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| Chemical Investigations |
| Anodising Aluminium |
| Teacher / Technician Guide |

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## Anodising aluminium - background

Anodizing is an electrochemical process that converts a metal surface into a decorative, durable, corrosion-resistant, anodic oxide finish.

Anodizing is carried out by immersing the aluminium into an acid electrolyte bath and passing an electric current through the medium. A cathode is mounted to the inside of the anodizing tank; the aluminium acts as an anode, so that oxygen ions are released from the electrolyte to combine with the aluminium atoms at the surface of the part being anodized. Anodizing is, therefore, a sort of highly controlled oxidation.

The aluminium oxide is not applied to the surface like paint or plating, but is fully integrated with the underlying aluminium substrate, so it cannot chip or peel. It has a highly ordered, porous structure that allows dyes to be absorbed into the structure rather than just sitting on the surface.

Below are details of a method that we have thoroughly tested and which has consistently given us good results.  We suggest the use of aluminium sheet or aluminium takeaway food containers as both of these produced good results.  Aluminium drinks cans, although plentiful and ‘free’ are not recommended since they have internal and external coatings. These are very difficult to remove and they inhibit the anodising process.

## Each group will need

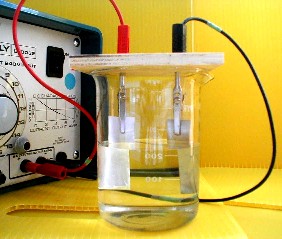
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| Aluminium metal sheet or food ‘takeaway’ container | DC power supply, variable 0 to 16 V |
| 2 x leads to connect to power supply with crocodile clips at the other end. | 10 cm square (max. 7 mm thick) piece of wood with two 4 mm holes drilled 5 cm apart |
| 500 cm3 beaker | 1 mol l-1 sulphuric acid |
| Industrial Methylated Spirits (IDA) (The purple form is fine) | Various coloured dyes (clothes dyes, waterproof drawing ink) |
| Distilled water | Forceps or tweezers |

## To Do

### ****Preparing the Aluminium Strip****

1. Cut out 2 strips, 2 cm x 6 cm, from an aluminium sheet or food container.  Attach a crocodile clip to each of these.
2. Clean and de-grease the aluminium strips by immersing in a beaker of Industrial Methylated Spirits (IMS) for about 1 minute.
3. Remove the aluminium strip from the IMS, handling  the crocodile clips only.  Once the aluminium has been so cleaned do not touch it.  Rinse it with distilled water and use immediately.

### Anodising ****the**** Aluminium ****Strip****

1. Add about 300 cm3 of 1 mol l-1 sulphuric acid to a 500 cm3 beaker. Aim to leave about 1 cm of the aluminium strip above the level of the acid and ensure the crocodile clips are kept out of the acid (Fig. 1 - opposite).
2. Fit two, 4 mm test lead plugs through the holes in the square of wood and fit the crocodile clips holding the aluminium strips to these.  Taking care not to touch the strip to be anodised, place the assembly in the beaker of acid.
3. Connect the aluminium strip to be anodised to the positive terminal on the power supply.
4. Turn on the power supply and adjust to 15 V.  An aerosol of acid may be produced but,  if this does occur,  the ‘wooden lid’ will contain it.  Leave running for 30 minutes.
5. Prepare the dyes for use.  The dyes work best if they are hot but not boiling!  So start warming them up before you stop the anodising process.
6. After 30 minutes switch off the power supply. Disconnect the anodised aluminium strip and rinse with distilled water (Take care!  The crocodile clips and acid can get very hot).
7. Place the anodised aluminium in the hot dye solution for about 10 minutes, moving it every minute or so.  Then, using tweezers, remove the aluminium from the dye solution and wash it under a running tap to remove any excess dye.  Drop the aluminium into a beaker of boiling water and leave for 10 minutes to seal the dye.

To obtain the best results use fresh sulphuric acid for each strip of aluminium to be anodised.

## Fig.2 - Examples of dyed anodised aluminium strips.****Dyes****

We found that Dylon clothes dyes (one tin in 250 cm3 of water) and Pelikan and Uno waterproof drawing inks (slightly diluted) worked well.  The best colours were blue, purple and red.  We also managed to produce a navy blue effect using black Quink ink.

## ****Safety****

Wear eye protection and work in a well-ventilated laboratory.  Ensure any acid aerosol produced during the anodising process is contained or work in a fume cupboard.