

# **SURFACE FINISHING - INTRODUCTION**

*Mario S Pennisi*

*Laboratory Manager - Department of Mining, Minerals and Materials Engineering, The University of Queensland.*

*Executive Director - Powder Coaters Association*

*Principal Consultant - Penlia & Co*

*1997*

## **INTRODUCTION**

Surface finishing may be defined as any process that alters the surface of a material for aesthetic or functional purposes.

The basis material (whose surface is being altered) can be a metal, a plastic, concrete, a ceramic; ie any material used for engineering or decorative purposes.

20 years ago, if you asked the layman to define surface finishing the answer would probably have been "chrome plating". The same question today could elicit the answer, "powder coating", the *in coating of the nineties*.

Surface finishing can hide any number of faults in a casting, but there are limits. Surface finishing can improve the aesthetic appeal of a casting by changing its gloss, shininess and colour, can improve corrosion resistance and tailor surface properties.

## **SURFACE FINISHING TECHNIQUES**

The five major processes that make up surface finishing are:

- \* abrasive blast cleaning and protective coating.
- \* anodising
- \* electroplating and electroless plating
- \* hot dip galvanizing and tinning
- \* powder coating

There are a score of minor niche finishes for specific purposes. Some of which are relevant to casting.

- \* mechanical preparation
- \* metal polishing
- \* plastics coating, eg nylon, polythene
- \* weld surfacing

## **USEFULNESS OF SURFACE FINISHING TO OUR LIFESTYLE**

It is fair to say that humans would not have developed to our lifestyle without a surface finishing industry, right from the beginning. Stone Age man produced cutting edges and spear points by splintering stone. Finishing consisted of rubbing two pieces of stone together to improve the cutting edge.

Today, not one activity can be undertaken by mankind that does not include surface finishing.

When one awakes to the clock radio or similar it is the surface finishing industry that has made possible the design of the unit and the decoration on it. Look up and you see a light fitting. If it is made from metal, then surface finishing provided the lustre or colour of the fitting; if made from plastic the mould into which the fitting was formed had to be surface finished so that the plastic would flow evenly and provide the required surface profile on the component. The filament of the incandescent lamp is made of metal, drawn through surface finished dies. The contact between the light

bulb and the electrical wiring (often lead) was surface finished. The electricity which passes through the filament and makes it glow to produce *light* is generated in power stations where surface finishes including electroplating, galvanizing, powder coating, abrasive blasting and industrial coatings are essential for a continuous and non interrupted supply.

And we haven't even got out of bed yet.

### **MAJOR SURFACE FINISHING ACTIVITIES-BY VOLUME OF OUTPUT**

There are five main surface finishing activities, in alphabetical order:

- \* Abrasive blast cleaning and industrial painting
- \* Anodising
- \* Electroplating and electroless plating
  - Decorative
  - Functional
- \* Galvanizing
- \* Powder Coating

#### **Abrasive Blasting**

Abrasive blasting is the major method used to prepare large structures for painting. Abrasive grit is sprayed at the surface to be cleaned removing all manners of soils, oxides, scale, etc. The grit can be mineral sands such as garnet and ilmenite; copper slag and zinc slag; crushed glass or glass beads; crushed nut shells such as walnut shells; dry ice pellets, crushed limestone; steel shot or steel round.

Abrasive blasting will not necessarily remove oils and greases.

In the foundry industry, abrasive blasting can be used to remove impregnated sand from cast metal surfaces, to “hide” minor defects such as fine porosity, minor cracks, etc. The danger with this practice is that a following finishing operation such as electroplating or powder coating will blister at these imperfections.

The term *painting* is normally used to mean the application of an organic coating from a liquid, eg house paints etc. Paints of this type have been in use for many years.

