***Chemistry***

**17: Electrochemistry**

**17.6: Corrosion**

43. Consider the following metals: Ag, Au, Mg, Ni, and Zn. Which of these metals could be used as a sacrificial anode in the cathodic protection of an underground steel storage tank? Steel is mostly iron, so use –0.447 V as the standard reduction potential for steel.

Solution

For cathodic protection, the overall reaction must be spontaneous. Thus, the standard cell potential of the anode must be less than the standard reduction potential of steel/iron (the metal to be protected), which, from the problem, has . With standard reductions in parentheses: Mg (–1.185 V), and Zn (–0.7618 V) could be used as a sacrificial anode, while Ag (+0.7996 V), Au (+1.629 V), and Ni (–0.257 V) could not.

45. If a sample of iron and a sample of zinc come into contact, the zinc corrodes but the iron does not. If a sample of iron comes into contact with a sample of copper, the iron corrodes but the copper does not. Explain this phenomenon.

Solution

Both examples involve cathodic protection. The (sacrificial) anode is the metal that corrodes (oxidizes or reacts). In the case of iron (–0.447 V) and zinc (–0.7618 V), zinc has a more negative standard reduction potential and so serves as the anode. In the case of iron and copper (0.34 V), iron has the smaller standard reduction potential and so corrodes (serves as the anode).

47. Why would a sacrificial anode made of lithium metal be a bad choice despite its , which appears to be able to protect all the other metals listed in the standard reduction potential table?

Solution

While the reduction potential of lithium would make it capable of protecting the other metals, this high potential is also indicative of how reactive lithium is: It would have a spontaneous reaction with most substances. This means that the lithium would react quickly with other substances, even those that would not oxidize the metal it is attempting to protect. Reactivity like this means the sacrificial anode would be depleted rapidly and need to be replaced frequently. (Optional additional reason: fire hazard in the presence of water.)

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