POWDER COATING

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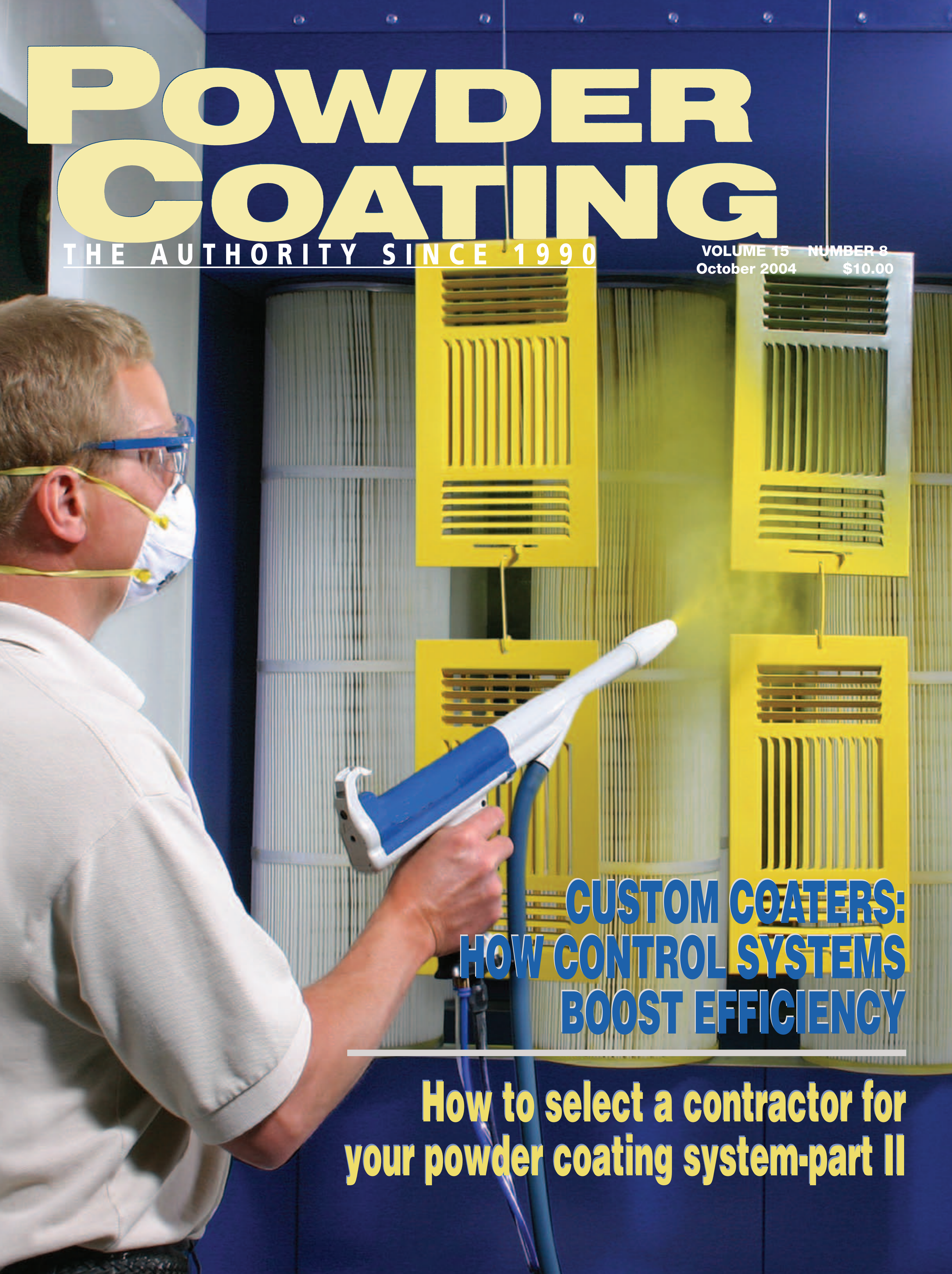


CUSTOM COATERS: HOW CONTROL SYSTEMS BOOST EFFICIENCY

How to select a contractor for your powder coating system-part II

APPLICATION CONTROLS

Custom coater powder application: How control systems can boost efficiency

John Binder ***Nordson***

On any given day, a custom coater processes an array of parts through the finishing line. It can be an onerous task dealing with the various gun settings for all the different parts. This article discusses the various benefits of control systems to speed up the process for better efficiencies. It discusses part identification and gun triggering controls, as well as creating part recipes to handle multiple parts on one line.

Sophisticated controls surround us in our daily lives. From the nearest ATM at the drive-up window and the neighborhood grocery where we use touch screens to get through the checkout line, to our homes where dozens of remotes provide control for cooking and entertainment and virtually everything in between. When it comes to coating parts, however, the world seems a bit more primitive, with lots of manual buttons and dials. This article surveys past, present, and future control technology for powder systems.

