PREDOMINANCE ZONE DIAGRAM (PZD) FOR A CARBON STEEL IN Na$_2$SO$_4$ CONTAINING SOLUTIONS

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Figure 1. Predominance zone Diagram (PZD) for the $Fe(II) - SO_4^{2-}$ system.

Figure 2. Corrosion rate variation as a function of sodium sulfate concentration.

Introduction

A thermodynamic study based on predominance zone diagrams (PZD) construction was carried out in order to determine the stability of soluble species of Fe(II), as a product of corrosion of carbon steel in an aqueous sodium sulfate dissolution, according to the model proposed by Rojas et al.[1] For this diagram, the generalized species and thermodynamic constants available in the literature were considered for its construction. Figure 1, shows the PZD for the system formed by Fe(II)-SO$_4^{2-}$-H$_2$O.

The analysis of the system (metal-dissolution), shows that, an important increasing of corrosion rate is observed when the thermodynamically predominant specie of Fe(II) product of corrosion steel changes from Fe^{2+} to FeSO$_4$ (see Figure 2). The goal of this kind of analysis is to give additional information about the corrosion behavior of any metal immersed in an electrolyte of any nature.
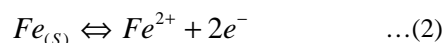
Conclusions

From PZD diagram constructed here it can be seen that thermodynamically, the corrosion of carbon steel in these media will take place by means of two different semi-reactions depending on the sulfate concentration into the solution.

If $\log[SO_4^{2-}] \geq -2.25$, the corrosion of carbon steel will take place according the reaction (1).

$$SO_{4(aq)}^{2-} + Fe_{(S)} \Leftrightarrow FeSO_{4(aq)} + 2e^- \quad ...(1)$$

In the other hand, if $\log[SO_4^{2-}] < -2.2$, then the corrosion process thermodynamically favored will be given by reaction (2).

$$Fe_{(S)} \Leftrightarrow Fe^{2+} + 2e^- \quad\quad ...(2)$$

References

1. A. Rojas, M. Teresa Ramírez. Ibáñez JG, González I. J. Electrochem. Soc. 138 365(1991).
2. A. Rojas and I González, Anal. Chimica Acta, 187 279(1986).
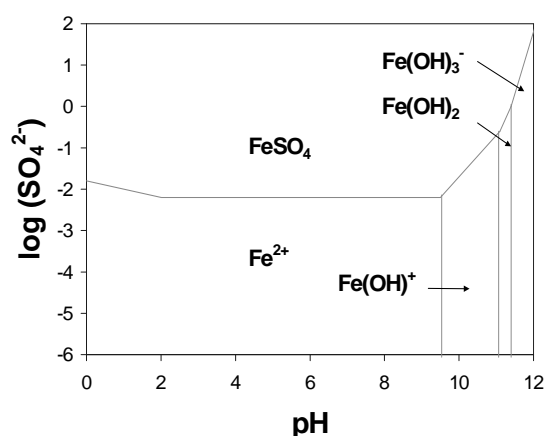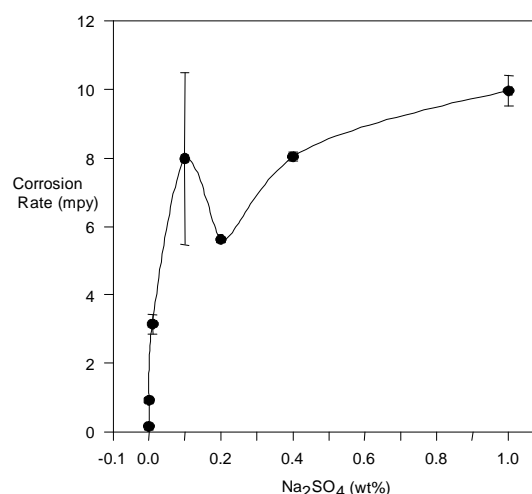3. A. Ringbom and L. Harju, Anal. Chimica Acta, 59 33 (1972).