PICKLING AND BRIGHT-DIPPING

by Lars Kirmser

SAFETY

When preparing metal surfaces in the instrument repair shop, it is quite often necessary to handle a number of potentially dangerous chemicals. These chemicals more commonly fall into the **acid** category, however, occasionally potentially dangerous **alkaline** solutions are utilized as well.

Before handling these substances, some definite safety precautions must be observed. For example, when performing pickling operations, the technician should have protective glasses, rubber gloves, and a rubber apron at his disposal. If dangerous fumes are emitted from the various pickling baths, adequate ventilation must also be provided. When mixing the solutions, **ALWAYS** pour acid into the water. **NEVER** pour water into acid; a dangerous reaction may cause some of the acid to splatter from the container. In the event acid, or any dangerous chemical for that matter, gets on ones person, facilities must be conveniently located so that this substance may be immediately flushed with cool running water.

APPLICATIONS

Some of the metals that are more commonly chemically prepared are low carbon and stainless steels, as well as aluminum, copper, nickel, zinc and their many alloys. Some chemical surface preparation techniques have the additional advantage of not only producing a luster, but affording increased corrosion resistance to the metal that is being prepared. The most common application for chemical surface preparation, however, is to produce a bright, lustrous surface.

EQUIPMENT

Regardless of the size and nature of the pickling or bright-dipping operation the corrosive nature of the various chemical solutions being used makes it necessary to provide special dip tanks, materials, and many times, adequate ventilation. These tanks, dipping baskets, barrels, and in some instances exhaust systems are usually constructed of austenitic stainless steel, earthenware, fiberglass, glass, lead, rubber, and certain plastics such as polyethylene, polypropylene and polyvinyl chloride.

Small scale surface preparation, such as may be used in the instrument repair shop, is effectively performed in large earthenware crocks or polyethylene-lined steel drums.

Wood is one of the most readily available acid-resistant materials. It may be utilized beneath dip tanks and on the floor, if it is inspected regularly and replaced periodically. Acid-resistant brick and tile that is set in acid-resistant cement may also provide an efficient and long-wearing surface around the pickling tanks.

PICKLING AGENTS

Sulfuric Acid (H_2SO_4) is the most common pickling agent. This is largely because it is the lowest costing acid available for the job. Hydrochloric acid (HCl) is also a good pickling agent. It is used less than sulfuric acid because it is more costly and the fumes of HCl tend to be more of a problem. Many repair shops prefer to use hydrochloric acid because it renders a better pickling rate than H_2S0_4 at room temperatures. The pickling rate for acid mixtures may be raised by: 1. increasing the acid concentration, 2. agitation, and 3. by raising the temperature. However, loss of the pickling agent by vaporization and the consequent corrosion of nearby equipment and tools presents serious problems at temperatures above 130°F. A third pickling agent frequently used in surface preparation is Phosphoric acid (H_3P0_4) which is intermediate in price between H_2S0_4 and HCl.

PICKLING AND BRIGHT-DIPPING

As a general rule, the agents listed as **pickling** solutions will tend to be more aggressive than those listed as **brighteners** or bright-dips. For the most part, pickling agents will be prescribed for situations where radical corrosion or scaling is present. Bright-dips will be utilized in situations where simple surface corrosion is to be removed with a minimum of metal etching.

Bright-dipping solutions usually involve the mixture of two or more of the following acids; sulfuric, phosphoric, chromic, nitric, and hydrochloric. The acid ratios and concentrations will vary widely as will the prescribed length of time the piece is submerged in the solution. This may vary from 5 seconds up to 5 minutes or more depending upon the circumstances.

CONCENTRATIONS

In the following formulas, the concentrations are expressed as follows:

- *Liquids* - Percent by volume (e.g. 10% is equivalent to 10 gallons per total of 100 gallons), avoirdupois ounces per gallon (oz./gal.) or fluid ounces per gallon (fl. oz./gal.).

- Solids - Avoirdupois ounces per gallon.

- *Sulfuric acid - Commercial* 66° Bé (93% H_2S0_4). Sometimes expressed as oz./gal. of the 66° Bé acid.
- *Hydrochloric acid - Commercial* 20° Bé (31% HCI muriatic acid).
- *Nitric acid - Commercial* 42° Bé (67% HNO_3).
- *Phosphoric acid - 75%*
- *Fluboric acid* - 47% by weight.
- *Acetic acid* -- 99.5%

PICKLING AND BRIGHTENING SOLUTIONS

Iron and Steel Pickles

1.

Water .... 1 part (by vol.)
Hydrochloric acid .... 1 part (by vol.)
Room Temperature

2.

Water .... 1 gal.
Sulfuric acid .... 1 pint
Room temperature up to 175°F

3.