#### **Industrial coatings**

These are heavy-duty paints designed specifically for the purpose of imparting very good corrosion resistance to surfaces. Everyone is familiar with paint. It is used in the home to paint plaster, timber, metal, etc. In industry specially formulated paints are used to coat white goods, automobiles, trucks, ships, chemical tanks, industrial buildings, etc. Foundries use paints to colour items for identification or as a protective coating prior to another operation.

#### **Anodising**

Anodising is the process by which the natural film on aluminium is greatly increased in thickness.

Aluminium metal is on the anodic side of the galvanic series. Its position is similar to zinc and magnesium, ie it is readily oxidised. The oxide on aluminium is naturally corrosion resistant, very hard, abrasion resistant, an insulator and very tenacious. In its natural form the oxide film on aluminium is less than 0.50 microns thick.

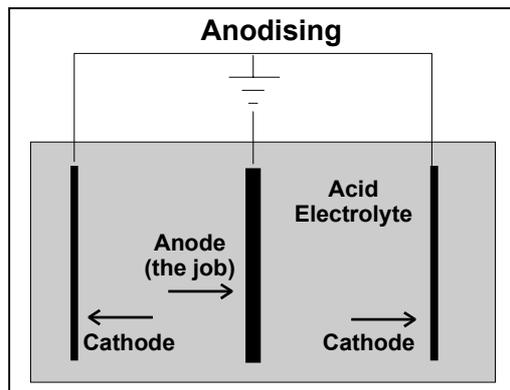
Because the naturally occurring film is very thin and attached to a soft ductile metal, it is easily damaged. Building up this coating provides very useful properties for the aluminium surface.

### Preparation

The basis of every good coating is preparation. In anodising, good preparation is essential. Oils and greases are removed in weak alkali solutions and the surface is etched to remove heavy oxides. After rinsing, the aluminium is dipped into a desmut solution to remove the insoluble components of the aluminium which remain on the surface after etching, rinsed and presented for anodising.

### How is it done?

Anodising is electroplating in reverse. During anodising the part is made the anode (positive electrode) in an electrolytic cell.



The aluminium is immersed in an electrolyte consisting of an acid/water solution. A range of acids may be used, eg sulphuric acid for relatively soft, easily dyed coatings and organic acids for hard integral coatings. The temperature of the solution is controlled to give the desired properties, eg at 20°C a sulphuric acid anodising solution will give a soft,

transparent clear, easily dyed coating whereas at 5°C a hard, dense, dull grey coating is produced (hard anodising).

A DC (direct current) electric current is passed between the aluminium that is made the anode (positive terminal), the electrolyte and a cathode (often lead).

When the current is applied, the water in the electrolyte breaks down and oxygen is deposited at the anode. This oxygen combines with the aluminium to form oxide and thus builds on the oxide film always present on the surface. The acid in the electrolyte tries to dissolve this oxide and produces a porous oxide film on the aluminium surface. Coating thickness up to 25 micron are recommended for external use. The oxide grains are hexagonal in shape and each grain contains a hexagonal hole within it.

Once the required thickness of anodic film is obtained, the aluminium is removed from the electrolyte and rinsed thoroughly to remove the acids from the pores in the film.

The anodic film thus produced is quite porous and will accept or trap any material into its pores, either advantageous or disadvantageous to its properties. To prevent this occurring these pores are closed or the coating is "sealed". This is done by adding water to the oxide (hydrolysing). The oxide swells and in so doing the pores close-up. The resultant film is now smooth, hard, homogenous and transparent. The sealing process may be carried out in boiling water, or in chemically enriched water at room temperature.

### How is colour introduced?

There are three basic methods for introducing colour into anodised films.

### ***Surface dyes or pigments:***

The clear anodised aluminium with its unsealed porous film is immersed in a bath containing organic dyes or inorganic pigments. The colorant is absorbed into the pores of the film and subsequently sealed in.

Almost all organic colours are affected by environmental factors such as UV radiation. Colour change is inevitable with exterior use.

