Bulk Application of Electrocoat: The Application of the Future

The most common method of coating fasteners is the dip-spin method; however, it does have some disadvantages that electrocoat can handle...

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As electrocoat formulations have improved over the years, applicators have been looking for new ways to use electrocoat to coat parts. With the release of new pigment and resin systems, bulk application of electrocoat, especially cathodic electrocoat, has come to the forefront as a coating system for fasteners and small stamped parts.

Typically, fasteners have been coated in bulk using various application methods. The most common method is a dip-spin application. This process can achieve high throughput, but it does have some drawbacks, such as transfer efficiency and the high possibility of recess head fill or bridging on the threads. Electrocoat eliminates head fill or thread bridging concerns while producing a film that is a consistent thickness. This can all be achieved while parts are processed in a high volume application, such as a barrel, to achieve excellent production volume of pounds of parts produced per hour.

Finish Quality

Small stampings are usually racked in electrocoat systems. Although you get the high quality and efficiency of the electrocoat system, hanging small parts on a rack is time consuming and costly. A bulk application of electrocoat can still give a quality finish and eliminate racking.

To determine if a bulk application will fit, the first thing that must be considered is the quality requirements of your customer. If your customer requires a "Class A" finish, bulk application is not for you. However, if your customer requires a continuous paint film with only a few small blemishes, it could be a viable option. Bulk electrocoat will also meet many automotive small parts specifications for salt spray resistance, humidity and water immersion.

Bulk application of electrocoat on fasteners has made great strides in quality improvement during the last few years. Small fasteners are easy to coat in bulk and achieve excellent appearance. Small fasteners also test very well in salt spray when coated 0.6-0.8 ml thick.

Bulk Coating for Automotive

In automotive circles, it is the larger fasteners that are difficult to coat in any bulk application. The weight per sq ft of surface area can cause touch marks on heavier fasteners. The touch marks, although very small, can cause corrosion points. Often this is the only corrosion on the part.

The goal for most automotive fasteners has been to meet the salt spray requirements of USCAR 1. This specification has been drafted as a reference test criteria for automotive fasteners. It is a difficult specification to meet, but it does ensure that the

finishes meeting the requirements of USCAR 1 will serve the automobile industry well. Bulk application of electrocoat can fit certain specifications for fasteners right now. Work is being done to find a bulk electrocoat finish to test to 600 hr salt spray and meet the USCAR 1 criteria of no more than 0.1% red rust on the part. It will be a difficult hurdle to overcome but a goal many feel is attainable.

Figure I: Barrel full of fasteners is transported from a black electrocoating tank to the rinse tank. Bulk electrocoat offers high-quality, high-throughputand lower overhead costs.

Torque tension is another significant requirement of automotive specifications, specifically on fasteners. This is to insure that the fasteners will assemble consistently in the assembly plants and make a good joint every time. Torque tension modifiers are added to the product to achieve the necessary torque tension values. In production runs of the cathodic electrocoat, fastener coating torque tension values have been consistent with deviations well within specifications.

It is important that you have a complete understanding of your customer's test requirements to give you the basis for an evaluation of bulk electrocoat as an application option. In many cases it can work.

Part Shape and Size

Part configuration is another important aspect of determining if bulk application of electrocoat can work for your organization. Some parts lend themselves very well to bulk applications others do not. When evaluating the parts you would like to run in bulk, look at part size, part geometry, part weight and part final appearance.

Size of part in bulk application is important from an equipment perspective. If the part is too large, you many not be able to ecoat enough parts in bulk to make the investment worthwhile. If the part is too small, special equipment maybe needed to process the pieces. Typically, fasteners are relatively easy to process in bulk. Stampings up to a size of 2-3 sq ft in surface area can be processed in a bulk application. It is important to size your equipment for your largest part.

Part geometry can restrict the types of parts processed in bulk. Although parts with many sides are easy to process, flat parts are not as easy. Part-to-part nesting needs to be evaluated when deciding to bulk process parts. Parts that tend to nest will not coat as uniformly as parts that break up in the load. This nesting will cause part-to-part variance in film appearance and film thickness. It will also increase the amount of part-to-part sticking in the load. Be aware of the part geometry when evaluating a bulk application.

The weight of parts is another aspect of the process that needs to be evaluated. Heavy parts with a high weight to square foot of surface area may cause significantly more touch than lighter parts. This happens because the part compresses the uncured film. As the weight of the part and the load of parts increase, the more the film compresses, until it actually causes a touch mark to form. These voids then can cause a problem in corrosion testing.

Final Finish

The final part appearance is also critical in evaluating if bulk electrocoat is acceptable as a finish option. The bulk operation will produce a uniform film that has good aesthetics. It will rival a part that has been coated on a rack line. It will not produce a "Class A" finish. If your customer wants a "Class A" finish, bulk applications are not for you. If your customer wants a finish that is uniform in appearance, gloss and film thickness, then bulk application of electrocoat is a viable option.

Bulk barrel coating of fasteners has been done for many years using anodic electrocoat. This worked well for barrel applications, but it did not offer good corrosion resistance.

