ANODIZING – Step by Step

I started in aluminium casting about three years ago, and have produced some useful items, and learned much along the way. Much of what I learned came from various Yahoo groups and some websites I found independantly.

One of the things I learned about was colouring my aluminium products by anodizing them.

As presented on many sites, anodizing seems to be an arcane process that won't work properly unless you've just had a haircut, hold you mouth *just so*, and sacrifice a perfectly good virgin on the altar of marriage harmony. But it's NOT!

It's as easy as A-B-C. No haircut, no virgins (bu%@#r!), and it doesn't matter how you hold your mouth. So easy, in fact, even an Orang Utan could learn to do it.

There are a lot of variables...chemical concentration, power supply voltage and current, temperature of the various baths, spacing between anode and cathode, and timing. If you are not trying to make a commercial enterprise out of it, there is very little of really critical importance. Weaken the acid and caustic baths, reduce the voltage and/or current – these will cause the process to just take a little longer. If you want to use higher voltage/current combination, the acid might need some cooling process more effective than just a fan. So, in the beginning, you should experiment a little to find out just what your setup requires and can manage.

There are some precautions you should be downright anal about as you will be handling battery acid and caustic soda, but I'll tell you about them as I take you through the steps.

What you will need:

NOTE: You should always wear rubber gloves and eye protection when working with acid and caustic. A vinyl apron and rubber or plastic boots could also be a good idea.

Three plastic airtight containers big enough to hold about a gallon or so – with lids. The acid, dye, and caustic soda can be re-used many times.

Some aluminium wire or thin aluminium or lead strips to use as anode (positive) hooks. In use, aluminium will become anodized and will not conduct current very well unless stripped before re-use – about 10 minutes in the caustic. DO NOT use copper, brass or iron as these will contaminate the acid and degrade both the process and the product.

A lead sheet at least twice the area of the biggest anodizing job you are likely to do – say about the size of one side of the plastic container will probably do – it will be used as the cathode (negative).

A variable power supply capable of supplying about 12 volts at up to about 3 amps. It should

have an ammeter to show output current. Or you could just use a charged car battery or even a battery charger set to 'trickle charge'.

You will need a can or jar of caustic soda from the supermarket (*you can omit this – see later*)

And about a third of a gallon of battery electrolyte (**NOT** CONCENTRATED ACID!) from the automotive battery shop. This should have a sg (specific gravity) of 1.27. Getting the acid from old batteries is unlikely to work very well unless they are discharged before you empty them – if they are even partly charged, the acid is quite weak. A fully charged battery contains only distilled water.

You will need a couple of pairs of good rubber gloves – one to use with acid, the other with caustic – red ones for use with acid and green or blue for use with caustic. Wash them thoroughly between uses.

In addition, a good supply of sodium bicarbonate. Keep a plastic bucket of water with a good handfull of bicarb dissolved in it near where you are working. It's handy to dip things in to neutralize the acid, for cleaning your rubber gloves, and for neutralizing any acid spills.

You will need a large supply of distilled water. Best (cheapest) is if you have a still. Solar stills are cheap to make, and cost nothing to run. Over a period, they can produce all the distilled water you will need,

Setting up:

Fill one of your containers to about one third with distilled water. Carefully and gently add the battery electrolyte to the water (REMEMBER the THREE A's: **A**LWAYS **A**DD **A**CID!) until the container is about two thirds full. The mixture will get fairly warm. Put the lid on and set it to one side to cool. DO NOT allow any of the other chemicals anywhere near the acid!

Another of your containers should be two thirds filled with distilled water, and about two eggcups-ful of caustic soda crystals added. DO IT SLOWLY as the solution will fizz and get quite hot – you DON'T want to get splashed with hot caustic solution! Put a lid on it and set to one side. ***This step in the process can be omitted, although the finely etched surface finish it can provide can improve the uniformity and appearance of your product.*** The main benefit from omitting it is that you will have one less highly reactive chemical to store and handle.

In the third container, mix up a good strong batch of whatever dye you are going to use. You can use food colourings, coloured inks, natural colours and fabric dyes – almost any kind of colouring will do so long as it is water solluble. Some fabric dyes have relatively coarse pigmentation and, although the part will take up the dye, it will tend to cover the surface rather than be absorbed into the very fine pores; and most will wash off during the fixing process. It might pay to produce some test pieces with any dye you might like to try so you know which ones work and those that don't.

The anodizing process converts the aluminium oxide on the surface of the part into aluminium hydroxide, with millions of microscopic pores, into which the dye gets absorbed. The fixing process then converts the hydroxide into aluminium monohydrate which has no such pores, trapping the colour and producing a very hard, wear resistant surface.

The process:

First, prepare the surface of the metal. A good finish is essential as anodizing cannot hide poor surface preparation. Final preparation can be with (say) 1200 grit emery paper.

Next, you must CLEAN the part(s) to be anodized. Best is in very hot water with strong detergent and a stiff brush, followed by thorough rinsing in distilled water. The better you clean the surface, the better your final result can be, so you can take this step to extremes! Use rubber gloves and DO NOT TOUCH THE METAL WITH BARE SKIN.

Etch:

If you are going to use the caustic etch step, place the part now into the caustic solution for no more than one minute. The weaker the caustic solution, the longer this step can take. REMEMBER: the caustic is etching (dissolving) the aluminium. The longer it is in the caustic the smaller it becomes (holes get bigger). It will fizz and bubble. Remove when it appears a nice grey colour, but certainly don‘t leave it longer than one minute..

Anodize:

Again, wash thoroughly in distilled water and then suspend it on an aluminium or lead wire hook, fully submerged in the acid bath, ***not in contact*** with the cathode or the sides of the container.

Connect the power supply: POSITIVE to the part (anode) and NEGATIVE to the lead cathode, and run it at twelve volts for about 45 minutes. You may need to experiment with this. The bigger the piece being anodized, the higher the current should be. You should try for about 160 milliamps per square inch of the anode (workpiece), although this is not critical

You may need to aim a fan over the acid to reduce the heat generated by the reaction. Ideally, you should try to keep it at about 20 degrees C. The cathode will fizz quite a bit and some bubbles will also come from the anode. All normal.

Next, remove the part from the acid and wash in distilled water. It is now anodized and requires only colouring and sealing, or only sealing if a natural metal finish is required.

Colour:

Immerse in the dye for somewhere between one and fifteen minutes, depending on how much colour you want. Heating the dye will speed up the process but ABSOLUTELY NO HOTTER THAN 50 DEGREES C, otherwise you will start closing up the pores in the anodized surface and REDUCE the colour takeup.

If you need to keep some uniformity between batches of the same colour, you should take note of the temperature of the dye and the time. Keeping everything the same will produce near uniform results.

Seal:

Finally, remove the part from the dye and place it in distilled water at about 90 degrees C, then bring it to simmering over the next 5 minutes or so. Keep it at this for up to maybe an hour. Some of the dye will colour the water.

If you are going to use an aluminium pot for this step, you will find that the dye will only stain the surface of the pot – it will clean up without permanent stains *unless you anodize it first*!

Dry and buff the part with a soft cloth. Some dye may come off the surface onto the cloth, but it is only from the surface. Longer boiling times may reduce this somewhat.

Job DONE!

Cleanup:

Disconnect the power supply, remove and wash the lead cathode from the acid bath, cover the containers with their airtight lids firmly in place and store in a safe place where animals and children will not be able to get at them. DON'T mix up the lids! use the one from the acid container for the acid etc. A bit of coloured paint on the lid AND the container (red for acid, blue for caustic?) will probably help with this