anodizing aluminum

Dear HR:

The article on anodizing aluminum in the January, 1979, issue offers some interesting material. It also proffers some remarks which I feel need some clarification. The statement is made early in the article that the natural surface of aluminum breaks down, causing it to be unsuitable for applications where a long-term, stable surface is needed.

In contrast to this, let me quote a statement by the American Society for Metals:* "Aluminum, a member of Group III of the periodic table, is stable in air because of the presence of an extremely thin, but remarkably tight and adherent, transparent oxide film. Growth of this natural oxide film on aluminum is self-limiting." The two points of view seem to be widely divergent, to say the least.

Other statements in the article refer

**Aluminum*, volume 1, page 22, American Society for Metals.

to ". . . an otherwise easily corrodible metal." Now, all metals are corrodible; in fact, stainless steel depends on a somewhat similar oxide film mechanism to achieve its corrosion resistance. Look around and you'll see bare aluminum performing in such long-term applications as electric transmission lines, culverts, and many others. In most instances the metal chosen for these applications was aluminum because of its ability to resist corrosion.

The photo on page 64 has a caption which speaks of ". . . a carbon speck or other alloying constituent." Granted that the cause of such an anomaly is difficult to ascertain since only the void exists, usually at the time of discovery. But a carbon-alloying constituent it is not. Over seventy-five commercial alloys are presently available in the United States, and carbon is not recognized as an alloying agent in one of them.

On page 66, the author says: "The cathode must be constructed of lead." Cathode materials may be of aluminum, stainless steel, or lead. Some precautions must be considered in the way of cathode placement, but there's a choice of materials to use.

Furthermore, I could not reconcile the current density quoted with that employed by commercial anodizers in this country. Most H_2SO_4 (sulfuric acid) anodizing in the U.S. is done at 12 amperes per square foot. Small pieces may be calculated at 0.0833 amperes per square inch but in either case keep in mind that both sides of the piece are treated at the same time. Thus one square foot of sheet metal will represent two square feet of anodizing surface when calculating current density.

Even thickness should be considered, since it's easy to see that a panel 6 × 12 × 1/16 inch thick will have 2.25 square inches of surface area exposed to the bath along the edges alone. Total surface area then is

$$2(L \times W) + t(2L + 2W)$$

(Continued on page 81)

comments

(Continued from page 6)

wherein L, W, and t represent length, width, and thickness.

To maintain 12 amperes/square foot, you must measure the resistance of the bath with the piece to be processed in place and apply Ohm's law or use a variable voltage supply with an ammeter in the circuit. Maintaining this current will require a power supply capable of supplying 15-20 volts at a current equal to 125-150 per cent of the calculated amount. Voltage will vary with bath temperature and alloy.

Best anodizing results are obtained by maintaining a constant current throughout the cycle. By maintaining the bath temperature between 68 and 72F (use a long glass dairy thermometer) and the current at 12 amperes/square foot, the time required to produce a given coating thickness will be 80 ampere minutes per 0.01 mil or 0.0001 inch. In other words, 6.7 minutes' time will produce 0.0001 inch of coating (80 divided by 12) if the other parameters are observed.

In substantiation of this, note that automobile trim is generally required to have a 0.3-mil coating, and most anodizers achieve this with a 20-minute treatment.

Most dyes work well on coatings of 0.3 mil and up. Note, too, that for any alloy worthy of consideration by the Amateur fraternity, the coating weight or thickness will vary no more than three per cent in either direction when coated according to these suggestions.

Proper operating practice should be observed if you expect usable results. The material must be *clean* as a prerequisite to anodizing. Scrubbing the piece with a good soap or detergent should suffice, provided the piece is then thoroughly rinsed. A good test for cleanness is that the rinse water falls off the surface in an unbroken fashion; that is to say, it should not form beads as does the rain on the waxed hood of a car.

Pretreatments such as buffing, wire brushing, or etching should be given some thought by the experimenter. Once the piece has been properly racked (fastened to the aluminum rod or strip for suspension in the bath), it should be carefully lowered into the electrolyte with the power off.

The power should then be applied at a low level and quickly increased to the calculated current. The bath should have some mild agitation during the whole anodizing cycle. Whatever method is used to agitate the bath must take into consideration the hazards of dealing with an *acid* bath. The power should be turned off before the piece is removed.

Aluminum racks are anodized along with the piece of work. Hence, before they're used again they should be sanded, wire brushed, or etched in the contact areas to ensure a good electrical contact. Alloy 2024-T3 or -T351 will work best as rack material for Amateur use. Good electrical contacts are very important to the success of any anodizing experiment.

Anodizing may be done by various methods (including ac anodizing) and for many reasons. By and large, the greater portion of such treatments represented by the H_2SO_4 processes are meant to enhance the appearance of the item treated. The use of the process by the Radio Amateur should be regarded as a means of improving his handiwork.

Any experimenter in need of further corrosion protection of an aluminum item would be well advised to take his problem to a professional anodizer. These sources are listed in the yellow pages of your local phone book.

The work cited in the reference is a three-volume set and is highly recommended to anyone interested in more information on aluminum or the processes employed to fabricate it.

Robert A. Ridout, WA9UXK
McHenry, Illinois