Powder booth airflow direction: What's the difference?

Nick Liberto, P.E.  
*Powder Coating Consultants  
Division of Ninan, Inc.*

Powder booths come in all shapes, sizes, and designs. It's sometimes difficult to determine which booth design is most appropriate for a specific application. One of the most obvious differences in booth design is the direction of the airflow within the booth and how it affects powder recovery. This article sorts out the nuances of each powder booth design in relation to airflow direction.

**Downdraft booths.** This booth uses downdraft technology, which means the air flows downward within the booth. It can be coupled with cartridge, filter belt, and cyclone booth types and can handle large amounts of overspray powder very efficiently. (Examples are shown in figures 1 and 2.) This design is also considered self-cleaning because the air flows in the direction of gravity.

As a result, the powder deposits into the recovery system without manual intervention, such as squeegeeing the booth floor.

The most effective booth designs incorporate downdraft airflow evenly along the length of the booth to eliminate high-velocity airflow zones. Consequently, the recovered powder...

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**Understanding booth airflow designs**

The direction of booth airflow is independent of booth type—for example, cartridge, filter belt, or cyclone—and is akin to the extraction point of the booth containment and safety air. (This extraction point is also where some or all of the powder overspray goes as it enters the recovery system.) In each booth type, the air flows in one or more of the following directions: (1) downward, (2) sideward, or (3) upward. Booth air can't be designed to flow in any other direction. As a result, booth airflow designs are downdraft, sideward, updraft, or combinations of these.

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**FIGURE 1**

An example of an evenly distributed downdraft filter-belt-type booth
has a more homogeneous particle size distribution than it would otherwise. Because the overspray powder moves toward the extraction point unopposed by gravity, powder particle size separation can't occur.

When the direction of booth airflow and gravitational forces oppose each other, the heavy, or large, powder particles fall to the booth floor because gravity has more influence on them. Conversely, the light, or small, powder particles are pulled to the extraction point by the booth airflow. This can affect the surface appearance and film thickness of the powder on the parts; therefore, it's a good idea to introduce fresh powder constantly and clean the booth floor frequently.

In some booth designs, an even downdraft airflow isn't practical. This is the case when powder collectors and ventilation fans must share the limited space under the booth. In this design, you have to manually move the powder that has fallen in the booth section without airflow to the extraction point.

In addition, the extraction point in this booth must be located away from the automatic guns to prevent the higher-velocity air from pulling the powder away from the part surface. In systems that have both manual and automatic spray operations in the same booth, this means that the extraction point (tied to the location of the cartridge collector) is directly under the manual spray zone. This can cause visibility problems when large amounts of airborne powder produced by the automatic guns are pulled into the manual spray zone.

Furthermore, the booth floor, and thus the operator platform, in this design is elevated to allow room for equipment or duct work under the booth floor. This surface can be 3 or more feet above the plant floor. This means you have to have operator platforms with handrails that are approved by the Occupational Safety and Health Administration to allow the manual sprayers access to the parts on the conveyor line. This may be cumbersome in systems that use roll-off booths.

**Figure 2**

An example of an evenly distributed downdraft cyclone-type booth

**Figure 3**

An example of a sidedraft cartridge-type booth
er, booth wall space is limited because the extraction point must compete with automatic and manual gun stations. This can present problems for the equipment designers when they must put several automatic and manual gun stations around one or more extraction points. Particular problems exist when the extraction point is adjacent to these stations. In these situations, the booth airflow is opposite the powder flow and can interfere with the movement of charged powder to the part. In some cases, the equipment designer locates adjacent extraction points as far away as possible from the powder application point to minimize this effect.

Conversely, transfer efficiency can increase when the powder and booth airflow are in the same direction. This happens when the extraction point is opposite the automatic or manual spray stations. Although this situation is the most desirable condition for efficient powder application, it usually demands longer powder booths than those in other designs, which can create plant-floor space problems and increase equipment costs.

Updraft booths. This booth, although not prominent in the powder coating industry, uses upward airflow patterns directed toward the roof of the booth. Normally used in conjunction with booths that have powder feed hoppers in the booth base, the airflow is designed to remove the light airborne particles from the spray area. This overspray is then collected for disposal, while the heavy powder particles fall (by gravity) into the feed hopper for reuse.

The automotive industry also uses multiple airflow patterns extensively to gain control of the overspray powder in the large booths that are necessary for coating car bodies. In addition, the return fresh air is introduced at specific locations to help move the powder toward the extraction points. By design, these systems are self-cleaning to prevent accumulated powder from collecting within the booth. This design also prevents accumulated powder from falling onto the car bodies being coated.

Choosing the right airflow design
Consider airflow direction when you select a powder booth for your application. Keep in mind, however, that the prominence of airflow in the selection process should be balanced by other—and possibly more important—booth features, such as floor space, collection technology, cost, booth material, and warranties.