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Powder Comes Full Cycle at Trek

Rapid color-change booths help the bicycle manufacturer increase production.

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Most companies are reluctant to switch finishing systems, especially if they are working well. Trek USA, on the other hand, had been painting bicycle parts for 19 years when it decided to invest in a powder coating facility. The result, company officials say, has been improved durability and additional jobs for U.S. workers.

At Trek headquarters (Waterloo, WI), a liquid coating is applied to

high-end bicycle parts, including bonded aluminum and carbon-composite materials. This facility applies as many as 50 colors per day. Until last year, any parts to be powder coated were jobbed out. Trek also purchased its lower- and mid-range bicycles from Taiwan.

In 1995, Trek opened a \$10 million manufacturing plant at Whitewater, WI, to meet the increasing demand for its mid-range bicycle lines. The Whitewater plant makes Trek and Gary Fisher mid-range model bicycles, the lion's share of Trek's volume. As the company grows, greater emphasis will be placed on the Whitewater facility, thanks to the \$1.7 million powder coating line.

Everything about the Trek powder line is state-of-the-art. The pretreatment, powder coating and curing of

bicycle parts occur in a 20,000-square-foot environmental powder room, designed and built by Tri-Star (Elmhurst, IL). The enclosure controls temperature and humidity and helps protect parts from contamination from the welding and assembly areas nearby. "Humidity is more critical to control in tribocharging operations," says Ed Schmoltdt, paint technician at the Whitewater Div. "If the humidity is too low or too high, it affects the charge, which changes the amount of film-build. The environmental enclosure was essential to maintain consistent film-build."

All bicycle parts coated at the Whitewater plant are steel. Pretreatment consists of iron phosphate, plant-water rinse and sealer, with chemicals supplied by Brent America (Lake Bluff, IL). Parts then go through a dry-off oven at 280°F for 3 minutes. Therma-Tron-X (Sturgeon Bay, WI) designed and built the washers, ovens, conveyors and cool-down tunnels.

The heart of the operation is the powder booths. Six booths, all supplied by Nordson Corp. (Amherst, OH), are located in three areas within the environmental room. In the first area, Nordson corona guns apply a primer/basecoat in metallic or pearlescent silver or black. Trek uses a Horizon™ 400 cartridge booth. "Since we don't change colors very often in the primer area, a cartridge model was our best choice," says Fred Harmon, general manager of the Whitewater Div. A Versa-Coat™ booth is used for spray-to-waste primers.



The roll-on/roll-off Nordson Cyclo-Kinetic booths allow color to be changed off-line without stopping production. (Photos courtesy of Nordson)

After curing in a gas-fired convection oven at 390°F for about 12 minutes, parts go through a cool-down tunnel for another 12 minutes to reach ambient temperature. They then move to the colorcoat area.

Trek applies as many as 15 colorcoats, so cartridge technology was not the best choice, according to Harmon. Trek chose Nordson's newest model, the Cyclo-Kinetic™ (CK) booth. These booths use a series of horizontal separators rather than cartridge modules. Over-sprayed powder is drawn into the separators, where the powder is removed from the air. Once separated, the powder is pumped back to the feed hopper. The air is directed through an afterfilter and final filters before being returned to the plant as clean air.

The main advantage of the CK booths is efficient color change. The CK booths allow Trek to reclaim

most colors without purchasing multiple color modules. During color change, an operator opens each separator and wipes out the excess powder. Once clean, the feed hopper for the next color is connected, and the system is ready to spray. Todd Larson, finishing manager of the Whitewater Div., says the separators can be cleaned in about 10 minutes because of their easy accessibility. Trek uses two CK booths to speed color change even further. While one booth is on-line, the other is being cleaned.

At present, Trek only changes colors two or three times a day, but Larson says the quick color-change capability will be particularly useful as Trek ramps up production at the plant and color-change frequency increases. The colorcoat area also houses a conveyORIZED Versa-Coat booth for small-volume spray-to-waste colors.

The colorcoats are applied with Tribomatic II guns, also from Nordson. These coatings are nonemissive polyesters. All primers and colors are supplied by Morton Powder Coatings (Reading, PA).

Following the colorcoat, decals are applied to the frames. After heating, the frames are conveyed to the last powder area, where Tribomatic II guns apply the clearcoat in a Horizon 400 booth. "To our knowledge, we are the only bicycle manufacturer that applies a powder clearcoat over the decal," Harmon says. "This gives the decal more protection and adds depth to the finish."

