HYDROGEN EMBRITTLEMENT SUSCEPTIBILITY OF DEPOSITED NICKEL-BASED ALLOY 82

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Weld Metal Alloy 82 used in the primary circuit of nuclear plants has shown a decrease in mechanical properties (ductile tearing resistance) while exposed to specific environmental conditions of a pressurized water reactor (PWR), typically at low temperature (<100°C), and when the test is performed in primary water. This behavior, called LTCP (Low Temperature Crack Propagation), is attributed to the hydrogen of the environment. The main objective of the present work is to evaluate the susceptibility to hydrogen embrittlement (HE) of this type of weld metal. The study was carried out on an Alloy 82 (designated in RCC-M code ERNICr-3) type weld made by GMAW process, representative of some welds used in PWR plants. Its highly heterogeneous microstructure was characterized at various scales with a combination of different techniques (optical and transmission microscopies, electron probe microanalysis, microhardness measurements, and electron backscattered diffraction) across the whole depth of the deposit. Tensile tests were performed on as deposited samples and heat treated (at 300 °C for 200 h) samples to consider the potential evolution in mechanical properties due to exposure to PWR conditions. Then, tensile tests were performed on as deposited samples in an autoclave, in air or in the simulated PWR environment, with or without pre-exposure to this environment at 300 °C for 200 h. The results obtained from these tensile tests were compared to those obtained for the reference samples (without exposure to PWR environment). The fracture surfaces and the shaft surface of the specimens were also studied to investigate a potential change in the fracture mode after exposure to PWR environment. Hydrogen content measurements were made to assess the hydrogen uptake during the exposure. Hydrogen content measurements and tensile tests were also performed on cathodically hydrogen-precharged samples (as deposited and heat-treated samples) to better understand the hydrogen contribution to the mechanical behavior changes. The results showed a hydrogen uptake after exposure to PWR exposure. The decrease in mechanical properties and changes in the fracture modes after exposure to PWR environment were consistent with the evolutions observed for the cathodically hydrogen-precharged specimens, which confirmed the HE phenomenon.