Wang, Y.-Y., Liu, M., Interaction of Characteristic Mechanical Properties and Mechanics in the Evaluation of Weld Integrity of High Strength Linepipes, Proceedings of HSLP-IAP 2006: International Seminar on Application of High Strength Line Pipe and Integrity Assessment of Pipeline, Xi'an, China, June 15-16, 2006

Abstract

Modern high strength linepipes (pipe grade X80 and above) are usually made from low carbon control-rolled TMCP steels. These steels generally have excellent weldability and high impact toughness, in addition to its high strength. They may also have some undesirable mechanical properties, such as low strain hardening (high yield to tensile ratio), low ductility, and anisotropy. The low-carbon low-alloy chemical composition leads to low hardenability. Consequently the thermal cycle of a welding process can cause the heat-affected zone (HAZ) to soften, i.e., HAZ having lower strength than the base metal. The softened HAZ may act as a site for strain concentration. This increased strain level, together with the possible existence of fusion boundary defects and low HAZ toughness, can have a critical impact on the structural integrity of the welds.

The evolution of chemical composition, steel making process, and some key mechanical property parameters at increasing of linepipe strength level is first reviewed. The implications of these changes on weld integrity are examined. Two particularly important features relevant to high strength TMCP linepipe steels, HAZ softening and anisotropy, are examined in details. The final part of this paper provides a general overview of research activities in North America in addressing the unique challenges of high strength linepipes and their weld integrity.

Keywords

Pipeline, Linepipe materials, Welding process, High-strength steel