PIPELHYNE

PIPELines for HYdrogen NEtworks

3rd of December 2021

Collaborative fracture mechanics testing program at RICE: Integrity of network steels with 100% H_2

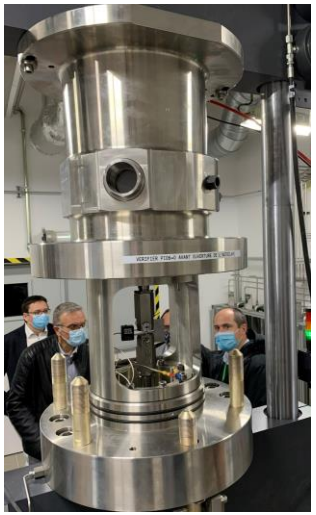
- H_2 embrittlement assessment of new "H_2 compatible" pipeline steels (different grades ranging from L245 / Grade B to L485 / X70)

  → assessment of ASME B31.12-2019 conservatism

  - Fatigue Crack Growth Rate (FCGR) tests under 100 bar H_2
  - Fracture toughness (FT) tests under 100 bar H_2

- Addition of small quantities of 2 embrittlement inhibitors to the H_2

- **4 program partners so far** with cost shared according to each party interests



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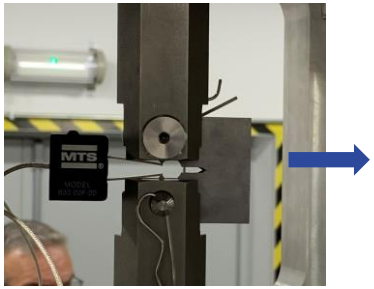

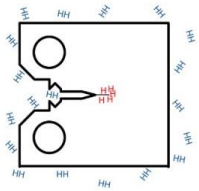

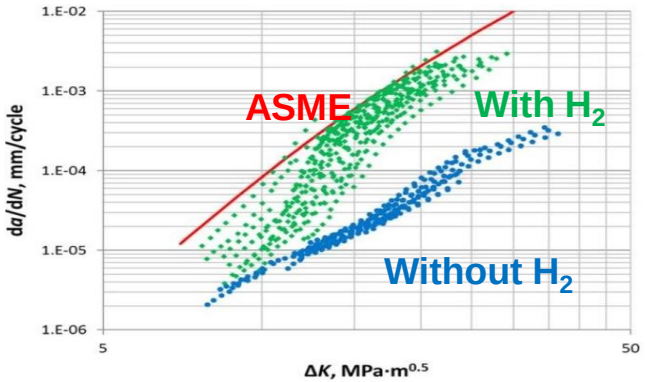

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Collaborative fracture mechanics testing program at RICE: Integrity of network steels with 100% H_2

- 8 different base metals will be tested (FCGR and FT) under 100 bar H_2
- Sourcing of materials is still ongoing → pipe manufacturers are involved in this step
- Tests will be carried out on the new GRTgaz Hydrogen platform

