Homework No 2

MSEN 446/646

1) The electrode potential of titanium immersed in a sulfuric acid solution of pH approximately 1 was measured to be –0.70 V vs. SCE (a) Confirm that titanium undergoes active corrosion under these conditions and (b) consult the Pourbaix diagram to suggest three different means to provide corrosion protection.
2) If iron is immersed in a solution of pH 3.0, what electrode potential must be maintained to prevent the evolution of hydrogen gas, and what conditions (describe in detail)?
3)

Using the following data for the corrosion of iron in hydrogen-saturated, oxygen-free solution, calculate (a) the corrosion rate and (b) the exchange current density for the hydrogen evolution reaction (HER) on iron:

pH = 4; $a_{Fe^{2+}} = 0.02$ M; $i^{o}_{Fe} = 9 \times 10^{-7}$ A/cm^2; anodic $d\eta/d(\log i) = 0.04$ V/decade; the corrosion potential of iron is -0.215 V vs. RHE and $e^{o}_{Fe^{2+}|Fe} = -0.44$ V vs. SHE. For the HER, the cathodic $d\eta/d(\log i) = -0.12$ V/decade.

4)

Iron corrodes in a solution saturated with oxygen. The pH of the solution is 7 and the partial pressure of oxygen is 1 atm.

(a) Calculate the corrosion current and corrosion potential of the system.
(b) Calculate the protection current required to reduce the corrosion current to zero.

Additional information:

$$[Fe] = 0.7\text{M} \quad \text{pH} = 7 \quad P_{O_2} = 1 \text{ atm}$$

$$b_a = 0.08\text{V/decade} \quad b_c = -0.11\text{V/decade}$$

$$i^{o}_{Fe} = 10^{-5}\text{A/cm}^2 \quad i^{o}_{OH^-} = 10^{-6}\text{A/cm}^2$$

5)

Calculate the corrosion potential, corrosion current, and protection current needed to stop corrosion for cadmium in a corrosive deaerated medium.

Additional information:

$$\left[Cd^{2+}\right] = 10^{-5}\,M \quad pH = 1 \quad a_c = -0.360\,V \text{ vs. SHE}$$

$$b_a = 0.100\,V/\text{decade} \quad b_c = -0.120\,V/\text{decade} \quad i^{o}_{Cd} = 10^{-3}\,A/cm^2$$