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The What, Why & How of Powder Coating

Solutions to six potential problem areas for powder applications

TWGema

TROUBLESHOOTING TIPS FOR POWDER APPLICATIONS

Solutions to Six Potential Problem Areas

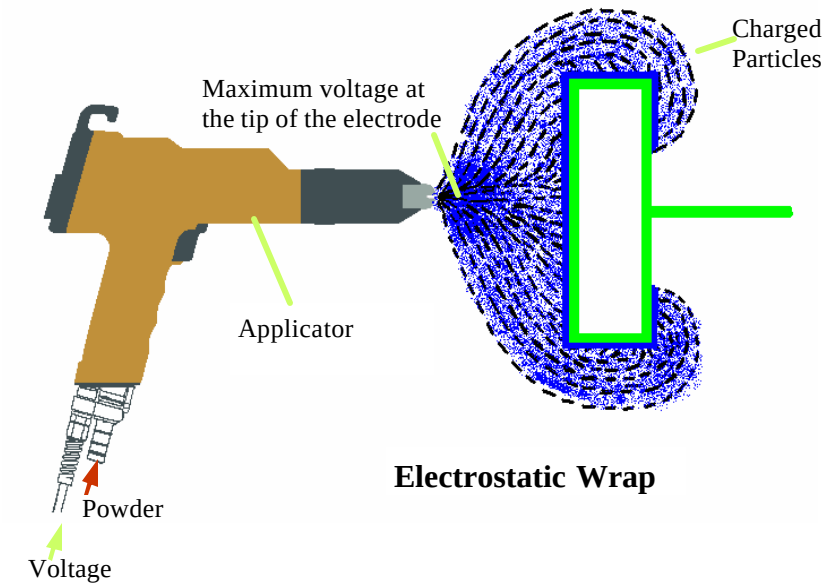
One of the keys to continued success for powder coating operations is to have operators well trained to trouble shoot performance. Properly trained operators help to improve operations in three areas: lower operating cost, higher profitability and better production throughput. The following is a review of six typical problem areas that powder coating operators must know how to address in order to achieve optimal performance with a powder coating system.

Trouble: Poor Charging

Transferring the powder to the part is critical. Often if powder is not being transferred to the part it is the result of a lack of ground. Many times the substrate to be coated is insulated from an earth ground and, therefore, not able to accept the charged coating. This may occur when the path to ground is insulated. The path to a good ground is often complicated and can have multiple points of contact including; the conveyor and it's trolleys, the hook attachment to the conveyor or load bar and the actual part hanging points on the rack or hook.

When a part cannot make good contact with the hanger or transporting rack, then only a small amount of powder will be attracted to the part surface. To avoid this problem, the following solutions may help:

- Clean hangers regularly. This is dependent on the volume of powder sprayed and the hook design. The number of times a hanger can pass through an application before the powder builds too heavily is variable. A reasonable rule of thumb is 2-4 passes through the system.
- Make sure the part is making good connection with the hanger each time a part is loaded on the line. A good hanger design allows for positive contact surface between the part and the hanger. When possible the actual contact point should be shielded from the powder application to reduce build up.
- Check the resistance to ground periodically. By using a megohm meter, the resistance to ground may be measured and should be no greater than 1-mega-ohm of resistance. The megohm meter should be connected to a true earth ground such as a ground rod and the other lead connected to the part. This gives the total combined resistance from the part to ground. Less resistance is better.
- Grounding may also become a safety issue. If the part becomes isolated from ground it will not dissipate the applied charge. In this case the



Electrostatic Wrap

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part effectively becomes a capacitor and may create an arc or spark to ground. This condition is not safe for the operators or application environment.

