



What happened?

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Greetings and salutations from Connecticut! In the 1990s, I wrote a regular column for Powder Coating magazine titled "Inside Information." The column tackled a diverse range of topics on the powder coating process from color change to high-technology gizmos. Several of my associates at Powder Coating Consultants, including George Trigg, also contributed to the column. Although we enjoyed writing it, we got the opportunity to write the Questions & Answers column for this magazine. Eventually, I went on to write a similar Q&A column for another publication while George took over the column for Powder Coating. Well, I'm back with a guest column to be published occasionally throughout the year, and am thankful for the opportunity to once again write for the first publication dedicated to the powder coatings industry—Powder Coating magazine. Beginning with the August issue, both George and I will answer your questions in the Q&A column. So, send those questions. Simply go to [www.pcoating.com], click on Problem Solving, then Q&A, and Click here to submit a question.

Our company has been providing consultation services since 1988 (20 years and counting). We provide a plethora of services to help current and future end-users of powder coatings. One thing we hear often when a product does not meet expectations is "what happened?" This question arises whether we are providing an operational audit on a process that does not reliably produce defect-free parts, a forensic analysis of the coating failure for a part we are given, or expert witness testimony in support of a litigation matter. Occasionally, we provide analytical and performance laboratory testing services to prove the causation of coating failures. It all comes down to determining what caused a particular coating failure, or series of coating failures.

Identification of what caused the coating failure in the first place is a necessary step before corrective action can be applied to eliminate the problem(s). Sometimes identification

is necessary to assign blame, as in the case of litigation support. Whatever the reasons for performing the investigation in the first place, the same conclusion applies: You can't fix something if you don't know what caused it in the first place.

What we have found after all our investigations is that all coating failures have problems that fall into one or more of the categories shown in Figure 1.

By definition, all powder coating systems comprise finishing materials (including powder and cleaning/pretreatment chemicals), product design (including their finishing requirements), the application process, and their interactions. Without complete forethought and compatibility of all these system issues, the coated product will undoubtedly fail prematurely. Not any one of these is more important than the others. However, if one of these issues is not fully and completely considered and estab-

lished, then no matter what you do with the other issues the outcome will be the same...bad.

Finishing materials. The finishing materials are the coating powders used on the parts as well as the chemicals used to clean/pretreat the ware. Given that the product has been properly designed and the application process is suitable, then if these materials are not properly formulated to meet the finishing requirements, it will prove extremely difficult if not impossible to attain the desired quality of finish or the performance of the coating.

Product design. It should be clear that the requirements for quality and performance of the product's finish drive the selection of the substrate material, substrate cleaning/pretreatment, and powder coatings, and the definition of the application process. This is sometimes referred to as the design of the product to meet stated coating performance objectives. If the product design or finishing requirements are incompatible with the current application process and/or the selection of the finishing materials, it will prove extremely difficult if not impossible to attain the desired quality of finish.

Application process. The application process comprises the methods used to clean, coat, cure, and convey the parts. The application process also includes the execution of these methods by the responsible personnel; this includes maintenance and housekeeping. If it is given that the product has been properly designed and the finishing materials are properly formulated, then if the application process is out of control, the process will produce finishing defects resulting in poor product performance.

Examples. A few real-world examples can go a long way in explaining the importance of these finishing issues. Let's say your product is fielded in severe environmental conditions that necessitate at least 1,000 hours salt spray resistance. However, your process has only a three-stage washer using iron phos-

phate and can apply a single powder coating onto the substrate you selected, in this example cold rolled steel. The results of this combination of circumstances will yield a part that will reliably pass 250 hours of salt spray, only one-quarter of what is required. The answer for this particular example lays with a better substrate (galvannealed steel), a product design issue; use of a five to seven-stage pretreatment process employing zinc phosphate, a process definition problem, which is a design issue; and the same single coat of powder.

Now let's say that the substrate is galvannealed steel and is pretreated properly with zinc phosphate, but the powder coating is under-cured. In this example, the product design is fine, but the process is the problem because an under-cured powder coating will not provide the desired corrosion resistance of 1,000 hours.

