17° Congreso Internacional de Metalurgia y Materiales
CONAMET-SAM
18-20 de Octubre de 2017
Copiapó-Chile

EVALUATION OF BIOFILM FORMATION AND CORROSION BEHAVIOUR OF SAE 1010 CARBON STEEL IN SRB CULTURES BY MICROSCOPIC TECHNIQUES AND ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY

M. Viera [a,b], S.E. Rastelli [a,c] , S.G. Gómez de Saravia [a,c]

[a]CIDEPINT (CICPBA-CONICET), 52 e/ 121 y 122, La Plata (1900), Argentina. [b]Fac. Cs. Exactas. UNLP, 47 y 115, La Plata (1900), Argentina. [c]Fac. Cs. Nat. y Museo, UNLP, 60 y 122, La Plata (1900) , Argentina.

s.gomez@cidepint.gov.ar

Biofilms cause various problems such as medical infections, fouling of water cooling system, product contamination, and microbiologically influenced corrosion (MIC)[1]. MIC accounts for as much as 20% of all forms of corrosion, amounting to billions of dollars in losses each year[2]. Among bacteria related to MIC, sulfate reducing bacteria (SRB) are most often blamed [3]. The ubiquity of these bacteria leads to a variety of impressive industrial, economic and ecological effects because of their proneness to generate large quantities of H_2S. SRB are the main reason to cause the MIC by accelerating corrosion rate, inducing stress corrosion and pitting corrosion [4-6]. The aim of this study was to evaluate the corrosion associated with the formation of SRB biofilms on carbon steel surfaces. The bacterial strain used in the experiments was *Desulfovibrio vulgaris* cultured in Postgate´s C medium. Carbon steel coupons of SAE 1010 were placed in the cultures for biofilm development during 7 days. Then, coupons were extracted and bacterial adherence and biofilm formation were measured by viable bacteria counts, epifluorescence microscopy and by the crystal violet assay. Surface attack of carbon steel and biofilm morphology were analyzed by scanning electron microscopy (SEM). The corrosion behavior of the carbon steel during biofilm formation was analyzed by electrochemical impedance spectroscopy (EIS) after 1, 3 and 7 days of immersion in the culture. Studies carried out allowed correlating the biofilm formation with the different degree of attack suffered by the SAE 1010 carbon steel coupons. In Figure 1 it is possible to observe the adhesion of *D. vulgaris* to the steel surface and abundant corrosion products. The number of viable SRB found in the biofilm after 7 days was 10^2-10^3 bacteria/cm^2 as determined by the dilution to extinction method, while the number of planktonic bacteria was 10^3-10^4 bacteria/mL. The impedance spectra (Figure 2) show that the charge transfer resistance increases with time due to the action of the microorganism under study.

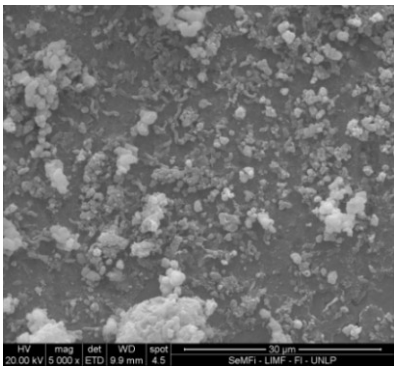

Fig. 1: SEM image of SRB biofilm formation on SAE 1010 carbon steel coupon after 7 days of incubation

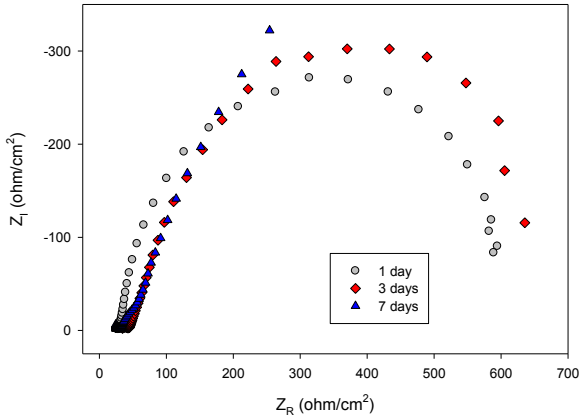

Fig. 2: Experimental impedance spectra plotted as Nyquist diagrams of SAE 1010 carbon steel coupon after 1, 3 and 7 days of immersion in SRB culture.

Keywords: SRB, 1010 Carbon Steel, SEM, EIS.

Área de interés: Área 2, Manufactura y Materiales. 5. Corrosión, protecciones y electroquímica.

Tipo de presentación: Oral ( ) Poster (X)

Referencias:

[1] Kjellerupa B.V., Kjeldsenc, K. U., Lopesd, F., Abildgaardc, L., Ingvorsenc, K., Frølunde , B., Sowersb K. R., Nielsena,P. H. (2009). Biocorrosion and biofilm formation in a nutrient limited heating system subjected to alternating microaerophilic conditions. Biofouling 25 (8), 727–737.

[2] Flemming, H.C. (1996). Economical and technical overview. In: Heitz, E., Flemming, H.C., Sand, W. (Eds.), Microbially Influenced Corrosion of Materials. Springer Verlag, Berlin, New York, pp. 5–14.

[3] Feio, M.J., Rainha, V., Reis, M.A., Lino, A.R., Fonseca, I.T.E. (2000). The influence of Desulfovibrio desulfuricans 14 ATCC 27774 on the corrosion of mild steel. Materials and Corrosion 51, 691–697.

[4] Videla, H.A., Herrera, L.K. (2005). Microbiologically influenced corrosion: looking tothe future. International Microbiology 8, 169–180.

[5] Kuang F., Wang, J., Yan, L., Zhang. D. (2007). Effects of sulfate-reducing bacteria on the corrosion behavior of carbon steel. Electrochimica Acta 52, 6084–6088.

[6] Santana Rodrıguez, .J., Santana Hernandez, F.J., Gonzalez Gonz´alez, J.E. (2006). Comparative study of the behaviour of AISI 304 SS in a natural seawater hopper, in sterile media and with SRB using electrochemical techniques and SEM. Corros. Sci. 48, 1265.