A few inorganic pigments are resistant to UV induced colour changes. Unfortunately, many of these are no longer acceptable environmentally and are not used.

This method of colouring films lends itself to silk screening patterns into the surface.

### **Integral colour**

In this process the colours are derived by electro-chemical means. The colour results directly from the alloying elements in the metal, the electrolyte composition, temperature and current density (the amount of current applied per unit of area).

The aluminium is immersed into a special electrolyte under carefully controlled electrical conditions and temperature for various time periods to produce a variety of colours. In some instances special aluminium alloys are required. The colours are due to the colouring of the intermetallic particles that are spread throughout the depth of the anodic film.

### **Electrolytic Deposition**

Naturally stable metals and metallic oxide particles are electrolytically deposited at the base of the porous anodic film. The film is then “sealed”. The colour is generated through the film and is locked within the clear anodic film.

### **Why anodise?**

Anodising produces a high specification metallurgically bonded finish that resists corrosion, abrasion and exposure to industrial, marine and other severe environments. Some bending is possible of anodised aluminium, but this is not recommended, as the film tends to crack.

Aluminium, titanium, zinc, cadmium and magnesium are the usual metals to be anodised. Anodised aluminium is used in the familiar anodised aluminium window frames, commercial building fascias, etc.

Aluminium castings contain high levels of alloying metals such as silicon. The inclusion of these materials reduces the transparency of the anodic film and produces a greyish finish not greatly appreciated for decorative purposes. Aluminium castings are sometimes anodised for engineering purposes to increase surface hardness and abrasion resistance. This process is carried out at low temperatures (less than 7°C)

### **Electroplating**

Electroplating was first reported almost 200 years ago. It may be defined as the process wherein an electric current is carried across an electrolyte and in which a substance is deposited at one of the electrodes.

Electrolysis is possible because solvents, water in particular, have the ability to ionise substances dissolved in them, that is they split them into components that carry positive and negative charges. These ions are electrically charged and are attracted to oppositely charged electrodes where they are neutralised by the charges on these electrodes. The products of electrolysis appear on the electrodes. The cathodic product is the deposition of metal and the anodic product most often is the dissolution of metal.

### Why electroplate?

Electroplating is one of the means available to the surface finisher to apply a metal coating to a metallic or plastic component.

Electroplating is used to deposit a very wide range of pure metals and alloys for use in decorative, functional and jewellery applications.

Nickel/chromium composites (usually called “chrome” plating), copper, brass (an alloy), bronze (an alloy) and zinc are used for decorative applications.

For functional applications zinc, tin, heavy coatings of nickel, “hard” chromium, silver and gold are used. Various alloys are deposited for bearing surfaces.

Functional uses include building up worn parts and changing the surface characteristics of a metal such as electrical inductance, or conductivity, or corrosion resistance.

For jewellery applications, gold, silver and rhodium are plated. Gold is often plated on 18-carat and 9-carat solid gold jewellery to obtain colour matches.

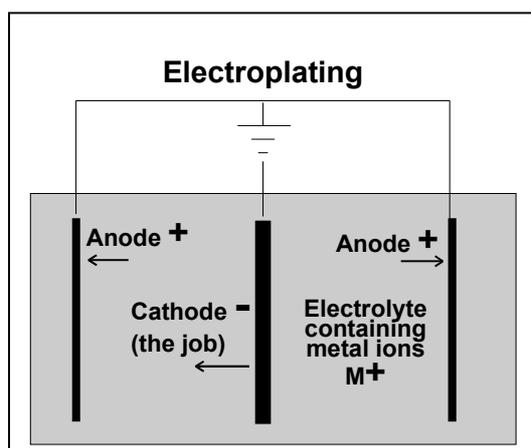
### Preparation

The basis of any good coating is preparation.

For electroplating, oils and greases are removed in weak to strong alkali solutions (depending on the metal being cleaned and the soils being removed). The surface oxides are removed in acids (strong pickles are used to remove heavy oxides and rust from steel). After rinsing, the parts are presented for electroplating.

