Case Study 2:

Pressure Feed HVLP VS. Conventional Air Spray

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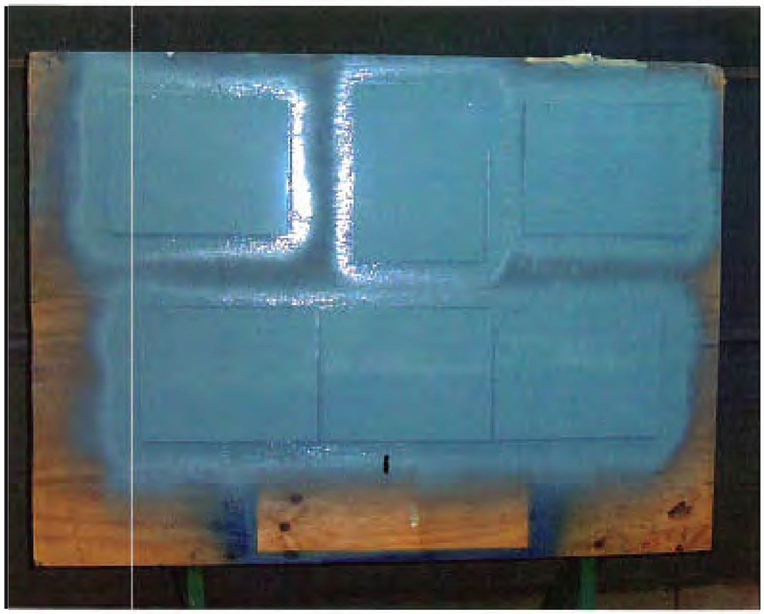
Introduction

Findings of Case Study I prompted Process Training staff to perform an in-house comparison of pressure fed HVLP and conventional air spray equipment using a relatively high viscosity coating. The intent of the study was to assess the performance of HVLP and conventional air spray in regard to transfer efficiency, production speed and finish quality when spraying a relatively high viscosity industrial coating.

Methods and Procedures

Spray application equipment used for the study included a variety of HVLP and conventional spray guns pressure fed by a diaphragm pump. Because of the viscosity of material, fluid nozzle sizes selected for the study ranged in diameter from 0.070" to 0.087". Atomizing air to the spray guns was conveyed through a 25-foot section of 3/8-inch air hose fitted with large capacity quick disconnects. Fluid from the pump was conveyed through approximately five feet of 3/8-inch fluid hose to a Micro Motion Elite fluid metering sensor. This metering system was used to monitor and record the amount of material sprayed for each spray gun on a mass and volume basis. It also provides information on the density, temperature and fluid delivery rate (on a mass or volume basis) of the material sprayed. After exiting the sensor, the fluid traveled through approximately 25 feet of 3/8-inch fluid hose to the inlet of the spray gun.



Test panel configuration used in the case study.

table 1

HVLP vs Conventional Air Spray Performance Data

Spray Gun Type and Panel Set ID	Fluid Pressure	Fluid Nozzle Diameter	Atomizing Air Pressure[1]	Fluid Delivery Rate[2]	Fluid Delivery Rate w/air[3]	Transfer Efficiency	Average Film Build	Total Oz Sprayed
HVLP (HC)	6.2 psi	0.086"	49 psi	4.2 oz/min	2.0 oz/min	65%	2.00	6.82 oz
Conventional (CD)	4 psi	0.070"	30 psi	1.5 oz/min	2.4 oz/min	64%	1.85	6.86 oz
HVLP (HD)	6.8 psi	0.087"	58 psi	5.3 oz/min	3.6 oz/min	67%	2.05	6.89 oz
Conventional (CF)	5.5 psi	0.070"	38 psi	3.0 oz/min	3.8 oz/min	66%	1.89	6.26 oz

[1]Dynamic air pressure measured at the pressure gauge on the regulator at the wall of the spray booth.
[2]Measured with atomizing air hose disconnected from the spray gun at a working height of five feet.
[3]Measured with atomizing air supplied to the spray gun at a working height of five feet.

Sherwin Williams Kem 400 alkyd enamel was sprayed during the study. This product was selected because of its fast-drying characteristics and suitability for a broad number of industrial applications. Paint viscosity and solids content measurements were taken and recorded throughout the course of the study. Throughout the comparison study, the viscosity and percent solids of the coating remained relatively constant. The viscosity measured approximately 16 to 17 seconds on a #3 Zahn cup while the percent solids of the material was determined to be approximately 46 percent by mass.

Flat test panels measuring 16.5 by 12.5 inches and constructed of 1/16-inch aluminum were used as targets. Prior to painting, each panel had been cleaned and labeled with a unique identification number. Each set of six panels were then arranged in the configuration illustrated in Figure 1, providing a total surface area of approximately 8.6 square feet (ft^2). The pre-coating mass of each panel was also measured and recorded to the nearest tenth of a gram for subsequent transfer efficiency (TE) calculations.

