# Cleaning power

Clifford Green, who is lab superintendent at Brighton Technical College, has developed his own electrolytic process for cleaning brass, de-rusting ferrous metals and sharpening old files. Here he passes on the secret.

Common metals are divided into two groups - ferrous and non-ferrous. Most corrode readily with a few exceptions, such, as aluminium, chromium, tin and nickel, where an oxide film rapidly formed resists further corrosion under normal circumstances. Stainless steel, which is usually classed as a ferrous material also resists corrosion by having chromium as a constituent of the alloy. All other ferrous metals are subject to rusting in the presence of moisture and oxygen. Rust forms as an oxide which does not fit the lattice structure of the parent material. Eventually flakes form and drop off leaving pits on the surface and fresh areas to rust. Continued rusting will eventually destroy the original artifact completely.

Copper, zinc, lead and tin are classified as non-ferrous metals. These elements are then alloyed together to produce bronze (copper and tin), brass (copper and zinc), pewter (lead and tin or lead and antimony). All these metals and alloys are subject to oxidation and corrosion, with perhaps the exception of pure tin.

Simple oxidation will produce a dull dark finish which, under ideal conditions, develops into a pleasing protective patina. Such a finish is well left undisturbed as it will enhance an artifact, especially artifacts made from bronze.

Oxidation coupled with corrosion, when salts such as chlorides and carbonates are formed should be treated without delay or the artifact can become badly pitted or in severe cases whole sections disappear.

There are many techniques available for cleaning and polishing metals. Most of these involve some mechanical operation - wire brushing, emery cloth, wire-wool and various types of metal polish. All these methods depend upon the removal of metal by scratching the surface. Even fine materials such as Silvo and jeweller's rouge scratch the surface to some degree.

Acids such as nitric will dissolve oxides and other corrosion from copper and its alloys, but great care must be exercised or fine etching will occur, leaving a matt surface. Strong ammonia solution (ammonium hydroxide) will also dissolve surface contamination from copper leaving the parent material relatively untouched - an emergency technique that can be employed in order to stop any further progress of degradation.

## General principles

The article to be cleaned and polished is made the anode (+) in a solution of strong acid with a stainless steel cathode (-). A heavy current is passed between the two electrodes for a short period when metal migration occurs from anode to cathode taking oxides and other material with it and leaving a clean, highly polished surface on the artifacts.

## Details of process

A mixture of 95 per cent concentrated orthophosphoric acid and 5 per cent concentrated sulphuric acid is placed in a suitable container of either glass or polythene (metal must be avoided) a 2 lb jam jar being very suitable. Two stainless steel cathodes (old tea-spoons or knife blades will suffice) are connected electrically and positioned in the acid solution, one on either side of the container. The article to be cleaned is then fixed to a suitable metal clip which in turn has a length of connecting wire soldered to it. The item is then suspended in the acid solution midway between the two cathodes.

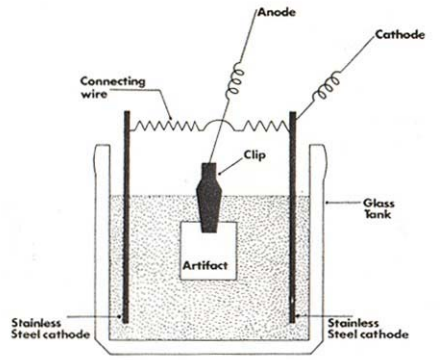


Figure 1. Details of the electrolytic cleaning bath.

Both electrodes are connected via an ammeter and voltmeter to a variable DC electrical supply. Power is applied and the current adjusted to about 5 amps. Liberal amounts of gas will be evolved from the two electrodes - oxygen from the anode and hydrogen from the cathode. These two gases form an explosive mixture so no smoking, sparks or naked flames, and always turn off power before removing from the bath. In most cases artifacts will be clean and polished in a few minutes - 'overcooking' should be avoided or unnecessary amounts of metal will be removed. Layers of lacquer, varnish or paint make good electrical insulators so removal before treatment is essential - most of these substances can be stripped off with paint remover.

The acids used in this process are corrosive to human flesh so it is recommended that rubber gloves be worn as well as eye protection. Any spillage must be cleaned away

immediately with plenty of water. When mixing the two acids always add the sulphuric to the orthophosphoric.