We'll try to avoid the trap of praising controls for their own sake. Any of us who have spent several seemingly endless minutes trying to get through an automated telephone system when a real-live human being could have helped us in a few seconds realize that more is not always better when it comes to controls—and that's part of the story.

The purpose of controls

Controls let us set things exactly the way we want them with more accuracy and precision, whether it's the temperature of a room, the speed of a car, or the volume of a TV set. Controls for powder systems, such as the one in Figure 1, let us take charge of parameters that need to be changed to produce good quality parts efficiently.

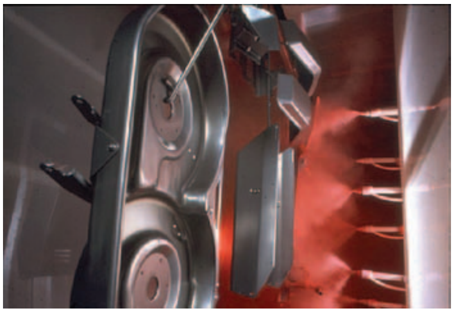
The underlying philosophy is simple: First determine the equipment settings necessary to produce one good part as efficiently as possible, and then use these same settings to spray each part the exact same way. The trick is to do all of this without waste, error, and lost profits. Like programming a robot, the actions will be perfectly repeated each time, provided nothing changes. In reality, of course, things do change. Consequently, the most advanced control systems must anticipate change and be able to make adjustments to accommodate it.

Deviation due to manual setup

Quality control is all about repeatability. The keystones of Six-Sigma and SPC (statistical process control) are about reducing deviation in the process. Think about the following scenario:

FIGURE 1

Powder system with controls for accuracy and precision



All photos courtesy Nordson

Two people are told to set a room thermostat to 68°F. One room has an older-style dial thermostat with numbers painted on the dial every 10 degrees. The other has a newer digital thermostat with an LCD digital display. Of the two thermostats, which one will be set more accurately? Clearly, the digital thermostat. And, if after the initial setting the thermostat is readjusted and needs to be reset repeatedly, the results are even more predictable.

In fact, we conducted a blind experiment recently with powder technicians in the field. They were instructed to set the powder flow rate on a calibrated analog regulator (see Figure 2) to 214 grams per minute (gpm) and compare the results with a digital regulator. They were also told there might be insufficient coverage at less than 214 gpm; therefore, the regulator shouldn't be set below that threshold. Powder flow was measured, the regulator reset, and the same procedure done again. Figure 3 shows the results of repeating this experiment 20 times.

A few things are obvious from this experiment. First, the results from digital control are far more repeatable than the results from analog control. There is virtually no deviation (0.1 gpm) in the output. Because 214 gpm was regarded as the lowest acceptable threshold, the average setting was much higher (238 gpm). This meant wasted money due to overcompensating for suspected unreliability in the controls by bumping up the flow rate. If the flow rates were set lower on average, there would have been insufficient coverage many times over.

In summary, manual adjustments because of the inherent sensitivity of the equipment, combined with the difficulty in interpolation and precision, don't provide an efficient means of control if efficiency and repeatability are the criteria.

Deviation due to external forces

Powder systems would be a lot more dependable if nothing ever changed. But in reality the coating system is connected to the rest of the plant and depends on utilities such as compressed air and electricity to run other subsystems.

Compressed air, for example, is used to fluidize powder and control the performance of the spray guns themselves. Each spray gun uses air to control the powder flow rate of the gun and is typically run through an adjustable regulator. The problem is that the compressed air feeding the powder system changes constantly and unpredictably. Air pressure rises and falls as other plant devices draw air themselves. This change in compressed air at the input to the powder regulators, if left unchecked, can cause the same sort of variation in the powder process.

Fortunately, sensors can be used to detect air input changes and compensate for them so that air output remains at a constant level. This closed-loop control (Figure 4) is like setting cruise control on a car. Whether the car is going up or down a steep hill, the engine controls are adjusted continuously to maintain constant speed.

