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Rustproofing

What is rust?

Rust¹ is a mixture of iron and oxygen: iron oxide. It is made of two molecules of iron and three of oxygen (Fe_2O_3). It forms as a redox (oxidation-reduction) reaction. In a **redox reaction**², one substance is **oxidized**³ (loses electrons/gets oxygen) and another is **reduced**⁴ (gets electrons/loses oxygen). For rust to form, iron is oxidized, and oxygen is reduced. The chemical reaction is, generally,



Rust is a compound of iron and oxygen.

iron + oxygen + water = hydrated iron (III) oxide

Iron (Fe) loses two electrons ($2e^-$) to become Fe^{2+} . Oxygen (O) picks up those electrons and joins with the hydrogen in water to become OH^- : $\frac{1}{2}\text{O}_2 + 2e^- + \text{H}_2\text{O} \rightarrow 2\text{OH}^-$.

When rust forms, it **corrodes**⁵, or eats away, iron or steel. Corrosion happens when electrons move through an **electrolyte**⁶ (a liquid that transfers electrons) from an **anode**⁷ (metal that gives up electrons) to a **cathode**⁸ (metal that takes electrons). The electrolyte helps oxidize the anode, which makes it let go of its electrons. When those electrons leave the anode, they cause the anode to break down. While only water is needed for rust to form, salt is a better electron mover, so saltwater makes things rust faster.



Rust causes corrosion.

Did You Know?

Metal rusts faster in saltwater than fresh water.

What is affected by rust?

Ecobottle Sample



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¹ **Rust:** a mixture of iron and oxygen – iron oxide

² **Redox reaction:** an oxidation-reduction reaction; one substance is oxidized, and another is reduced

³ **Oxidize:** lose electrons and/or get oxygen

⁴ **Reduce:** get electrons and/or lose oxygen

⁵ **Corrode:** eat away

⁶ **Electrolyte:** a liquid that transfers electrons

⁷ **Anode:** a metal that gives up electrons

⁸ **Cathode:** a metal that takes electrons

Rustproofing

As a first defense, paints and primers keep water from getting to the metal beneath, which protects it from rust. However, any scratches in the paint will let water in, so paints only work until they get damaged. **Resins**⁹, thick liquids, can work in the same way. Because they are thicker than paints, they protect metals longer. Waxes do the same thing. Resins and waxes can get damaged and water can get under the coating and cause rusting. Coatings also work best when put on new structures. When put on older things, like used cars, they can trap moisture and dirt that are already in cracks in the metal.

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Some iron and steel products are covered with another metal that doesn't rust. Some metals that don't rust are nickel, tin, or chromium. Tin is used to protect food cans, for example. **Alloys**¹⁰, metals mixed with other elements, are also used to cover metals that rust.



Zinc-coated metals are protected from corrosion.

Zinc is another rustproofing cover. Using zinc to coat a metal is different, however, from using tin or an alloy. Zinc is used because it is more likely to rust than iron or steel and it corrodes very slowly. So it starts to rust before the iron or steel it is protecting, and it lasts a long time. Aluminum and magnesium also work like zinc to protect metals.

Some types of anodes give up electrons without corroding. These materials protect the important metals from rusting without breaking down.

Some chemicals, called **corrosion inhibitors**¹¹, can stop the rusting process. They react with the metal or with oxygen to keep the metal from reacting with the oxygen.

⁹ **Resin**: thick liquid

¹⁰ **Alloy**: metal mixed with other elements

¹¹ **Corrosion inhibitors**: chemicals that stop the process of rusting

Reading Comprehension Questions:

1. What is rust?
2. What
3. Explain the corrosion process.
4. Why is
5. How do paints and primers protect metal from rusting?
6. Why is oil a good protector?

Extension Questions:

7. What
8. Choose one

Ecobottle Sample



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