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CORROSION STUDY OF SOME STAINLESS AND CARBON STEELS FOR STRUCTURAL APPLICATIONS

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ABSTRACT

The aim of this work was to characterize, using a 3.56% NaCl solution, the corrosion resistance of some stainless steels (AISI 316L and AISI 304L) and four other commercial carbon steels (X52, X70, S275, S355) for structural applications. Open circuit potential measurements, anodic polarizations, immersion tests and optical microscopy have shown that stainless steels are more corrosion resistant than carbon steels.

Keywords: corrosion, stainless steels, carbon steels, anodic polarization.

INTRODUCTION

Typical corrosion mechanisms in pipelines and naval ships structures include uniform corrosion, stress corrosion cracking, crevice, and pitting corrosion. Corrosion damage and failure are not always considered in the design and construction of many engineered systems. Moreover, the combined effect of corrosion and mechanical damage can result in unexpected failure of the structures (Gudze, 2008; De Leon, 2005).

Corrosion studies have been performed using a 3.56% NaCl solution. Immersion tests have been carried out using the NaCl solution and the area of every samples exposed to the solutions in the electrochemical cell was equal to 0.785 cm^2. Open circuit potential measurements, during one hour, before anodic polarizations, were performed using an electrochemical three electrodes cell.The sweep rate was equal to 0.25 mV/min. and started for every samples 0.25 V bellow the corrosion potential, $E_{corr,}$ The electrochemical experiments were performed with an EG&G Princeton Applied Research model 273 A potentiostat. In addition, all the samples have been subjected to immersion tests during eight days. Optical microscopy has been used in order to observe the surface morphology of the specimens. These experiments have shown important differences between the stainless steels and carbon steels. The electrochemical and immersion experiments have shown that both stainless steels are more corrosion resistant than the commercial carbon steels. Uniform corrosion has been observed for the commercial carbon steels during polarizations and immersion tests.

RESULTS AND CONCLUSIONS

In Fig. 1 is given an anodic polarization curve of 316L stainless steel and in Fig. 2 is given an anodic polarization curve of X70 carbon steel. As one can see the pitting potential, $E_{p,}$ is well defined for 316L SS being equal to 0.276 V while it was not possible to determine this

potential for the X70 steel. This phenomena are associated, in one hand, with localized corrosion for 316L SS and on the other hand, with uniform corrosion for X70 steel that occurred during the polarization and leading to intense dissolution of the steel and production of a precipitate that protected the specimen of localized corrosion impeding the specimen to show the pitting potential,E_p. In table 1 are given the resultsof anodic polarizations of both steels, as examples. The i_{corr} value for 316L is quite lower than the value for X70 showing that 316L is more corrosion resistant than X70. Similar results have been obtained for the other samples.

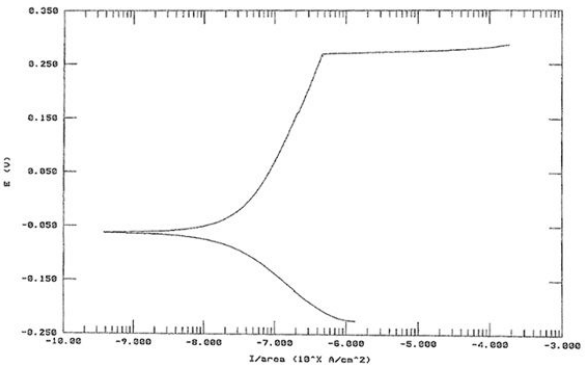

Fig. 1 - Anodic polarization curve of 316L SS

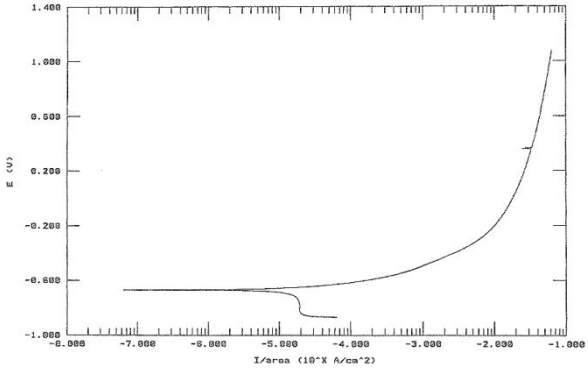

Fig. 2 - Anodic polarization curve of X70 steel

Table 1 - Electrochemical parameters of 316 L stainless steel and X70 carbon steel

Sample	βa	βc (V/decade)	I_{corr}(mA/cm^2)	E (I=0) (V)	E_p(V)
316L	0.2249	0.1132	$2.848x10^{-5}$	-0.12	0.276
X70	0.1342	0.611x106	0.985	-0.4468	-

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