Sulfuric acid .... 8 fl. oz./gal.
Hydrochloric acid .... 10 fl. oz./gal.
Room Temperature

Iron and Steel Bright-dip

4.

Oxalic acid .... 3.3 oz./gal.
100 vol. hydrogen peroxide .... 1.7 oz./gal.
Sulfuric acid .... 0.01 oz./gal.
Room Temperature

Stainless Steel Pickle

5.

Sulfuric acid .... 1/2 pt./gal.
Hydrofluoric acid .... 1/2 pt./gal.
Chromic acid .... 8 oz./gal.
Room Temperature or elevated

Stainless Steel Bright-dip

6.

Nitric acid .... 4 parts (by vol.)
Muriatic acid .... 1 part (by vol.)
Phosphoric acid .... 1 part (by vol.)
Acetic acid .... 5 parts (by vol.)
Temperature at 160°F

Nickel and Nickel Alloy Pickles

7.

Water .... 5 gal.
Sulfuric acid .... 1 pt.
Sodium dichromate .... 1/2 lb.
Room Temperature or elevated

8.

Water .... 2 gal.
Hydrochloric acid .... 1 gal.
Cupric chloride .... 1/2 lb.(optional)
Temperature 180°F.

9.

Sulfuric acid .... 1 pt./gal.
Sodium nitrate .... 3/4 lb./gal.
Sodium chloride .... 3/4 lb./gal.
Temperature 180 - 190°F.

Nickel and Nickel Alloy Bright-dip

10.

Phosphoric acid .... 60% (by vol.)
Sulfuric acid .... 20% (by vol.)
Nitric acid .... 20% (by vol.)
Use at 180°F; dipping time 1 to 3 minutes

Copper and Copper Alloy Bright-dip

The copper-rich alloys are usually resistant to attack by sulfuric acid while copper oxide is readily attacked. For this reason, sulfuric acid is most often used as the pickling agent for radical corrosion and scaling on copper and copper alloys. A solution containing 5 to 10 percent H_2SO_4 by volume often gives a good pickling rate at room temperature.

Bright dips for copper and copper alloys consist usually of nitric and sulfuric acids in varying proportions together with small quantities of water and, hydrochloric acid. A common formula will consist of:

11.

Water .... 1 1/2 gal.
Sulfuric acid .... 2 gal.
Nitric acid .... 1 gal.
Hydrochloric acid .... 1/2 fl. oz.
Room temperature

12.

Nitric acid .... 20% (by vol.
Acetic acid .... 25% (by Vol.)
Phosphoric acid .... 55% (by vol.)
Hydrochloric acid .... 0.5% (by vol.)
Use at 190°F

13.

Nitric acid .... 40% (by vol.)
Phosphoric acid .... 30% (by vol.)
Acetic acid .... 30% (by vol.)
Sodium Chloride 1.0%
Use at 150°F

The hydrochloric acid is added to increase the luster but an excess of this compound will tend to cause the surface to spot. Sodium chloride may be used in place of the hydrochloric acid in this formula. After bright-dipping and rinsing thoroughly in cold running water, the piece may be dipped into a solution of 4 oz./gal. of sodium cyanide to remove the remaining stains. It may then be thoroughly rinsed again in cold running water, and then dried.

Silver Bright-dip
14.

Water .... 1 gal.
Nitric acid .... 2 gal.
Room Temperature or elevated

15.

Sulfuric acid .... 1 gal.
Nitric acid .... 1 pt.
Room Temperature or elevated
Work should be dry

REMOVAL OF SOFT SOLDER

Chemical removal of excess soft solder often results in a reduction in subsequent buffing and finishing efforts. Some repairpersons use a solution of 1 part water to 1 part nitric acid at room temperature to remove excess soft solder. Another method is to immerse in 10% fluoboric acid (1 vol. 42% HBF_4 to 3 vol. water) containing 6.5 fl. oz./gal. of 30% hydrogen peroxide. This solution may be used at room temperature resulting in an immersion time varying from 5 to 15 minutes or longer. The stripping action of this solution may be accelerated by making it electrolytic. The piece is made to be the anode (+) at 1 - 2 volts, with lead used as the cathodes (-). If this method is used, the lead cathodes must be removed and rinsed thoroughly after each use since they would dissolve if allowed to remain in the acid solution. Caution should be taken not to allow the base metal to etch due to excessive duration of treatment.

REMOVAL OF SILVER SOLDER FLUX

The following solutions may be used to remove the stubborn borax or silver solder flux that will remain after silver soldering: Mix 9 parts water with 1 part sulfuric acid. A second solution would be to mix 7 parts water, 1 part Nitric acid, and 2 parts sulfuric acid.

