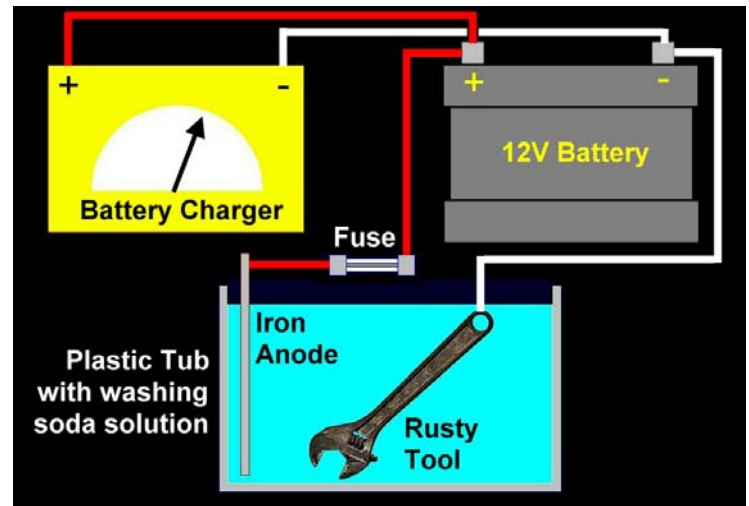


REMOVING RUST WITH ELECTROLYSIS

Rust is a two-step process. When iron and steel tools are exposed to moisture and air, black oxide (Fe_3O_4) forms on the surface. The black oxide does not harm the tool, but with continued exposure it quickly converts to ferrous oxide (Fe_2O_3) or “red rust” and the surface begins to flake off. This is why when rust forms on a porous surface such as cast iron, it leaves behind a dark stain even after you polish it. That stain is the unconverted black oxide embedded in the molecular structure of the metal.

You can remove ferrous oxide by converting it back into black oxide in a process known as electrolysis. A low-amperage electric current reverses the electrochemical process that created the rust, causing a sacrificial scrap of iron to rust instead and leaving behind loosely-bonded black oxide that wipes away like a black powder.

To setup for electrolysis, you need a source of direct current, such as a car battery or a deep-cycle battery. You also need a battery charger to keep the battery juiced during the process. A low amperage or “trickle” charger works best. Also scare up a non-conducting container such as a plastic tub to hold the rusty tool, the sacrificial iron, and enough electrolytic solution to cover them both. (This solution allows the current to flow between the sacrificial iron (the *anode*) and the tool (the *cathode*). The tub should be large enough to hold both the iron and the tool without them touching.



Make the electrolytic solution by combining a tablespoon of washing soda (sodium carbonate, Na_2CO_3) to one gallon of water. You can usually find washing soda in a grocery store with the laundry soap. In a pinch, you can use dishwasher soap; it's mostly sodium carbonate. This stuff doesn't dissolve quickly or easily; you'll have to do quite a bit of stirring. Make enough to fill the tub to a depth that completely covers the tool.

Place the tool and the sacrificial iron in the tub. The iron should be clean and free of any coating like grease, oil, or paint. A length of construction “rebar” works well. Cut the rebar long enough that one end with stick up above the surface of the washing soda solution.

Connect the battery charger to the battery, but don't plug in the charger yet. Connect the negative (-) post of the battery directly to the tool and the positive (+) post to the part of the iron/rebar/anode that protrudes above the liquid. Finally, plug in the charger and turn it on. Should the anode and cathode accidentally touch, the battery or the charger will short out. To prevent this damage, it's a good idea to add a fuse between the positive post and the anode. The fuse should have about twice the amperage rating as the charger.

This process produces hydrogen which bubbles off the tool, so ventilate the area where you do the electrolysis. The time it takes to clean the tool will depend on (1) the size of the tool and (2) the amount of rust to be removed. You can tell when the rust is zapped when the tool turns black. Reach in the solution with a plastic toothbrush and brush the surface. If the black comes away and shows gray metal beneath, the tool is cooked. Turn off the charger, disconnect the wires, and remove the tool from the tub. Scrub the black oxide from the tool with a wire brush or steel wool.