

Everyday Chemical Changes

Have you ever thought about why cars rust? Or, more importantly, why only the metal parts rust while the plastic parts do not? You have learned that different substances have different physical and chemical properties that determine their uses.

One chemical property that has great economic importance is the slow chemical reaction of a metal with oxygen from the air, or **corrosion**. Can corroded metal be fixed, or must it be replaced? Can corrosion be prevented?

Rusting is a specific example of corrosion. Rusting involves the corrosion of iron (**Figure 1**). Iron reacts with oxygen from the air, water, and other chemical substances dissolved in the water. Rust, or iron oxide, is the product of this chemical change. Every year, millions of dollars of damage are caused to vehicles, building structures, and other iron products. Rust is particularly damaging because of one of its physical properties: rust is porous. It absorbs water almost like a sponge. The rust eventually flakes off, exposing fresh metal underneath to oxygen. This process continues until the rust has eaten its way right through the metal.

Aluminum, on the other hand, has a similar chemical property. It also reacts with oxygen in the air, but the aluminum oxide that forms is strong and unaffected by water. The oxide layer protects the aluminum from any further corrosion.

The corrosion of silver (**Figure 2**) results in a surface coating, or tarnish. The black layer can be removed by polishing the silver.

Preventing Corrosion

There are several ways of preventing corrosion. Each involves protecting the metal surface from oxygen. Exposed metal surfaces, such as the bridge in **Figure 3**, and the outside of cars can be painted. As long as the painted surface is not broken or cracked, oxygen cannot get at the metal. For the same reason, the bottom and inside surfaces of cars can be sprayed with oil to protect them.



Figure 1
Rust damages the metal car body.



Figure 2
Silver slowly corrodes in the air.



Figure 3
Some bridges are so big that painters take years to finish the whole structure. Then they have to start over again!

Another way to prevent corrosion is to use materials that do not react chemically with oxygen in air, or with water. Car bumpers and panels may get bumps or scratches. Plastics are

being used for these parts because even when they are scratched, they never corrode. They always stay strong and flexible.

Try This

Activity Preventing Corrosion

You work for a small corrosion laboratory. Your company has a contract to investigate ways to prevent corrosion of aluminum, magnesium, and steel metals. Your team is assigned to investigate and compare the effectiveness of two methods of preventing corrosion: painting and oiling. You will be given these materials:

- sample strips of aluminum
- magnesium and steel nails
- paint brushes
- 6 containers
- salt
- water
- paint
- motor oil
- Design a test, including safety procedures, to compare the effectiveness of paint and oil in protecting metals from corrosion.
- When you have your teacher's approval for your design, make a data table to record your observations.
- Conduct your test using the necessary materials.

- (a) Describe the appearance of the materials before you start.
- (b) Describe any changes in the materials during the test.
- (c) Was your experimental design a fair test? Explain.
- (d) Was paint or oil more effective in preventing corrosion? Use your observations to explain your answer.
- (e) What changes would you make to your experimental design? With your teacher's permission, try them.
- (f) Present your results in a report to be distributed to companies that manufacture aluminum, magnesium, and steel.

Understanding Concepts

1. What is corrosion?
2. How is iron oxide formed?
3. Describe three ways to protect a metal from corrosion.
4. (a) Which parts of a car corrode the most? Why?
(b) How can car owners help to reduce the effects of corrosion?

Making Connections

5. List objects in your home that can corrode. What steps can you take to protect these items from corrosion?

Challenge

- 2 How can you make sure that the artifacts or materials that you choose for your time capsule will not undergo corrosion?

Work the Web

Visit www.science.nelson.com and follow the links from *Science 9: Concepts and Connections*, 1.5, to find additional ways of preventing rust and corrosion.