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Ask Joe Powder

Why Are We Falling Flat?

Q Hey Joe,

Why are we seeing random flat spots in a textured powder after the metal has been washed?

Aaron K., Decatur, Ill.

A Dear Aaron,

This is a very interesting problem and one that allows me to dust off my chemistry wizard's hat to help you understand and solve this caper. Random flat spots can occur when using a rather specific powder cure chemistry. In this case, it is technically not a "textured" powder finish but a "wrinkle" finish.

In the powder technical world we can create textures through a variety of means. Typically, a formulator will load a product with either a dry, absorptive filler or a non-melting particle (or both) to create a texture. The filler dries up the binder to the point of restricting melt flow and thereby creating a texture. The incorporation of non-melting particles (typically PTFE-based, a Teflon®-like material) causes protrusions in the powder film and hence a texture reflecting the size of the non-melting particles.

The product you're using and experiencing trouble with probably uses neither formulating approach to achieve its textured surface. Polyester-based wrinkle finishes rely on a funky cure mechanism to create the wrinkled surface. This phenomenon is based on a very specific catalyst system that keeps the melted powder film fluid until long into the curing phase.

Then after a certain amount of time in the oven the coating surface kicks over and tightens against the fluid film creating the wrinkle.

Now here comes the chemistry part. This catalysis system is based on an organic acid. The influence that your wash system has on the wrinkling phenomenon is due to residual alkali on the surface of the metal. Most common metal wash systems use an aqueous solution of a strong base (a.k.a., alkali) such as sodium hydroxide. This residue neutralizes the catalytic acid which essentially stymies the wrinkling mechanism. (Boy, am I glad that I finished my chemistry degree.)

So what can you do to correct this problem? I suggest that you find a way to more thoroughly rinse the cleaning solution off the metal. This will eliminate the localized buildup of alkali residue that causes the interruption of the wrinkle. If you don't want to follow this course of action, you could consider switching your powder chemistry from a wrinkle finish to a more traditional texture based on filler or PTFE particles formulating technology.

Thanks for the question, Aaron. It's always a pleasure to justify all those tuition payments I made long ago.

— Joe Powder

Air, Meet Particles

Q Hi Joe,

What makes one powder fluidize better than another?

Jason S., Denver, Pa.

A Dear Jason,

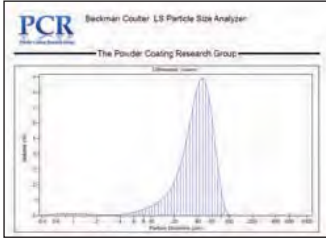
This is an excellent question. To make a powder coating perform well, many physical and chemical properties need to be aligned properly. Fluidization performance is one of the critical physical properties needed to successfully apply a powder coating. For you newbies, fluidization involves incorporating a volume of air into a quantity of powder to prepare it to be transported from the feed hopper to the application gun. This mixture of air and particles not only helps in transporting the material but also enhances the delivery of electrostatic charge to the individual particles as they exit the spray gun.

Particle size distribution (PSD) is the primary factor that influences fluidization. Powder coatings are comprised of range of different sized particles from about 1.0 micron upwards to around 90 microns.

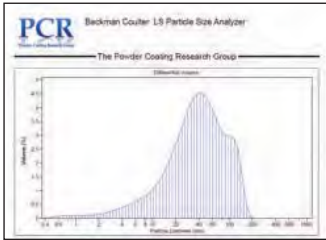
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Ideal: Narrow Particle Size Distribution—Low Fines, Low Coarse



Poor: Wide Particle Size Distribution—High Fines, High Coarse

The best fluidization occurs with the heart of this range typically 20 to 60 microns. Fines (< 10 microns) tend to agglomerate and impair fluidization. Coarse particles (> 90 microns) are difficult to fluidize because of their mass. Hence, the best fluidizing powder coatings possess tight particle size distributions. This means a minimal level of fines and also a minimum of coarse particles.

If you employ a reclaim system to capture and recycle oversprayed powder this can be a factor in

fluidization. The best suited particles are preferentially deposited on the parts you coat. And as you can surmise, the fines and coarse particles populate the overspray. Reintroducing overspray into your virgin powder feed will affect fluidization. This increasing in the level of fines and coarse may require adjustments to your fluidization process.

