

## Cleaning Rusty Tools; Electrolysis Made Easy

### Editor's Note:

Electrolysis is the least destructive and most thorough method available to remove oxidation. Electrolysis removes no base metal and does not require a grinder, wire wheel, scrapper, acid or sandpaper, and when done properly can remove rust and oxidation yet leave the appearance of "patina" so valued by the collectors. Electrolysis comes as close as possible to a compromise to the ideals of both categories of old tool enthusiasts. Also useful for cleaning up old engines.

### Introduction

This is a fantastic way to remove rust and oxidation from steel and iron tools. It is not recommended for brass, aluminum, copper or exotic metals and alloys.

Electrolysis is a method of removing iron oxide by passing a small electrical charge from a battery or battery charger through the rusty metal to stimulate an exchange of ions while the tool is submerged in an electrolyte solution.

### List of Supplies

A two to five gallon plastic (non metallic) container.

2. A two amp or larger automotive battery charger with an ammeter.
3. A moderately flat piece of iron or steel.
4. A box of Arm and Hammer "Washing Soda" or "Baking Soda".
5. A tablespoon measure.
6. One to five gallons of water.
7. A pair of kitchen type rubber gloves.
8. A kitchen or similar sink full of warm sudsy water.
9. A non metallic 3M type Scotch Bright Finishing Pad product #10144NA.
10. A small tooth brush size stainless steel wire brush.
11. Paste or liquid, non-silicone, car wax.

### Supply Discussion

1. The container can be any shape, size or configuration that is large enough to hold your tool completely submerged. The key element here is non-conductive (plastic) containers.
2. Any power supply that provides a steady 6-24 volt dc current at 2 amps or larger should work well. An inexpensive 10 amp battery charger with an ammeter can be bought for under \$30 and is the best suited device for the job. The charger with an ammeter is almost essential. With heavily rusted metal getting good contact to the tool is not easy, and the ammeter is the simplest way to tell if you have got it. Avoid using the little overnight trickle chargers.
3. You need an anode for the (red) positive side of the battery charger. A stainless steel kitchen pan lid because it is small, has lots of surface area and is usually cheap. The anode is sacrificed and will eventually erode away to nothing. Stainless steel is best because it deteriorates the slowest, however one reader advised that using stainless steel creates a toxic waste, so you may want to stick with plain steel or iron, although this whole procedure is arguably potentially toxic. Anyway, most any steel or piece of iron will work. Its size in bulk is not as important as its size in surface area. Look for something about 5 inches square or what will fit your container and still not come into direct contact with your rusty tool. You can bend it, fold it, cut it. The larger the surface area the more efficient your system will be.
4. You need to obtain one of two chemicals to add to the water. No complications here. Get yourself a box of "Washing Soda" or "Baking Soda." Both are readily available at your local food store. "Washing Soda" is found with the clothes washing detergents. "Baking Soda" can be found near the flour and baking supplies at your local food store. Chemically these products are different, but similar and both will work. If you have a choice between the two use the "Washing Soda." If you can't find it don't hesitate a second about using the "Baking Soda."
5. Using either "Washing Soda" or "Baking Soda" add about 1 tablespoon per 4.5 litres of water to your container. You now have an electrolyte solution. Although the solution becomes a nasty color and is filled with the residue of old rust you can continue to use it time and again, provided you keep your anode clean.

6. Add the appropriate amount of water to your container. The water should be deep enough to cover the tools you will clean but not so high that it will overflow when the tool is placed in the water. You now have a "vat."

The first time you fill your "vat" add water 4.5l at a time. After pouring each 4.5l into the vat make a mark on the outside of the container with a bold black marker and label it 1, 2, 3, etc. for each 4.5l you add. In the future you no longer have to measure your water. Just use a garden hose and fill to the appropriate line.

7. After adding water and Soda powder the water is hard on your hands. Wear the rubber gloves while working in and with the electrolyte. This is a general precaution. The electrolyte is not an acid nor is it seriously bad to contact your skin but precautions are always best.

8. After removing everything that is not steel or iron from the tool, clean it in warm sudsy water using dish washing detergent. Remove any dirt, oil and grease that might retard the electrolysis.

### Let's Make It Work

1. Put on your rubber gloves and wash your tool in warm soapy water and make sure to remove any grease or oil. These areas will not be de-rusted effectively if not thoroughly cleaned.

2. Fill your vat with the appropriate amount of water and add 1 tablespoon of your "Washing or Baking Soda" per gallon of water.

3. Clip the "positive" red lead of your battery charger to the object you've chosen for an anode and place to the side or at one end of your vat. It is not necessary that the anode be fully covered by the water but the more surface area that is available for the electrolysis to faster the process proceeds. Try to keep the red clip from your battery charger out of the solution to avoid it being eroded away with the anode.

