

INSIDE INFORMATION

How to eliminate outgassing, the powder coating faux pas

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Most etiquette experts in this country would find the act of expelling bodily gases in public as quite socially unacceptable. In some countries, however, the same act is greeted as a compliment to a well-prepared and tasty meal. In the powder coating industry, outgassing is typically met with the same attitude that meets a loud belch at the dinner table in a fine restaurant here. This article describes how and why outgassing occurs and what steps can be taken to reduce or eliminate its effect on powder-coated surfaces.

What is outgassing?

Outgassing occurs when trapped gases are released through a powder coating during the cure process. When the gas passes through the coating, it forms pinholes. Moisture or corrosive materials can then penetrate the coating via the pinholes and corrode the part. The pinholes can also be unsightly on high-quality parts.

What causes outgassing?

Many things cause outgassing on powder-coated parts. Outgassing can be attributed to the substrate material, to surface contamination, and to the powder itself. Outgassing can occur for the following reasons:

Castings. Both sand- and die-cast pouring processes trap gases in castings. These gases can be anything from trapped air to gas formed when molten metal cools. The quality of the metal and the care taken in the pouring process directly affect the amount of air trapped. A casting of high-quality metal, for instance, usually has a low amount of trapped gas. Outgassing can occur when a substrate containing trapped air is powder coated.

Galvanized (zinc-coated) substrates. Outgassing can occur when a powder coating is applied to a zinc-coated substrate, galvanized steel, for example. As with castings, the zinc application processes produce gases that can be trapped within the subsequent surface coating. This is especially true with hot-dip galvanizing. Outgassing doesn't occur with galvanized steel, however, because the surface has been annealed to relieve the stresses and release the entrapped gases.

Surface contamination. Outgassing can occur when a powder coating is applied over a substrate with surface contaminants. The contaminant can be oil, grease, mold release, or any other material that can vaporize through the powder coating during the curing process.

Although the problem is usually labeled as stemming from improper pretreatment of the substrate, not outgassing, the defect on the coated surface is the same.

Coating thickness. Outgassing can also occur when powder is applied thickly during a single pass. In this case, gases released during the curing process burst through the coating surface, causing pinholes.

How can you eliminate outgassing?

Now that you know what outgassing is and how it occurs with some substrates, you should evaluate the methods of reducing or eliminating the problem. In some cases, it's unnecessary to completely eliminate the problem. For example, if the outgassing occurs with a nonappearance part that doesn't need high corrosion resistance, you shouldn't really worry too much about it. Certainly you couldn't justify the costs of taking care of the outgassing problem. The first question you need to ask yourself is this: Does this part require the corrosion protection or high-quality appearance that outgassing interferes with? If you answered yes, then read on for ways to take care of the outgassing problem.

Preheating the part. This is the most popular method of dealing with outgassing. The part is preheated to release the trapped gas before powder coating. You can preheat the part in the dry-off oven with a temperature higher than the cure temperature. Or you can allow the part to travel through the entire powder coating line, including the cure oven, without applying the coating. The heat from the cure oven drives out the trapped gas. Then, you can coat the part on its second trip through the line. The second method is normally used if the plant has the conveyor time or if the dry-off oven temperature can't be raised high enough. This method may not eliminate outgassing if the part has a lot of trapped gas. If the part has that much trapped gas, it just keeps releasing it no matter how many times you preheat the part.

Aging the castings. In the past, castings were allowed to age naturally, which released trapped gas and made the material more stable for machining. In today's marketplace, however, waiting 6 months or more for castings to age before they can be used is all but unthinkable. There are ways you can accelerate this process by using artificial aging techniques. Contact your casting supplier or talk to a metallurgist for details.

Sealing the part surface. This method requires you to apply a primer or another material to seal the gas inside the substrate, which eliminates the outgassing. Some companies specialize in impregnation processes with such materials. Contact a primer coating manufacturer to find out about sealant products. [Editor's note: For more information, see "Outgassing expertise with castings fuels job shop's push into powder," by Matthew Knopp, *Powder Coating*, vol. 6, no. 5 (October 1995). Also see "A job shop masters methods to outwit outgassing," *Powder Coating*, vol. 4, no. 4 (August 1993).]

Changing the curing technology. Switching to an infrared cure oven can eliminate outgassing. Infrared ovens heat only the part surface, not the part. And heated

parts give off gas. This method may not work for you, however, because of line-of-sight problems associated with IR curing of complex parts.

Formulating the powder. You may have to ask your supplier to improve the flow characteristics of the powder coating you use. Improving flow enables the powder to remain in a melted form for a longer time during the cure process, which allows the gases to escape. The coating flows over the pinholes in the castings and creates a smooth finish. However, high-flow powders can cause problems more difficult to solve than outgassing. A high-flow powder may sag more easily than other powders and may draw back from sharp edges to reduce edge coverage. You should talk to your powder supplier about what features are more important for your specific application. You could also replace a powder coating that appears smooth when cured with one that appears textured when cured. The texture will mask the outgassing pinholes, but it won't improve the part's corrosion resistance. The pinholes will still be there to allow corrosive liquids to penetrate the coating.

Changing the substrate. This could be your best bet if you can't use any of the other methods discussed here to eliminate outgassing. I know it sounds like you may be giving up, but sometimes retreating is the best strategy.

Eliminating the contamination. When outgassing occurs on parts with surface contamination, the solution is easy: Clean the part before you powder coat it. Find the contaminant and remove it before coating the substrate, and the outgassing problem will go away. Contact your pretreatment chemical supplier for help.

Controlling the coating film thickness. If excess film thickness on the part is causing outgassing problems, then reducing the film thickness is the easiest way to get rid of the outgassing. If you require a thick film build for the parts, you could try applying the powder in two coats. If that's not practical, have your powder coating supplier

reformulate the powder so that it can be used in a thick-film-build application.

How do you stay free of outgassing?

You can see that outgassing in the powder coating industry doesn't have to raise eyebrows. It's necessary to first find the cause of the outgassing on the part and then start investigating solutions. Following the recommendations in this article should help you find a solution that works for your substrate. And remember, never allow those eyebrow-raisers who say gas shouldn't be expelled in public to intimidate you in your search for the outgas-free part.

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