FACTFILE:
GCSE
Engineering and Manufacturing
3.3.1 Finishing Techniques

Rewarding Learning

Finishing Techniques

Learning outcomes

Students should be able to:

- apply knowledge and understanding of finishing techniques and methods to include:
  - painting;
  - dip coating;
  - powder coating;
  - lacquering;
  - electroplating;
  - galvanising; and
  - polishing.

Painting

Most metals will need a pre-treatment in order for paint to stick to surfaces. Paint is the most commonly used material to protect steel. Paints for steel structures have developed over the years in response to demands from bridge and building owners for improved durability performance. Previously, five and six coat systems have been used but this has been replaced by typically three coat alternatives, and the latest formulations have focused on the application of even fewer numbers of coats, with increasing individual film thickness. Examples of this are epoxy and polyester glass flake coatings that have high build thickness in one or two coat applications, and single coat high build coatings, up to 1000µm (microns) thick.

It is very important to prepare metal before painting

- Whether you are painting ferrous metal or galvanised metal, it is important to prepare the surface for the prime coat. Ferrous metal needs a clean rust-free surface. A wire brush or a scuff pad can be used to remove rust and a cloth should be used to remove all dust. Prime the metal immediately after preparation to avoid rust from forming on the surface.

All rust must be removed and surfaces degreased

- New galvanised metals need to be washed with a detergent solution to remove the oily residue present on new galvanised metal. If the galvanised metal is old and has white oxidation on it, this will need to be removed.

A red oxide paint is applied as a first coat to prevent further oxidisation

Primer and undercoat is applied before the final top coat

– Spray painting, electrostatic painting, and powder painting are methods, that are generally used for surface decorations. Anti-rusting and anti-corrosion treatments are also used.

Plastic dip coating

Dip coating is a suitable surface finish for most metals. This form of surface finish is generally used for coating products such as hanging baskets, brackets, kitchen drainers and tool handles. It is important to remember the following procedures:

Metal must be cleaned and degreased before heating to 180 degrees C

– Parts to be coated should be chemically cleaned to remove contaminants. This results in superior primer adhesion as well as improved corrosion resistance.

The metal is then dipped into the plastic granules and taken out

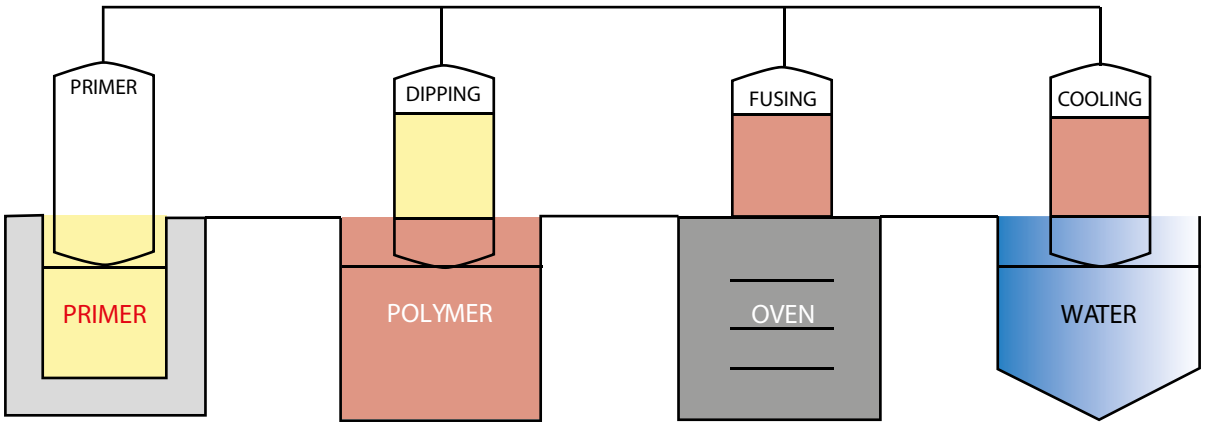
– All hot parts of the product immersed in the liquid polymer will coat upon withdrawal from the bath with a layer of semi-fused plastic. The amount deposited will depend on the length of time the part was immersed, the metal temperature, and the plastic compound used. The higher the metal temperature, the longer the immersion time, the greater the film thickness.

Returned to the oven to allow the metal to bond to the metal

– The part covered with the semi-fused polymer is baked to a temperature between 300°F and 350°F, depending upon the specific plastic compound formula.

Cooling

– When the hot part coated with fused polymer comes out of the oven, it is cooled down in a tank of circulating cool water to a maximum of 120°F before handling.



Advantages of Dip Coating

1. Dip coating provides a protective shield that resists corrosion.
2. Insulates against heat, cold, stress and electrical currents.
3. Adaptable to high volume orders requiring fast delivery.
4. Durable and UV resistant.
5. Alternative colours and finishes (glossy and matt) can be created easily and economically.
6. A wide range of thicknesses, textures are available.

Disadvantages of Dip Coating

There is one major disadvantage with this method that is over time the plastic becomes cracked and breaks off the metal.

Powder Coating

Powder coating is a dry finishing process that has become extremely popular since its introduction in North America in the 1960s. Representing over 15% of the total industrial finishing market, powder is used on a wide array of products for a high-quality, durable finish. Used as protective and decorative finishes, powder coatings are available in an almost limitless range of colours and textures, and technological advancements have resulted in excellent performance properties.

