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Total Number of Pages: 02

B.TECH
PCMT4403

7th Semester Regular / Back Examination 2016-17
CORROSION AND DEGRADATION OF MATERIALS

BRANCH(S): CHEM, METTA, MME

Time: 3 Hours

Max marks: 70

Q.CODE: Y114

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

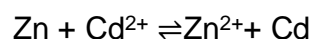
Q1 Answer the following questions

(2 x 10)

- What are the factors that affect the corrosion of metals?
- What is a standard half-cell oxidation-reduction potential?
- Given : $\text{Fe}^{2+} + 2\text{e}^- = \text{Fe}$, $E^\circ = -0.440\text{V}$ $\text{Fe}^{3+} + \text{e}^- = \text{Fe}^{2+}$, $E^\circ = 0.771\text{V}$
Calculate E° for the reaction : $\text{Fe}^{3+} + 3\text{e}^- = \text{Fe}$
- For an over potential of 0.1V for Zn, calculate the anodic exchange current density if the corrosion current is 1 A/m². (Tafel constant $\beta_a = 0.045$).
- For hydrogen evolution reaction the exchange current density is 6.8×10^{-7} A/cm². If the reaction is proceeding at an over potential $\eta = -0.1$ V: calculate the current density. Taken the electrode area as 1 cm² and $\beta = 0.5$.
- What is impressed current?
- What is sacrificial anode?
- Define hydrogen electrode.
- What factors are responsible for a metal to form a protective oxide?
- Define mixed potential theory.

Q2 Consider the following reaction :

(10)



- Calculate the voltage of this cell at 25 °C.
- Calculate the Gibbs free energy change involved in the reaction.
- What is the cathodic half cell reaction?

4) What is the ratio of the activities of ionic species required to make the polarity of the above cell reverse?

Given: ($a_{\text{Cd}^{2+}} = 0.2$) and ($a_{\text{Zn}^{2+}} = 0.0004$).

- Q3 a)** Explain the difference between electrode potential and electrochemical potential. (5)
- b)** Explain how can you predict an electrochemical reaction and determine the rate of corrosion reaction by using Tafels Law. (5)
- Q4 a)** If copper and zinc are in contact determine which metal will corrode. If the corrosion rate is 2.4×10^{-7} cm/s. Calculate the minimum cathodic current which must be applied to the couple in order to passivity the metal. Take the area of Cu = 4.5 mm^2 and area of Fe = 0.8 mm^2 . (5)
- b)** Differentiation between the corrosion of metals and ceramics. (5)
- Q5 a)** What is passivation? Briefly describe the following theories of passivation of metal. (5)
- b)** Explain the criteria for cathodic protection of the materials with examples. (5)
- Q6 a)** Define crevice corrosion? Explain the effect of acidification, chloride concentration, and depassivation on crevice corrosion. (5)
- b)** Discuss the fundamental difference between uniform corrosion and localized corrosion. (5)
- Q7 a)** Calculate the ratio of the oxide volume to metal for the oxidation of aluminum to aluminum oxide, Al_2O_3 . The density of aluminum = 2.70 g/cm^3 and that of aluminum oxide = 3.70 g/cm^3 . Assuming that 100 g of aluminum is oxidized. (5)
- b)** Prove that the thickness of oxide layer increases as the square root product of time and diffusion coefficient at constant temperature. (5)
- Q8 Write short notes on any two:** (5 x 2)
- a)** Polarization.
- b)** Nernst Equation
- c)** Intergranular corrosion.
- d)** Liquid metal embrittlement.