How do you avoid this problem? The best strategy is to use high quality powder coating from a reputable powder

manufacturer. The best suppliers have well-controlled grinding processes that yield relatively narrow PSDs. Narrow PSDs deliver high first pass transfer efficiency and hence less overspray to contend with.

A secondary factor that contributes to poor fluidization is moisture. “Wet” powder will be very difficult to fluidize and transport through a powder application system. High levels of moisture are usually due to poor storage and handling of powder coating inventory. Powder should be stored in an air conditioned environment and open bags/containers are to be avoided. In addition you should be careful to avoid introducing “cool” powder into a warmer, moister environment. The cool powder will act as a desiccant and absorb the ambient moisture. It is wise as you move powder from storage to the application area to allow it to acclimate to the ambient application environment before opening the package. Thank you for the question.

— Joe Powder

What’s the Alternative?

Q Dear Joe,

We powder coat in house and have a 5 stage washer of which 1 stage is a phosphoric acid bath. Do we have to have iron phosphate to get good adhesion? Is there an alternative process for iron phosphating?

Thanks!
Ken

A Dear Ken,

There are a number of alternatives to a five stage iron phosphate pretreatment. What you choose as your cleaning/pretreatment process largely depends upon three issues.

1. The type of metal(s) that you coat.
2. The condition of the metal substrates.
3. The specification and expectation of coating performance.

The first step in preparing a substrate for powder coating is to clean any foreign materials and compounds from the surface. This can be accomplished by mechanical means (e.g., abrasion, blasting, tumbling), chemical means (e.g., alkalis, solvents or soaps) or physical means (e.g., flame, plasma, corona).

Mechanical means can work very well if the substrate is relatively clean to begin with and if you use an epoxy based powder. As you probably know, epoxies are great for hardness, corrosion and chemical resistance but do not fare well in outdoor environments (UV degradation). However, epoxy or hybrid (epoxy-polyester) powders can provide very

good indoor performance with only a clean, abraded or blasted surface.

If the coating requirement involves any resistance to outdoor elements you need, at the minimum, to clean thoroughly, rinse and apply a chemical conversion compound to establish a bond between the powder coating and the metal substrate. This will provide a minimum of outdoor durability for resistance to corrosion and attack by moisture.

If the coating will find service in a more demanding environment (i.e., coastal areas, northern states where salt is used on roads, marine, etc.) then you need a minimum of a five-stage iron phosphate or better yet a multi-stage zinc phosphate pretreatment system. These have a long history of performance and are offered by many chemical companies.

If you wish to avoid using phosphate-type pretreatment systems due to handling or regulatory issues, then you can consider a few other options. Recently, non-phosphate systems based on zirconium, titanates and/or organo-silanes have replaced iron and zinc phosphate systems. These new systems require close process control and usually have to be tailored to the substrates and substrate conditions of the finishing line. All the major chemical companies have versions of these. I can provide a list of them if you wish.

Another option is to consider using a one-step pretreatment. One company in particular, Carpenter Chemicals, has a technology that was developed in Italy that has demonstrated success as a single-stage pretreatment. This technology is known as Plaforization and involves an organo-phosphate (not phosphoric acid) that is claimed to provide cleaning and metal pretreatment in one step.

Regarding physical cleaning methods such as plasma, flame and corona, these are most commonly used to clean and activate plastic surfaces rather than metal substrates. Plasma has an intriguing performance profile but is restricted to relatively small

substrates or low volume when used as a pretreatment process.

I hope this helps. Please let me know if you need more information.

— Joe Powder

Joe Powder is our technical editor, Kevin Biller. Please send your questions and comments to Joe Powder at askjoe powder@yahoo.com.

Editor's Note: Letters to and responses from Joe Powder have been edited for space and style.

Not Your Average Joe...

Each issue, we take the padlock off the PCI® Test-Lab door for a few minutes so our favorite technical editor and "powder guru" Joe Powder can run in the yard. When he's not nipping at the mailman's heels, he loves to answer readers' questions. Go ahead and send him one at askjoe powder@yahoo.com... he doesn't bite. Maybe it'll end up in the next issue!