



LIGHT METAL AGE

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Globalization in Aluminum Extrusion



Figure 1. Panoramic view of powder coating: (L-R) loading, pretreatment, powder application, curing, and sawing.

Frontier Aluminum Meets the Global Challenge *New State-of-the-Art Vertical Disk Paint Line in Mexico*

By Jude Mary Runge, Contributing Editor

By investing over \$13 million in technical innovation to further process improvement through updating aging capital equipment, reducing labor costs through the construction of a *maquiladora* plant in Mexico, and automating its extrusion presses with equipment purchased from Italian and Chinese manufacturers, Frontier Aluminum met the challenge of global competition head-on (“Frontier Aluminum Responds to Globalization of North America’s Extrusion Business,” *Light Metal Age*, August 2007). Continuing this strategy, Frontier has now replaced its aging horizontal liquid paint line in Corona, CA with a state-of-the-art vertical disk powder system at its Tecate, Mexico facility, Frontera Aluminios. The new line produces an orange-peel-free paint coating less than or equal to 1.8 mils (45 microns). This paint system is the only one of its type in North America, is designed to handle commercial products up to 24 feet in length (approximately 8 meters), and provides green manufacturing (Figure 1).

Background

Based in Corona, CA, Frontier is a family business that initially focused on the production of aluminum door and window extrusions, and then diversified during the tough times of the construction slow-down. Frontier met this challenge by increasing customer service and increasing their range in mill and finished products. In doing so, through the last decade of the 20th century and into the 21st century, the company established itself as a premier extruder among the competition in the west coast market.

During the early years of their existence, to meet the challenges in the construction market, the clear Frontier strategy was to continuously improve their processes by investing in extrusion equipment. However, as the roller coaster of the construction industry rose and fell, a review of the entire process flow determined limitations in Frontier’s finishing capability. By 2004, although their horizontal paint line was at capacity, the company had a sense of security that wet paint coated extrusions were insulated from the impact of imports (primarily from China), which were exclu-

sively powder coated. Nevertheless, Frontier president Mike Rapport recognized the need to further develop the company’s competitive edge with surface finishing, and decided to implement anodizing at the facility, a capability that had always been outsourced for their aluminum profiles.

Although cost reduction had always been a part of Frontier’s competitive strategy, diversification of their finishing process to include anodizing was the first time that they sought to level the global playing field by meeting the competitive challenge with an international solution: building a *maquiladora* plant in Mexico. In addition, the company’s automated anodizing line was procured in China, at a significantly lower price than anodizing lines available in the U.S. or Europe. In fact, the two solutions were inextricable from one another. In 2007, Rapport noted, “For Frontier to build an anodizing facility to compete as closely as possible and to meet the pricing of imported anodized extrusions, the anodizing plant had to be located in Mexico with an added proviso—it had to be engineered and made in China.” Today, Frontera Aluminios has an anodizing capacity of 90,000 pounds per day.

Frontier’s competitive strategy also expanded into the purchase of Italian-designed automated handling equipment for extrusions from Cometel, which was manufactured for a reduced price in China. This purchase paid for itself in less than three years through the savings realized by reduced labor costs.

As of 2007, Frontier was at a pinnacle with state-of-the-art extrusion and anodizing lines, and their labor costs were reduced to the lowest level possible. However, their aging liquid paint line was at capacity and more powder-coated product was being substituted for liquid paint finishes. To further complicate matters, the green movement was beginning to impact liquid paint facilities, with governments cracking down on transient emission of volatile organic compounds (VOCs). Health and safety issues of chromium-based primer systems were well documented. As a small extruder, Frontier could take no risks with regulatory agencies and the possibility of associated fines should the existing paint line, although currently operating within legal limits, for any reason be found



noncompliant. The next piece of their competitive strategy was identified: find an alternative delivery system for the aging paint line.

