Ideal Layout for a Hard Chromium Plating Shop

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Updated by Dr. James H. Lindsay, AESF Fellow, Technical Editor

This article is based on material contributed by Arthur W. Logozzo, one of the early mainstays in our industry, for the "AES Update" series that ran in this journal in the late 1970s and early 1980s. In the April 2002 issue of *P&SF,* an article on hard chromium processes, by Myron Browning, CEF, was offered. This month, the equipment and operations are ably covered in a most welcome practical style. Since this article was written, there has been considerable history added to hard chromium plating technology. Nevertheless, the reader may benefit both from the information that remains relevant and the historical perspective of the technology.

Because of the highly specialized category that hard chromium plating falls into, it is essential to plan a layout that differs from shops that handle other types of plating. There is a myriad of details involving stress-relieving, polishing, masking, special surface treatments and so forth, peculiarly individualistic to hard chromium requirements.

Although the layout recommended in this article may be thought of as idealistic or farfetched, it is actually based on *present and workable plans*. Air conditioning is a feature of a labor atmosphere that is conducive to a better sense of balance and quality likened to a modern office. Another feature that, for some strange reason, commands no attention and should be considered indispensable is a dehumidified room, which offers an atmosphere free of moisture to prevent oxidation and rusting of critical, expensive, machined components and all kinds of dies and molds. This obviates an age-old condition the plating room has been subject to as a necessary evil since the inception of electrodeposition. Yet, a small investment and practically no upkeep eliminate this bugaboo.

The Essentials

Now, let's move into the layout area. The discussion of the physical layout of the shop will be broken down into two parts: the actual necessities for operating a hard chromium shop, and the embellishments that are in keeping with recent developments and, therefore, help to yield exceptional results for the above-average job.

Pretreatment Tanks

Tankwise, the first to be considered is for alkaline cleaning. This unit can double as a stripping tank, and therefore eliminate duplication. It can be constructed of plain steel with a reverse or anodic hookup and some plain steel cathodes. However, a system must be provided to exhaust spray and fumes from above the bath. Heating is supplied with a steel coil.

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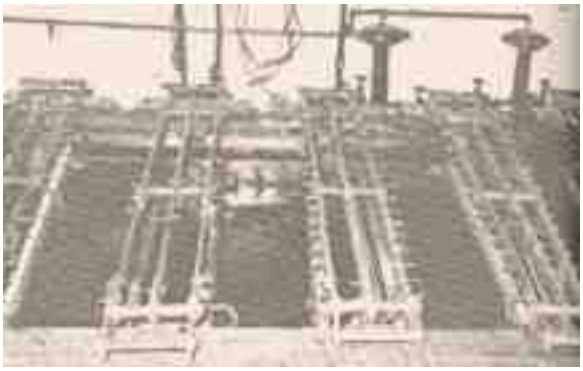

Fig. 1—Multi-bay plating tank simplifies bath maintenance, reduces equipment costs and permits utmost versatility for the hard chromium plater. This tank has seven bays.

The next tank is a water rinse and, ideally, should be built with plain steel and coated inside and out with white Koroseal®. The tank can also be constructed with fiberglass, polyethylene, wood or plain steel, painted white. The tank does not have to be exhausted, but should be aerated with the safety valve in the incoming water line. This practice prohibits any backing-up of water into the main lines—a direct violation of sanitary and health codes. The valve also provides agitation, and, by incorporating the dam overflow-type tank, the optimum in good rinsing is obtained.

The third tank, for pickling, should be lined with a material suitable for room-temperature muriatic acid (HCl), and should also have exhaust provisions. The tank does not require current.

The fourth tank is for chromic acid etching and is usually made of steel and lined with Koroseal®, lead, brick, polyethylene or any of the vinyls resistant to chromic acid. The etch tank is connected anodically for reverse current and heated using a lead, tantalum or titanium coil. This tank, too, is fixed with an exhaust system.

