Chemical Engineering 378

Science of Materials Engineering

Lecture 33

Exam 3 Review

Spiritual Thought

"When difficult things are asked of us, even things contrary to the longings of our heart, remember that the loyalty we pledge to the cause of Christ is to be the supreme devotion of our lives. Although Isaiah reassures us it is available 'without money and without price'—and it is—we must be prepared, using T. S. Eliot's line, to have it cost 'not less than everything.'"

-Elder Jeffery R. Holland

Simple Question Competitions

- What is concentration polarization?
- What is activation polarization?
- What is the general composition of 1076 steel?
- What is the alloying component of 4476
- Describe Ductile Iron
- Describe Malleable Iron
- Name a drawback of ferrous alloys
- What are refractory metals?
- What is extrusion?
- What is forging?
- What is hardenability?

Additional Question Challenges

- T of F – Adding particles softens a material
- Name 3 common applications of ceramics
- What is the critical current, I_{crit}
- What is the corrosion current, I_c?
- What is the exchange current, I_e?
- Name three general uses of ceramics.
- T or F – nanocarbons are science fiction
- Describe Glass Blowing
- What is the difference between T_g and T_m?

Final Short Question Challenges

- How does firing work?
- What is sintering?
- What are the two types of polymerization?
- Name 2 benefits of polymer additives
- What is compression molding?
- T or F – if $l_f < l_c$, they are considered continuous
- What is a MMC?
- Name 3 of the 4 classifications of composites
- T or F – continuous fiber-reinforced composites are always very strong in the transverse direction
- Describe pultrusion

Example Problem 1

- A Zn/Zn^{2+} concentration cell is constructed in which both electrodes are pure zinc. The Zn^{2+} concentration for one cell half is 1.0 M, for the other, 10^{-2} M. Is a voltage generated between the two cell halves? If so, what is its magnitude and which electrode will be oxidized? If no voltage is produced, explain this result.

Example Problem 1 (cont)

$$Zn_2 + Zn_1^{2+} \rightarrow Zn_2^{2+} + Zn_1$$

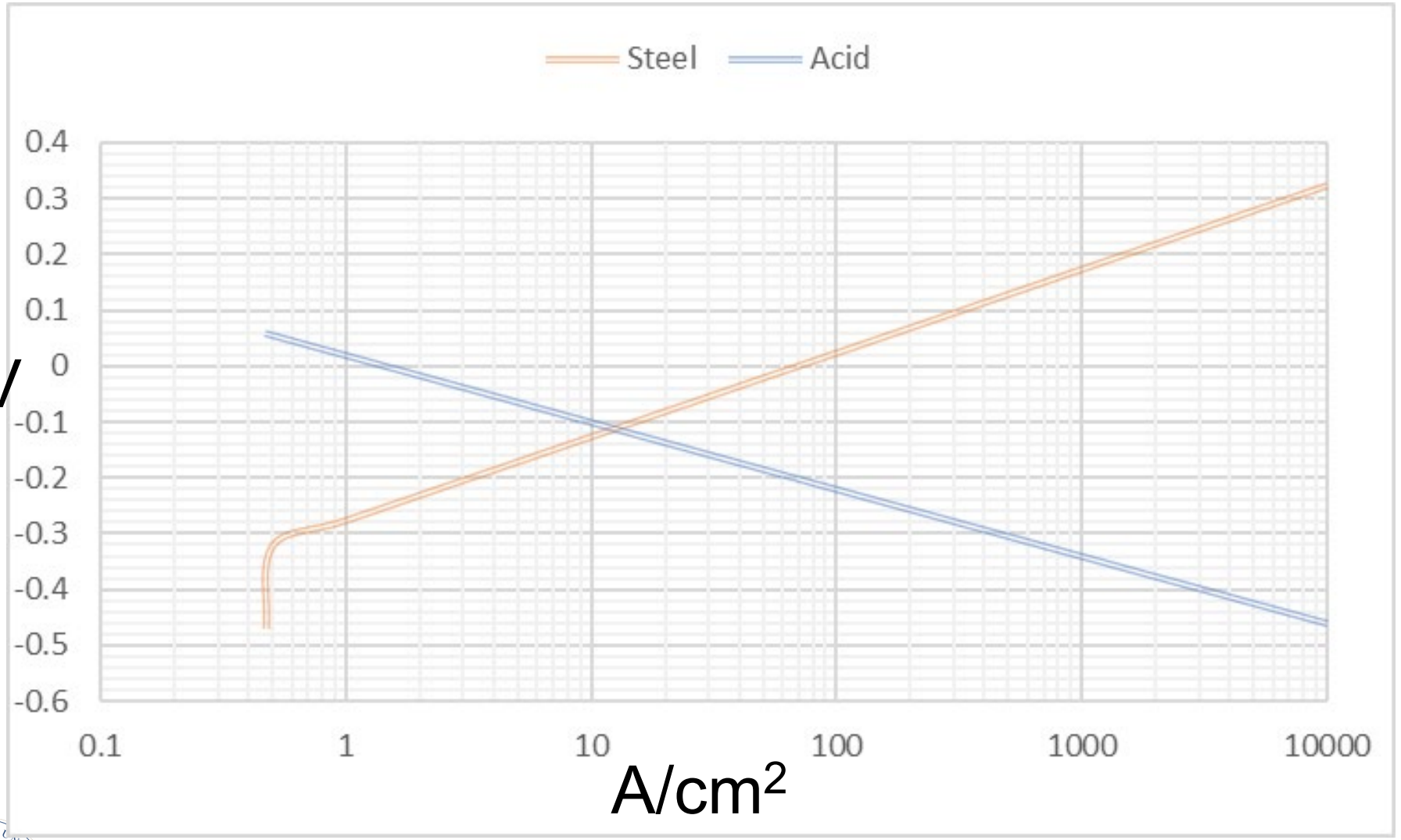
$$\Delta V = -\frac{0.0592}{2} \log \frac{\left[Zn_2^{2+}\right]}{\left[Zn_1^{2+}\right]}$$

$$= -\frac{0.0592}{2} \log \left[\frac{10^{-2}\,M}{1.0\,M}\right] = +0.0592\ \text{V}$$

Example Problem 2

You are out with your friends on the search for the legendary treasure of One-Eyed Willy, the pirate. You find the ship, but it is on an island in a lake of strong acid! On the shore close to you, you find an oar and an empty steel square crate that is about 100 cm x 100 cm, and is 1.5 cm thick. About 33 cm of the crate is submerged in the acid when you both get in and your friend estimates it will take an hour to row to the pirate ship. Using the supplied polarization curves (which you found scratched into a nearby rock, of course), could you make it to the ship unscathed?

Steel (to Fe^{2+}) vs. lake acid



Solution

- First, find the total mass of the crate, as well as the surface area:
- M = 100cm * 33 cm *1.5 cm * 4 + 100 cm * 100 cm *1.5 cm *7.874gm/cm^3 = 274.15kg
- A = 100cm*100cm + 100cm*33cm*4 = 2.32 m^2
- Next, find the current density, and the rate of corrosion
- From plot, A=13A/cm^2
- r = I/nF*MW = (13A/cm^2)*(2.32m^2)*(55.85gm/mol)/(2)/(96500C/mol)
- r = 0.136 kg/s
- M/r = 0.558 hr

You'll sink right in the middle!

Don't do it!!!