### How is it done?

Electroplating is carried out in an electrolytic cell. The part to be plated is made the cathode and the metal to be deposited is often made the anode. The electrolyte contains salts of the metal being deposited as well as other compounds.



papers\sur\_fin\_intro\_1\397

The parts to be plated are placed on racks (for still plating) or barrels (for barrel plating of small components such as fasteners) and the racks or barrels immersed in the electrolyte. A DC (direct current) electric current is passed between the items (negative terminal), the electrolyte and the anode. The composition of the electrolyte, the temperature and current are all

controlled within close limits to give consistent results. In most cases, the electrolyte is filtered continuously to remove solids, which might otherwise stick to the part being plated and so produce rough deposits.

When the current is applied, metal simultaneously deposits from the electrolyte onto the part and dissolves from the anode to replenish the electrolyte. When an insoluble anode is used, such as in chromium plating or gold plating, the metal ions in the electrolyte are replenished by adding chemicals.

After plating the items are rinsed, dried, inspected and packed.

When zinc is plated, the surface of the zinc reacts with the air and tends to stain and corrode. To overcome this tendency the zinc coated parts are dipped in a chromate solution (chromate conversion coating) for a few seconds. This chromate treatment can be clear or blue, or iridescent gold, or iridescent gold/green, or black in colour. The corrosion resistance is least for the clear and blue chromates and highest for the iridescent chromates.

Electroplating is used to coat fasteners, jewellery, engineering components, to build up worn components, and sometimes as an undercoat for powder coating or painting.

Metals also can be deposited from a solution of the metal to be deposited without the use of electric current by a process called electroless (autocatalytic) deposition. Electroless coatings are deposited very evenly, much more evenly than electroplates and so find use to coat close tolerance dies for manufacturing plastic parts and where corrosion resistance is required using thin coatings.

### **Galvanizing and other hot dip coatings**

The first use of hot dip galvanizing on steel was some work reported by the Frenchman P J Malouin in 1742. A French patent was issued to Sorel in 1837 and an English patent to H V Craufurd in the same year. Very little has changed in the process since that time. (see “The Origins of Galvanizing” in Corrosion Management, August 1995 page 3).

Zinc is very successful as a protective coating for steel because in most environments to which steel will be subjected, zinc will act as the anode; ie it will dissolve in preference to the steel. In simplistic terms, while there is zinc on the surface the steel will be protected from corrosion.

Hot dip galvanizing is one of a number of methods available to the surface finisher for applying a zinc coating to an item. Other techniques include electroplating, mechanical plating, sherardising, painting with zinc-rich coatings and zinc spraying or metallising.

In the hot dip galvanizing process, a uniform coating of metallurgically bonded zinc-iron alloy layers and pure zinc is produced.

The life expectancy of zinc coatings is independent on the coating process – an equivalent coating of zinc will provide the same life expectancy regardless of the coating process. Hot dip galvanizing will provide over 80 microns of zinc coating, while zinc electroplates are normally less than 25 micron.

The hot dip galvanizing process is widely used in a number of applications, particularly constructional. Galvanizing is normally carried out to AS1650 ***Hot dip galvanized coatings on ferrous article***'.

### ***The Galvanizing process***

Chemically clean items are galvanized by full immersion in molten zinc. The total coating thickness is automatically determined by the mass of the steel being galvanized and the composition of the steel, particularly silicon and phosphorus. In all other zinc coating processes there is no relationship between mass, composition and thickness of coating.

Virtually any article may be coated. Articles ranging in size from small fasteners to structures hundreds of metres high may be protected. Large galvanizing vats, together with modular design techniques of construction and double-end dipping allow almost any sized structure to be galvanized. While there is zinc on the surface of the steel maintenance costs are reduced and service life is extended.

Visual inspection of aged galvanized products shows that items are completely protected.

