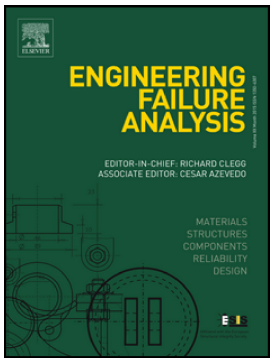

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Hydrogen Embrittlement of Large Diameter High-Strength Rods for Special Structural Applications

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Abstract:

This work aims assessing the stress corrosion behaviour in distinct aggressive environments of a commercial class of high-strength low alloy steel bars of randomly oriented pearlite structure, intensively used in tensioning systems of structural engineering. The research is based on tensile testing of un-notched and circumferentially notched cylindrical specimens that are simultaneously subjected to slow strain rate loading and environmental damage. To vary the damage intensity, seawater media of distinct aggressiveness, and ammonium thiocyanate solution are employed. In addition, fracture tests of chevron-notched short bar specimens, fatigue pre-cracked perpendicularly to the bars axis, provided the experimental data to benchmark the bars toughness. The results indicate that damage inducing failure consists of pearlite interlamellar decohesion as result of hydrogen-induced local embrittlement of the steel. This activates a continuous stable cracking of sickle shape until brittle rupture of the remnant undamaged ligament is finally triggered.

Keywords: High-strength low alloy steel bars, hydrogen embrittlement, seawater stress corrosion, sickle shape surface crack

Highlights:

- Pearlite interlamellar decohesion results from local embrittlement, hydrogen-induced
- Sickle shape cracking of bars, cohesive at macroscale, follows pearlite delamination
- Sickle shape cracks trigger the brittle collapse of the undamaged ligament of bars