

POWDER COATING SYSTEM SELECTION

TECHNICAL ARTICLE

Selecting the right powder coating system

Kirk Shirar *Deimco Finishing Equipment*

If you are trying to decide what kind of powder coating equipment you need, whether you are new to powder or a veteran adding new systems, you need to read this article. It discusses how to go about making an informed decision. Overviews of the types of powder systems are discussed. The article also includes a section about key regulatory requirements.

As the benefits of powder coating have become increasingly recognized, more manufacturers are exploring methods to apply durable, environmentally friendly, and cost effective powder coated finishes. Selection of the right powder coat system can seem difficult, particularly to an end user who is newly adopting powder coating technology.

Businesses can better ascertain their powder coat system needs by evaluating several factors. Considerations include

- What are the characteristics (part geometries, weights, dimensions, construction material) of the parts needing finishing?

- What are the volumes of parts needing finishing?
- What facility constraints (footprint, elevation, utility) exist?
- What economic constraints exist?

Powder system types

Most powder systems can be characterized as one of four types by determining the answers to two questions:

1. How is the powder being applied?
 - Manually
 - Automatically
2. What happens to the powder overspray?
 - Sprayed to waste
 - Reclaimed

Figure 1 shows the two by two matrix that defines these four primary powder system types.

Manual spray-to-waste systems. Manual spray-to-waste powder systems come in many sizes and configurations.

FIGURE 1

Four primary powder system types

Overspray	Reclaimed	Manual reclaim system	Automatic reclaim system
	Wasted	Manual spray-to-waste system	Automatic spray-to-waste system
		Manual	Automatic

FIGURE 2

A walk-in batch booth



rations. For individual parts or groups of small parts, a compact batch booth might be ideal. Parts are typically hung from a grounded rod in the booth and then manually sprayed with a hopper-fed or box-fed manual electrostatic gun. Compact batch booths are small, economical, and portable. Frequent uses are for cell units, lab units for test panels, or gun cleanout areas.

As the size of the individual parts or small batch of parts being finished increases, a larger batch booth is needed. Walk-in batch booths are typically floor mounted. The load usually enters and exits the booth via the same opening, which can be either an open-face door or a filtered door. Walk-in batch booths (Figure 2) are typically used in conjunction with a wand wash booth and a batch oven. Many liquid batch booths can be easily converted to powder batch booths by replacing the liquid booth plenum section with appropriately sized powder collectors. (See Figure 3.)

When the quantity of parts being finished increases, in-line booths can be used to coat parts of differing sizes and shapes. Manual spray-to-waste in-line system booths are typically floor mounted. The load usually enters and exits the booth 180 degrees apart on an overhead conveyor. For deep parts or parts with complex geometries, dual opposing collectors are frequently used. Upon entering the booth, parts will pass the first of two operator stations where powder will be manually applied to one half of the part. The first collector bank is mounted immediately opposite the manual station and will draw powder away from the operator. As the part progresses down the conveyor line, the part will pass a second operator station on the side of the conveyor opposite the first manual operator station. Powder is manually applied to the second half of the part with

the second collector bank again drawing powder away from the operator at station two. (See Figure 4.)

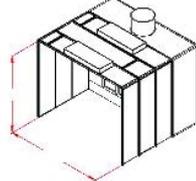
Manual reclaim systems. Compact batch booths can reclaim powder overspray when equipped with a fluidized base. Overspray powder and powder that is expelled during the reverse pulse cleaning of the cartridge filters accumulates in the compact batch booth fluidized base. Compressed air is injected beneath a porous membrane called a *fluid plate*. The captured overspray powder can be automatically or manually conveyed by a venturi-type pump to a powder hopper, powder sieve, or alternate point before reuse. Frequent uses of compact batch reclaim booths are dedicated color units that can roll-on or roll-off line as needed.

Manual reclaim in-line system booths have integral floors. Overspray that accumulates on the floors is recovered and reused. The operators who manually apply the powder may be located inside or outside the booth. (See Figure 5.)

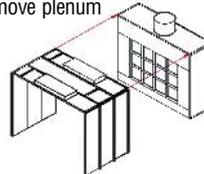
FIGURE 3

Converting a liquid batch booth to a powder batch booth

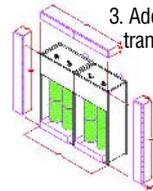
1. Existing liquid booth



2. Remove plenum



3. Add collectors and transition metal



4. Spray powder

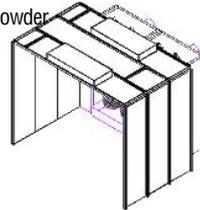


FIGURE 4

In-line dual opposing spray-to-waste powder system



FIGURE 5

Powder coating agricultural equipment in a manual in-line system



detected parts as they are conveyed to the automatic guns. A parts rotator engages the fixture and spins the part in front of the automatic guns as the guns are automatically triggered (Figure 6). The powder-coated parts typically enter a curing oven. Upon exiting the powder oven, cured parts are cooled before returning to the unload area, which is immediately adjacent to the load area. Chain-on-edge cells are ideal for parts that fit an approximate 12-inch by 24-inch window.

Taller profile parts fitting an approximate window of 12 inches by 60 inches can be similarly finished in an overhead cell. A vertical reciprocator or oscillator is used to move the requisite number of automatic guns up and down as the parts are conveyed into the compact spray-to-waste powder booth.

Flat-line cells use a horizontal conveyor that is electrically conductive to coat one side of parts that are pri-

marily flat in nature. As the parts are conveyed into the specially designed booth, a horizontal reciprocator moves the required number of automatic guns perpendicular to the travel direction of the conveyor.