### ***Preparation of castings for galvanizing***

The first requirement is to remove oils and greases and old paint coatings. This is normally done in hot strong alkali solutions. If scale, rust and other surface contaminants are present abrasive blasting may be necessary, otherwise these contaminants are removed by acid cleaning or pickling in sulphuric or hydrochloric acids, followed by rinsing. Hydrochloric acid is preferred because it is more easily reclaimed. Iron and steel castings are usually abrasive blast cleaned followed by a brief acid dip. In some circumstances items may be cleaned electrolytically to remove foundry sand and surface carbon.

### ***Fluxing***

Before a component can be offered to the hot zinc bath, all moisture must be dried from the surface and other cavities. The surface of an acid cleaned steel is very active and will oxidise rapidly, more quickly than the surface can be dried. The metallurgical reactions between the molten zinc and the steel surface will not occur if oxides are present on the steel surface.

To prevent this oxidation, the chemically clean, highly active steel surface is immersed in a flux solution, usually 30% zinc ammonium chloride with wetting agents, maintained at about 65°C.

### ***Applying the galvanized coating***

The galvanizing reaction takes place at between 445 and 465°C.

When the dried steel part is immersed in the galvanizing bath the steel surface is wetted by the molten zinc and reacts to form a series of zinc-iron alloy layers. The work remains in the bath until its temperature reaches that of the molten zinc, so that all the galvanizing reactions can go to completion. After the surface of the molten zinc is skimmed to remove the dross from the surface, the job is withdrawn from the bath at a controlled rate. When the surplus surface metal has drained off, the item is either air quenched or quenched in water containing

potassium dichromate. The item carries with it an outer layer of molten zinc that solidifies to form the relatively pure outer zinc coating. This shiny pure zinc layer does not always form – in the presence of high levels of silicon in the steel the pure zinc layer does not form and the surface will be a dull grey colour.

The period of immersion in the galvanizing bath varies from several minutes for relatively light articles, up to half an hour or longer for massive castings. This is one of the reasons that hot dip galvanizing is charged by the weight of the item being coated.

The resulting galvanized coating is tough and durable, normally comprising a surface of relatively pure zinc covering zinc-iron alloy layers bonded metallurgically to the underlying steel. This coating completely covers the article and provides excellent resistance to abrasion.

One of the advantages of the hot dip galvanizing process is that a visual inspection can show that the coating is continuous. Defects such as uncoated areas due to incorrect preparation, carry over of dross (dull grey rough deposits) can be found easily.

### ***Quenching***

The galvanized zinc surface is highly reactive. It will oxidise rapidly in moist air (a relative humidity above 65% is sufficient to cause the onset of corrosion) and white corrosion products form rapidly when two zinc surfaces are stacked on each other (storage corrosion). To delay this corrosion, galvanizers normally water quench items in a solution of potassium dichromate which applies a chromate film to the zinc surface.

The chromate film formed from this dichromate solution is not suitable for powder coating. If the item is to be powder coated the galvanizer should air quench the item after galvanizing. To prevent the generation of corrosion products before powder coating, it is essential that the powder coating be applied within a few hours of galvanizing. If this is not possible, then a light acid etch, followed with a zinc phosphate or chromate conversion coating is mandatory.

### ***Galvanizing defects***

As the item is withdrawn from the galvanizing kettle, zinc drips off the item causing spikes, dags and a rough surface. Tilting the parts as they emerge from the bath reduces the incidence of these defects. Thus, any drips are found at the drip point. These spikes are removed prior to returning the parts to the customer. The lighter the section the quicker the zinc will freeze so that drips and dags are possible on thin sections.

When designing parts that are to be galvanized, it is important to follow a number of design strategies that will result in good draining and venting of closed sections. This action will allow the galvanizer to do a good job safely.

