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Inluence of steel slab internal quality on hydrogen-induced crack resistance in normalized heavy plate for pressure vessels

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The influence of internal soundness levels on hydrogen induced cracking (HIC) resistance of ASTM-A516 grade 60 normalized steel plates was evaluated. Three heats were produced on a state-of-the-art steel-making plant using advanced primary and secondary refining practices and continuously cast on sophisticated vertical curved machine doted of high-end technologies, such as spray-3D secondary cooling, dynamic soft reduction in all segments, 2.2 m of vertical zone, mold with 0.8 m of length, tundish with 80 t of capacity and quality tracking system with more than 40 online parameters checking. Aiming for optimal internal soundness results, the casting parameters were varied, obtaining slabs with Mannesmann internal soundness levels 1 and 2. The slabs were hot-rolled and heat-treated through the normalizing process. Cross-sectional samples on slabs were conducted to assess the level of internal soundness. In heavy plates, susceptibility to HIC according to standard NACE-TM-0284 solution A tests and characterization of crack nucleation regions were evaluated. The HIC cracks were observed in the central heavy plates thickness, an area with the highest concentration of hydrogen-trapping sites due to the inherent higher central segregation in this region. These cracks nucleated and propagated between microconstituent regions of higher hardness. An increase in HIC resistance was observed with the reduction of central segregation in the plates. Heavy plates from the internal soundness level 1 exhibited satisfactory resistance to HIC.