

Removal of Rust

The electrolytic method of rust removal is a cheap, gentle and effective method. There is minimal alteration to the metal surface. It is easy to set up and use. It is quite safe, provided certain sensible precautions are taken.

The rusty object is immersed in an electrically-conducting solution of washing soda (sodium carbonate). The negative lead (black - cathode) from a battery charger is attached to the object, and the positive (red - anode) lead is attached to a steel electrode dipping into the solution. When the current is turned on, electrochemical reduction reactions occur at the metal/oxide interface on the object's surface. This loosens the rust layer, allowing it to be easily brushed off. At the negative electrode hydrogen is produced by the electrochemical reduction of water. The hydrogen may in turn react chemically with the iron oxides, or it may simply act to physically dislodge the rust layer. Whatever the mechanism, the process does not appear to cause etching or deposition on the metal surface. However, removal of rust will reveal any damage to the surface (such as pitting) which has already occurred.

Caution *A major reaction occurring in the bath is the splitting of water into hydrogen gas (at the negative electrode) and oxygen at the positive electrode). Hydrogen will combine explosively with oxygen or air if ignited. All flames (including cigarettes) must be removed from the area, and sparks caused by touching the leads together must be avoided. The work should be well ventilated to remove these gases safely. Do not use this method in a confined, poorly ventilated area.*

Preparation of the Electrolyte Solution

An appropriate concentration of washing soda is about 10 gram/litre (about 1 teaspoon per pint). The concentration may be increased somewhat but the results will not change greatly. Make sure all the crystals have dissolved before using the solution.

The Electrolytic Bath

Use a non conducting inert plastic container (plastic bucket, bowl, box, bath, bin etc.). After removing any wooden handles, brass fittings, etc. from the object, sufficient washing soda solution is added to completely submerge it. A steel strip is recommended for the positive electrode or anode (a piece about 2-3" wide and long enough to emerge from the solution). Ordinary scrap iron or steel can be used.

Do not use copper or other metals, as these will be rapidly eaten away. *Do not use stainless steel as toxic chromates can accumulate.* The reactions at the anode involve the production of oxygen gas from oxidation of water, plus the direct oxidation of the metal electrode. The anode should be brushed clean at intervals. The red lead from the battery charger should be clipped to the anode where it emerges from the solution. If this attachment clip dips under the surface, it will be eaten away. The negative lead (black) is attached to the rusty object. In this case, the attachment clip may be submerged under the solution - corrosion does not occur at the negative electrode (cathode). It is very important to have good contact at the attachment point, so these should be cleaned by wire brush or emery paper. The object and the positive electrode should be separated by at least a few inches. If they are allowed to touch, a short circuit will occur and the battery charger may be damaged.

The Battery Charger

Any 12-volt battery charger will work, provided it can produce a few amps of direct (DC) current. A current of about two amps at 12 volts is typical (a charger with a current meter is useful as it shows you what is happening). The current may be reduced by increasing the separation between the object and the anode or by diluting the solution with water. A car battery would also work as a DC power source.

The Process

Once the circuit is completed, bubbles will stream from both electrodes (almost immediately). The time required for effective de-rusting will vary from 30 minutes for small objects (bolts) to some hours for large objects such as a lathe chuck. Overnight operation is common. No harm is done by leaving the circuit on for long periods, as long as the charger does not overheat or gases do not build up in an unventilated area.

After a time the object should be rotated to avoid uneven de-rusting. If part of the object has been left projecting above the solution, the object should also be inverted to de-rust the exposed part.

Some of the rust will fall off and sink to the bottom of the container. When enough time has elapsed (learned mainly by experience), turn off the charger, remove the object from the bath and rinse off the electrolyte with water.

The residual rust will now appear as a dark surface sludge which can be easily removed with a hand wire brush or plastic scourer, preferably under water. After rinsing and thorough drying, the object will now appear free of red rust, but there may still be a thin layer of black oxide.

Protect from rerusting immediately.

I can confirm this really works well. I acquired a three jaw lathe chuck with quite a bit of surface rust, but more importantly when stripped down, one of the components was heavily rusted. Overnight in the electrolyte cleaned it up very nicely. Lots of gas but no explosions! Lots of rust on anode too.

Ed