Erosion corrosion of austenitic and duplex stainless steels

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The problem of erosion-corrosion in stainless steel components, such as: pipes, valves, pumps and heat exchangers, has a major economic impact on the maintenance and management of fluid-handling plants. Even though this phenomenon is recognised as a critical one for the industry, a limited amount of research has been devoted to it [1, 2].

In order to gain a more insightful understanding of the environmental parameters relevant to damage phenomena related to erosion-corrosion, in this paper we report on electrochemical studies carried out on two kinds of two-phase stainless steel (2205 and 2507), comparison test were performed with a traditional austenitic stainless steel (AISI 316).

Two test rigs were employed in order to measure the erosion-corrosion effects of a slurry containing micrometric SiC particles suspended in chloride-containing aqueous solutions (10 vol% HCl and artificial seawater): a fluidised-bed and (ii) a stirred-reactor.

The erosion-corrosion behaviour was evaluated on the basis of: (i) weight loss measurements, (ii) recording of potentiodynamic curves, (iii) SEM metallographic observations.

The results allow to assess a synergy between the mechanical abrasion of the passive films brought about by particle impact and the electrochemical polarisation.

In the case of an aggressive acidic environment (10 vol% HCl) the dominating damage mechanism is of a corrosive nature: the erosion-corrosion resistance of the austeinitic stainless steel is better than that of the duplex grades.

In the neutral chloride-containing environment the duplex stainless steels perform better. In this case the erosive aspect of the damage is the dominating one. A higher chemical stability of the passive films (which can be ranked, e.g., through the traditional Pitting Resistance Equivalent Number) of the duplex stainless steels with respect to traditional austenitic ones ensures a higher resistance.

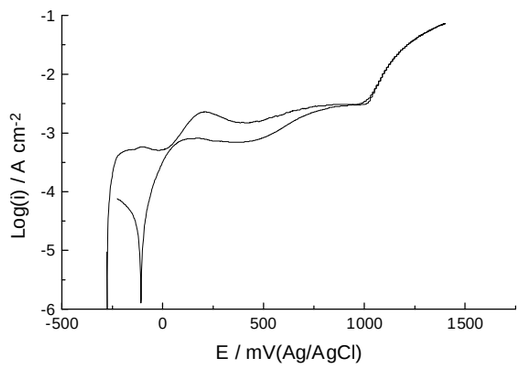

Figure 1 - Anodic cyclic potentiodynamic scans for solution-annealed grade 2205 in 10 vol% HCl at room temperature, scan rate 2 mV s^{-1}

[1] L.Renaud, B. Chapey, J. C. Bosson, R. Oltra, J. Charles, Proc. of Duplex Stainless Steel '91 Conf., Beaune (France), 1991, Vol. 2, p.939-947.
[2] A. Dwars, Proc. of Stainless Steel World Conf., The Hague (The Netherlands), 2001, p.417-419.