First Successful Vertical Powder Coating Line Running Smoothly at Extruders, Inc.

By Joseph C. Benedyk, Contributing Editor

As a division of the Atrium Companies, Inc., Extruders, Inc. in Wylie, Texas produces 6000-series aluminum alloy extrusions on four presses, many of which are sold to the window and door market as well as to the patio furniture, trailer, RV, and other markets. Only about 30% of the aluminum extrusions made by Extruders are sold to Atrium. This year, Extruders estimates that it will extrude some 96 million pounds of aluminum billet on their presses, with about 75% of the extrusions being painted on their two vertical paint lines—one an existing wet paint line and the other a powder coating line that first began operating in August 2005 as the first such line in the U.S. The vertical powder line, designed and built by Trevisan Cometal S.p.A. (based in Verona, Italy), now in production less than one year, is running smoothly and profitably according to Jamey Rentfrow, vice president/general manager of Extruders (Figure 1).

Figure 1. Jamey Rentfrow proudly displays samples of UltraGrain™ powder coated wood grain finished extrusions.

The Extruders operation is an exceptional opportunity to compare vertical wet and powder lines, one applying wet and the other powder paint, operating side by side in one plant with associated production factors relatively constant. Also, both lines utilize a similar chrome-free pretreatment (E-CLPS®). Thus, the two lines offer a good basis of comparison of the operating efficiencies, coated product differences, and costs of wet versus powder paint in the aluminum extrusion industry in the U.S.

Powder Coating Venture and Startup

Founded in 1975, Extruders began producing aluminum extrusions on a 1,450-ton Watson Stillman press. In 1982-83 one 1,800-ton press was installed. In '99-2000, two more presses were installed, one an 1,800-ton and the other a 2,500-ton press, and in 1998 it installed a UBE 2,750-ton press. Altogether, these presses extrude 6000-series billets ranging from six to nine inches in diameter. The vertical wet paint line at Extruders was installed in 1995 by Tellkamp Systems, Inc.

By 2003, the expanding market for painted extrusions prompted Extruders to solicit bids for a new vertical line to supplement the output of its single vertical wet paint line. Then, Trevisan Cometal North America (Carrolton, Texas) approached Extruders about the possibility of installing a vertical powder coating line. As a member of the Trevisan Cometal Group, Cometal Engineering S.p.A., based in Brescia, Italy, had already equipped Extruders with handling systems, billet furnaces, billet shears, double pullers, and age ovens for their extrusion operations, so the proposal was taken seriously.

Rentfrow, with 25 years of experience in the aluminum extrusion industry, considered the Trevisan Cometal proposal with an open mind but cautiously. He was familiar with the short history and shutdown of a failed vertical powder coating line installed in Texas at Rockwall in the 1980s by what was then Alumax Extrusions. With the exception of the U.S., efficient vertical powder coating lines have operated successfully in Europe and elsewhere, mainly to supply the architectural market. Powder coating in the U.S. is basically limited to horizontal lines, which have low production rates, and higher costs relative to vertical powder coating lines. Needing the productivity and other advantages of a vertical line, Extruders had to make a decision between installation of a vertical wet paint or a vertical powder coating line.

Trevisan built the first vertical powder coating plant in Italy in 1981 and has innovated constantly since then. These innovations include two vertical powder booths working in parallel introduced in 1998 to increase overall system flexibility and eliminate conveyor stoppages for color, cascade tunnel pretreatment technology introduced in 2002 to achieve better quality and efficiency in preparing aluminum extrusions for painting, and a recently developed powder-on-powder wood grain effect decoration process that Trevisan calls EFFECTA (www.effecta.biz).

According to Trevisan chief engineer Alessandro Corra, Trevisan has sold about 120 vertical powder lines worldwide—the Extruders line being only the first in the U.S. He also notes that Trevisan operates five job shops in Italy, each equipped with a vertical powder coating line, with about 25% of the total powder coating on extrusions done in Italy involving wood finishing, as these natural looking wood grained extrusions are often used in Italian restoration projects.

In making a final decision on a vertical paint line, Rentfrow visited several plants in Europe that had vertical powder coating lines operating successfully. Thermosetting powder coatings for architectural aluminum extrusions were introduced into Europe in the early 1970s, and their commercial applications have grown there to the point where they now command a major portion of the market for finishing aluminum windows, doors, and curtain wall in residential and commercial buildings. Trevisan sensed the potential for rapid growth of powder coatings in the U.S. building and construction market, especially in competition with wet paint finishing, and it was ready to establish a successful precedent with the sale of a vertical powder coating system to Extruders.

These visits to successful European vertical powder coating facilities convinced Rentfrow to choose powder over wet paint, and so he essentially became a pioneer by breaking ground on the first operating vertical powder paint line in the U.S. aluminum extrusion industry. He liked the cascade tunnel pretreatment station and the multiple booth concept designed by Trevisan, only he wanted a system with not two but three vertical coating booths operating in parallel. He also wanted the option of applying powder-on-powder wood grain finishing by

the EFFECTA process, now marketed by Extruders under the UltraGrain™ label.