THE COLORING OF METALS

Although the practice of chemically coloring or oxidizing metals is not necessarily inherent to the field of musical instrument repair, there is the chance that some of our readers are currently engaged in the restoration of antiques to which many of the following formulas may be applied.

An almost unlimited variety of shades and colors may be applied to metals by using chemical solutions. The outcome will depend, for the most part, upon the skill of the technician, more so than the particular formula used. The results will also vary with the slight composition differences of similar metal alloys. Contrast in color may be obtained by scratch-brushing with fine pumice, hand rubbing with a pumice paste, or by buffing.

BLACK ON BRASS:

Copper carbonate .... 1 lb.
Ammonia .... 1 qt.
Water .... 2 1/2 qts.
Temperature .... 175°F

The copper carbonate and the ammonia are thoroughly mixed before adding the water. An excess of copper must be present. The color, which is a blue black, may be fixed by a subsequent dip in a 2 1/2% solution of caustic soda.

GRAY BLACK ON BRASS:

Hydrochloric acid .... 1 gal.
White arsenic .... 2 lbs.
Anitmony trichloride .... 1 1/4 lbs.

This solution is used hot and no water should be added.

BLUE ON BRASS:

Lead acetate .... 2 - 4 oz.
Sodium thiosulfate .... 8 oz.
Acetic acid .... 4 oz.
Water .... 1 gal.
Temperature .... 180°F

This will produce a blue color on a nickel deposit and also on polished high carbon steel. The color will change if not lacquered.

ANTIQUE GREEN ON BRASS:

Nickel ammonium sulfate	8 oz.
Sodium thiosulfate	8 oz.
Water	1 gal.
Temperature	160°F

HARDWARE GREEN ON BRASS:

Ferric nitrate	1 oz.
Sodium thiosulfate	6 oz.
Water	1 gal
Temperature	160°F

BROWN ON BRASS OR COPPER:

Potassium chlorate	5 1/2 oz.
Nickel sulfate	2% oz.
Copper sulfate	24 oz.
Water	1 gal.
Temperature	195° - 212°F

CRYSTALLIZED BRASS:

Copper sulfate	8 oz.
Ammonium chloride	4 oz.
Water	1 gal.

Solution may be used either cold or warm. After the crystallized effect has been obtained, a dip in a sulfide solution will bring out the crystal effect even more distinctly.

LIGHT BROWN ON BRASS OR COPPER:

Barium sulfide	1/2 oz.
Ammonium carbonate	1/4 oz.
Water	1 gal.

The color is made to be more clear by wet scratch brushing and repeating the dipping.

BLACK ON COPPER:

Immerse at room temperature in a solution of 1/4 oz./gal. liver of sulfur or liquid polysulfied. Colors will progress through the spectrum from yellow to dark purple to black. The strength of the solution should be such that the black color forms in about 1 minute. If it forms much more rapidly, the copper sulfide film will be brittle and non-adherent, in which case the concentration should be reduced.

STATUARY BRONZE ON COPPER:

The same procedure and solution are employed as above for black on copper. However, the articles are removed when they show a reddish-purple iridescence, and rinsed. Dry scratch-brushing will then result in a chocolate brown color.

BLUEING STEEL:

The following baths will produce a blue color on steel:

1.

Ferric chloride	2 oz.
Mercuric nitrate	2 oz.
Hydrochloric acid	2 oz.
Alcohol	8 oz.
Water	8 oz.

Use at room temperature. Parts are immersed for 20 min., removed and allowed to stand in air for 12 hours. Repeat this again, then boil in water for 1 hour. Dry, scratchbrush and oil.

2.

Sodium thiosulfate	8 oz./gal.
Lead acetate	2 oz./gal.

Use at boiling temperature.

3.

White arsenic	16 oz.
Hydrochloric acid	1 gal.
Water	1/2 gal.

Use warm.

4.

Mercuric chloride	4 parts
Potassium chlorate	3 parts
Alcohol	8 parts
Water	85 parts
Temperature	Room

5.

Caustic soda	5 oz./gal.
White arsenic	5 oz./gal.
Sodium cyanide	1 oz./gal

Make parts cathodic, using steel anodes, at 2 amp./ft.^{2} for 2 -4 minutes. The blue color produced should be rubbed and oiled.

Bobby came home from school one day and said to his mom, “Mommy, I learned the alphabet today! The rest of the class could only get up to F I got all the way through!” His mom replied, “That’s because you’re a violist, Bobby”. The next day came and Bobby said, “Mommy, I counted to a hundred in school today. Everybody else could only get to 60.” “That’s because you’re a violist, dear,” came the reply. So again, the very next day Johnny came home with, “Mommy, I’m taller that everyone in my class. Is that because I’m a violist?” “No dear, that’s because you’re 26.”