Finding the Right System

At ET '08 in Orlando, FL, Rapport first met with Trasmetal from Milan, Italy, and learned about their vertical disk powder paint system. The possibility of powder coating vertically suspended profiles at speeds (and therefore productivity) far greater than those ever reached by systems equipped with traditional electrostatic equipment was intriguing. Other powder lines on the market, while designed to coat vertical extrusions, use common powder coating delivery systems, which put too much powder on the part and did not control orange peel. By developing the Trasmetal system for use at Frontier, the continuous process improvement strategy was expanded within the realm of technical innovation and cost reduction to include material savings costs: less paint, a faster process, and better coverage could be realized, creating a superior finish. This would bring Frontier a competitive edge in the industry; however, the price for the line, at that time, was prohibitively expensive.

Having previously purchased Italian-designed extrusion handling technology manufactured in China, Rapport traveled to China shortly after ET '08 to visit a vertical powder line near Guangzhou built by Trasmetal to evaluate the process and to determine if a similar deal could be made. The samples he was provided from the vertical disk paint line during his visit were all high gloss, with no visible orange peel. The quality and smoothness of the finish were convincing enough for him to decide that the disk system was the way to go.

An extremely important detail learned during this visit was that the facility formulated and manufactured proprietary powder for the disk system. Not completely understanding the significance of this detail, Rapport continued to visit different powder line manufacturers in Asia and Europe to discuss design and price for a new powder line. However, after seeing the samples he obtained at the plant in Guangzhou, no manufacturer was up to taking on the challenge of building a powder line that yielded the liquid paint quality finish he desired for his customers. Discouragement continued when he returned to the U.S., where he encountered the same response—all thought his goal was something at which Frontier could not succeed.

In the two years following, the desire to build a new powder coating line for Frontera did not fade. The automated anodizing line was proving successful, and with its return on investment so encouraging, the Rapport family agreed to pursue a powder line for Mexico.

Taking Action

With no easy and financially feasible solution in sight for the purchase of a paint line, Rapport made the decision to try to develop a paint line of his own design. As part of a test powder module, a unique set of powder guns never used for coating extrusions were added to the existing horizontal liquid paint line at Frontera Aluminios. Remembering his experience with the first disk line he observed in China, he also brought the challenge to U.S. powder manufacturers to develop a powder that looked like liquid paint when finished.

Development of the new paint line and a new powder formulation went forward in parallel, and the horizontal powder paint line came close to delivering the desired finish quality. During this time, Tim Niland and Steve Laddatto of Spraylat Powder Coatings Group rose to the challenge to help develop the powder formulation for the application. Spraylat's powder coatings business unit, based in Gainesville, TX, has established a reputation within the powder coatings industry for superior customer service and responsive technical support.

Nevertheless, the finish obtained through the combination of the unique powder guns being tested on the horizontal line at Frontera Aluminios and the eight variations of powder formulation were not proving to have the quality of finish that Rapport had seen on his first visit to the vertical disk line in China. He continued to gather information about other paint line designs and even visited Trasmetal to negotiate prices for the disk system, with the aim of installing a new paint line before the company's 2012 deadline, should the development of a Frontier-designed powder paint line prove to be a failure. He learned during his European visits that there were over 80 Trasmetal vertical disk paint lines world-wide. Each powder maker had their own unique recipes, which, combined with the paint line system, could produce the high quality finish he desired. This emphasized more than ever the need to develop a powder that would consistently yield a paint finish with the color, gloss, flexibility, impact resistance, and absence of orange peel—in other words, the finish he had seen at the vertical powder line in China in 2008.

In order to keep his options open on price and quality, Rapport continued powder development with two major powder coating suppliers. With the deadline of having the paint line installed and operating by 2012 approaching, he decided to purchase the vertical paint system with an Over Flow Bed (OFB) disk from Trasmetal. This would be Trasmetal's first sale of a vertical disk powder paint line in North America. The company's desire to seal the deal with Frontier led to a unique offer: in addition to the line about to be ordered, Trasmetal offered

Frontier a small vertical test line to install in Corona, CA, ahead of the full line installation in Mexico in order to enable the development and testing of an optimal powder formulation. Thus, the test paint line was installed at the main extrusion headquarters in Corona, as construction began with the production scale line in Tecate. It took six months and over 40 trials with various powder formulations and paint line parameter optimization attempts with the small vertical test line to achieve the desired paint appearance. It was on the 40th try that Spraylat provided the powder formulation, which was successfully tested. Known as Ultraflo HP, it became Frontier's proprietary blend made exclusively by Spraylat. Success occurred only one month before the Trasmetal production line was ready for testing in Tecate.