The installation of the vertical powder line in Wylie, Texas required the construction of a new building addition, which was completed in 2005, while the components of the powder line were stacked in containers waiting to be assembled. Assembly of the vertical powder line was managed by Trevisan Cometal engineers, however, the maintenance department at Extruders assembled the system themselves. Rentfrow said that this was done to assure that his maintenance department completely understood the layout and operation of the system. By August 2005, the line was operational.

As for startup, which took place in August 2005, he explains that, "Of course, as with any new paint line, the first 30 days were the hardest, but we learned well enough. Over the next few months, the production system was initially ramped up to ten hours a day, six days a week; then to 20 hours a day, five days a week; now the powder line runs production at 21 hours a day, six days a week."

Vertical Powder Line Equipment and Operation

In our recent visit to Extruders, Ted Brockway, finishing manager, pointed out the distinguishing features of their vertical powder line, which in some respects mirrors that of their vertical wet line. That is, on both lines, extrusions up to 24.5 feet in length are loaded (Figure 2) onto conveyors, pretreated with the E-CLPS chrome-free system (pretreatment by Bulk Chemicals, Inc.), electrostatically painted (Figure 3), and unloaded (Figure 4). Both lines provide a wide range of standard colors, including metallics.

Figure 2. Aluminum extrusions being loaded onto a vertical powder line.

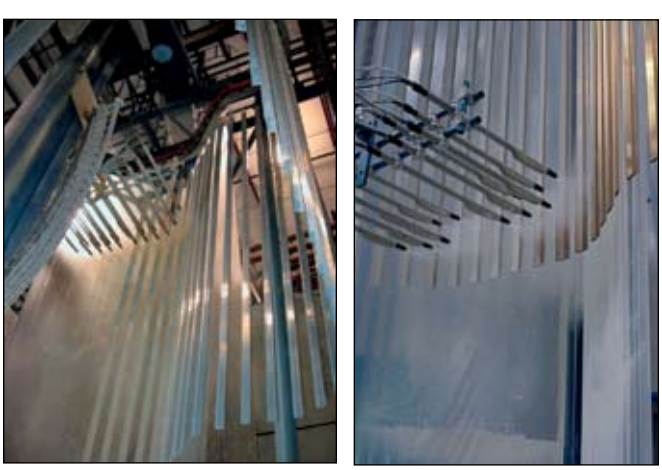

Figure 3. Powder coating in the first of three powder booths in the Extruders vertical line with electrostatic powder guns at top (left) and bottom (right) of stroke.

Figure 4. Unloading zone on the vertical powder line.

Powder coatings for finishing aluminum extrusions are mainly of the thermosetting type, formulated from polymers that react with chemical curing agents during heating in ovens to form hard, tough, and durable finishes. Electrostatic spray application of the powders is followed by curing in convection ovens at approximately 160-210°C (320-410°F) for approximately 20 minutes. Typical architectural grade powder paints are based on a carboxy-functional polyester resin and a triglycidal diisocyanurate (TGIC) curing agent with proven exterior durability. These are color pigmented and contain other ingredients to control flow, gloss, and performance. As with wet paint, powder coatings require cleaning and a pretreatment that provides a proper conversion coating to assure good adhesion and filiform corrosion protection. Wet paints used at Extruders are purchased from various suppliers, although Valspar is the largest supplier of the thermosetting polyester powder almost exclusively used on the Extruders line. Both Rentfrow and Brockway referred to Valspar as a partner.

The Extruders vertical powder line incorporates the latest Trevisan Cometal technology, their energy efficient and low maintenance cascade tunnel pretreatment system, three powder booths operating in parallel with cyclone powder recovery, automatic powder guns and automated cleaning delivery system supplied by ITW Gema (Figure 5), automatically synchronized gun stroke length and reciprocating speed, and filters to recirculate air. Convection ovens with supplementary infrared heating dry the pretreated extrusions and cure the powder paint.

The UltraGrain patterns require a randomly applied powder pattern that mimics natural wood color and texture over a partially set powder basecoat. This is done in a three-stage process, with the first stage involving the application of a partially cured base coat. The final two stages involve a light powder spray with a self-adjusted spray

Figure 5. ITW Gema electrostatic spray control system used on the vertical powder line.

gun tracking the extrusions vertically and horizontally during their motion through the booth, then running the extrusions through special ridged rolls that mechanically distribute the loose powder into a wood grain effect before curing.

Comparison of Vertical Wet and Powder Paint Lines

In comparing operations on the vertical wet and powder paint lines at Extruders, Brockway points out that wet paint overspray is naturally lost on all wet lines but powder overspray is recovered on the powder line and recycled with powder utilization at Extruders averaging 98%. Compared with the wet paint line, booth clean up is easier on the powder line, that is, the booths on the wet line require three hours each night for clean up while those on the powder line only require four hours a week for clean up.

