

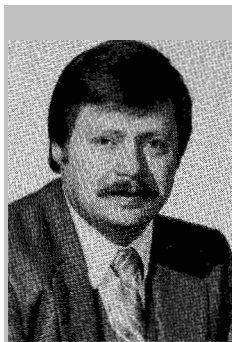
Electrostatic Powder Coating

Finishing for the Future

by Donald S. Tyler
Volstatic, Inc., Florence, KY

P-040

273



Biography

Donald S. Tyler is executive vice-president of Volstatic, Inc. He started in the powder industry in 1968 with a major powder manufacturer, acting in a variety of areas within this organization including R&D, technical service, field sales, production management and product management.

He is a director of the Powder Coating Institute, a senior member of AFP/SME, and vice-president of the Cincinnati Chapter of the Chemical Coaters Association.

INTRODUCTION

Powder coating has come of age in the 1980's. The rapid advance in the sophistication and practicality of powder application equipment and the broadening selection of powder coating materials have come about at the same time that many other forces in industry compel changes in finishing technologies.

Among these forces are increasingly stringent environmental regulations and awareness, increasing energy costs, consumer demand for more product durability, and in-

creased industrial demand for capital equipment retooling at the end of a long recession.

Although powder coating is not new, it has only recently begun to be broadly known. Many perceptions of this technology are either simply untrue or years out of date, for example:

FILM THICKNESS:

Powder can be and is now being applied in high production facilities below 1.0 mil.

COLOR SELECTION:

Powders are available in a full range of opaque colors, tints, textures and gloss ranges. Some effects are still difficult or unavailable in powders, but some powder effects cannot be duplicated in liquid coatings.

MATERIAL COST:

Although powder, as purchased, is more money per pound than paint, powder is often less costly when applied because overspray is recovered and re-used. Also, there are no solvents in powder, so

virtually all powder purchased may be applied to the parts to be coated.

EQUIPMENT COST:

Conversion of liquid finishing lines to powder requires purchase of new equipment, but so does high solids and waterborne conversion. Whether the powder equipment system will be more or less capital cost requires individual analysis of production needs.

Powder equipment is available in a full range from very small manual equipment through automobile-size finishing lines. It is common to realize a payback justification of less than one year for converting to powder.

COLOR CHANGE:

Properly designed powder systems can change colors in minutes; currently, high-production powder systems apply more than 20 different colors, with several color changes per day.

In summary, powder coating is a mature, economical and very beneficial coating technology. The following information is intended to

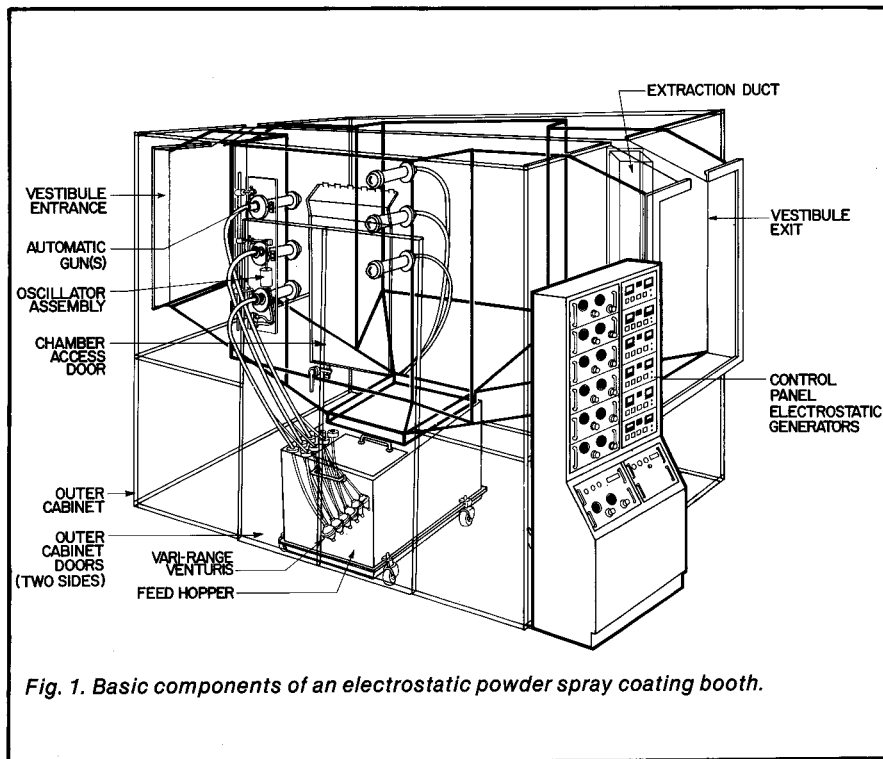


Fig. 1. Basic components of an electrostatic powder spray coating booth.

help the reader become familiar with the basic principles of powder coating.