Chromium Plating Tanks

The chromium plating tank should immediately follow the etch tank. No rinse is needed in between because they both contain chromic acid, even though the etch tank does not contain a catalyst. The plating tank should be made of heavy-gage steel and lined with brick or one of the organic materials. Lead was the lining in practically all chromium plating tanks prior to World War II, but, with the advent of the more complex and active catalysts in many modern solutions, it is seldom used anymore. An ideal lining is a double one—

Koroseal directly over the steel and then a layer of plasticized vinyl. Koroseal provides the chemical protection and the outer coating lends resistance to impact and abrasion. This combination will give many years of uninterrupted service. Polyethylene, in sheet or sprayed form, is also used for lining tanks.

The chromium tank can be designed with as many bays as needed to meet the particular requirements of the captive or jobshop. This multi-bay arrangement (Fig. 1) can make a mockery of the many accepted standards of pricing a hard chromium job, especially when so much emphasis is placed on cost per tank-hour. Its flexibility is amazing and most productive, and ideal when jumping from those small nuisance jobs to the large and unwieldy parts that ordinarily require special equipment.

The beauty of the multi-bay is that it contains only one set of heating coils, one automatic temperature controller, and one solution to maintain. Because of the larger solution volume, the chemical changes are slight from week to week, guaranteeing a more uniform result. There are no partitions required—only separate electrical controls. It is possible operate the bays individually or to combine any number of them to meet the changes in daily requirements.

The chromium tank(s) should be the most elaborately equipped item in the plating shop and much thought should be given to it. Inasmuch as temperature control is so important, an easy-to-read unit, visible to any operator, should be selected. It can be either air- or electrically operated.

Reverse-acting solenoid valves for heating and cooling are preferred. It is interesting to note that in warm weather, the cooling factor will be called upon more often than the heating factor, particularly when fairly large loads are being processed at high current densities, causing heating-up of the solution.

The coils in the chromium tank can be lead or tantalum, and, in some cases, titanium. The titanium coils are cheaper but, as yet, have not developed a history of use in chromium solutions, so a definite recommendation cannot be made at this time [as of 1979], other than to suggest investigating them. When tantalum coils are used, it is necessary to protect them anodically to preclude the possibility of their dissolving and going into solution.

Electric heating, using quartz heaters and other special units for acid baths, is also a possibility, and has provided trouble-free service in many installations. The chromium tank must be exhausted, and it is advisable to impinge the fumes and water-wash the residue to prevent blowing it out into the atmosphere.

Rinse Tanks

The chromium tank is followed by a drag-out rinse, which can be used to replenish solution, cutting down on chromic acid costs. The tank can be made of plain steel, with a dam overflow and aerated-water inlet for clean rinsing if the drag-out is not used. In any event, the tank or a subsequent counterflow-rinse tank, should be followed by an alkaline neutralizing bath. The unit should be similar in construction to the first alkaline tank but does not need any current. It is a still tank, heated to 82°C (180°F). The alkaline solution is most useful in neutralizing chromic acid both before and after stop-off removal, when selective plating is the order of the day. A final pair of tanks provides another water rinse and a hot rinse.

This concludes the regular line-up for the average hard chromium layout, but now let's get to the equipment necessary for that added know-how and those extra finishing touches.

Auxiliary Equipment

Surface Preparation

A good vapor-blast machine or any dry-blast unit is a must for preplating and post-plating treatment. Grit size varies but medium (#300-grit) suffices for most jobs. Wherever a lot of internal-diameter areas must be vapor-blasted, additional rotating equipment must be provided. A shot-peen unit should also receive consideration to meet certain specifications, but it is not a "must."