The chain-on-edge, overhead, and flat-line powder cells all exhibit tremendous functionality in a compact footprint. The cells expend minimal labor and utility costs to produce small quantities of custom products while also being quite capable of efficiently producing high quantities of similar-sized products.

Automatic reclaim systems. Automatic reclaim systems are typically used in high-production environments. Automatic reclaim system in-line booths can use either cartridge filters or cyclone separators to recover the overspray powder. Cartridge filter booths have the highest overall reclaim efficiency but require a dedicated filter module for each color reclaimed. Cyclone booths can reclaim all colors but have a much higher acquisition cost than cartridge filter booths and a lower reclaim efficiency.

Automatic booths typically consist of three major components. Cartridge filter booths consist of the booth canopy, the fan package, and filter module. Cyclone booths consist of the booth canopy, the cyclone separator, and a cartridge collector to filter the air that is discharged back to the plant.

Automatic guns can be stationary, or they can be mounted on gun movers that move them vertically, move them closer to the parts being sprayed, or both. Reciprocators and oscillators can be employed to increase first pass transfer efficiency and finish uniformity. As an example, an automatic reclaim system with a work opening of 18 inches wide by 72 inches tall would frequently use 12 stationary automatic guns (six on each side of the booth). This same 18-inches wide by 72-inches tall work opening would frequently achieve better finish results with six

automatic guns operating on two radial oscillators (three guns on one oscillator on each side of the booth). The gun movers oscillate the guns in approximate 30-degree-arc lengths, in the process effectively doubling the coverage area versus a stationary gun. The cost of a radial oscillator is comparable to the cost of an automatic gun.

Zoned gun triggering is another way to dramatically reduce overspray material. As different part heights and depths are detected, only the automatic guns that are required to coat

FIGURE 6

Automatic chain-on-edge cell system



FIGURE 7

Automatic and manual reclaim hybrid system



FIGURE 8

Reclaim canopy with stainless steel, polypropylene (roof), and polycarbonate materials



those parts are triggered. Due to the large coverage area and fan pattern of an automatic gun, high-resolution part detection systems using light curtains are typically an unnecessary expense.

Most flat panel parts can be fully coated using automatic guns. For parts that are deep and complex, manual touch-up is frequently required. The manual touch-up stations are usually located after the automatic stations.

When a wide mix of part profiles are finished, hybrid booths can combine the full functionality of an automatic reclaim system and a manual reclaim system in a single booth (Figure 7). Parts enter the booth and proceed to an automatic section with automatic stations, before widening to a manual section. The manual application section provides ample room for the operators to manually spray deeper, more complex parts.

Optimizing the powder system solution

Attention to additional details can help to optimize any powder coat system type. An average face velocity of 125 feet per minute (fpm), and an absolute minimum of 100 fpm, is required to adequately contain the powder for most systems.

Much attention should be paid to any operators working in or near the selected system. Sound should be dissipated so that operators are not exposed to noise levels above 85 decibels. Powder should be drawn away from the operator. Reject any design that places the operator between the part being powder-coated and the powder collector. Operators manually spraying inside a booth should have room to safely maneuver around the parts. If parts are presented on an overhead conveyor, they should be hung at a height that minimizes operator movements such as bending, stooping, kneeling, and stepping up and down ladders or platforms. Sufficient light should be provided.

Filtration efficiencies will give an indication of the filter quality. The amount of filter media relative to the collector fan size will give an indicator of filter service life. Air-to-cloth ratios (fan cubic feet per minute divided by square feet of filter media) below 3.0 are desirable.

The mechanical integrity of the booth and its materials of construction are interconnected. A combination of stainless or polymer materials are needed for reclaim booth canopy systems (Figure 8). Spray-to-waste booth canopies could also use galvanized, aluminized, or powder-coated steel.

Beyond mere purchase price, there are many differentiators that have a material impact on the installed operating cost of a powder system. Most powder system suppliers require a majority of the system purchase price to be paid before shipping. Customers should ascertain whether the system will be fully assembled and operated so that an acceptance inspection may be completed before shipment. Many powder system components can remain largely

Key regulatory requirements of powder systems

Many federal, state, and local agencies have the authority to enforce operating standards in different localities. The following regulations are broadly applicable to most powder systems.

- NFPA (National Fire Protection Association) 33, *Standard for Spray Application Using Flammable or Combustible Materials*
- OSHA (Occupational Safety and Health Administration) 1910.107, *Spray Finishing Using Flammable and Combustible Materials*
- NFPA 79, *Electrical Standard for Industrial Machinery*
- NEC (National Electric Code) 2005
- UL (Underwriters Laboratory) 508A, *Industrial Control Panels*

These regulations broadly mandate that powder systems adhere to the following general requirements:

1. A minimum 60 feet per minute (fpm) velocity must be maintained at booth openings and cross sections.
2. The filtration system must be continuously monitored if the exhaust air is returned to the plant.
3. Flame detection must be provided if automatic guns are in use.
4. Hazardous Class II, Division 1 and 2 locations in and around the booth must be complied with.
5. UL listed controls are also required in a growing number of locations.

intact during shipment. This minimizes installation time and cost.

Powder system suppliers should have relevant successful experiences to share with prospective customers considering similar powder system types. Powder system providers should be readily able and eager to share a list of customer references. The best powder system providers are able and willing to customize the system for the end user's optimal benefit. **PC**

Editor's note

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Kirk Shirar is general manager of Deimco Finishing Equipment, 1004 E. 5th St., Tama, IA 52339; 641/484-8806; [www.deimco.com]. He and his wife, Cindy, are co-owners. He holds a bachelor of science degree in chemical engineering from Rose-Hulman Institute of Technology, Terre Haute, Ind. He was general manager of North America for GE Sensing Solutions and has held engineering, operations, and management roles for Pfizer and Texas Instruments.