WHAT IS POWDER COATING?

Powder coating is dry paint. Instead of being dissolved or suspended in a liquid medium, such as solvent or water, powder is applied in its dry form, finer than ground pepper, coarser than flour, directly to the surface to be coated. Contained within each powder particle are the resin, pigments and modifiers and, if it is a reactive system, a curing agent.

Powder is most often applied by electrostatically charging the powder particles and applying them to a grounded part. Grounding is usually done through the conveyor or fixture holding the part.

This application usually takes place in a coating chamber which contains the powder being sprayed and collects overspray in a reclaim system.

Spray guns (along both sides of the parts) are controlled by a pneumatic control panel outside the coating booth. The charged powder adheres to the coated part by

electrostatic charge until it enters the curing oven. Under heat, the powder melts onto the surface of the part.

THERMOSET-THERMOPLASTIC:

If the powder is a reactive system (called a "thermoset"), curing or "crosslinking" takes place so that, once cured, the coating will not remelt. Typical thermosetting powders are epoxies, acrylics and most polyesters.

"Thermoplastic" powders do not chemically crosslink upon application of heat, but melt and flow over the part in the oven. As the part cools after exiting the oven, the film hardens, but will remelt upon application of sufficient heat. Some typical thermoplastic powders are vinyl, nylons and fluorocarbons.

A specialized powder application is porcelain enamel, usually for oven appliances. As porcelain is a glass, it might be likened to a thermoplastic, but is fired at much higher temperatures than organic powders.

POWDER COATING EQUIPMENT:

The largest volume of organic

powder coating is applied by electrostatic spray using equipment specially designed for powders. Other methods of application are fluidized bed dipping, electrostatic fluidized bed and flocking.

Electrostatic application of powder is made possible because powders, being generally non-conductive, will retain an electrostatic charge and cling to a grounded substrate without dissipating that charge until melting in the cure oven.

The charge may be positive or negative, but negative is the most efficient for most materials and equipment configurations, and is most widely used.

Figure 1 shows the basic components of an electrostatic spray coating booth. Powder is picked up from a feed hopper (usually a fluidized bed), transported by compressed air to application "guns" which apply a charge created by the generator. The guns direct the spray pattern toward the parts which attract the powder because of difference in electrical potential.

In this system, about 50% of the overspray falls to the feed hopper by gravity. The balance of the overspray is collected through an extraction duct to the reclaim system.

The reclaim system might consist of a cyclone separator combined with a final filter and fan or, in a single-color system, the cyclone might be eliminated. In some cases, for color change speed or flexibility, the filter-fan apparatus might be duplicated for different color capability, or cartridges might be exchanged within a filter module.

The final filter might be tubular cloth "socks", "envelope" type elements, or backpulsing cartridge elements. The use of an efficient coating chamber, however, with a self-cleaning cyclone, allows an unlimited number of color changes without duplication of filtering equipment.

The spray guns are moved in an oscillating motion as the parts pass through the chamber. This motion assists in distributing the spray pat-

tern and "washes" the parts with a fan of powder.

Note in Fig. 1 that the charged powder is carried along with the parts toward the extraction duct located near the exit vestibule. This extends the exposure of the charged powder to the part to be coated.

ECONOMIC ANALYSIS

There are many variables in any analysis of the economics of a finishing system. The following is intended to show some typical examples of factors in coating system technologies. Table I compares finishing line components for a liquid paint and a thermosetting powder. Costs are given in Tables II and III for materials and energy consumption.

Material cost is usually the largest single operating cost of any production finishing operation. Applied cost is a function of the cost and solids content of the coating material as it is actually applied, material utilization efficiency, recognizing that liquid paint overspray is lost forever, and the thickness of the applied coating.