The clearcoat is used to achieve the final depth of the finish. Larson says that many customers of the mid-range bikes prefer a matte finish to a glossy appearance. The powder clears are supplied by Govesan (Woodbury, MN) and PPG



Bicycle frames are colorcoated in the CK booth (above). Three horizontal separators, attached to the right side of the booth, separate the reclaimed powder from the air. The separators allow easy access for cleaning.



The powder colorcoat is applied with Tribomatic II powder guns (left). After the colorcoat is cured, a powder clearcoat is applied in a Horizon 400 booth (right).



Industries (Cleveland). Trek is currently using TGIC polyester for the clearcoat, but has the capability to switch to acrylic since the clearcoat has its own conveyor and environmental room.

Quality control top priority

As in any finishing operation involving a high-profile consumer product, quality control is a top priority at Trek. Reducing the defect rate is a constant challenge, according to Larson.

"If we applied only a single coat and had a 5% reject rate, we would think we were doing well," Larson says. "But multiply that 5% reject rate by three and add the decals, and that's a huge fallout rate. We have to approach a near-0% reject rate on each step, and that's tough."

Larson says Trek's overall acceptance is about 80%, but his goal is to get to 90% or more overall. To do this, Trek is monitoring many of the process variables. The oven temperature is monitored with a control system from Datapaq (Wilmington, MA).

One of the key areas of quality control is monitoring mil thickness: primer, 1.5 to 2 mils; colorcoat, 1 mil; and clearcoat, 1.5 to 2 mils. Trek

measures the primer mil thickness with a standard film-thickness gauge, but measuring the second and third layer of coating is more difficult, Larson says. To maintain daily control of these operations, a technician weighs random parts before and after applying the colorcoat and clearcoat.

Putting a primer, colorcoat and clearcoat on bicycle parts creates a final film thickness that is similar to an

automotive finish. The multiple layers of coating build translucence, Larson says. That's why he is so interested in the pigment concentration of the powder formulas.

"To achieve color at the desired mil thickness is difficult," Larson says. "If the pigment concentration is too heavy, the finish will be too dark. If it's too light, we have to increase the mil thickness to achieve the right color."

The Trek to the Top

It's amazing what can happen in 20 years. In 1976, a five-person bike-building shop opened in the small farming community of Waterloo, WI. Since then, Trek Bicycle has grown to become the world's leading dealer-market brand of performance bicycles.

Trek's success is largely due to its innovative R&D. For example, Trek pioneered the broad introduction of the mountain bike in 1983. It introduced the first carbon-composite

road bike, and in 1992 produced the world's lightest road frame. Trek bicycles are even used by the U.S. Secret Service to protect the president when he jogs.

The growth in popularity of Trek bicycles has been a boon for Wisconsin. The company has brought hundreds of jobs to the Whitewater plant. The Whitewater Div. will powder coat over 300,000 bicycles this year and expects to more than double in the future.

Larson says he works closely with Morton Powder Coatings, which supplies all the colorcoats, to ensure that the pigment concentration is exactly what Trek needs.

Developing coatings for the high-tech appearance Trek requires is no small task for any powder manufacturer. "This presents a great challenge to our suppliers," Larson says. "Our designers at the Waterloo facility are very happy with the effects achieved by liquid coatings. Here at the Whitewater Div., we're constantly testing new powders to achieve the look we were accustomed to getting with liquid." Trek may spend six months developing the array of colors and textures it will offer for a given bicycle model, but may not offer these colors more than a couple of years. So suppliers are constantly having to develop new formulations.

Not all of the unique appearance of Trek's mid-range and high-end bicycle lines is achieved by the coatings formulas. "We sometimes develop colors in-house by altering which coating is applied at which stage,"

Larson says. "We might apply a transparent colorcoat over a pearlescent primer to one model, and a metallic colorcoat over a solid primer to another to get totally different looks."

Trek technicians have also learned to create a multicolor bicycle frame with powder by adjusting the application techniques. Ionizers blow off part of the charged powder prior to curing. This creates the appearance of "fading" from one color to the other, a high-tech look usually only achieved with liquid coatings.

Harmon feels that powder surpasses liquid coatings, particularly in durability. For that reason, Trek's flagship, the liquid-coated Y-bike, has a powder-coated rear triangle. "In addition to increased finish durability, powder has decreased our costs because we can reclaim 90 to 95%," Harmon says. "Add to that the positive environmental impact it has on our community, and that makes powder the perfect fit for Trek."

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