A periodic-reverse-current unit is an indispensable piece of equipment and should be standard in the jobshop, where the work is so varied. Also, many jobshops receive heavily scaled parts, and the periodic-reverse current used in conjunction with an alkaline-type descaling solution will save many extra hours of labor. The alkaline descaling tank is made of plain welded steel and current is introduced through carbon electrodes. Because this tank operates at room temperature, no provisions for coils, etc., are needed.
An ultrasonic unit can be used to excellent advantage for special cleaning, stripping and scale removal, and so should be considered for the ideal layout.

Polishing Equipment

Surface preparation of parts for hard chromium plating also involves polishing, and it is most advisable to include at least one standard buffing jack. In addition, the flexible-type equipment is a must, particularly on complex shapes such as those encountered on molds and dies for plastics and die castings. An overhead rail is ideal and to this should be added small hand-grinders and oscillating equipment. In fact, if a good finish is a specialty, the highly specialized nature of the equipment almost makes this setup a department in itself. Naturally, to complete the polishing department, a tremendous assortment of materials, such as wheels, felt bobs, rouges or compounds, silicon papers and flours and aluminum oxides, is needed.

Generators & Rectifiers

After many years of controversy as to whether the generator or rectifier should be chosen for the hard chromium shop, it has narrowed down to rectifiers, in most cases. As of this writing (1979), the generator is still specified in larger installations and does an excellent job.

The rectifier has many advantages and comes in many varieties, the most popular of which are the selenium and the silicon types. It is essential to specify a ripple of 5 percent or less (to eliminate the possibility of a laminated or interrupted deposit) and a three-phase circuit. The low ripple factor is essential on low-voltage, close anode-to-cathode setups. In high-voltage plating (6V as

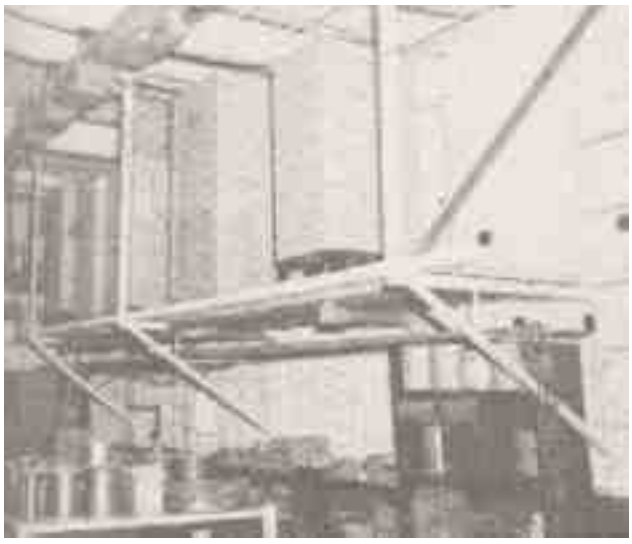

Fig. 2—Rectifiers isolated from chromic acid mist in plating area have longer lives.

opposed to a low voltage factor of 3.5 to 4.0), the ripple is not important. On the low-voltage jobs, if a high ripple were present, the current would be in and out of the plating range, having the same result as continuously breaking the current. This cannot be tolerated during hard chromium plating.

Current and voltage control are most important, and power-actuated powerstats are recommended. These are suited to any type of hard chromium plating—from the very close anode-to-cathode ratio work, requiring splitting of tenths of a volt, to the larger jobs, calling for the top range and not involving anything closer than a one- or two-volt spread. At the tank itself, the typical tank-control setup consists of a start-and-stop button, a raise-and-lower button, an ammeter and a voltmeter. This is all that is required at the tank; the powerstats and rectifiers can be in another location—preferably behind an adjacent partition, away from chromic acid spray and fumes, for longer, trouble-free life, as shown in Fig. 2.

Another advantage of the rectifier is its flexibility when using the multi-bay system. The individual control from separate units makes it possible to operate several tanks in one. Figure 3 illustrates this point.

Odds & Ends

Stress-relief oven: An oven capable of reaching at least 260°C (500°F) is necessary to cope with stress-relieving of parts before and after plating. The control should be within ± 2.8 C° (5 F°) to comply with many of the new specifications.

