

## Study on hydrogen embrittlement sensitivity of X60 base metal and girth weld under different hydrogen partial pressure environments

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**Abstract** This paper explores the hydrogen embrittlement sensitivity of pipeline steel under different hydrogen partial pressures to provide data support for the safe operation of natural gas hydrogen pipelines. The hydrogen embrittlement sensitivity of X60 pipeline steel parent material and girth weld under different hydrogen partial pressure environments was studied. Slow strain rate tensile and in-situ gas phase hydrogen permeation tests were carried out at different hydrogen partial pressures of 10%, 20%, and 30% (total pressure 12MPa). According to the tensile curve and fracture morphology, it is shown that with the increase of hydrogen partial pressure, the mechanical properties of the parent material and girth weld gradually decrease, and the hydrogen embrittlement sensitivity increases. Due to the presence of a coarse-grained Widmanstätten structure, the hydrogen embrittlement sensitivity of the girth weld is much higher than that of the parent material. When the hydrogen partial pressure reaches 30%, the hydrogen embrittlement sensitivity of the girth weld reaches 27.3%, which is twice as high as the parent material. With the increase of hydrogen partial pressure, the time for hydrogen diffusion in the girth weld to reach a steady state is faster, the steady-state current density is higher, and the apparent hydrogen diffusion rate is higher, which further shows that the hydrogen embrittlement sensitivity at the girth weld is higher than that of the parent material.

**Keywords** X60 base metal and girth weld, different hydrogen partial pressures, in-situ gas phase hydrogen permeation, slow strain rate tensile, hydrogen embrittlement sensitivity.

### Reference

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