
Corrosion

Learning Objectives

- Define corrosion
- List some of the methods used to prevent or slow corrosion



What is Corrosion?

Corrosion is defined as a natural process that converts a refined metal into a more chemically-stable form such as oxide, hydroxide, or sulfide. It is the gradual destruction of materials (usually a metal) by chemical and/or electrochemical reaction with their environment.

Examples of Corrosion:

- rust on iron,
- tarnish on silver
- blue-green patina that develops on copper

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Cost of Corrosion

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Corrosion affects our society on a daily basis, causing degradation and damage to household appliances, automobiles, airplanes, highway bridges, energy production and distribution systems, and much more.

The cost of controlling this naturally occurring phenomenon—and costs associated with the damage it causes—is substantial. The current per capita direct cost of corrosion for U.S. residents, based on July 1, 2001, figures from the U.S. Census, is approximately $970 per person per year.

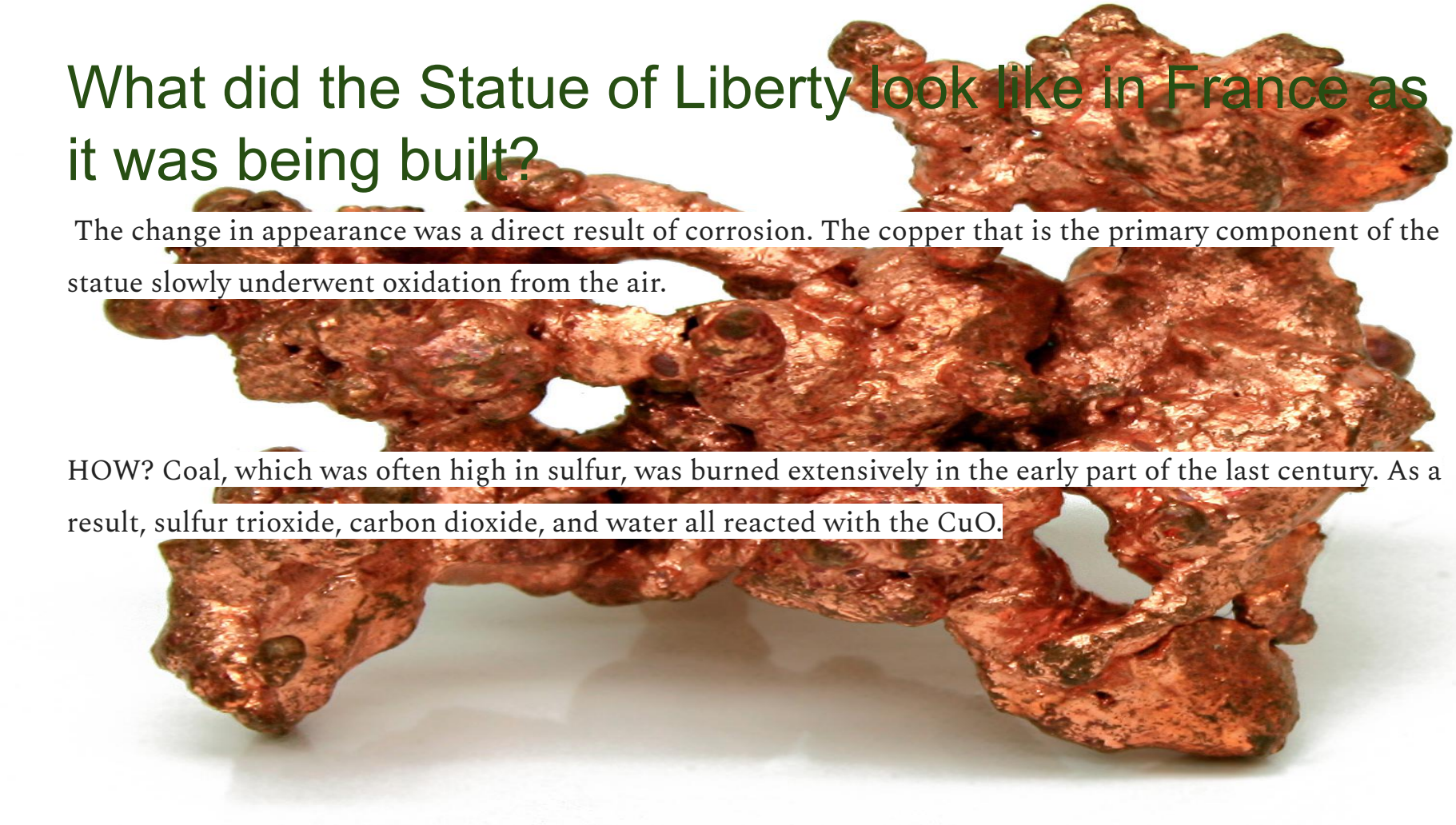
Statue of Liberty

Statue of Liberty: Changing Colors

The Statue of Liberty is a landmark every American recognizes. The Statue of Liberty is easily identified by its height, stance, and unique blue-green color (Figure 1). When this statue was first delivered from France, its appearance was not green. It was brown, the color of its copper "skin." So how did the Statue of Liberty change colors? The change in appearance was a direct result of corrosion. The copper that is the primary component of the statue slowly underwent oxidation from the air. The oxidation-reduction reactions of copper metal in the environment occur in several steps. Copper metal is oxidized to copper(I) oxide (Cu_2O), which is red, and then to copper(II) oxide, which is black

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What did the Statue of Liberty look like in France as it was being built?



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HOW? Coal, which was often high in sulfur, was burned extensively in the early part of the last century. As a result, sulfur trioxide, carbon dioxide, and water all reacted with the CuO.

What can we do to prevent corrosion?

One way to prevent, or slow, corrosion is by coating the metal.

Rust--One way to keep iron from corroding is to keep it painted. The layer of paint prevents the water and oxygen necessary for rust formation from coming into contact with the iron. As long as the paint remains intact, the iron is protected from corrosion.

Other strategies include alloying the iron with other metals. For example, stainless steel is mostly iron with a bit of chromium. The chromium tends to collect near the surface, where it forms an oxide layer that protects the iron.

Zinc-plated or galvanized iron uses a different strategy. Zinc is more easily oxidized than iron.

Think about this!

Suppose you have three different metals, A, B, and C. When metals A and B come into contact, B corrodes and A does not corrode. When metals A and C come into contact, A corrodes and C does not corrode. Based on this information, which metal corrodes and which metal does not corrode when B and C come into contact?