Wax-dipping tank: The waxing tank is indispensable in many hard chromium operations, especially the captive shop. Fumes and spray must be exhausted above the unit, which can be heated by steam or electricity.

Lacquer-removal unit: This is another important item and should be customized to meet the needs of each shop. A setup designed for complex shapes comprises a rod agitator and two tanks: one for preliminary stripping and another for final cleaning. This agitation saves much hand labor, especially when very fine holes must be stripped of lacquer.

Fixture Setup: Storage of work bars and fixtures should be neat and simple and not space-consuming. This, of course, is largely dependent on the variety of work processed in a given shop. A simple, yet effective, hanger arrangement consists of one set of "horses" for pre-plating, fixturing or jigging, and another set for post-plating disassembly. The pre-plating setup is on an always-dry floor, whereas the after-plating array is situated in the tank area with duckboard flooring, under which drains will carry away any drippings. This is a unique and effective arrangement because it separates the specialist preparing work from the cleanup man, whose only function is disassembly.

Containers: There should be several acid containers with some of the new activating acids, most popular of which are the sulfamate and hydrofluoric/sulfuric proprietary mixes. The containers can be of any size and made of polyethylene, vinyl or earthenware.

Maintenance Shop

Because of the many details involving mechanical ingenuity in hard chromium plating, it is reasonable to expect to find a good mechanic in the guise of a rack- or fixture-maker. In the smaller shop, this mechanic might also double as plant maintenance man. The value of this approach will be reflected by cutting the costs of outside servicemen, such as plumbers, electricians and painters, whose fees may outstrip anything a plater earns.

The department should have a drill press, a lathe, a grinding setup, electrical test equipment, oxygen-acetylene torches and welding equipment, thread and die equipment for plumbing repairs, carpentry tools, soldering and lead-burning facilities. An oscilloscope for checking rectifier ripple saves much grief by eliminating the guesswork on this all-important operation. If an oscilloscope is not included, it is advisable to have a rectifier serviceman come in for a periodic check. Another electrical "must" is the tong tester, which can locate many of the idiosyncrasies that surface during a day's work.

Fig. 3—Individual controls from several rectifiers convert a standard plating tank into nine small tanks.

Inspection Department

Improper inspecting and gaging of hard chromium-plated parts can break an entire operation. To properly carry on these tasks, much equipment is needed, particularly that for gaging. Some of this equipment is indeed sophisticated.

The visual inspector should have good magnifying glasses with individual loops. For precise work, microscopes should be included, and at times, reflectometers are required to examine finishes on special die work.

Gaging equipment should include micrometers to measure the largest inside or outside diameters that will be plated, and calipers, verniers, thread mikes, telescoping gages, depth gages and indicators to meet special requirements. In addition, magnetic-type gages, developed especially for measuring hard chromium deposits over ferrous bases, are a must. There are probe types for actually measuring the work without breaking contact in the plating tank—by merely raising the work above the solution and determining whether it needs more chromium or not.

Laboratory Equipment

Even in the captive plant, a certain amount of testing equipment is needed for quick checks. In the jobshop, a fairly complete laboratory equipped with the essentials for maintaining the chromium solution is a must. A direct-reading hydrometer giving the oz/gal or g/L ratio should be used daily, and the weekly analysis should be more complete. Instruments for checking chromic acid, sulfate, trivalent chromium and iron concentrations should be available. Titration sets for cleaners and other solutions are valuable and require little capital investment.

Receiving & Shipping

In the jobshop, the receiving and shipping department must be carefully set up and equipped. The receiving section—usually employed only for uncrating, unpacking and checking—requires little equipment, but the shipping area necessitates a steel-strapping machine, a parcel-post scale, a taping machine, wrapping paper, shipping waxes and crating and packaging facilities. Besides this, information must be updated on inter- and intra-state carriers, parcel services, and all air-freight services. ***P&SF***