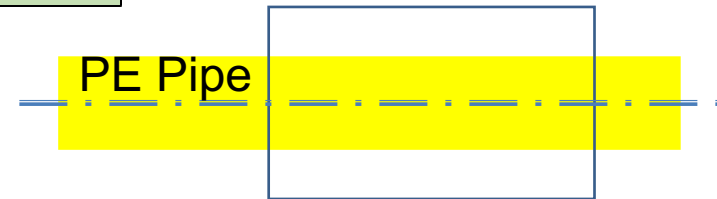
Target of the study

- Thousands of kilometers of natural gas distribution PE pipes are existing worldwide
- Switching to even 100% hydrogen does not effect the physical properties of classified PE resins (PE80, PE100, PE100-RC) and should be possible (referenced publications)
- Hydrogen is a smaller molecule and permeation rate is expected to be higher than methane
- Gas network owners need to perform a technical and risk assessment related to expected permeation volumes of hydrogen over time on their specific network
 - Define permeation rate on specific pipeline sections
 - Investigate and define critical sections (like entrapped gas)
 - Risk mitigation actions
 - Adjusted selection criteria for future gas network extensions
- PE100+ provides typical temperature dependent permeation coefficients for the typical classified PE resins

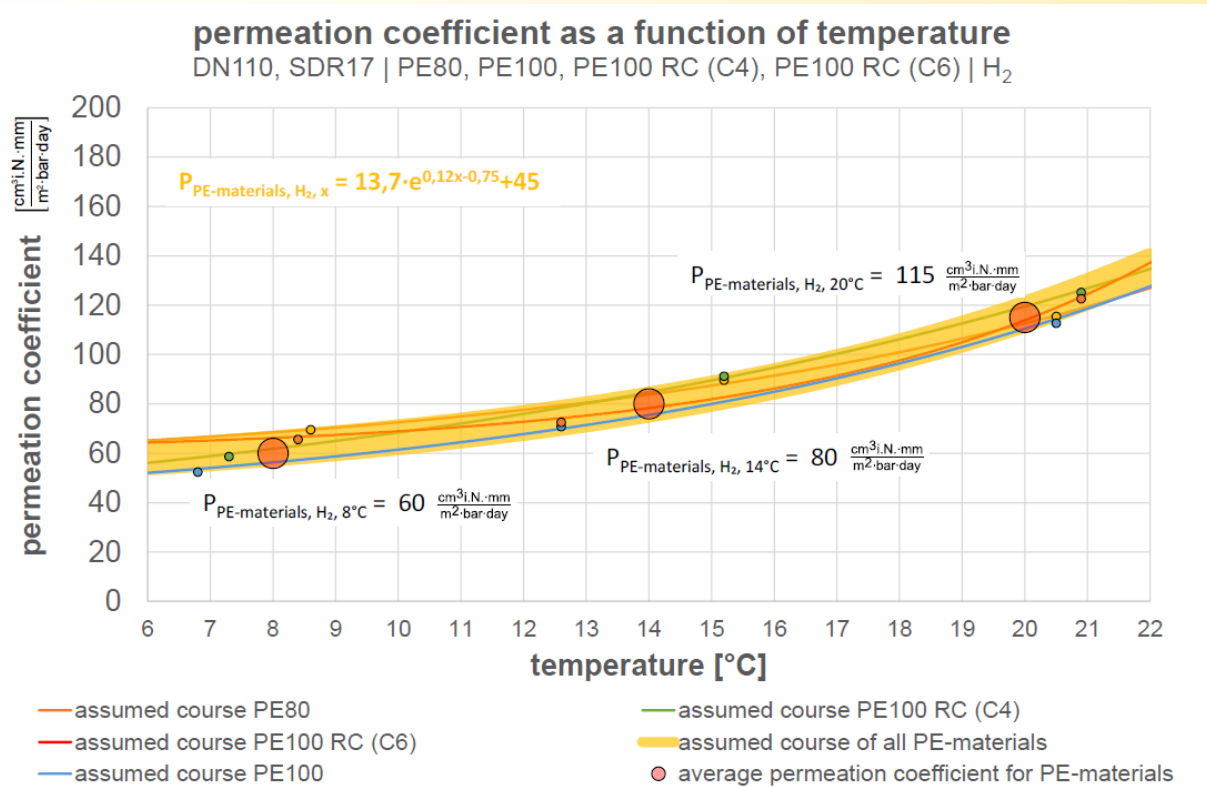
Materials and test set-up

Classification	Material	Manufacturer	Medium	Target Gauge Pressure	Target Test Temperature
PE80	PE80 MDPE Yellow	BOREALIS	H ₂	6.3 barg	8°C, 14°C, 20°C
PE100	PE100 (C4 based) Black	SABIC	H ₂	6.3 barg	8°C, 14°C, 20°C
PE100-RC	PE100-RC (C4 based) Black	LyondellBasell	H ₂	6.3 barg	8°C, 14°C, 20°C
PE100-RC	PE100-RC (C6 based) Black	INEOS	H ₂	6.3 barg	8°C, 14°C, 20°C

- Classified PE pipe resins used
- Pipe OD 110mm SDR17, about 1,2m length
- Hydrogen media 99,999% purity
- Target pressure 6,3barg
- GC (Gas-Chromatograph) measures permeated H₂ volume concentration in a calibrated measuring cell with 100mbarg



Permeation coefficient versus temperature for typical pipe resins



Exponential function assumed

Support of EN standardization

NWIP prEN 1555-1:2023

Annex B
(informative)
Additional information related to the suitability of PE pipe systems for 100% hydrogen and its admixtures with natural gas

Temperature in °C	Hydrogen permeation coefficient Range P_c (ml·mm)/(m ² ·bar·day)	Methane permeation coefficient Range P_c (ml·mm)/(m ² ·bar·day)
8	55-65	6-9
14	75-85	not measured
20 - 25	108-193	10-37
40	321-523	98-165

- Data of the PE100+ Association study have been partly used for the Appendix of the new prEN 1555
- Gas network owners have to perform their own risk assessment based their own data