

Anodising aluminium – Part One

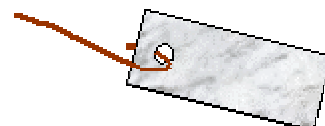
Your piece of aluminium has to be really **CLEAN** for the process to work. Ordinary cleaning is not enough. Special chemical cleaning is needed (we will have to do this bit for you).



Eye protection must be worn

Job 1

Using the scissors, cut out a piece of aluminium from your can. Watch out for **SHARP EDGES!** About 5 cm x 2 cm is OK.



Make a hole in the strip at one end.

Bend one end of a length of copper wire to make a hook, and put it through the hole.

From now on, only hold the aluminium using the wire – not your sticky paws!



Job 2

Fill a large beaker about $\frac{3}{4}$ full with **distilled** water (not tap water). Take your beaker and the piece of aluminium to the fume cupboard.



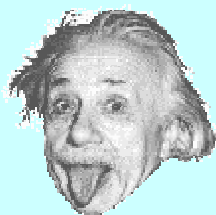
Ask one of the teachers for help now.

Job 3

Ask one of the teachers to process your aluminium for you.

We will do the following things for you:

- Dip the aluminium in 2M sodium hydroxide at 50°C for about 10 seconds
- Rinse it in some distilled water
- Dip it in 3M nitric acid at room temperature for about 3 seconds
- Rinse it again in the distilled water
- Put it into your beaker of distilled water for you to carry back to your bench.



The two substances needed to clean the aluminium are dangerous.

2M sodium hydroxide solution at 50°C – really nasty.

3M nitric acid at room temperature – pretty nasty too.

You are now ready for Part Two of the process

Anodising aluminium – Part Two

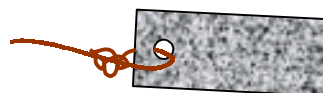
Aluminium has a thin layer of aluminium oxide on it.
Aluminium oxide will soak up dyes for permanent colouring.
To get deep colours, we need to make a really thick layer of aluminium oxide.
We can do this using electricity – a process called **anodising**.



Eye protection
must be worn

Job 1

Get your gloves on – you are going to clean a piece of lead.
Put your lead onto a paper towel, and clean it with steel wool.
Watch out for sharp bits of steel wool!
Scratch the lead with a screwdriver (care!)



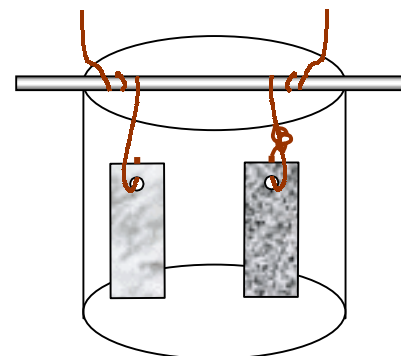
Thread a piece of copper wire through the hole in the lead.
Make sure that there is a good electrical connection by twisting the wire tight.

Job 2

Now you have to set up the anodising cell.

Put the 500cm³ beaker on top of some paper towels.
Lay the glass rod on top of the beaker.

Hang the piece of lead from the rod using the copper wire.
The lead should hang just above the bottom of the beaker.
Make sure that some copper wire sticks up from the rod.
This will let you make an electrical connection.



Do the same thing with your cleaned aluminium strip but:

- Don't touch it with your hands
- Don't let it touch the lead

Job 3

You are now ready to start anodising.
For it to work, you must complete the electrical cell with sulphuric acid (this will conduct electricity between the lead and aluminium).

Carefully pour 1.5M sulphuric acid into the beaker. You need just enough to:

- Cover most of the lead, and
- Cover most of the aluminium strip (but leave about 1cm above the surface)



Plug one wire into the negative terminal of the power pack.
Connect the crocodile clip from this wire to the copper wire on the piece of lead.

Plug the other wire into the positive terminal of the power pack.
Connect the crocodile clip from this wire directly to the top of the aluminium strip.



**Ask one of the teachers to check your work.
You must not switch on without permission.**

You are now ready for Part Three of the process.

Anodising aluminium – Part Three

Job 1

Cover the beaker with a piece of paper towel. During anodising, a light spray of acid is produced because of gas bubbles formed at the metal electrodes. The paper towel stops it causing any damage.



Eye protection must be worn

To start the anodising, turn on the power supply and adjust the voltage to about 15V. The process will take about 30 minutes. Perhaps time for a break?

Job 2

After 30 minutes, turn down the voltage. Turn off the power pack. Remove the crocodile clip from the aluminium strip. Carefully lift out the aluminium strip using the copper wire hook.

