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## **Abstract**

Since the 1970s, the development of high-strength pipeline steels has followed the route of progressively reduced hardenability through lower carbon and alloying element contents. Microalloying, controlled rolling (CR), and thermo-mechanical controlled processing (TMCP) have been used extensively to achieve the high-strength and other material property requirements despite the trend towards lower carbon content.

The primary driving force behind the evolution of these alloying and processing strategies stems from the concerns over the weldability, particularly the hydrogen assisted cracking (HAC), at ever-increasing strength levels. In doing so, the adverse effects of this steel making philosophy on the structural integrity and steel manufacturing cost have become more pronounced. The steels made using those processes can exhibit high yield to tensile ratio (low strain hardening), low uniform elongation, HAZ softening, and splitting; all of which tend to have detrimental effects on pipeline integrity. The objective of the work described here was to evaluate alternate steels with enhanced hardenability and identifying those that would have a potential to (1) meet the high strength/high toughness requirement but without the adverse effects of the early trial heats of microalloyed TMCP X80 and X100 linepipe steels, and (2) exhibit sufficient resistance to HAC. Three enhanced hardenability steels were evaluated through a full range of mechanical tests, metallurgical examination, and weldability tests. Although none of the three alternative steels met the full requirements of X100 linepipe material, one of them showed good promise in meeting the X100 linepipe material requirements.

### **Keywords**

High strength linepipe, Weldability, Hydrogen assisted cracking (HAC), Hardenability