Operation of the Vertical Disk Painting System

According to Trasmetal, the vertical painting systems for aluminum profiles using the OFB4 disk represent the most advanced evolution of Trasmetal electrostatic technology. OFB4 is equipped with two separate air circuits, one for feeding the fluidized bed for the powder, while the other is an auxiliary circuit for continuous electrode cleansing and supporting air/powder mixture emission. The most important innovation, which is the subject of a patent application dated 2005, consists of a new geometry of the electrodes adopted for the ionization systems, which allows for homogenization of the powder and maximizes charge on each powder particle an instant before it is sent through the slots of the disk. This produces a powder cloud of extremely high electrostatic efficiency, which maximizes the consistency of the powder layer deposited on the work piece, as compared with the previous generation of disks, and improves extension and penetration of powder coverage into difficult part geometries.

In actual operation, extruded profiles are racked with a vertical orientation to enable loading and unloading and to maintain electrical contact. The vertically hanging metal is transported mechanically along a fixed path in an omega loop pattern. The path begins with a six-stage cleaning and chrome-free conversion coating (Bulk Chemical E-CLPS 20) process that terminates in a dry-off oven prior to entering the paint process. Remaining on the rack, the work travels continuously from the dry-off oven to the first paint booth. Instead of using a powder distribution system that employs a spray gun, as the work travels, it passes through an electrostatic powder cloud delivered by vertically traveling disks. There are two disks within each booth that maintain the electrostatic cloud and enable total powder paint coverage (Figures 2 and 3).

As the painted profiles exit the powder booth and proceed to the cur-



Figure 2. Two disks in action showing powder cloud of paint coverage.

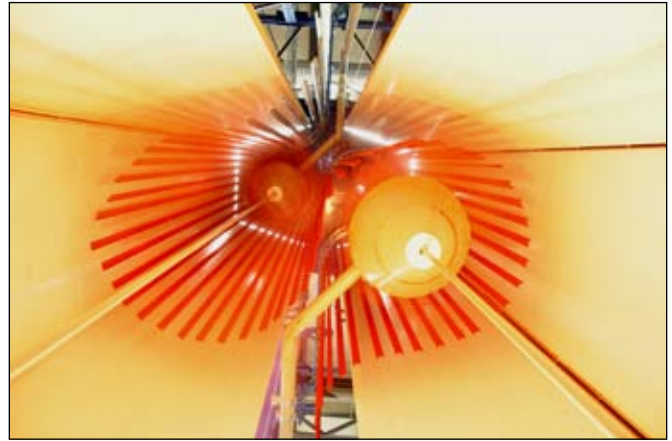


Figure 3. View of the two disks inside paint booth looking up.