ADVANTAGES OF POWDER COATINGS

Powder coatings have the following advantages over solution coatings:

1. Capital costs for a powder system are generally less than the cost of a solution system, starting from scratch.

2. A powder coating of a higher quality can be applied at the same

Table I. Comparison of Finishing Line Components

	<i>Liquid Paint</i>	<i>Thermosetting Powder</i>
Power spray washer	3-5 stage	3 stage
Substrate coating	Iron/zinc phosphate	Iron phosphate
Passivating	Chromic acid	Chromic or phosphoric compound
Dry-off oven	Yes	Yes—can be integrated with bake oven
Cool-off	Yes	Yes
Average temperature difference	300°F-70°F	300°F-180°F
Spray booths	2 automatic 1 manual	1 automatic 1 manual (or combination)
Flash-off tunnel	Yes	None
Bake oven time	20 minutes	1-15 minutes
Bake oven temperature	300°F	360°F
Solvent exhaust	Yes	None
Conveyor	560 feet	375 feet
Air replacement	Yes	None
Paint mix room	Yes	None
Paint circulating or routine maintenance	Once/day (Minimum)	Once/day (Minimum)
Average time/gun	10 minutes	2 minutes
Major cleaning (except color change)	Once/week (Minimum)	None
Average time/gun cleaning (except color change)	2 hours	None

Table II. Typical Material Costs

	<i>Liquid Paint</i>	<i>Powder Coating</i>
A. Cost	\$9/gal (mixed)	\$2.15/lb
B. Solids content	35% (mixed)	100%
C. Specific gravity	—	1.5
D. Utilization efficiency	50%	98%
E. Coverage/mil*	280 sq ft/gal	125 sq ft/lb
F. Applied cost/mil	\$0.0321	\$0.0172

* For paint: $E (\text{sq ft/gal}) = 1600 \times B \times D$
 For powder: $E (\text{sq ft/lb}) = 192 \times B \times D \div C$

Table III. Typical Energy Requirements for Solvent vs Powder Application Areas

	<i>Solvent Coating</i>	<i>Powder Coating</i>
Number of booths	2	1
Spray booth size, ft	8 x 10	—
Size of openings in spray booth, in	—	(2) 30 x 54
Air velocity, ft/min	150	100
Exhaust air, SCFM	24,000	None
Inside/outside air temperature, °F	70/33	70/33
Make-up air heating, Btu/hr	1,198,800	None
Gas required @ \$0.50/therm	\$6/hr	None
Additional gas required for incineration of solvent overspray	Yes	No
Cost/year @ 2000 hrs	\$12,000	None

cost as a lower quality solution coating. Solvents add to the expense and detract from the properties of cured coatings.

3. 95 to 99% utilization of powder can be realized by a properly designed recovery system vs much lower efficiency for solution coatings.

4. There is no overspray sludge or contaminated water to be disposed of with powder as there is with liquid coatings.

5. Air used to exhaust the powder spray booth is recirculated directly to the plant, eliminating heating or cooling costs of the make-up air that occur when air is exhausted from the plant.

6. The cost of heating the curing oven is less since large volumes of the air are not exhausted from the oven to remove solvent fumes.

7. Since powder coatings devel-

op full cure during the bake and usually resist abuse better than solution coatings, there is less damage during handling and assembly operations. Also, they do not have to be packed as carefully for shipment.

8. Badly sprayed parts can be blown clean with an air gun prior to baking instead of stripping in solvent.

9. Powder application equipment requires only about two-thirds as much floor space as a solution coating system for the same volume of work. Powder booths spray from both sides at once eliminating one spray booth. Among those areas eliminated are flash off zones, and paint mixing rooms. Cure ovens may be hotter and shorter.

10. Fire hazards are greatly reduced, allowing possible insurance savings.

11. Low-skilled labor may be used because of the simplicity of application. Sags, drips and runs are impossible with powder.

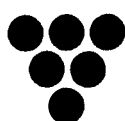
12. Epoxy and polyester powders require no primer, which means a one-coat finish.

13. Modern powder coatings may be applied at thicknesses equivalent to modern liquid coatings.

CONCLUSION

Substantial studies have been made in the improvement of both powder coating materials and equipment. The ease of application and recent reductions in initial cost have broadened the availability of start-up equipment to include almost any sound company engaged in metal finishing. Electrostatic powder coating is well established as a finish for the future. **MF**

*For More
Information about
Powder Coating
Equipment contact:*



Volstatic, Inc.

7960 Kentucky Drive, Florence, KY 41042
(606) 371-2557 • Telex 21-4592 Volstatic Flon

International Leaders in Powder Coating Equipment.



A Member of
THE POWDER COATING INSTITUTE