UV Coat-and-Cure System for Metal Containers

By David Hagood

In today's manufacturing environment, it is critical to utilize leading-edge technology to drive cost savings and deliver ROI—Return on Investment. This article provides a financial and technical case study on the implementation of UV coatings on metal containers. In this case study, the manufacturer transitioned to UV coat-and-cure technology and was rewarded by the economic benefits—plus the sustainability of this green technology.

The decision to move ahead with a UV coat-and-cure system was made very easy because of the homework done before purchasing the system. The data showed the manufacturer how the UV system could give them more production capacity at a lower cost per part than with their old system.

Existing Process—Reasons for Change

The existing coating system was based on solvent technology, which contributed to several problems. The manufacturer was faced with escalating energy costs due to the use of high-temperature ovens. They could not preassemble their products because they used a heat-sensitive seal that would distort in the oven process. This resulted in post-finishing handling which caused more rejects. The finishing line was a slow and pacing process—it's the bottleneck of the production operation. Because of the line length required for curing, there was excessive work-in-process. This also caused a great deal of rejects because if something was out of adjustment in the spray process, it wasn't seen until the part exited from the oven. Production volumes also needed to increase to keep up with customer demand. Lastly, the existing system consumed a large area in the factory, inhibiting the customer from creating a better process workflow for manufacturing their product.

Potential Solutions—Technology Reviews

The manufacturer looked at a variety of potential solutions, including the following:

1. Low-heat cure powder
2. Two-component, solvent-based coating
3. 100% solids UV coating

Each coating technology was reviewed by the manufacturer and details were provided on the most recent changes and updates to each respective technology. This gave the manufacturer the data required to perform a comparison model of each technology with both its pros and cons.

Low-Heat Cure Powder

Low-heat cure powder coating technology addressed the issue of the heat-sensitive substrate, which would allow them to preassemble their product. Some of the limitations of low-heat powder include an overall footprint that is almost as large as the existing solvent-based system. Even though the powder is low-temperature cure, the part temperature still reaches

200°F, requiring a cool-down period before operators can handle the parts. Also, special cleaning was required before coating, which adds to the floor space required for the system and to the overall cost of operation. A completely new system was required because the technology was different than the solvent-based system. Also, even with lower heat, the temperature required for curing was at the threshold level for softening the seal and potentially creating a problem. Lastly, low-heat cure powder requires special handling. Because it tends to pack and clump easily, it is required that the powder is stored in an air-conditioned room and the boxes of powder cannot be stacked on top of one another, thus requiring more space for storage.

Two-Component, Solvent-Based Coating

Two-component, solvent-based coating was a potentially attractive technology because it allowed the manufacturer to use most of his existing equipment. The two-component coating also allowed him to coat and cure without having to be concerned with damaging the seal in his product, thus allowing him to preassemble his product. Some of the drawbacks of using the two-component technology included the continuation of using a VOC-laden coating; using a coating that posed more health hazards than any of the other technologies, including the existing coating material; and the coating has a short pot life (meaning that a short time after mixing component A and component B together, the coating will harden). This process requires careful attention to mixing the right amount of coating to minimize waste and making sure the equipment is cleaned properly, in a timely fashion, to prevent the coating material from setting up in the system.

100% Solids UV-Curable Coating

UV-curable coating technology was a foreign concept to the manufacturer. At first, he was apprehensive about these coatings because he had minimal knowledge about the technology. He learned that the UV process had a unique set of parameters to contend with to keep his process working properly, but he determined that these parameters were easier to deal with than the other technologies. The UV coating had no volatile organic compounds, no hazardous organic compounds, and took up a smaller footprint than any of the other technologies. Like powder, the process was also very efficient due to the ability of reclaiming the oversprayed coating for reuse. The process also proved to be the most energy efficient and the overall applied cost-per-piece was lower than with the other technologies, even though the cost-per-gallon was higher.

After a series of tests in which they worked on optimization of the process and customization of the coating formulation for the substrate being coated, the customer chose to switch to a UV system. Below are some of the comparisons that allowed them to understand the process and make the decision for choosing the 100% solids UV technology.

Overall UV Process

Outlined in Figure 1 is a pictorial representation of the UV coating, cure and finished handling of the UV coating process.

