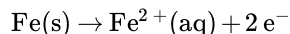
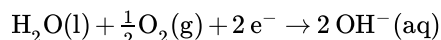


16.8: Corrosion- Undesirable Redox Reactions

Corrosion of metals is a serious economic problem. Corrosion occurs as a result of spontaneous electrochemical reaction as metal undergoes oxidation. For example, the rusting of iron begins with the oxidation of solid iron:



The corresponding reduction reaction involves water:



The flaky brown solid that we call rust forms when Fe^{2+} undergoes additional oxidation to form Fe^{3+} , then reacts with hydroxide ions to form iron (III) oxide, Fe_2O_3 , and iron (III) hydroxide, $\text{Fe}(\text{OH})_3$.

The rate of corrosion can be affected by several factors. Some examples:

- Metals corrode faster when in contact with another metal. The Statue of Liberty, for example, has a skin made of copper, but is supported by iron ribs. Since iron is oxidized more readily than copper, it acts as the anode. Earlier repairs to strengthen the statue used iron bolts, which exacerbated the problem. More recent repairs have replaced the iron ribs with stainless steel alloys. Stainless steel resists corrosion.
- Salt water speeds up the corrosion process, because the ions in salt water form a salt bridge between the anodic and cathodic sites. Salt may be great for icy roads, but it is tough on cars.

There are a number of ways to slow down corrosion, if not prevent it:

- Prevent oxygen and water from contacting the metal. This can be accomplished by paint, grease, plastic, or other methods of covering the metal.
- Cathodic protection: pieces of zinc or magnesium metal may be bolted to the surface of iron. Because they are more readily oxidized than Fe, Zn and Mg become oxidized over time, thus sparing and protecting the iron. Propeller shafts of speedboats are often protected this way. Anode rods in water heaters also work this way (they are often called **sacrificial anodes**). Galvanized nails—nails coated with the more reactive zinc—provide yet another example.
- Metal alloys: an alloy is a mixture of metals, or a mixture of a nonmetal with a metal. An alloy such as stainless steel (chromium is added to steel—a mixture of iron and other elements such as carbon—to make stainless steel) is highly resistant to corrosion, but can be prohibitively expensive.

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