Brockway explained how extrusions destined for the wet and powder paint lines are isolated in racks and tagged "white" for wet and "blue" for powder paint line loading (Figure 6). The wet paint line operates at a maximum speed capacity of 30 ft/min but the line is normally run at 25-27 ft/min with an average output of 7,500 lbs/hr. The powder line has a maximum speed capacity of 11.5 ft/min but allows for denser packing, so its average output is 5,500 lbs/hr. UltraGrain requires a rotation of the extrusions during the coating process, so wood grain finishing is run at only 3-5 ft/min.

Figure 6. Extrusions stacked and color labeled for finishing on the wet or powder lines.

Utilizing the E-CLPS chrome-free pretreatment, both the wet and powder coated extrusions meet AAMA 2603, 2604, and AAMA 2605 specifications.

According to Rentfrow, a typical Extruders window shape averages 0.4 lb/ft and has an average wall thickness of 0.055 inch. The polyester powder coatings come in 16 different colors. The wet paint line typically runs about 30 colors, although Extruders has 295 colors matched with suppliers. Wet paint coating thickness runs 0.8-1.0 mil, while powder averages about 1.8 mil. A wrapping effect is achieved on both lines due to the electrostatic action, although only the powder line can recycle overspray.

The Extruders powder line has three powder booths, which makes for rapid and easy color changeover, with as many as 20 color changes per shift possible on the line. Also, because powder coatings give better coverage and due to the parallel operation of the multiple paint booths on the vertical powder line, large and short batch runs can be powder coated with different colors together on the same run (Figure 7).

Figure 7. Small lots run with different colors (six profiles in yellow painted between regular run of red profiles) on the vertical powder line at Extruders with no loss of production.

As for cost comparisons between vertical wet and powder paint lines, Trevisan designs both types, and Riccardo Manera, ceo of Trevisan Cometal North America estimates that investment costs are higher for a wet line by about 20-30%. The speed gap favoring wet paint is narrowed due to the fact that the automation and special features designed into the Trevisan Cometal vertical powder lines allow for high productivity independent of color changes, closer to the parameters of a well designed vertical wet paint line. Manera notes that applied material costs ($/ft^2) in the U.S. are about 20-25% higher than in Europe for powder paint, which is priced higher than wet paint and is applied thicker as well, but he expects a reduction in the price of powder in the U.S. as the powder coating market grows. Energy costs are estimated to be about 50% higher for wet paint due to spray booth and cure oven heat loss and solvent incineration requirements.

Advantages of Powder vs. Wet Paint

In summary, Manera points out several key advantages powder offers over wet paint:

- Environmentally friendly (no solvent emissions)
- Easier application (powder is ready to use, no mixing of paint and solvent, no risk of wrong color)
- Powder utilization at 98% or more

•Denser hanging centers on powder line
•Thicker coating with powder provides more protection and extrusion coverage
•Lower reject/rework rate with powder
•Wood grain effect achieved by powder-on-powder layers

Tellkamp Systems/Trevisan Cometal Agreement

Earlier this year, Tellkamp Systems, Inc. (Santa Fe Springs, California) announced their exclusive agreement with Trevisan Cometal to promote the sale of vertical powder coating systems to the aluminum extrusion market in North America. From their California headquarters, Tellkamp Systems will manufacture, install, service, and support Trevisan Tellkamp vertical powder coating equipment in North America and Mexico. The two companies will share technology and engage in joint development.

Tellkamp Systems was established in 1971. According to Scott Bogut, director of sales, the company built its first vertical wet paint line in 1983 and has since then installed about 20 vertical wet paint lines, many equipped with innovative Volatile Organic Compound (VOC) emission control systems.

Future Prospects for Vertical Powder Coating Systems in North America

The lag in powder coating of architectural aluminum products in North America relative to Europe and other parts of the world may now be coming to an end. Besides the vertical powder line now operating at Extruders, other aluminum extruders are convinced that efficient powder coating has its place. Indalex has installed and began operating a vertical paint line at its Gainesville, Georgia plant late in second quarter 2006 to supplement its vertical wet paint line. Nordson Corporation installed the Indalex powder line, which features a self cleaning booth with a composite canopy, internally purged automatic spray guns, integrated programmable controls, a central powder feed center, and powder recovery system. The benefits stated previously for vertical powder coating are also claimed by Nordson—environmentally friendly, recovery of overspray, and more durable coatings.

Manera believes the Extruders operation demonstrates to the U.S. aluminum extrusion industry that powder coating can offer all the benefits of liquid coatings such as quick color changes, thin film build, cost effectiveness in small lots, and more. He notes, "Basically, all the barriers thrown up by liquid coating are gone." Rentfrow confirms the powder coating choice, "Domestic extruders, to stay competitive with foreign suppliers, need to think outside the box and we did by combining some of the best European technology with American production attitudes and skills."

Joseph C. Benedyk (Dr. Joe) is a research professor at the Illinois Institute of Technology (IIT) working to establish cooperative industry/university research programs in the fields of heat treatment, casting, and extrusion of aluminum and aluminum alloys. Dr. Joe has contributed many articles to Light Metal Age *on aluminum and magnesium developments and now serves as contributing editor covering applications and technology of light metals.*