The overall footprint of the UV coat-and-cure process was

FIGURE 1

Overall UV process

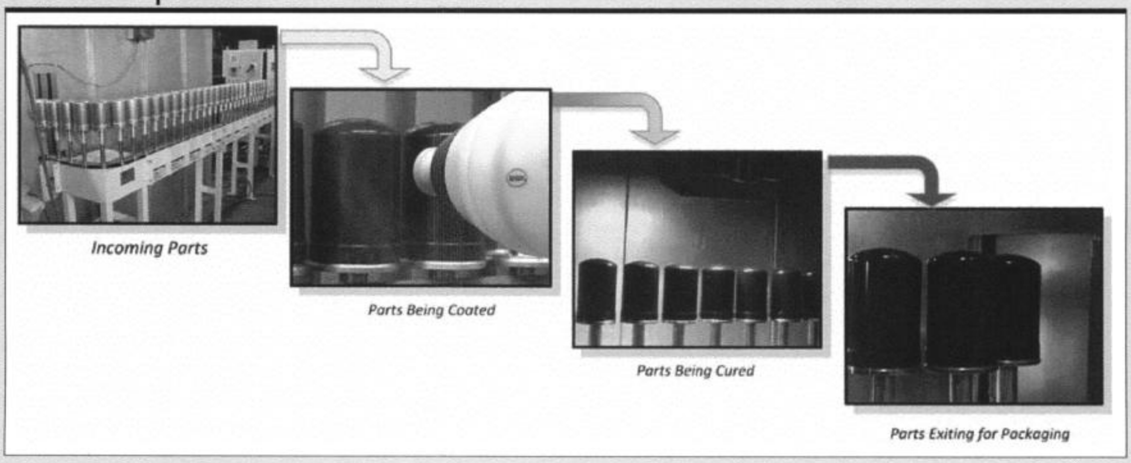

TABLE 1

Example of increase in line speed using UV versus solvent-based technology

Description	Solvent-Based	100% Solids UV Coating	Comments
Line Speed (Ft/Minute)	8	16	UV can run double the speed with room for higher speed in the future by adding more lamps for curing.
Minutes/Day Worked	960	960	16 hours/day x 60 minutes/hour
Production/Week	92,160	184,320	Parts on 6" centers = [(2 parts/ft. x line speed)*minutes of production]*days per week
Annual Production	**4,792,320**	**9,584,640**	**UV produces 100% more product based on increased line speed.**

15 ft. x 25 ft.= 375 ft^2 as compared to the existing solvent-based system with convection oven cure at 15,000 ft^2.

Faster Line Speed

UV coatings typically will deliver much faster line speed than conventional water- and solvent-based coating technology, mainly due to the fact that the coating cure is typically 1-2 seconds (See Table 1). The customer was able to increase line speed from 8 ft. per minute to 16 ft. per minute. UV technology delivered faster line speed which resulted in higher system throughput, increased overall production and better utilization of capital.

Coating Cost Analysis

Compared to the existing solvent-based coating, the overall material utilization stated in cost-of-coating per-part is lower using the 100% solids UV coating. Utilization of a highly efficient rotary atomizer for the application provides much higher first-pass transfer efficiency than the solvent-based process that utilized non-electrostatic airspray guns. Also, because the UV coating is 100% solids and contains no solvent or water, the oversprayed coating can be reclaimed and reused, thus providing a much higher overall transfer efficiency than with the solvent-based coating process. Table 2 describes the differences.

Return on Investment

The investment required for installing the UV line was approximately $250,000. As you can see in Table 3, the return on investment for switching to a 100% solids UV line is just over six months using coating savings as the only factor in the ROI equation.

TABLE 2

Cost comparison between solvent-based and 100% solids UV coating

Description	Solvent-Based	100% Solids UV Coating
Coating Cost/Gallon	$34	$95
Solids by Volume	42%	100%
Theoretical Coverage Square Feet/ Gallon @ 1 mil	674	1604
Coating Thickness Applied	1.0 mil	1.2 mils
Actual Coverage Square Feet/Gal	674	1,337
Transfer Efficiency without Reclaim	30%	75%
Actual Applied Square Feet/Gal	202	1,003
Coating Recovery Collection	None	95%
Additional Square Feet/Gal Using Recovery System	0	267
Total Square Feet/Gal Applied	202	1,270
Parts Coated per Gallon (.88 Sq/Ft/Part)	230	1,443
Cost of Coating per Part	**$0.1478**	**$0.0658**

TABLE 3

Return on investment in just over 6 months when switching to a 100% solids UV line

Description	Solvent-Based	100% Solids UV Coating	Comments
Coating Cost/Part	$0.1478	$0.0658	
Annual Volume	4,792,320	4,792,320 – 9,584,640	Can double volume with UV
Annual Cost Total	$708,305	$315,335	Even if UV volume is doubled, annual cost is only $630,670
Annual Savings	0	$392,970	
System investment for UV System: $250,000 **Return on investment at same production rate using coating cost—6.36 Months**			

Other Factors Not Taken into Account in Payback

Some of the other factors to consider for return on investment are energy savings, smaller footprint, elimination of hazardous waste, fewer booth filter changes and increased production capacity (which can translate to labor savings and less potential for rejects because work-in-process is so small).

Conclusion

In this case, the decision to move ahead with a UV coat-and-cure system was made very easy because of the homework done before purchasing the system. The data showed the manufacturer how the UV system could give them more production capacity at a lower cost per part than with their old system. The benefits of the UV system were substantially greater than with the other technologies considered for the project. The customer was able to purchase and install the UV system with confidence that it would meet all their objectives for their project.

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