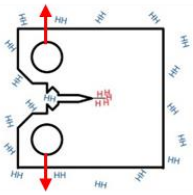
FenHYx

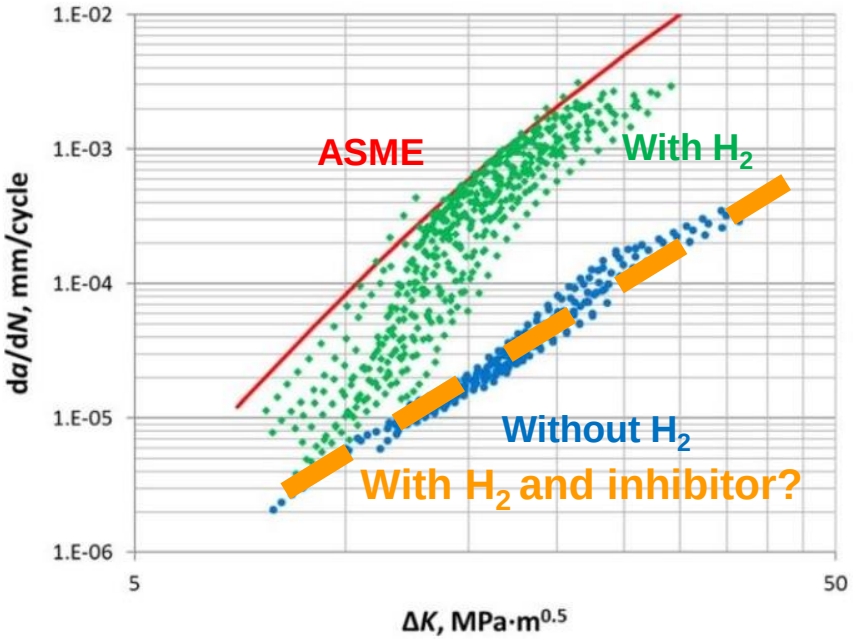
Steel grade	Tube type	Sample type
L245NE (Grade B)	SMLS	Base metal
L245NE (Grade B)	HFI	Base metal
L360NE (X52)	HFI	Base metal
L360ME (X52)	SAWL	Base metal
L415ME (X60)	SAWL	Base metal
L415ME (X60)	SAWH	Base metal
L485ME (X70)	SAWL	Base metal
L485ME (X70)	SAWH	Base metal

Effect of O_2 as inhibitor of H_2 embrittlement

L360NE HFI will be tested under 100 bar H_2 + some O_2 to study its embrittlement inhibitory effect

- Timing: July 2021 till December 2022
- FCGR at R=0.5 and f=1Hz (reference curves will be measured in 100%CH_4)
- FT (reference curves will be measured in 100%CH_4)
- 3 different O_2 concentrations will be tested





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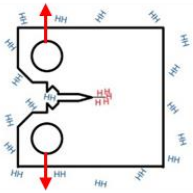
New "H_2 compatible" pipeline steels

8 different base metals will be tested under 100 bar H_2

- Timing: January 2022 till March 2026
- FCGR at R=0.3 & 0.5 & 0.7 and f=1Hz (reference curves will be measured in 100%CH_4)
- FT (reference curves will be measured in 100%CH_4)
- All tests carried out in triplicate



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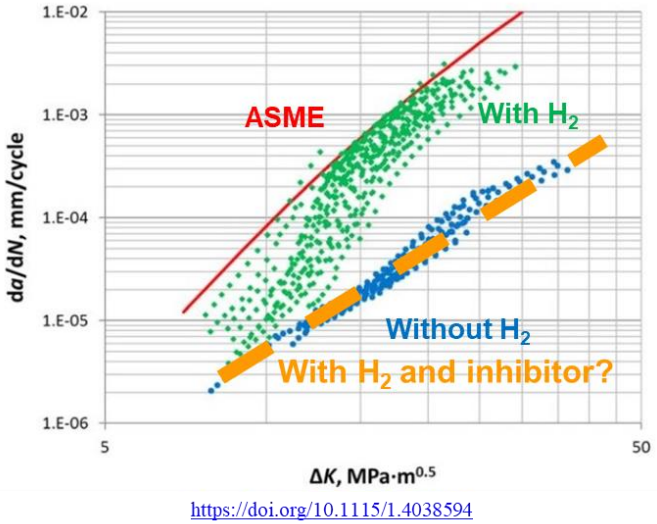
Effect of O_2 and another inhibitor of H_2 embrittlement

8 different base metals will be tested under 100 bar H_2 + some inhibitor

- Timing: January 2023 till December 2028
- O_2 inhibition testing on 7 remaining “new” steels
- Other inhibitor (in collaboration with a chemical company) testing on L360NE HFI base metal
- FCGR at R=0.3 & 0.5 & 0.7 and f=1Hz (reference curves will be measured in 100%CH_4)
- FT (reference curves will be measured in 100%CH_4)
- 3 different inhibitor concentrations will be tested



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