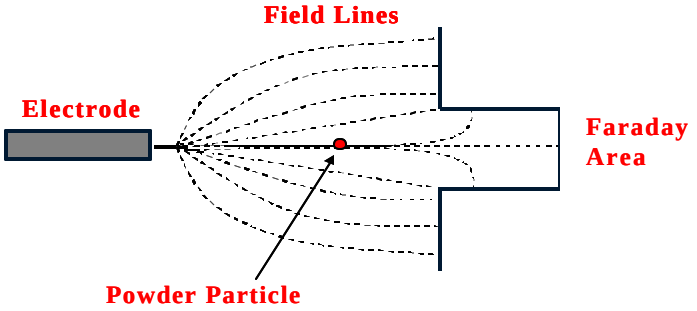
- Poor charging may also be the cause and can be created by external factors such as the application environment. For more consistent performance it is important to maintain the ambient conditions in the room to the recommended levels suggested by the materials and equipment suppliers. Typical relative humidity in the room should be 50% ± 10%. Temperature should also be controlled in a range of 75°F ± 5°F .
- If the environment is controlled and the problem cannot be traced to a grounding issue, investigate the power supply and applicator for a failure. Powder equipment manufacturers offer specific high voltage gun meters to match their designs. Including the manufactures recommended meter in a preventative maintenance program is a good idea to help eliminate the applicator as a potential problem source.

Trouble: Poor Penetration

Powder delivery rate, low supplemental or atomizing air, poor ground, incorrect spray pattern, high voltage and/or poor gun placement may cause poor penetration of the powder material. If the powder cannot penetrate and cover the product you are coating, a great deal of money, time and energy will be spent recoating these parts until they are sufficiently coated.

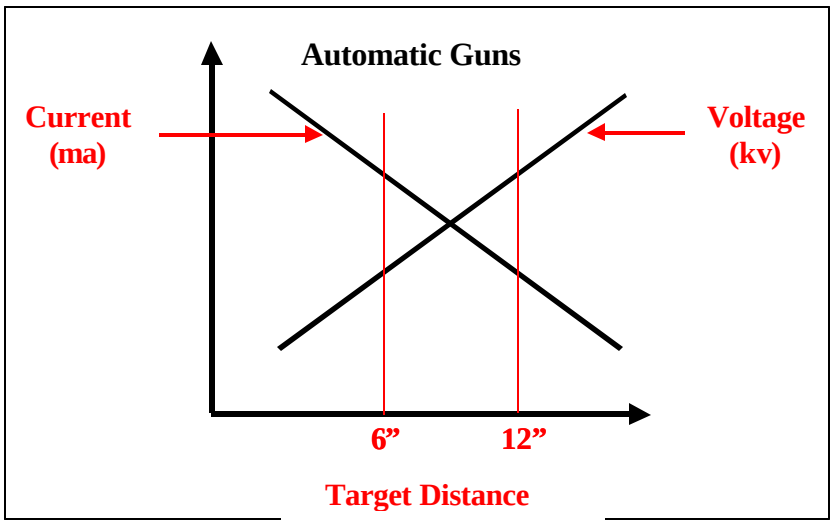
Most problems of penetration are caused by the "Faraday cage effect". The Faraday effect occurs when an electrical cage is created by the part configuration. Edges and shapes that create deep recesses are attractive antennae for the charged particles, inhibiting the penetration into the corners. The charged powder particles always want to take the path of least resistance.

Faraday Cage Effect



To overcome this problem, several techniques may be employed:

- Try various nozzle tip designs. Different tips produce a different and particular spray pattern and some are designed specifically to increase penetration. Tips best suited to penetration typically have narrower pattern or focus and as a result higher forward velocity.
- Another method, often combined with tip design, is to decrease the gun to target distance. By bringing the gun closer to the part, the powder is forced into the recessed area that is to be coated. This works well for manual applications and may serve well in automatic applications. In automatic applications, the adjustment should be tested to ensure that coverage is not lost somewhere else on the part by relocating the guns. In automatic applications the right gun target distance is very important. By moving the gun in or out relative to the product coated causes the effective pattern size to change. This will change the ability of the powder to cover the part. If the penetration area can be made repeatable by hanging configuration an additional target gun may be used to improve the performance.
- Gun target distances for manual applications may be from 2" to 6" away from the substrate. For



(under resistive load)

automatic applications, a target distance of 8” to 12” from the substrate is common.

- Increase the spray velocity by increasing the supplemental air or possibly increasing the powder delivery. Increasing delivery air pressure will give the powder particles more forward velocity in an attempt to overcome the Faraday area. Because there is more forward velocity it is important that the angle and target location of gun is set to reduce the possibility of the powder simply blowing back out of the area being addressed. The drawback to higher velocity is often more powder being sprayed. This can cause additional build on the edges and surfaces surrounding the penetration area.
- Voltage and current of the applicator can often be used to manipulate penetration performance. Often it is best to turn the voltage down to penetrate a recessed area. Minimizing the voltage achieves better penetration by reducing the effects of the electronic cage created. To improve penetration decrease the percentage of the guns output voltage by 30 to 50%.