FIGURE 2

Calibrated analog regulator

FIGURE 3

Powder flow repeatability—one gun

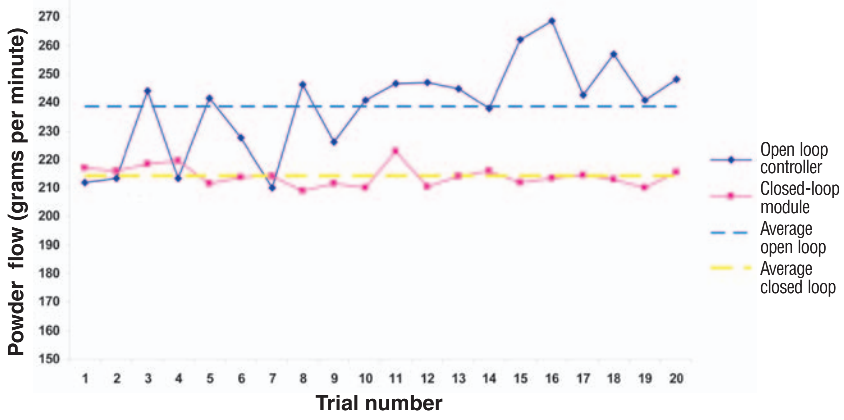


FIGURE 4

Closed-loop control

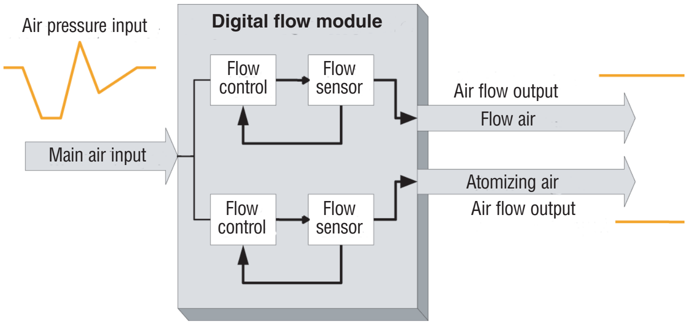
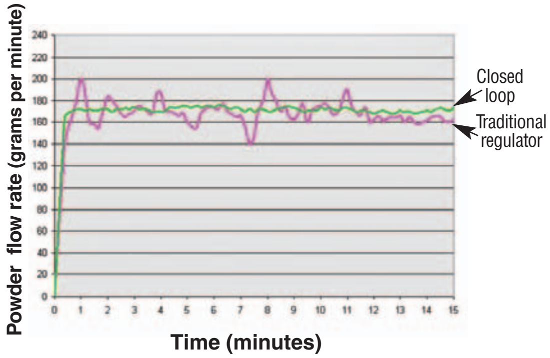


FIGURE 5

Closed-loop versus traditional regulator



In actual trials, we measured powder output of spray guns fed by both traditional and closed-loop flow control regulators. The guns were set to deliver 170 gpm. Actual flow rate was measured over a 15-minute period. The closed-loop flow control system showed far less fluctuation than the traditional regulator. (See Figure 5.)

In theory, it sounds good. But how does better flow control really perform on an actual production line? We measured savings at the production plant of a decorative hardware manufacturer in suburban Illinois. This plant runs a first-class powder line with critical attention to detail.

The plant conveyor line runs 3- by 6-foot racks of parts at a speed of 6 feet per minute on 8-hour shifts each day. The customer agreed to measure powder consumption and film build on parts before and after installing closed-loop flow control to determine its effectiveness.

Before installing closed-loop flow control, the hardware manufacturer averaged 2.5 mils of powder per part. With more accurate flow control, the average mil build was reduced to 2.25 mils per part, resulting in annual powder savings of over $46,500.

Controls for an array of parts

Few manufacturers powder coat just one single type of part. More often, several part shapes and sizes need to be coated routinely. For a custom coater, part runs may last only a day or two.

Controls for dedicated parts could be made much simpler than those needed for a wide range of possibilities. In fact, control schemes for devices that repeat may require little, if any, interface to the user. But to powder coat a wide array of shapes with various colors, several features can produce the same ease and repeatability that's attainable with a dedicated line:

- Part identification and automated gun triggering
- Control system recipes
- Fast color-change control

Part identification and automated gun triggering. When powder guns are on, it's just as if money is coming out the other end. If powder goes on the parts, that's one thing; if it just sprays air and goes on the booth floor, that's another. Even with a good reclaim system, some powder is lost, and sometimes the reclaim equipment is inefficient. A good system triggers the spray guns on in time to powder coat parts and triggers them off when no parts are present. (See Figure 6.)

Photo-eye arrays are a common means to determine the presence of a part on its way to the booth (Figure 7). As many as eight different zones can be configured to trigger guns on and off at the right time. They also can be set to trigger the right number of guns on and off for the job. Software can anticipate the leading and trailing edges of each part or rack as well so that proper film build is achieved automatically on the entire part.

