

## Training Objectives

After watching the video and reviewing this printed material, the viewer will gain knowledge and understanding of the basic painting and powder coating finishing processes used in industry.

- The components of paint and powder formulations are detailed
- Solventborne and waterborne coatings are explained
- Paint and powder application methods are demonstrated
- Drying and curing methods are examined

## Paint and Powder Coatings

Paint and powder coatings are organic coatings made up of carbon based compounds. They consist of four basic elements:

- Pigments
- Additives
- Resins
- Solvents

Pigments contribute color, corrosion resistance and mechanical strength to the coating.

Additives are chemicals that impart special properties to the coatings. Additives may include thickeners, ultraviolet stabilizers and anti-foaming agents.

Resins, such as acrylics and epoxies, bind the pigments and additives together into a solid, durable film.

Solvents affect viscosity and drying qualities of coatings. Powder coatings by their nature are produced and applied without the use of solvents.

By combining variations of pigments, additives, resins and solvents a variety of coating formulations are created. These formulations include:

- Primers
- Sealers
- Basecoats
- Clearcoats
- Topcoats and others

## Enamels and Lacquers

Because they act as the binder and film former, resins are the most critical component in paint formulation. Resins are made up of molecular structures known as polymers. These paint polymers can be categorized as either enamels or lacquers, depending on how they form their film.

Enamels rely on solvent evaporation while the resin polymers undergo chemical "crosslinking" to form a film. Crosslinking is where the polymer molecules

reacts with another chemical called a crosslinker, to form larger polymer chains. These chains link and bundle together with other chains to produce an extremely strong film bond.

Lacquers, like enamels, use the evaporation of a solvent to form their films but do not undergo additional crosslinking. In a lacquer, the molecules in the existing polymer matrix simply bond together as the solvent evaporates.

## Liquid paints

Liquid paints are the most common coatings applied in industry. Most liquid paint formulations today are often broadly categorized as either solventborne or waterborne high solids coatings. High solids coatings, as the name implies, use special fluidization formulations to increase the solids content, approaching 50 to 80 percent of a formulation. High solids coatings have high viscosity and leave minimum residual solvents as environmental contaminants.

Solventborne coating use solvent to fluidize or disperse the coating solids. The most common types of resins used to produce solventborne coatings include: alkyds, polyesters, epoxies, urethanes, acrylics, and silicones.

Waterborne coatings use mostly water as their fluidizing agent but may include some solvents as well. Their formulation includes: water-reducible alkyds, modified alkyds, polyurethanes, latexs, and acrylic latexs and epoxy hybrids.

All painting processes can be broken down into three fundamental sequences:

- Pretreatment and Cleaning
- Paint Application
- Paint Curing

Part pretreatment and cleaning are a critical component to the success application of coatings. The primary types of cleaning processes include: chemical cleaning, vapor degreasing, and ultrasonic cleaning. Cleaning processes are determined based upon the part composition, the contaminants to be removed, the paint application method, and the part end use.

The application of paints are most often done in segregated and well-ventilated areas or enclosures. Application methods include:

- Air Spraying
- Airless Spraying
- Air Assisted Airless Spraying
- High Volume, Low Pressure Spraying
- Electrostatic Spraying
- Electrocoating

Paint application selection is based on the type of paint used, the size and quantity of parts, transfer efficiency, and waste factors.

A coating is transformed into a solid paint film through curing. Paint curing may occur at room temperatures or in some type of oven. The primary curing processes are heat crosslinking and radiation curing. Heat crosslinking is used for coatings that cure too slowly or cannot cure at room temperatures. Radiation

curing is a rapid curing process, usually within seconds, that utilizes a radiation energy source such as ultraviolet light.

## Powder Coatings

Developed in the 1960's, powder coatings are a viable alternative to liquid coating processes. Powder coatings are applied dry and most cure into a continuous coating by crosslinking when heated.

Powder coatings are made up of finely ground homogeneous plastic particles, each containing the proper proportion of resins, pigments, binders, flow aids, hardening agents and fillers. The primary types resins used to produce powders include: epoxies, polyesters, acrylics, silicones, and hybrid combinations.

Because powder coatings have no solvent content, the method is more environmentally friendly than liquid coatings. Additionally, there is minimal powder waste since most overspray is recoverable.

The powder coating process requires several subsystems including:

- A part pretreatment method or methods
- A powder application system
- A booth with a powder recovery system
- A curing oven
- A conveyor or other means to move the parts through the process

Pretreatment and part preparation is accomplished by either mechanical or chemical means.

The most common method of application is electrostatic spraying. The powder particles are suspended in an air stream and pumped by compressed air through a spray gun which imparts the electrostatic charge to the powder particles. These charged particles then cling to the parts which are grounded.

Approximately 50 percent of the powder particles adheres to the part during electrostatic spraying, so efficient powder recovery systems are an important aspect of the powder coating process.

The curing of powder coatings is accomplished in either convection or infrared ovens. Convection ovens, usually gas fired, heat the powder using circulation hot air. Infrared ovens can effect a cure much faster, acting on the parts immediately. However, since the infrared radiation is directional, complex parts with deep recesses can be difficult to cure.

## Review Questions

1. Organic paint coatings are:
  - a. oil based
  - b. alkali based
  - c. carbon based
  - d. acid based
  
2. Paint solvents are used to:
  - a. bind pigments and additives
  - b. affect corrosion resistance
  - c. affect paint viscosity
  - d. prevent color fading
  
3. Compared to liquid paints, powder coatings contain:
  - a. half the amount of solvents
  - b. no solvents
  - c. twice the amount of solvent
  - d. trace amounts of solvents
  
4. Resins are known as:
  - a. flow agents
  - b. pigments
  - c. drying agents
  - d. binders
  
5. Lacquer films are formed by:
  - a. crosslinking
  - b. solvent evaporation
  - c. aging
  - d. sunlight
  
6. The solids content in high solids coatings are generally between:
  - a. 10% - 30%
  - b. 20% - 60%
  - c. 30% - 70%
  - d. 50% - 80%
  
7. Powder coating particles are mostly:
  - a. plastic
  - b. metallic
  - c. carbon
  - d. mineral
  
8. The amount of powder that adheres to a part during application is about:
  - a. 90%
  - b. 70%
  - c. 50%
  - d. 30%
  
9. Powder coatings are cured by:
  - a. electrostatic charging
  - b. aging
  - c. chemical hardening agents
  - d. oven heating

## Answer Key

1. c
2. c
3. b
4. d
5. b
6. d
7. a
8. c
9. d