Trouble: Back Ionization

Back ionization occurs when charged powder particles can’t find a ground point on the surface of the part and consequently build unevenly onto other particles on the part surface. As the powder builds up on the part it insulates the grounded surface. The result is the surface texture (in the uncured state) appears very rough. Typically called “starring”, the uneven coverage of the powder will still cure, but produce an “orange peel” look. For most decorative appearances, the orange peel appearance is undesirable. Remember that back ionization is typically the result of heavy film builds or excessively “hot” or conductive powders.

To avoid back ionization try the following:

- Lower the voltage setting. But be aware that reduced voltage may lead to unacceptable penetration and/ or coverage.
- Optimize the gun target distance for coating the desired part and attempt to maintain that distance at all times. Often this relates to the hanger design. Make sure the hangers are consistent and repeatable. Bent hangers or swinging parts change the target distance. Typically having the gun too close to the part contributes to the problem.
- Use a grounding ring or some form of ion collector as a ground source to reduce the surface effect. These devices are made specifically for the applicator type by the manufacturef and when installed are located on the gun but behind the electrode tip. The purpose is to capture unused ions from the charging process that may disrupt the surface coating through bombardment of the already deposited powder.

Trouble: Powder Feed Surging

Powder surging is typically a result of an inconsistent compressed air supply or blockage in the powder pump or feed line.

For a quality compressed air supply, maintain the correct volume of air available for the powder paint system. Clean, dry air is important. The compressed air supply feeding the powder system needs to be conditioned. This is accomplished with a properly sized air dryer. Either a refrigerant or regenerative air dryer is acceptable. When the air volume required is 500 scfm or greater, a regenerative unit may be preferred. Other items required with the air dryer are a particle filter and a coalescing filter. It is best that the filters in the system be set up with automatic drains or flags that indicate when service or replacement is required.

Air quality requirements are three-fold: maximum oil content of 0.1 ppm, dew point of 35°F or lower, and particulate matter no larger than 10 microns.

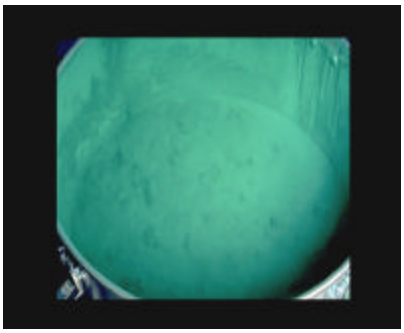
By keeping the powder free of moisture, oil and other dirt, powder fluidizes more evenly and the pump can lift the powder through the suction tube easier, transporting the powder to the gun more efficiently.

Other items to check when powder feed surging is taking place:

- Check powder feed hoses to determine if they are pinched, routed correctly, excessively long or kinked.
- Check for impact fusion inside the hoses or on the gun components that can impair flow and cause powder surging. Performing periodic maintenance of the equipment can avoid this problem. Follow the manufacturers' guidelines for regular checks and cleaning of the components in the powder path. This includes the gun tips, electrodes and pump inserts. To prevent additional build up never leave the powder hoses full of powder at the end of shifts or overnight. Before shutting down the system use compressed air to blow the lines and guns free of residual powder. As a regular rule this should also be done at the end of each shift and before going on breaks.
- Check fluidization that may cause powder surging. Uneven fluidization can cause too little or too much air in the mixture at the suction tube. Fluidization should be an even and uniform soft boiling in the feed hopper. Often a minor adjustment in the fluidization pressure corrects the problem.

Trouble: Hopper Fluidization

Fluidization of the powder hopper is the process of preparing the powder in the gun feed hopper to become "fluid-like", enabling the powder to become easily transported through the suction tube and to the gun. Other methods for preparing the powder are vibration, agitation (stirring the powder) or combinations of methods.



However, fluidization is the most frequently used method for material handling and conditioning of the powder. To fluidize the powder, compressed air is brought into the hopper through a plenum chamber and membrane. The air is delivered through the membrane and then through the powder in the hopper. As the air moves up through the powder it lifts or "fluffs" the powder, making it fluid-like.