Gun triggering (Figure 8) can rapidly add up to a significant savings in powder. For example, a company uses 12 automatic guns to spray parts, putting an average of 2 mils of powder on each part. Without triggering, the company annually sprayed 607,500 pounds of powder with an application efficiency of 35 percent. With gun triggering, the company reduced spray time by 25 percent and sprayed only 455,625 pounds of powder, raising application efficiency to nearly 50 percent. As a result, the company sprayed 151,875 pounds less powder, which, at a cost of $2.10 per pound, was a significant savings. In a nonreclaim system, this would be a disaster. But in a reclaim system with an efficiency of 95 percent, this would amount to a large savings in powder, as well as in equipment wear and tear, in spare parts, in maintenance, and in cleanup time.

FIGURE 6

Gun triggering on a conveyorized powder line

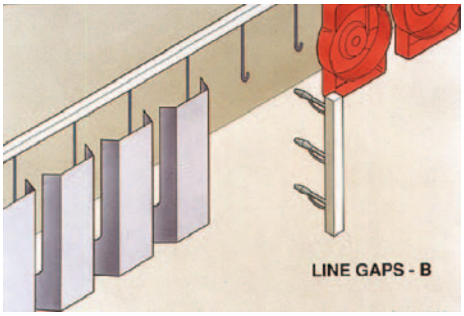


FIGURE 7

Photo-eye arrays at the powder booth opening

Control system recipes. Spraying powder with a single manual gun is pretty straightforward. A few simple adjustments can be made easily with gun in hand. But a shop running a hundred different part styles with 20 different colors and perhaps a dozen automatic guns on in-out positioners is a different story.

FIGURE 8

Gun triggering to save powder

Think of all the parameters that must be set (see Figure 9): atomizing air and airflow; electrostatic gun voltage and current settings; gun positioning; and on-off gun triggering. Setting each of these manually for every gun for every part and for every powder becomes physically impossible.

FIGURE 9

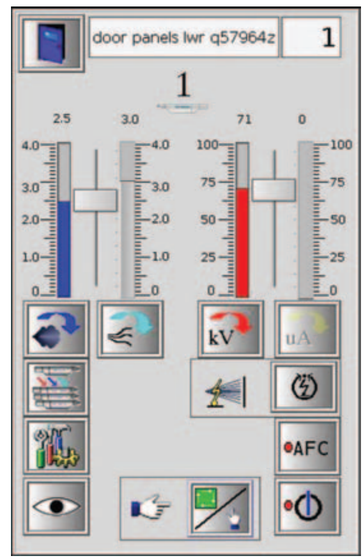
Gun control system

With recipes, however, gun electrostatics and air pressures can be configured to spray differently for recoated parts than for uncoated parts. Or, depending on powder chemistry, guns can be adjusted for powders heavy in metallic or mica content. Alternatively, gun controls can compensate for part shape when a deep recess needs to be coated instead of a flat panel surface.

As in the past, setting parameters could be done manually. But as we have already seen, each manual setting has potential for errors, and these errors may be compounded when making literally a hundred changes at a time (especially under the pressure of getting the line running again as quickly as possible).

FIGURE 10

Computer-driven control system menu



Fortunately, computer-driven systems allow these parameters to be stored together as a single-part recipe that can be activated with a few keystrokes. (See Figure 10.)

What's more, the same software makes recipe creation a simpler task than it was in the past through many of the same shortcuts we have become accustomed to with other software. Cutting and pasting, and copying and deleting are just quick keystrokes that allow complex recipes to be created, deleted, or modified in a matter of minutes. Removable storage media such as flash memory cards allow programming information to be backed up and stored safely, and even transferred from one system to another.

FIGURE 11

Advanced control system for color changing

Fast color-change control. The powder industry has worked hard in recent years to overcome obstacles that have prevented rapid color changes. Today, reclaim-to-reclaim color changes in less than 10 minutes are a reality, and that time is only shrinking.

Making color changes in such a short time requires advanced control systems (Figure 11). Controls become part of the automatic sequence of operations that tie operator and equipment together in a carefully choreographed routine. To achieve such rapid color change, sometimes several things must happen at the same time, not just sequentially.

For example, while the powder delivery system in the automated feed center is being run through a purge cycle, gun movers are being retracted automatically past a series of air nozzles that blow off powder from the guns and hoses.

In summary

In assessing the extent of sophistication needed for powder controls, step back and consider your needs.

- How many different parts do you coat?
- How many gaps are in the line?
- How many spray guns do you use?
- Do you need to change spray-gun position frequently?
- How many different types of powder do you spray?
- How quickly do you change color?
- How costly is overspray to the company bottom line?

Odds are if your system is complex and you require flexibility, better controls will save you money. And the return on the investment will come from many places: better powder use, more consistent quality, less variation in film build, better overall system efficiency, and less downtime from manual changes that need to be made. **PC**

Editor's note

For further reading on the topic discussed in this article, see *Powder Coating* magazine's Web site at [www.pcoating.com]. Click on Article Index and search by subject category.

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