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BIMETALLIC SENSORS FOR DETECTION AND MENSUREMENT OF PERMEATED HYDROGEN THROUGH METALLIC STRUCTURES

H.A. Ponte[1,*], A.M. Maul[2] and L.A. Correa[3]

[1]Federal University of Paraná, Chemical Engineering Department, Laboratory of Surface Electrochemistry and Corrosion (LESC), 81531-990, Curitiba, Paraná, Brasil, hponte@ufpr.br
[2]Federal University of Paraná, Post-graduation program in Engineering, LESC, Curitiba, Paraná, Brasil, ammaul@engquim.ufpr.br
[3]Metaldata, José Mendez Sobrinho street, 571, Cidade Industrial, 81350-320, Curitiba, Paraná, Brasil, lcorrea@uol.com.br

Abstract: Many corrosive processes found in equipments and pipes used in petroleum and petrochemical plants are directly affected by hydrogen. The damages are caused by hydrogen inclusion in metallic structures, generated by acid media (H^+), by chemical processes that lead to protons formation, by formation of atomic hydrogen (H_0) or even by adsorbed hydrogen gas (H_2). The structural damages are varied: hydrogen induced cracking (HIC), blistering, sulfur stress cracking (SSC) or stress oriented hydrogen induced cracking (SOHIC). The main problem is how to detect, in a safe, fast and economically viable way, the formation of hydrogen. Within this work, we built a cell for hydrogen permeation to study and evaluate a new hydrogen sensor. This new sensor is composed of two parts, each one build with a couple of dissimilar materials, being a sensor couple, for hydrogen flux measurement, and a reference couple, for temperature variation compensation (See Figure 1.(A)).

The results obtained show good agreement between the Devanathan-Stachurski Sensor (DSS) and the Bimetallic Sensor (BS). Both sensors had a sharp increase in current or potential, for DSS and BS, respectively, when the charging side of the permeation cell was polarized. Both sides in the permeation cell were filled with 0,1 M NaOH (continuous N_2 bubbling) and polarized at 3 $mA.cm^{-2}$. The peak potential for the BS was about 30 μV obtained 12 to 15 h after the polarization.

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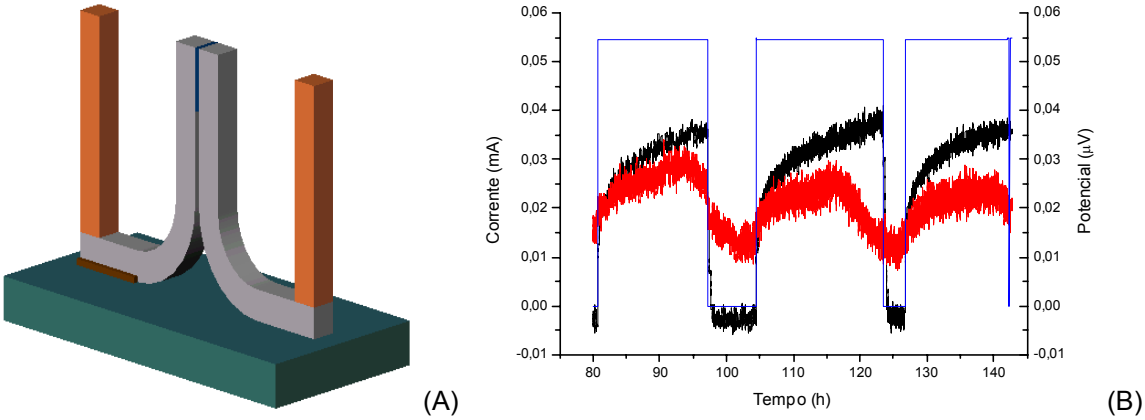

Figure 1 - (A) Schematic view of the sensor, showing the sensor couple (left) and the reference couple (right), (B) Comparison between Devanathan (black) and bimetallic (red) sensors. The blue line indicates cathodic charging of the sample