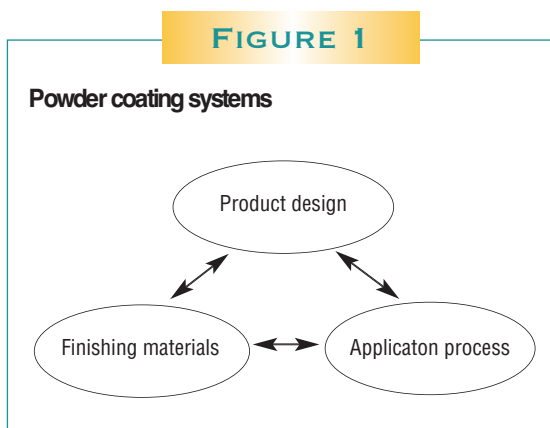
We have investigated powder coating failures caused by poorly formulated finishing materials, a rare occurrence. In one instance, the powder coating formulator purchased the base resin for the powder from a new supplier, not anticipating any problems with the resultant coating. However, the new resin supplier's material did not react with the formula to properly develop the textured appearance that was expected. This innocent mistake resulted in a nationwide recall of this "stock" material from numerous end users. Another time, a pretreatment chemical supplier mistakenly labeled a drum of iron phosphate as a cleaner/coater iron phosphate. The result was massive adhesion failures of the coating.

How to be a coating defect sleuth

Frequently, we are presented with a defective part in which the coating failed to meet the customer's objectives. We begin our investigation by asking a series of questions:

- What are the stated coating performance objectives? What are the fielded conditions? You need to know the answers to these questions to better understand if your powder coating system (finishing materials, product design, and application process) can meet your needs. Identified goals are essential; otherwise, how do you know if you succeeded in achieving them?
- What is the description of the process for the part? This will give you the information you need to determine if this application process was capable in producing products that meet your stated goals.
- Were any incoming inspections performed on the powder coating and cleaning/pretreatment chemical? This is a primary consideration when trying to determine if the finishing materials are at fault. Verifying finishing materials from the suppliers is the key to ensuring that the materials are what they are supposed to be. Incoming material inspection and/or certification and testing are the only insurance against improperly formulated coatings and chemicals.
- Are any quality assurance/quality control or process control records available to review that cover the time when this product was processed? This information can tell you if the application is "in control" and monitored for compliance to well-understood application parameters. If the records indicate that the process is properly controlled to parameters that are appropriate for the process, then it becomes pretty clear that the product design is at fault.
- Is this failure a rare occurrence or part of a larger issue? This tells you whether this failure is an aberration or indicative of poorly conceived product design, an ill equipped process, or both.

FIGURE 1



- What factors did you consider when selecting the metal substrate? Since substrate selection is key to achieving corrosion performance, knowing the factors for selecting the substrate are required for completing a proper failure investigation. Did you hear any of the following? "It was what was on the shelf at the time." "It was the cheapest I could buy." "I really don't know." If you heard any of these, be very suspicious about the substrate selection for the application.
- How was the coating selected? If the primary reason for a particular coating selection was color, then that is the only attribute you can judge for the coating. The coating may have other properties that are necessary for the application; however, it would be by pure serendipity that these properties were in the coating because they were not identified and verified in the formula beforehand.

Summary

Organizing your defect investigation results as finishing materials issues, product design issues, or application process issues is the best way to ensure complete evaluation of defect analysis. Without this organization, it can be very daunting to answer the question: "What happened?" Follow the clues to the areas where the faults lie, and you are well on your way to solving the problem. Once you know what went wrong, you can start the corrective action necessary to eliminate it from happening again. If you get good at this, give me a call. I might have a job for you!

Editor's note

For further reading, see the "Index to Articles and Authors 1990-2007," Reference and Buyer's Resource Issue, *Powder Coating*, vol. 18, no. 9 (December 2007), or click on the Article Index at [www.pcoating.com]. Have a question? Click on Problem solving to submit one.

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