Most users cannot take the time to adjust the hopper fluidization air setting each time the power level changes. As the level raises and lowers the density of the powder/air mixture in the hopper changes. As

a result the density also changes in the suction tube assembly.
This means that as the powder becomes more or less dense as the level changes the delivery air remains constant. The result is that the powder pump is actually delivering more or less powder to the gun. Users will notice that the gun outputs vary throughout the day as the powder level in the hopper rises and falls.
The best approach is to maintain a constant level of powder in the hopper. This minimizes the adjustments to the fluidization air and delivery air, keeping a consistent delivery of the powder to the gun and assisting the gun in applying the powder uniformly on the substrate.

Trouble: Inconsistent Powder Delivery

Control of the powder delivery is critical to the performance of the application. Charging efficiency and applied film thickness uniformity are dependent upon consistent powder delivery.

Many users do not understand the importance of powder pump control and how it affects a powder coating operation.

A pump is used to get powder to the spray gun. This pump, called a venturi or injector pump, is designed to pneumatically convey the powder material from the fluidized feed hopper to the spray gun.

By varying the delivery-rate, different volumes of powder are sprayed. This allows the user to coat products with different shapes and achieve the same or different film thickness.
Control of the powder delivery is important to maintaining good film control. If too much powder is sprayed, either more powder is applied to the part than is required or more reclaim powder is created. Too much powder delivery may also decrease charging efficiency by diluting the ability of the applicator to completely charge the material being applied. This leads to poor transfer efficiency and reduced material utilization. Standard venturi powder pumps are normally accurate to within ±5 to 10% of the desired output required. When delivery problems occur always check for insert or venturi wear and replace them early.

The accuracy noted, acceptable for the majority of applications, leads to greater variation in the powder film thickness applied. As a result, operators will often overcompensate by increasing the powder output to avoid undercoated or “light” parts. This leads to an increase in powder consumption for the same production volume. The optimal solution to the problem is to increase the accuracy of the standard delivery system.

One method is the use of process controls that provide reliable, accurate and repeatable control of powder delivery and electrostatic voltage. The analog powder process control equipment used for this purpose consists of an analog control module and gun control unit. Tied together with programmable logic control (PLC) automation, these two modules improve powder coating application by ensuring consistent and repeatable film build.

The analog control unit operates as a single interface between the PLC and the automatic powder gun control. The analog control unit is a micro-controller based interface designed to communicate the powder delivery rate and gun high voltage output to a gun control unit. The analog unit uses a micro-controller along with a gun control unit to regulate the amount of air volume and high voltage each gun receives.

The analog unit is designed to help control powder film build across substrates that have

complicated or changing profiles. The unit can be programmed to change powder delivery and change settings across any single part on a single pass through the powder guns coating zone. This helps to control edge build and center surface build up.

Due to the nature of electrostatic attraction of the charged particles, the leading and trailing edges of substrates have a tendency for heavier film build compared to the middle of the part. Parts that contain cavities, recessed openings or many returns create difficult to coat areas. With the analog control unit, the guns can be programmed to decrease powder delivery on leading and lagging edges of parts and modify charging performance within Faraday Cage areas. Since the program is permanently stored in the PLC it can be recalled quickly and sent to the unit for coating specific products.

Analog delivery systems are more expensive than basic delivery systems. Another alternative to improve uniformity and control may be accomplished through the use of triggering systems. Triggering minimizes the amount of over-sprayed powder and may also reduce excessive coating. In addition to minimizing over-spray, triggering also reduces amounts of powder sprayed when parts are not present in the system. Conversely, forgetting to turn guns back on may also cause inconsistent coverage when batches are changed in product configurations. In all, utilizing triggering to reduce powder waste also helps reduce wear and build up on the components of the system within the powder path.

There could also be other factors affecting the powder delivery rate, such as the following:

- Inconsistent compressed air supply or quality from the plant air source can cause pump delivery rates to increase or decrease
- Tubing and powder hose lengths can affect the ability to provide consistent delivery rates
- Wear of powder pump parts can cause poor powder delivery
- Maintaining a good blend of reclaim and new powder helps to control the powder particle size distribution.

The Results

Once operators have been trained and are operating and maintaining your equipment efficiently, you will see an increase in profit, better production throughput and lower operating costs.