As development of cathodic formulations evolved, it was evident that this type of chemistry offered many advantages compared to older anodic technologies. Corrosion resistance, more resistance and chip resistance were all advantages to anodic type formulations. The biggest obstacle in using cathodic epoxy or acrylic chemistries was parts sticking together and the high probability of the uncured paint film being damaged during the coating and material handling process.

Development work has centered on base cathodic epoxy formulations. Proprietary resin systems

in conjunction with advanced pigment feeds have been developed for bulk processing of parts to yield acceptable visual appearance and give enough corrosion protection to meet many specification requirements for many industries. This technology has been the backbone for most electrocoat applications in the world today. It appears that with further development, it will allow electrocoaters the option to bulk process parts that historically had been racked coated.

Figure II: Copper-color electrocoating is also done on fasteners and other parts.

Acrylic cathodic electrocoat has also been in development for bulk application. These products give good corrosion resistance and are excellent in outdoor exposure and resistance to chalking. Many of the same issues that have been encountered with epoxy technology have been evident with acrylic development. Application of acrylic cathodic products is being done on a limited basis today. Many advancements have been made to coat this technology in bulk. The lessons learned from epoxy development have been transferred to acrylic development. The biggest obstacle in bulk application of acrylics, especially in a barrel, is sticking. This has been minimized with new resin and pigment systems; however, it has not totally been solved.

The Bulk Coating Process

Parts are processed through a zinc phosphate system. Parts are cleaned of all soils and pickled with an acid if necessary. The zinc phosphate is then applied to the parts. Typical coating weights for the process can range from 250-800 mg/ft2. Parts are then rinsed, and a final seal (usually chrome-free) is applied. The final seal is rinsed in RO or DI water. The parts are now ready for the electrocoat application.

In the electrocoat system, the parts can be immersed for 1-5 minutes depending on application equipment and film thickness desired. Parts are then rinsed in permeate rinses and a final DI water rinse. The parts are then cured in an oven at the recommended temperature and for the recommended length of time.

Coating thickness can be manipulated to meet the specification of your customer. Film thickness of 0.6 – 0.8 mil is typically deposited on fasteners and small parts to meet most specifications. Higher film thicknesses are achievable by altering process variables.

Bulk Coating Equipment

Tanks for the system can be mild steel with a fiberglass reinforced epoxy lining. This coating should be on all tank materials below the solution level to prevent it from coating during the paint cycle. Rinse stages can be plastic materials or stainless steel.

The pumping and ultrafiltration system is a standard system for cathodic electrocoat. The system should sweep the bottom of the tank to minimize any settling of the paint. The system should have a heat exchanger and chiller system to be able to achieve recommended bath temperatures.

The application equipment used in bulk electrocoat is basically the same as in rack lines. The barrel used can be made from carbon or stainless steel. Hole size for the mesh can be 1/8 to 1/4 of an inch.

Material or part handling is the largest obstacle that must be resolved to make this process foolproof. Touch marks and voids from part-to-part touching have caused concerns for the overall corrosion resistance capability of the film. Work is being done on two fronts to eliminate these touch marks. Paint chemistry is being addressed to make the uncured paint film more resistant so that

Typical "Inline" Process			
Stage	**Process**	**Time***	**Temp**
1	Alkaline Cleaner	3 min	145-155
2	Alkaline Cleaner	3 min	155-165
3	C/F H20 Rinse	3 min	Ambient
4	C/F H20 Rinse	3 min	Ambient
5	Fresh R-O H20 Rinse	3 min	Ambient
6	Acid Pickle	3 min	Up to 160
7	Acid Pickle	3 min	Up to 160
8	C/F H20 Rinse	3 min	Ambient
9	C/F H20 Rinse	3 min	Ambient
10	Fresh R-O H20 Rinse	3 min	Ambient
11	Zinc Phosphate	3 min	145-155
12	Zinc Phosphate	3 min	145-155
13	C/F H20 Rinse	3 min	Ambient
14	C/F H20 Rinse	3 min	Ambient

15	Fresh R-O H20 Rinse	3 min	Ambient
16	Drain	3 min	Ambient
17	Index to Paint	3 min	Ambient
** Does not include transfer and drain times*			

when parts touch each other, they do not cause a touch mark or void in the coating.

Material handling engineering is also being researched to determine the best way to apply electrocoat in bulk and eliminate part-to-part and part-to-equipment touch marks. There are many interesting material handling systems that can allow electrocoat to be applied in bulk applications. Historically, it has been done in barrels or baskets. New innovations in material handling systems may be applicable to the bulk electrocoat process. Only time will tell if these innovations fit the process.

Bulk electrocoat of fasteners and stampings can offer many advantages to the application. High quality, high throughput and lower overhead costs are a few of the advantages. These uses of electrocoat can also allow end users some flexibility in specifying electrocoat to meet ELV (end of life vehicle) requirements and finish consolidation goals in the automotive industry for fasteners and small stampings. Electrocoat can be an option to replace many finishes now being used in industry today.