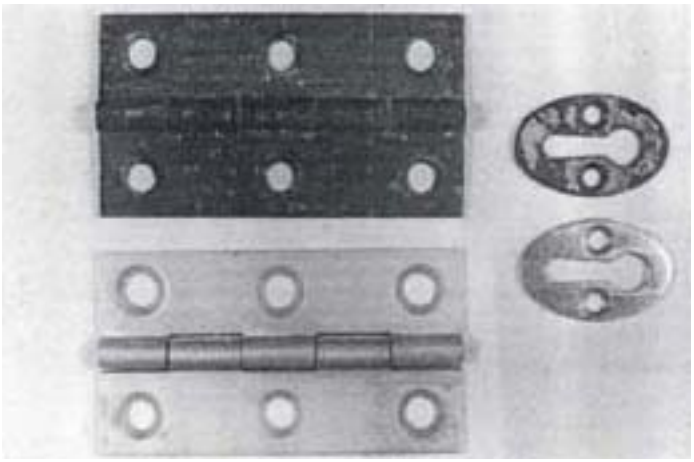

Figure 2. Victorian brass fittings before and after the treatment show the results of the electrolytic cleaning process.

The electrolytic polishing process described can also be utilised for de-rusting ferrous metals. A separate batch of solution must be used, or copper plating will occur if the bath has been previously used for non-ferrous work. Otherwise the process is as before with the exception of current density which should be slightly lower around 3 amps. All loose flakes of rust and any paint or similar insulating materials must be removed before treatment. In most cases a shiny finish can be achieved, but it has been found that steels containing a high percentage of carbon produce a matt finish which in fact is a phosphated surface that gives a protection against further rusting.

## Restoring worn files

Files that have become blunt and even those that have teeth filled with rust can be cleaned and sharpened by the same process. As before, any insulating material is removed and the file degreased in a suitable organic solvent such as trichloroethane. Carbon tetrachloride should be avoided as this substance is now classed as a carcinogen. Treatment should continue until all rust has disappeared and the teeth are nice and sharp. Current density around 3 amps - the matt phosphated finish produced will protect the file from further rusting.

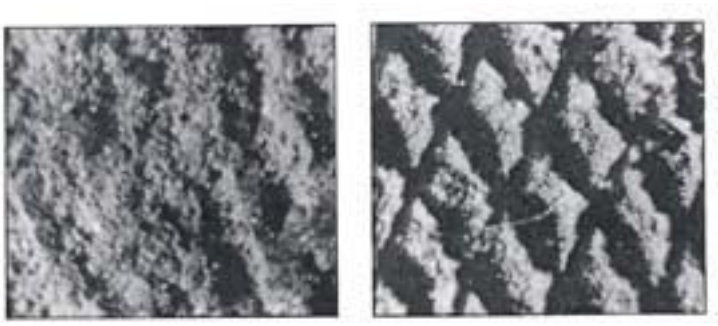

Figure 3. Magnified approximately 1,000 times, the pictures show the surface of a file before and after cleaning.

## Power supply

A circuit diagram of a suitable variable DC power supply is illustrated below. Readers who wish to build such a unit will be able to purchase the necessary components from advertisers in one of the popular electronic magazines. As an alternative a 12-volt car battery, the type with lead connector bars exposed, can be used allowing power to be tapped in 2-volt stages.

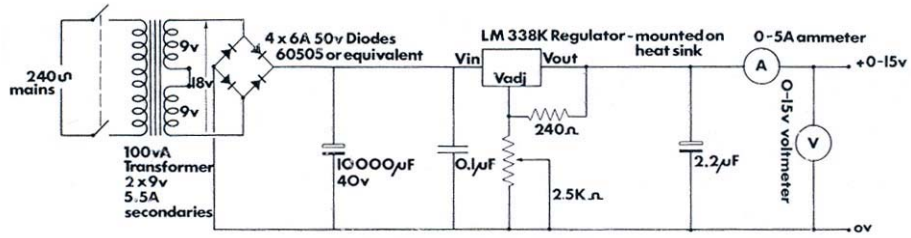


Figure 4. Power supply.

Finally, I would like to make acknowledgement to Mr I. Holmes for his assistance in producing the power supply circuit and to Brighton Technical College for the use of their facilities.