For consistency, the same Process Training staff person performed all the spray finishing. This same person was also responsible for adjusting each spray gun's atomizing air pressure and sizing the spray pattern with the shaping air valve. Additionally, the fluid needle adjustment knob was set to a full open position for each spray gun. Each set of panels was given two coats with approximately five minutes of flash-off time between coats. For comparative purposes, an effort was made to spray HVLP and conventional air spray guns at comparable fluid delivery rates (measured at a five-foot working height). This was accomplished through fluid pressure adjustment and nozzle size selection. The first fluid delivery rate used for the study was approximately 2.0 to 2.4 ounces per minute (oz/min). After finishing a set of panels at this rate with each type of spray gun, fluid delivery was increased to a rate of approximately 3.6 to 3.8 oz/min.

After curing, panels were again weighed to the nearest tenth of a gram to determine the mass of coating deposited on each part. Finish quality was also evaluated through visual inspection. To assess film build, ten dry film thickness measurements were collected at two-inch intervals diagonally across each panel. The average mil build for the entire set of panels was then determined.

Each set of panels was also ranked based on gloss and surface texture. This was conducted by displaying each set of panels side by side in no particular order. Without knowing the panel set I.D. numbers and conditions in

table 2

HVLP vs Conventional Finish Quality Rankings

Inspector	Parameter	Appearance Ranking			
		Best	→	→	Poorest
Staff Person #1	Gloss	HD	CD	CF	HC
Staff Person #1	Smoothness	CF	HC	CD	HD
Staff Person #2	Gloss	CF	CD	HD	HC
Staff Person #2	Smoothness	HC	CF	CD	HD
Staff Person #3	Gloss	HD	CF	CD	HC
Staff Person #3	Smoothness	CF	CD	HC	HD

which they were finished, three Iowa Waste Reduction Center (IWRC) staff were invited to rank the four sets of panels in order of gloss and degree of smoothness.

Findings

Table 1 summarizes the findings of the study. Information presented includes the type of spray gun used, the amount of paint used to finish each set of panels, the TE, and the average film build for each panel set. It also includes information on the operating parameters used to finish each set of panels (e.g., fluid pressure, atomizing air pressure, fluid delivery rates [with and without atomizing air to the gun], and nozzle size). Subjective data recorded for finish quality (in regard to gloss and smoothness) is provided in Table 2.

As indicated in Table 1, a negligible difference was found between the TE's obtained for HVLP and conventional air spray. Information in Table 1 suggests conventional air spray equipment is capable of achieving a TE comparable to HVLP while operating at a slightly higher fluid delivery rate. The volume of material used by each spray gun to finish the panels was also relatively consistent, ranging from approximately 6.3 to 6.9 ounces.

Another significant finding of the comparison was the finish quality achieved with each spray gun at different fluid delivery rates. As shown in Table 2, the HD panels (sprayed with the HVLP spray gun at a fluid delivery rate of approximately 3.6 oz/min) consistently ranked last for smoothness. A noticeably higher degree of orange peel was present on the HD panels. The panels identified as HC, CD and CF were comparable in appearance with respect to smoothness. This is reflected in the inconsistent ranking order assigned by each staff person and from staff comments on how difficult it was to rank these three panel sets.

In regard to gloss, the HC panels consistently ranked lowest. Again, based on the inconsistent ranking order and staff comments, the remaining panel sets (HD, CD and CF) were comparable in appearance.

Implications

The comparison study findings suggest the following in regard to TE, finish quality, production speed and fluid viscosity:

- ✔ For higher viscosity coatings, conventional air spray guns may be used just as efficiently as HVLP spray guns if they are properly set up and operated. As Table 1 indicates, conventional air spray guns are capable of achieving TE's comparable to HVLP air spray.
- ✔ From a finish quality perspective, conventional air spray equipment may be the best choice for high solids/viscosity coatings and production rates. As illustrated by study findings, the higher atomization energy levels available to conventional air spray equipment make it better suited for atomizing high viscosity coatings at higher fluid delivery rates. Consequently, conventional air spray guns may produce the desired finish when spraying high performance high viscosity coatings in a production environment while the finish produced by an HVLP air spray gun may fall short of expectations. As indicated above, this may be achieved without sacrificing TE.
- ✔ Findings suggest that HVLP's reputation for TE may simply reside in the fact that its design lowers the ceiling for excessive setup parameters, a particularly beneficial attribute when spraying easily atomized coatings. That is, when compared to conventional air spray, HVLP design restricts the degree to which operating parameters (i.e., fluid and atomizing air pressures) can be set to excessive levels. While advantageous for low viscosity or easily atomized coatings, this attribute puts HVLP at a disadvantage with more difficult-to-atomize high performance coatings.