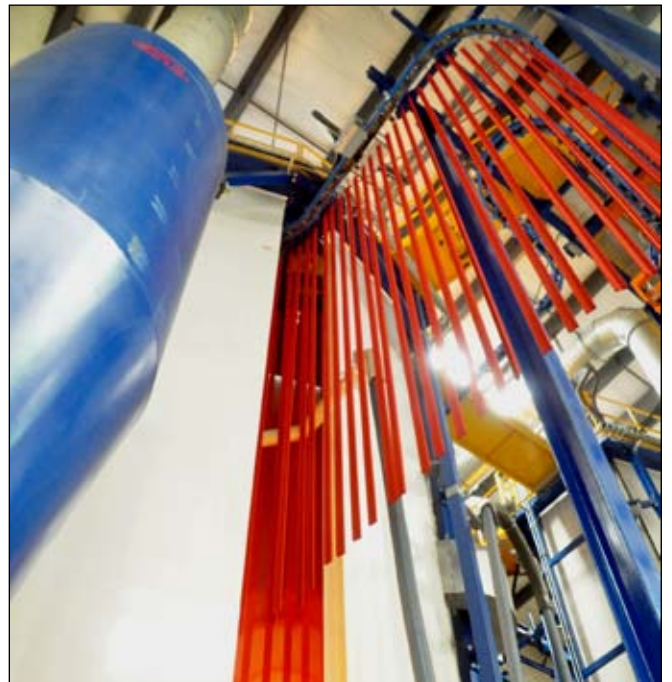


Figure 4. Painted profiles on the way to curing oven.

ing oven, the outstanding coverage of the parts is already apparent (Figure 4). Because of the electrostatic technology described, the transfer efficiency for this technology seems to be much higher than usual spray guns. Therefore it provides better coverage with a thinner, more consistent powder layer. When the parts exit the curing oven, the finish appears uniform and continuous with high gloss and no surface stippling or orange peel. Profiles now transition from vertical to a horizontal orientation to facilitate packing (Figure 5).

According to Niland, the five key characteristics of the paint finish are color, gloss, flexibility, impact resistance, and elimination of orange peel. While color and gloss are easy to achieve, the remaining characteristics are the most dependent upon formulation and process. The elimination of orange peel is perhaps the most difficult characteristic of all to achieve, as it is not only dependent upon how the paint flows during cure, but also depends on the thickness of the powder deposited on the work. Immediate quality testing of the paint finish on cured profiles following the demonstration of the paint line involved bending the profiles over into an approximate 180° bend. Evaluation of the tested samples determined that if the metal exhibited stress cracks, the paint corre-



Figure 5. Profiles are automatically bundled and ready for packing.

sponded, but there was no sign of associated peeling or flaking, testifying to the outstanding adhesion and flexibility of the finish. Examination of the finish with the naked eye and with a 10x loop determined no evidence of orange peel over the length of several painted extruded profiles.

Conclusion

Today, Frontier has the most advanced operational powder paint line in North America, with the lowest cost basis in the U.S., making the company ready for the legislated conversion of coatings from liquid to powder. The low cost determination is not only based upon labor costs, but also on material costs. All other powder systems apply 2-2.5 mils of powder (50-62.5 microns), otherwise the powder does not achieve penetration into all the recesses

of the profile that need to be coated. The Trasmetal system installed at Frontera Aluminios coats to a thickness of no more than 1.8 mils of powder (45 microns) with complete coverage, even in blind areas that do not face the disk delivery system. Once cured, the finish is pristine and without orange peel.

The carbon footprint for transporting the metal to Mexico for power coating is much less than the transient VOCs emitted from the current liquid paint line in Corona. At such a reduced powder coat finish thickness, the material cost basis is equal to liquid, and with the labor savings at 50%, stable finishing prices in the market can be offered. With the increasing cost of paint, the price stability for powder coating is a clear advantage.

The success described was truly a worldwide team effort. Rapport was the dreamer and the driver, who assembled the international team to tackle this global industrial challenge. The Chinese extrusion/paint company in Gangzhou successfully demonstrated the technology as a whole: a Trasmetal disk paint system with a proprietary powder that yielded a finish with the appearance of liquid paint. Trasmetal in Italy was the manufacturer of the winning disk paint system; and Spraylat, with Niland and their people in powder development, enabled Frontier to have more than just a better powder paint line. Rapport describes it as “a revolutionary powder line producing superior powder coated finishes that meet and exceed liquid paint in all respects.”

Through the strategic forward thinking of continuous process improvement that shapes Frontier, the company shows the best way to approach globalization is to meet it as a challenge and not to view it as a threat. Through this business approach, Frontier continues to lead the extrusion industry in the western U.S. with technical innovation and cost reduction.