Wash the strip in **distilled** water and store it in a beaker of **distilled** water.

Job 3

You are now ready to colour the aluminium strip. Try one colour first, because you can be more artistic with another strip later. To colour the strip, you just put into the dye of your choice.

Leave the strip in the dye for 10 minutes, but move it about a bit every minute.

After 10 minutes, remove your aluminium strip from the dye solution.

Put it on a watch glass. Wash it under a running tap to get rid of excess dye.

To seal your aluminium strip, put it in a beaker of boiled water from the kettle for 10 minutes. The dye is now **PERMANENTLY** sealed into the aluminium oxide layer.



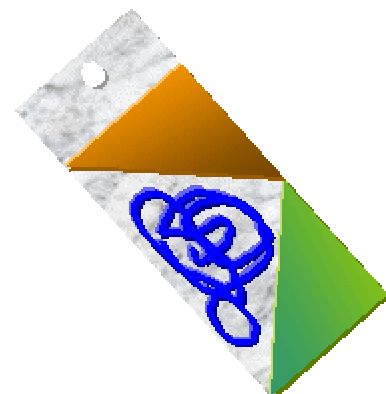
Be creative!

Now you know how to prepare and dye the aluminium, you can let your imagination loose. Things you could try include:

- Cutting out different shapes of aluminium to anodise
- Using more than one dye
- Trickling dyes over the surface
- Dabbing dyes onto the surface

... and for the really adventurous ...

- sealing corners separately with boiling water, and using different dyes in between to get shading effects



Teacher Guide for Anodising Aluminium

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Technicians' notes

Activity notes

There are several methods for simple anodising of aluminium. We use a lead cathode with a copper wire already soldered on, but you can use a large piece of aluminium instead. Preparation and patience is important - if students rush the cleaning and anodising stages, they get a poor result. We find that many drinks cans have a thin plastic coating on the inside. This can be removed using wire wool, or left in place if only one side is to be dyed.

Our sixth form helpers handle the cleaning stage, as the reagents involved are not suitable for younger students. It is possible to clean the aluminium using a hot detergent solution instead, but we found that the results were less satisfactory. Once cleaned, the aluminium must not be touched.

During anodising, a fine spray of acid may be produced, so it is important to keep the beaker lightly covered by a paper towel. The first run is often the best in our experience, largely because the students concentrate and follow their instructions carefully. Later, they are tempted to rush the process - they turn up the voltage too high and reduce the run time. As a result, the metal can break at the surface of the acid, and they get a poor uptake of dye. Good students spot a faint pink or purple colour in the acid during anodising - we think this is due to traces of manganese in the alloy used in drinks cans.

Some of the best results have come from simple dyes, such as diluted Quink fountain pen ink. Red ink gives particularly beautiful effects. Some of Dylon's Multipurpose clothes dyes also work well, especially Kingfisher Blue and Emerald Green. The orange and red Dylon dyes give poor results, however (only a patchy sludge colour!), so stick to the Quink inks for these colours. A nice "gold" colour can be obtained by making an aqueous solution of ammonium ethanedioate and iron(III) chloride (use approximately equal masses, harmful ☒).

Anodising Aluminium

Students' checklist

Check you have:

2 x 250cm³ plastic beakers
glass rod
watch glass
power pack
2 x 10cm lengths of copper wire
2 x leads with crocodile clips
lead sheet, 2cm x 5cm
aluminium drinks cans
fine steel wool
paper towels
wash bottle containing distilled water
250cm³ of 1.5M sulphuric acid

Anodising Aluminium

Technicians' notes

Per pair of students (assume 5 pairs):

2 x 250cm³ plastic beakers
glass rod
watch glass
power pack (+ and – terminals labelled)
2 x 10cm lengths of copper wire
2 x leads with crocodile clips
lead sheet, 2cm x 5cm
aluminium drinks cans
fine steel wool
paper towels
wash bottle containing distilled water
250cm³ of 1.5M sulphuric acid, labelled “1.5M sulphuric acid – **Corrosive** ☠”

In fume cupboard:

200cm³ of 2M sodium hydroxide in a 250cm³ beaker
Beaker should be labelled “2M sodium hydroxide – **Corrosive** ☠”
Sodium hydroxide solution to be placed in a water bath maintained at 50°C

200cm³ of 3M nitric acid in a 250cm³ beaker
Beaker should be labelled “3M nitric acid – **Corrosive** ☠”

Distilled water in a labelled beaker with spare water

In the open lab:

Assorted “Dylon” water-soluble dyes in covered 500cm³ beakers
Dyes to be kept in a water bath held at approximately 50°C
Kettle
Scissors
Distilled water
Nail, block and hammer