

- 23-37** A current density of 0.1 A/cm^2 is applied to the iron in an iron-zinc corrosion cell. Calculate the weight loss of zinc per hour
- if the zinc has a surface area of 10 cm^2 and the iron has a surface area of 100 cm^2 and
 - if the zinc has a surface area of 100 cm^2 and the iron has a surface area of 10 cm^2 .

Section 23-8 Oxidation and Other Gas Reactions

Section 23-9 Wear and Erosion

- 23-38** Determine the Pilling-Bedworth ratio for the following metals and predict the behavior of the oxide that forms on the surface. Is the oxide protective, does it flake off the metal, or is it permeable? (See Appendix A for the metal density.)

Oxide Density (g/cm^3)	
Mg-MgO	3.60
Na-Na ₂ O	2.27
Ti-TiO ₂	5.10
Fe-Fe ₂ O ₃	5.30
Ce-Ce ₂ O ₃	6.86
Nb-Nb ₂ O ₅	4.47
W-WO ₃	7.30

- 23-39** Oxidation of most ceramics is not considered to be a problem. Explain.
- 23-40** A sheet of copper is exposed to oxygen at 1000°C . After 100 h, 0.246 g of copper are lost per cm^2 of surface area; after 250 h, 0.388 g/cm^2 are lost; and after 500 h, 0.550 g/cm^2 are lost. Determine whether the oxidation is parabolic, linear, or logarithmic, then determine the time required for a 0.75-cm sheet of copper to be completely oxidized. The sheet of copper is oxidized from both sides.
- 23-41** At 800°C , iron oxidizes at a rate of 0.014 g/cm^2 per hour; at 1000°C , iron oxidizes at a rate of 0.0656 g/cm^2 per hour. Assuming a parabolic oxidation rate, determine the maximum temperature at which iron can be held if the oxidation rate is to be less than 0.005 g/cm^2 per hour.

Design Problems

- 23-42** A cylindrical steel tank 3 ft in diameter and 8 ft long is filled with water. We find that a current density of 0.015 A/cm^2 acting on the steel is required to prevent corrosion. Design a sacrificial anode system that will protect the tank.
- 23-43** The drilling platforms for offshore oil rigs are supported on large steel columns resting on the bottom of the ocean. Design an approach to ensure that corrosion of the supporting steel columns does not occur.
- 23-44** A storage building is to be produced using steel sheet for the siding and roof. Design a corrosion protection system for the steel.
- 23-45** Design the materials for the scraper blade for a piece of earthmoving equipment.

Computer Problems

- 23-46** Write a computer program that will calculate the thickness of a coating using different inputs provided by the user (e.g., density and valence of the metal, area or dimensions of the part being plated, desired time of plating, and current).

Knovel® Problems

- K23-1** Describe the mechanism of stray current corrosion.
- K23-2** Describe how the corrosion rate of copper changes with increasing solution velocity at different temperatures. Explain the mechanism for this change.
- K23-3** Five grams of zirconium are dissolved in 1000 g of water producing an electrolyte of Zr^{4+} ions. Calculate the electrode potential of the copper half-cell in this electrolyte at standard temperature and pressure using the Nernst equation.