### ***Storage of galvanized parts***

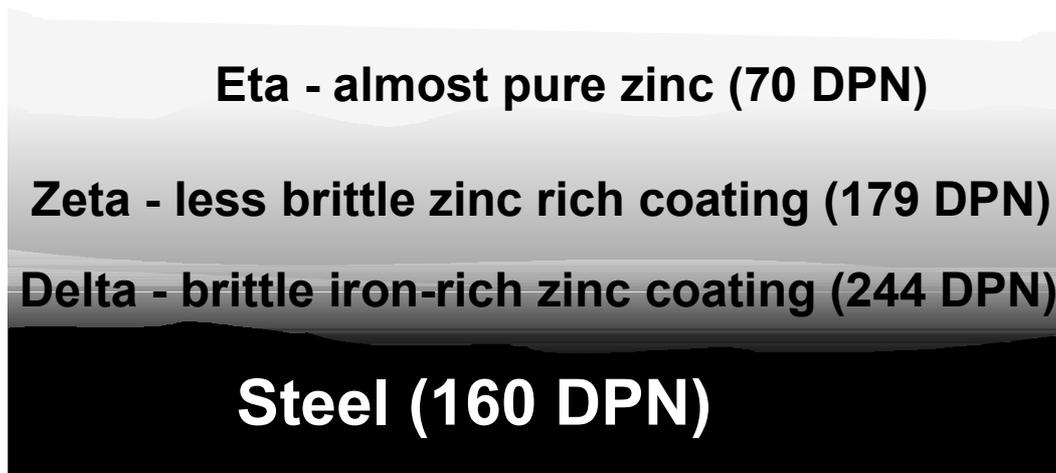
Zinc coated parts will sweat in humid environments when stacked closely. The sweating will lead to corrosion and ugly ***white corrosion products*** will be produced. Beneath each of the locations of white powder, a pit will have been produced and the coating thickness at these locations will have been reduced so that corrosion of the steel will occur prematurely.

Separate galvanized parts during storage so that air can circulate freely between the items. Use spacers to separate flat sheets.

### ***Galvanizing fasteners and small components***

Fasteners and small components are loaded into perforated cylindrical steel baskets. They are degreased, acid pickled, pre-fluxed and dried. The dry baskets containing the components are lowered into the galvanizing bath. At the end of the galvanizing treatment, the baskets of galvanized components are raised from the molten zinc and immediately placed into a centrifuge or *spinner* and rotated at high speed for 15 to 20 seconds. Excess zinc is thrown off. The resultant coating is smooth and uniform.

### ***Metallurgy of galvanizing***



*Galvanized layers and expected hardness*

The molten zinc in the galvanizing kettle removes the flux so that the zinc wets the steel surface. Immediately, a metallurgical alloy is formed between the zinc and the steel – a thin molecular layer of brittle, hard high-iron zinc alloy (the gamma layer – 21-28% iron). Next a much thicker, hard, brittle alloy (the delta layer 7-12% iron) forms. On top of this the zeta layer forms containing about 6% iron and finally the surface layer is virtually pure zinc (the eta layer).

The silicon and phosphorous content of the steel affect the formation of these layers. If the silicon content is very high, the eta layer may not form and a dull galvanized surface will result.

Each of these layers is metallurgically bonded to each other so that they cannot be separated from each other or from the steel as can a paint coating.

### ***Abrasion resistance of galvanized coatings***

Although the outer eta layer is soft and lacks abrasion resistance, the zeta and delta layers are harder and more abrasion resistant than the steel. The outer eta layer may be removed in service. The exposed harder, more abrasion resistant zeta and delta layers gives the galvanized coating outstanding abrasion resistance so that mechanical damage to galvanized coatings is minimised.

\* Galvanizing (hot dip) is the process of applying zinc to steel by dipping the part in a bath of molten zinc. It is used to protect steel from corrosion (rusting).

Galvanizing is used to protect large steel structural members, roofing material (galvanized iron, “galvalume”) etc.

