WELDING HIGH STRENGTH FERRITIC STEELS FOR HYDROGEN SERVICE

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Hydrogen is expected to play a major role in the decarbonization of the energy grid. Hydrogen shows an interesting energy density per unit mass, but also a very low mass density; for this reason, it is preferably stored and transported at elevated pressures in the gas phase to maintain a useful volumetric energy density. Unfortunately, interaction with hydrogen is known to be detrimental for container materials, and the phenomenon is made worse as hydrogen pressure increases. Materials showing a combination of high strength and low sensitivity to hydrogen embrittlement are therefore desirable for construction of pressure equipment. These materials are typically heat treated to enhance their properties, achieving a microstructure capable of ensuring both strength and fracture toughness. It is common knowledge that welding produces a microstructural transformation in the heat-affected zone that can ultimately compromise the material's performance. This is especially critical when the service environment is hydrogen. Dedicated welding procedures therefore need to be developed.

This work discusses the development and qualification of a welding procedure for high strength, quenched and tempered steel suitable for the construction of hydrogen pressure equipment. Special focus is given on the metallurgical challenges and characterization of the weldment's performance in the service environment.