Hydrogen Influence on certain mechanical and magnetic properties of a stressed low – carbon steel after corrosion in NaCl- water solution

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Abstract

Atomic hydrogen produced by corrosion of low-carbon steel in NaCl- Water solution may markedly affect its certain tensile mechanical and magnetic properties in a complex and peculiar manner. This influence was investigated by employing the intrinsic micro magnetic emission (ME)-response as well as mechanical response of this ferromagnetic material, where relevant processes and parameters of micromagnetic and mechanical activity were implemented. In this faction, it was shown that an increase in the hydrogen accumulation with corrosion time leads to an associated increase in the pervasive and embrittling influence expressed by a marked loss in ductility of the material. The competitive interplay of cumulative hydrogen, applied stress and plastic strain-induced microstructural damage was related to a specific ME-response parameter by which an increased magnetic hardening tendency of material with corrosion time was established. It was also shown that the embrittlement is a product of hydrogen accumulation and it's afterwards highly localized effect.

References

1. H. Möller, E.T. Boshoff and H. Froneman; "The corrosion behavior of low carbon steel in natural and synthetic seawaters" The Journal of South African Institute of Mining and Metallurgy, Vol.106, pp.585-592, 2006.
2. A.W. Thomson and I.M. Bernstein, Advances in corrosion Science and Technology, vol.17, R.W. staehle and M.G. Fontana, Eds. Plenum, New York,1980, p.53.
3. Jingwei Zhao, Young Soo Chun and Cong Soo Lee; "Hydrogen embrittlement of low carbon steel during slow strain rate Test" Advanced Materials Research, Vols.197-198, pp.642-645, 2011.