- \* Tin is also often deposited using the hot dip technique.

### Powder Coating

Powder coating is by far the youngest of the surface finishing techniques in common use today. It was first used in Australia about 1967.

Powder coating is the technique of applying dry paint to a part. The final cured coating is the same as a 2-pack wet paint. In normal wet painting such as house paints, the solids are in suspension in a liquid carrier, which must evaporate before the solid paint coating is produced.

In powder coating, the powdered paint is applied to the part, the part is then placed in an oven and the powder particles melt and coalesce to form a continuous film.

There are two main types of powder available to the surface finisher:

- Thermoplastic powders which will remelt when heated, and
- Thermosetting powder which will not remelt upon reheating. During the curing process (in the oven) a chemical cross-linking reaction is triggered at the curing temperature and it is this chemical reaction which gives the powder coating many of its desirable properties.

### Preparation

The basis of any good coating is preparation. The vast majority of powder coating failures can be traced to a lack of a suitable preparation.

The preparation treatment is different for different materials.

In general for all applications the preparation treatment for aluminium is as follows:



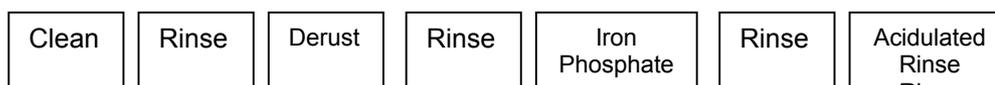
Oils and greases are removed in weak alkali solutions and the surface is etched to remove heavy oxides. After rinsing, the aluminium is dipped into a chromate or phosphate solution to form a conversion coating on the aluminium. This film is chemically attached to the aluminium. After rinsing, the aluminium is finally rinsed in demineralised water.

The conversion coating has two functions:

- It presents a surface to the powder which favours adhesion more than the oxides which form very readily on aluminium surfaces, and
- It reduces the incidence of under film corrosion, which may occur at holidays in the coating.

The use of demineralised water reduces the chemical salts on the aluminium surface. These salts have been found to cause filiform corrosion in humid conditions.

For steel the preparation for interior applications is:



For exterior applications:



The grain refiner is used after acid cleaning of steel before zinc phosphating because otherwise the zinc phosphate produced on acid cleaned steel will be very coarse low adhesion coatings. The powder coating applied to a coarse phosphate will be rough coatings and possess low adhesion.

### ***Preparing galvanized coatings for powder coating***

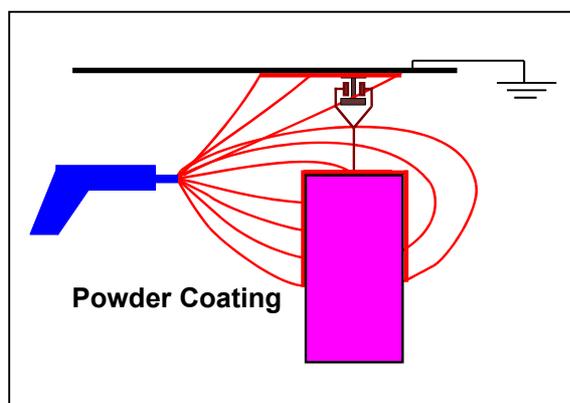
Galvanized coatings are a bright silvery grey colour. In these days of brilliant colours a bright silver finish no longer is sufficient in domestic applications. The coating of choice is a powder coating which eventually will be able to provide almost any colour that the mind can conceive. The powder coating is cathodic to the zinc and if there is an adhesion defect or there is a holiday in the coating, the underlying zinc will corrode under the powder coating film (under film corrosion). The corrosion products will ooze out through and over the powder coating giving an ugly **salt like** appearance to the surface. To reduce the possibility of this occurring it is essential to prepare the corrosion free zinc surface with a conversion coating, either zinc phosphate or chromate. A new Australian Standard is being developed for these types of coatings.

