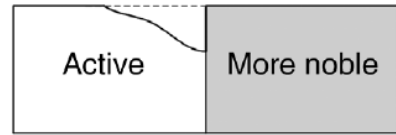


CH 692 in class w7d2

(A) Explain the shape of the corroding active metal.



Galvanic

(B)

Use the Evans diagram in Figure 16.4 to answer the following questions:

1. What is the value of the corrosion potential, and what is the net current at this potential?
2. What is the current due to hydrogen evolution at the corrosion potential? What is the current due to iron dissolution at the corrosion potential?
3. What is the equilibrium potential for iron, and how does it compare to the corrosion potential?
4. What is the overpotential for the anodic (iron dissolution) reaction at the corrosion potential? Is use of the Tafel approximation justified?
5. What is the equilibrium potential for the hydrogen evolution reaction (not shown in the diagram)?

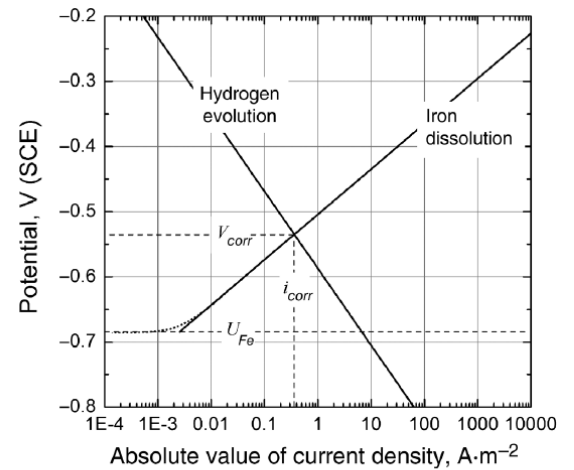


Figure 16.4 Evans diagram showing iron dissolution and hydrogen evolution (pH = 0.9, 1N HCl, deaerated). Source: Adapted from R. J. Chin and K. Nobe 1972, J. Electrochem. Soc., 119, 1457.

- (C) Derive the expression for the corrosion potential from the individual Tafel expressions from the cathode and anode reactions by setting the anodic and cathodic currents equal in magnitude.

$$i \approx i_o \exp\left(\frac{\alpha_a F}{RT} \eta_s\right) \quad V_{corr} = \frac{\alpha_c U_c + \alpha_a U_a}{\alpha_a + \alpha_c} + \frac{RT}{F(\alpha_a + \alpha_c)} \ln\left(\frac{i_{o,c}}{i_{o,a}}\right)$$

$$= \frac{b_a U_c + |b_c| U_a}{b_a + |b_c|} + \frac{b_a |b_c|}{\ln(10)(b_a + |b_c|)} \log\left(\frac{i_{o,c}}{i_{o,a}}\right), \quad (16.5)$$

$$i_{corr} = i_{o,a} \left(\frac{\alpha_c}{\alpha_a + \alpha_c}\right) i_{o,c} \left(\frac{\alpha_a}{\alpha_a + \alpha_c}\right) \exp\left[\frac{F}{RT} \frac{\alpha_c \alpha_a}{\alpha_a + \alpha_c} (U_c - U_a)\right], \quad (16.6a)$$

$$= i_{o,a} \left(\frac{b_a}{b_a + |b_c|}\right) i_{o,c} \left(\frac{|b_c|}{b_a + |b_c|}\right) \exp\left[\frac{\ln(10)}{b_a + |b_c|} (U_c - U_a)\right], \quad (16.6b)$$