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Investigation of pitting on AISI stainless steel using electrochemical impedance, hydrogen permeation measurements and SEM

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In the present work, Electrochemical Impedance and Hydrogen Permeation techniques were employed to study the pitting corrosion of the AISI 430 stainless steel. The experiments were performed in neutral chloride solution (NaCl 30 g/l) and acid chlorinated solution (0,1 N H2 SO4 + 30 g/l NaCl). At first series of electrochemical tests, (cyclic potentiodynamic experiments) were carried out for both solutions. The results of these experiments were exploited to choose the operating conditions to obtain pits and carry out the hydrogen permeation and impedance measurements. Pits were developed under anodic potentiostatic polarization. Open pits were obtained in a sulfuric acid solution containing chloride and closed pits were formed in pure neutral sodium chloride solution.The shape evolution of impedance diagram during the pit development has been related to geometrical effects due to the morphologies of the pits. Porosity effect was observed for closed pits and roughness effect was obtained for open pits. Even under hight anodic polarization Hydrogen formation is generally due to the local acidification and potential drop within pits. The simultaneous pitting-hydrogen permeation experiments were conducted using the technique developed by MAV Devanathan. The obtained results showed that the general shape of the hydrogen permeation curves depends on initial PH conditions. In neutral chloride solution, hydrogen permeation current density was related to local acidification and potential drop within closed pits. In the case of an acid solution containing sodium chloride, hydrogen formation was merely due to the potential drop within open pits. A good agreement was found between impedance diagrams, hydrogen permeation measurements and SEM observations.

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