Hot dipped galvanized coatings which have been stored for more than about 4 hours before powder coating the following process is necessary for exterior applications.



The etch is required to remove the zinc corrosion products which begin to form almost immediately the zinc is removed from the galvanizing kettle. The grain refiner ensures a fine phosphate is produced.

### **How is it done - spray coating?**



to the gun.

The powder may be applied with an electrostatic spray gun to a part that is at earth potential.

Before the powder is sent to the gun it is fluidised:

- to separate the individual grains of powder and so improve the electrostatic charge that can be applied to the powder and
- so that the powder flows more easily

Because the powder particles are electrostatically charged the powder wraps around to the back of the part as it passes by towards the air intake system. By

collecting the powder, which passes by the job, and filtering it, the efficiency of the process can be increased to 95% material usage.

The powder will stay attached to the part as long as some of the electrostatic charge remains on the powder. To obtain the final solid, tough, abrasion resistant coating the powder coated items are placed in an oven and heated to temperatures that range from 160 to 210°C (depending on the powder).

Under the influence of heat a thermosetting powder goes through 4 stages to full cure.

#### MELT, FLOW, GEL, CURE

The powder particles melt, flow together and fuse to produce a continuous film that will vary from high gloss to flat matt depending on the design of the powder by the supplier. During the cure cycle the chemical cross linking reaction, which gives thermosetting powders their unique properties, takes place.

#### **How is it done - dip process**

Another method that is commonly used for applying thermoplastic powders is the dip process. In this method the fluidised powder is retained in a pot and the part is either dipped into the powder, or the pot is raised to submerge the part to be coated. The powder may be electrostatically charged or not charged. If the powder is not charged the part is heated prior to being dipped into the powder. If the powder is charged the powder need not be heated prior to coating.

#### **How is colour introduced?**

Powder coatings are colour during the manufacturing process, ie before it reaches the powder coater. There is little that can be done to change the colour once the powder leaves the manufacturing plant.

#### **Why powder coat?**

Powder coating produces a high specification coating which is relatively hard, abrasion resistant (depending on the specification) and tough. Thin powder coatings can be bent but this is not recommended for exterior applications.

The choice of colours and finishes is almost limitless, if you have the time and money to have the powder produced by the powder manufacturer.

Powder coatings can be applied over a wide range of thickness. The new Australian Standard (not yet numbered) will recommend 25 micron minimum for mild interior applications and up to 60 micron minimum for exterior applications. Care must be exercised when quoting minimum thickness because some powder will not give "coverage" below 60 or even 80 micron. "Coverage" is the ability to cover the colour of the metal with the powder. Some of the white colours require about 75 micron to give full "coverage" and one of the orange colours must be applied at 80 micron.

Colour matching is quite acceptable batch to batch.

Powder coatings can be applied to almost any surface (including metals, timber, glass, concrete, rocks, McDonalds buns) if sufficient care is taken and the part will fit into an oven and will not deteriorate at the temperature used to cure the powder.

Powder coating has been used instead of wet paint, electroplating, galvanizing and anodising in such applications as white goods (wet paints), decorative knobs

for plumbing fittings, door furniture, etc (electroplating), concrete reinforcing rods, fencing (galvanizing) and window frames (anodising).

### **INSTALLATIONS AND MAINTENANCE**

During installations all coatings should be protected from damage due to abrasion and materials of construction such as mortar and brick cleaning chemicals.

Once installed, maintaining the initial appearance of the surface finish is a simple matter. The soot and grime which builds up on surfaces from time to time contains moisture and salts which will adversely affect the coating and must be removed. Coatings should be washed down regularly (at least once each 6 months in less severe applications and more often in marine and industrial environments). The coating should be washed down with soapy water – use a neutral detergent - and rinsed off with clean water.

When surface coated items are installed without damage to the powder coating and they are maintained regularly, they should be relatively permanent.