



# Tech Tip

## ELECTROLYTIC RUST REMOVAL

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Electrolysis is a method used to remove rust from metal parts.

All information, illustrations and specifications are based on the best information available at the time of publication.

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### **Additional Sources:**

<http://antique-engines.com/stainless-steel-electrodes.htm>

<http://www.htpaa.org.au/article-electro.php>

### **What is electrolysis?**

Electrolysis is a technique for returning surface rust to iron. It uses the effect of a low voltage electric current and a suitable electrolyte (solution). It has advantages over the old standbys, like vinegar, Coke™, muriatic acid, Naval Jelly, wire brushing, sand blasting. These methods all remove material to remove the rust, including un-rusted surfaces. With many, the metal is left with a "pickled" look or a characteristic color and texture. The electrolytic method removes nothing: by returning surface rust to metallic iron, rust scale is loosened and can be easily removed. Un-rusted metal is not affected in any way.

### **What about screws, pivots, etc. that are rusted tight?**

Electrolysis will frequently solve these problems, without the need for force, which can break things. Is it safe? The solutions used are not hazardous; the voltages and currents are low, so there is no electrical hazard. No noxious fumes are produced. The method is self-limiting: it is impossible to over clean an object.

*NOTE: Small amounts of hydrogen are emitted in the electrolysis process. Good ventilation or an outdoor work site is required.*

### **Where did this method come from?**

Electrolysis is a standard technique in the artifact restoration business. I wrote this up for the Chronicle of the Early American Industries Association a few years back. Most of the tool collectors around here use it.

### **What do I need?**

- A plastic tub
- An iron electrode
- Water and washing soda (ARM & HAMMER™, for example)
- Battery charger
- Eye protection (if lye is used)
- Gloves (if lye is used)

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Coke™ is a registered trademark of the Coca-Cola Company.

Arm & Hammer™ is a registered trademark of the Church & Dwight Co., Inc.

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**What is electrolyte solution and how is it made?**

### CAUTION!

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**If household lye is used, ALWAYS add the lye to the water. DO NOT add water to the lye!**

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Electrolyte solution is made from water with a soluble salt (usually sodium carbonate or washing soda) added to the water to enhance the conductance of electricity. Household lye can be used, however eye protection and gloves should be worn when handling the solution.

Add one tablespoon of soda to a gallon of water. If you have trouble locating the washing soda, others have reported success with baking soda.

*NOTE: It is the current that cleans, not the solution; nothing is gained by making a more concentrated solution.*

**How long does the solution last?**

Forever, though the loosened rust will make it pretty disgusting after a while. Evaporation and electrolysis will deplete the water from the solution. Add water only to bring the level back.

**What about stainless/iron electrodes?**

The electrode wants to be large (within reason); if possible, larger than the object being cleaned. The iron electrode works best if it "surrounds" the object to be cleaned, since the cleaning is "line of sight" to a certain extent. An iron electrode will be eaten away with time.

### WARNING!

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#### THE USE OF STAINLESS-STEEL ELECTRODES PRODUCES TOXIC BY-PRODUCTS!

**Stainless steel contains chromium. During electrolysis, poisonous chromates are produced in the electrolyte. Improper disposal of these by-products (on the ground, down the drain, etc.) is illegal.**

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While some suggest using stainless steel as electrodes, stating that it is not consumed and stays clean during electrolysis. In reality, stainless steel is consumed, however at a much slower rate, in the process poisonous hexavalent chromate is produced. These compounds can cause severe skin problems and ultimately, cancer.

How can you tell if your electrolyte contains chromates? If the electrolyte turns yellow, that is a sign that it contains chromates.

**How do I connect the battery charger?**

### CAUTION!

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#### POLARITY IS CRUCIAL!

**Connecting the power source incorrectly will result in damage to the work piece.**

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The iron electrode is connected to the positive (red) terminal. The object being cleaned, to the negative (black). Submerge the object, making sure you have good contact, which can be difficult with heavily rusted objects. Get it backwards and your object will be relentlessly eaten away! Make connections on a part of your electrode that protrudes out of the solution, or your clamps will erode rapidly.

**How do I know if it is working?**

Turn on the power. If your charger has a meter, be sure some current is flowing. Again, on heavily rusted objects, good electrical contact may be hard to make-it is essential. Multi-part objects may not have good electrical connections between them. Fine bubbles will rise from the object when cleaning is in progress.

**How long do I leave it?**

The time depends on the size of the object and of the iron electrode, and on the amount of rust. You will have to test the object by trying to wipe off the rust. If it is not completely clean, try again. Typical cleaning time for moderately rusted objects is a few hours. Heavily rusted objects can be left over night.

**How do I get the rust off after I remove the object?**

Rub the object under running water. A paper towel will help. For heavily rusted objects, a plastic pot scrubber can be used, carefully. Depending on the amount of original rust, you may have to re-treat. The amount of mechanical action will depend on the fragility of the object. Use your discretion.

**My object is too large to fit. Can the object be cleaned in sections?**

Yes. You can clean one end and then the other. Lap marks should be minimal if the cleaning was thorough.

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**After the object is removed, what should be done next?**

The clean object will acquire surface rust very quickly, so wipe it dry and dry further in a warm oven or with a hair dryer/heat gun. You may want to apply a light oil or a coat of wax to prevent further rusting.

**Will electrolysis remove pitting?**

No. It only operates on the rust in immediate contact with unruined metal. What's gone is gone. What will it look like when I am done? The surface of rusted metal is left black. Rusted pits are still pits. Shiny unruined metal is untouched.

**What about nickle plating, paint, japanning and the like?**

Sound plating will not be affected. Plating under which rust has penetrated will usually be lifted. The solution is likely to soften most paints. Test with a drop of solution in an inconspicuous place. Remove wood handles if possible before treating.

**How can I handle objects that are awkward to clean?**

There are lots of variants: suspending an electrode inside to clean a cavity in an object; using a sponge soaked in the electrolyte with a backing electrode to clean spots on large objects or things that shouldn't be submerged (like with lots of wood)

**How can I dispose of the electrolyte solution?**

The electrolyte solution will last until it gets so disgusting that you decide it is time for a fresh one. There is nothing especially nasty about it, so disposal is not a major concern, except you may not want all the crud in your drains.

*NOTE: If stainless steel has been used as an electrode, special precautions must be followed when disposing the solution.*

If stainless steel has been used as an electrode, wear rubber gloves when handling the solution or anything that has come into contact with the solution. When disposing of the solution, allow the liquid to evaporate and place the power into a sealed container. Dispose of the power at local "hazardous waste clean-up days".

**Should metal containers be used?**

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**CAUTION!**

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**The use of metal containers is highly risky.**

**Chemicals in the solution can negatively react with certain metals.**

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Galvanized metal can introduce zinc into the solution.

If lye is used in the solution, the lye will attack aluminum. You may have problems with electrical shorts, etc. Stick to plastic.

**How can odd-shaped objects be cleaned?**

Be ingenious. Plastic PVC pipe and eave troughs, wooden boxes with poly vapor barrier, kids wading pools, etc.