4. For your first trial use an old junk tool or piece of metal. Clip the "negative" black lead of your battery charger to your iron tool to be cleaned and place it in the vat. Be certain that you have a nice tight grip on the tool with the black "negative" clip. Make sure the tool is fully covered by the water. So far I've not experienced a problem with allowing the black clip to be immersed in the solution. My clip remains intact and undamaged.

The tool should have a clear "line of sight" path to your anode. If the tool is large you may have to turn the tool occasionally to de-rust it evenly and completely. If your anode is a cookie sheet or something similar you can bend it into a shape that will conform to the shape of the tool being cleaned or the contour of your vat for faster operation. The tool should be fully submerged at all times.

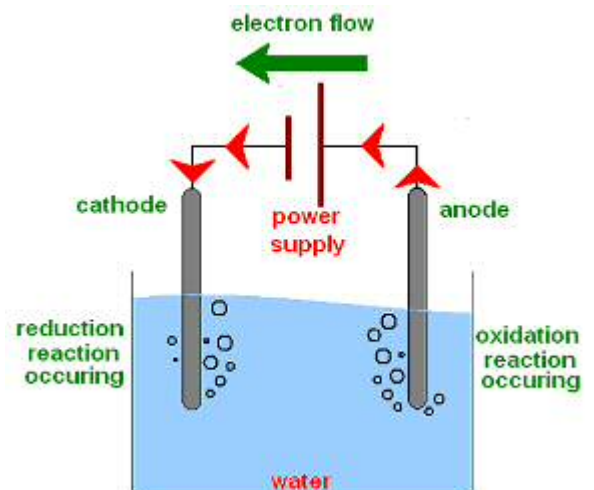
5. Check that the tool and the anode are not touching and have about 5 cm or more separation between them. If placed too close together the current on your charger will be higher than expected.

6. Set the battery charger to its highest setting. Plug in your battery charger and note the amount of current indicated on the ammeter. There is no right or wrong amperage except that you must not exceed the rating of your battery charger. Once you have applied power don't put your hands in the vat. Always turn off the power before attempting to check your tool or make adjustments to your system.

7. You will begin to see bubbles form on the tool and rise to the top. Congratulations, you're in business. A note about the gasses released during the process. Small amounts of hydrogen are released as a result of the electrolysis. You will notice while using your system just how small this amount of gas is. However to avoid a concentration of hydrogen, never cover the vat while in use. Although minute this hydrogen is flammable and I would not operate the vat next to your water heater, stove or other open flame.

8. Once the rust has turned to a dark gray or black it's time to remove the tool and wash it in warm soapy water using the Scotch Brite pad to remove the residue. If the tool comes completely clean you're done. If not, place it back in the vat for another session. Dry your tool thoroughly and proceed to the next step.

9. A freshly electro-cleaned tool will immediately begin to rust again so it is important that you immediately treat your tool. **(continues next page)**



## Cleaning Rusty Tools; Electrolysis Made Easy (continued)

### HOW IT WORKS

#### The Electrochemistry of Rust Removal By Electrolysis

The cleaning process has 4 components- a battery charger, the water with sodium carbonate (washing soda) dissolved in it, an anode (stainless steel object such as a spoon) and the cathode (the rusty iron).

The solution of sodium carbonate has two purposes. First, sodium carbonate is basic. The electrochemical reactions that occur at the rusted iron work best in a basic solution. Lye (sodium hydroxide) would work as well but it is less safe to use. Sodium bicarbonate, baking soda, may not work as well as sodium carbonate because it is less basic. The other purpose for the sodium carbonate is to make the water conduct electricity. When the salt, sodium carbonate, is dissolved in water it becomes sodium ions,  $\text{Na}^+$ , and carbonate ions  $\text{CO}_3^{--}$ . These positive and negative charged ions carry the current in solution. Carbonate moves to the positive wire from the battery charger and sodium moves to the negative wire. This movement of ions through the solution results in a current just like electrons moving in a wire results in a current. Pure water has a high resistance, about 20 million ohms per centimeter, and negligible current would pass without the sodium carbonate ions.

The battery charger is a source of electrical current and voltage. Current is the flow of electrons in a wire. Voltage is a measure of the electron energy. So, the battery charger provides electrons with energy of 12 volts at its negative lead and accepts electrons at its positive lead. The current indicated by the meter provides a measure of how many electrons are flowing. Current can also flow through water, if the water has ions dissolved in it, as provided by the sodium carbonate.

**\*\*Caution\*\*** Hydrogen gas reacts explosively with oxygen (in the presence of heat) to produce water vapor. **Shut down the power before adjusting/removing the electrodes to avoid the risk of sparks causing an explosion.**

If you are using electrolysis to remove rust///...and have a considerable broth of bubbles...be very cautious. That broth is not the place to discard a glowing cigarette ember, lit match...or any other spark. Be warned...!!

Neil Gray