Powder coating applies a decorative finish that is similar to paint, but with greater durability. The process involves melting dry plastic powder onto the metal to produce a textured, matt, or glossy coating. A textured powder coating machine is also highly effective in removing surface defects.

Lacquering

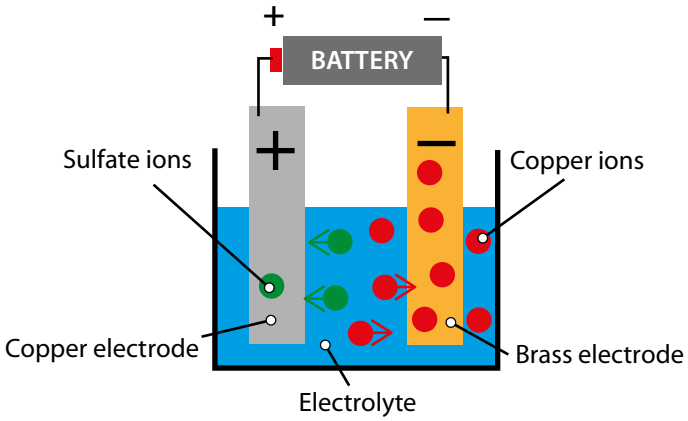
The term lacquer is used for a number of hard and potentially shiny finishes applied to materials. The finish can be of any sheen level from ultra matt to high gloss, and it can be further polished as required. It is also used for lacquer paint, which is a paint that typically dries better on a hard and smooth surface.

In terms of use on metal surfaces, it is used to reduce the need for frequent cleaning, on surfaces such as copper and brass. The surface of the lacquer gives a bright but shallow reflection clearly different to the deep glow of a good polish but is acceptable for domestic hardware and electrical fittings.

- Lacquers used must be suitable for copper-based materials in order to limit tarnishing.
- They must be applied on surfaces that have been cleaned and are free from oil or grease.
- Some lacquers, especially the basic cellulose type, allow tarnishing to take place under the surface of the coating.
- Care should be taken to select lacquers designated by the manufacturers as suitable for use on copper, brass and other copper alloys that include a tarnish inhibitor.
- Air drying lacquers can frequently be applied by brushing, dipping or spraying.
- Manufacturers recommendations for application and safety should always be followed.
- Most lacquers are not suitable for prolonged exposure outdoors.

Electroplating

This is a method of forming metallic coatings on metal surfaces submerged in solutions containing ions by using electrical reduction effects. Electoplating is used in a wide variety of fields from micro components to large products in the car industry, and home appliances for anti-corrosive plating. Electroplating is also commonly used to prevent metal objects from corroding.



The process deposits a thin layer of metal on the object being protected. Tin plating requires the object being protected to be connected to the negative terminal and surrounded by a solution of the ions of the metal being deposited on to the object. The negative charge attracts positive ions.

How it works

- The negative electrode should be the object that is to be electroplated.
- The positive electrode should be the metal to coat the object.
- The electrolyte should be a solution of the coating metal, such as its metal nitrate or sulfate.

Galvanising

Galvanising is a method of rust prevention. The iron or steel object is coated in a thin layer of zinc. This stops oxygen and water reaching the metal underneath. Steel is a versatile material used in many construction processes, but like many metals, it often rusts when exposed to moisture. Zinc has a different set of properties, but most importantly it is corrosion resistant.

The layer of zinc produces a dull silver grey finish. The layer of zinc protects steelwork used outside, e.g. fences, water tanks etc. This is applied in a batch process in which prepared steel is immersed in molten zinc at around 450°C. A bonded coating of zinc-iron alloy layers is formed with an outer layer of pure zinc.

The thickness of the coatings is measured in **µm** (an SI unit of length equal to one millionth of a metre, commonly known as a **micron**).

Polishing

Polishing and buffing are finishing processes for smoothing a surface using an abrasive and a work wheel. Technically, polishing refers to processes that use an abrasive that is glued to the work wheel, while buffing uses a loose abrasive applied to the work wheel. Polishing is a more aggressive process while buffing is less harsh, which leads to a smoother, brighter finish.

Polishing is often used to:

- enhance the appearance of an item;
- prevent contamination of instruments;
- remove oxidation;
- create a reflective surface; or
- prevent corrosion in pipes.

The removal of oxidisation (tarnish) from metal objects is accomplished using a metal polish or tarnish remover; this is also called polishing. To prevent further unwanted oxidisation, polished metal surfaces may be coated with wax, oil, or lacquer. This is of particular concern for copper alloy products such as brass and bronze.

Revision Questions

1. Identify **two** of the primary functions of a surface finish of paint.

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2. Name **three** stages in the process of applying a painted surface finish.

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3. Write down the dictionary definition of oxidization.

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4. How does the powder coating process differ from painting?

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5. Identify the **three** main stages of the dip coating process.

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6. List **two** advantages of dip coating and **one** disadvantage.

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7. Give **two** advantages of applying a surface coating finish on an object.

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8. What is meant by the term electroplating?

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9. What is the primary function of galvanising a product or material?

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10. Give **three** benefits of applying a polished finish to a surface.

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Additional sources

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