Corrosion Behavior of X100 Pipeline Steel and Its Heat-Affected Zones in Simulated Alkaline Soil Solution

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The microstructure changes underwent by the heat-affected zones (HAZ) of a X100 pipeline steel and the corrosion behavior of these zones and the base steel were studied in a simulated alkaline soil solution. The coarse-grained heat-affected zone (CGHAZ) and the intercritically reheated coarse-grained heat-affected zone (ICCGHAZ) were simulated by a Gleeble thermomechanical processing machine with different thermal cycle times, peak temperatures, and cooling rates. Open circuit potential (OCP), potentiodynamic polarization, electrochemical impedance spectroscopy (EIS), and scanning electron microscopy (SEM) were used to characterize the corrosion behavior of the X100 pipeline steel and its CGHAZ and ICCGHAZ in a simulated alkaline soil solution. The microstructures of the CGHAZ and ICCGHAZ were found to be significantly different than that of the base steel. The X100 base steel showed the most positive OCP, the lowest corrosion current density, and the largest polarization resistance. In contrast, the ICCGHAZ showed the most negative OCP, the highest corrosion current density, and the lowest polarization resistance. The CGHAZ and ICCGHAZ underwent corrosion to a higher extent compared to base steel after immersion in a simulated soil solution for similar periods of time. Those samples containing HAZ and base steel were found to present significant galvanic corrosion. The CGHAZ and ICCGHAZ of a X100 pipeline steel immersed in a simulated alkaline soil solution exhibited lower corrosion resistance than the base steel.

Keywords: X100 steel; heat-affected zones; corrosion behavior; simulated alkaline soil solution; electrochemical impedance

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