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Abstract

Most of the design, construction, and maintenance practices in the pipeline industry were established before the extensive use of modern control-rolled and microalloyed steels. These modern steels can behave very differently from older hot-rolled or normalized steels. For instance, these modern steels may have very low strain-hardening capacity and high levels of heat-affected zone (HAZ) softening due to their ultra-low carbon and low-hardenability chemistry. The low strain-hardening can potentially have a negative impact on the tolerance to anomalies such as corrosion or mechanical damage. The HAZ softening can reduce the longitudinal strain capacity of a pipeline.

In this paper, the linepipe manufacturing history is first briefly reviewed, with a focus on the chemical composition and rolling practices that directly affect the mechanical properties and the response to welding thermal cycles. The characteristics of linepipes made from modern microalloyed steels are contrasted with those made from vintage hot-rolled or normalized steels.

The expected behavior of old vs. new steels is compared under three possible failure modes: (1) burst of pipe segments with corrosion anomalies, (2) burst of cold-bend pipes, and (3) tensile rupture of girth welds. The implications of the pipe properties and weld characteristics on the design, construction, and maintenance of pipelines are highlighted. Future directions and best practices in linepipe alloying and specifications are briefly described.

Keywords

Linepipe properties, Strain hardening, Assessment of corrosion, Field cold-bends, Welding, HAZ softening, Strain capacity