The new Wabash ElectroShield finishing process is considered to be the world's largest e-coat system, according to Doug McPheron, electrocoat equipment manager for PPG Industries. The 16-step process includes trips through one shotblast booth, two curing ovens, and dips in 13 different tanks.

To accommodate 53-foot trailers and the jigs that transport them through the process, Wabash built the tanks 63 feet long. Had the company intended to e-coat only platforms, the tanks could have been smaller. But because the company will also use the system to e-coat dump trailers, the tanks are 12 to 16 feet wide and 14 feet deep. The result is a series of tanks, each filled with as much as 90,000 gallons of liquids.

The system is physically huge, and so are its benefits. For example:

- Paint utilization is vastly improved. The ElectroShield system deposits 98% of the consumed coating onto the trailer. By contrast, conventional spray painting wastes up to 70% of the paint consumed. Paint usage has dropped from nine gallons per trailer to 3.5 gallons. According to PPG's Gar Hoover, Wabash is covering approximately 531 square feet with a gallon of primer and 700 square feet with a gallon of topcoat.

- Air emissions are reduced. HAPs (hazardous air pollutants) are lower and VOCs (volatile organic compounds) are reduced by two-thirds, according to Tim McKowen, plant manager. And plant personnel do not need to wear protective equipment because the automated system does not require anyone to be near the tanks.

- Wastewater emissions are reduced. A system analogous to a sewage treatment plant separates water from solid waste. Treated water can be sent to a sanitary sewer system, and solids are compressed into blocks that can be taken to the dump.

- Less water usage. A closed-loop system reduces the amount of water consumed during the finishing process.

- The process does not present a fire hazard.

Beyond the manufacturing advantages, the process provides a superior finish. Wabash tests indicate the system is more resistant to corrosion, chipping, and fading than conventional coating applications.

"We still don't fully know the extent that the ElectroShield system improves the performance of the finish," says Larry Gross, vice-president of marketing. "But we do know that our test results show that it lasts considerably longer than conventional painting."

How It Works The e-coat process is not new. It has been proven in other applications for years. What sets the Wabash application apart is the size of the assemblies being e-coated and, therefore, the size of the equipment required.

Some e-coat system applications are used only to apply primer. However, the Wabash operation also applies the finish coat. Here are the steps involved:

1. Shotblast. The BCP/Wheelabrator shotblast booth can accommodate an 8'4" x 10' profile. A conveyor transports the horizontal trailer frame through the booth, where a combination of SAE spec 230 and 280 shot takes the steel down to white metal. "The shotblast booth is the key to a successful e-coat system," McKowen says. "You have to start with a clean surface."

2. Alkaline tank. The cleaning process continues by immersing the trailer frame in an alkaline solution that has been heated to 140ø F.

3. Water dip/rinse. This rinses the solution from the trailer.

4. Iron phosphate bath. Shotblasting produces a rough surface. The iron phosphate pickles the surface and applies a uniform crystalline structure onto the product to enhance paint adhesion. Nozzles are located throughout the tank to maximize the circulation of the solution. Pumps force the material through nozzles at a rate of 3600 gpm. Similar flow rates are found in the other tanks.

5. Water dip/rinse. The first in a series of baths uses plain water to remove impurities.

6. Nonchrome acid seal. This solution further fills in surface irregularities generated by the shotblast process. The nonchrome sealer fills any voids that might have been left from the iron phosphate process. It also is designed to improve adhesion and corrosion protection.

7. Deionized reverse osmosis water dip/rinse. Deionized water and reverse-osmosis water essentially are the same, McKowen says. Both are used to attract residual impurities from the steel. The rinse can be performed at room temperature.

8. Epoxy primer. Wabash uses PPG Powercron 590-634 cationic epoxy as its primer. Wabash recirculates the fluids in this tank at 5000 gpm. Permeate sent out from this tank is continuously run through ultra filtration systems at a rate of 10 gpm 24 hours per day. The paint is returned to this tank, and the permeate is returned to the rinse tanks.

9. Water dip/rinse. The permeate rinse uses reverse osmosis water to strip away the paint that has not been electrically charged and bonded to the steel substrate.

10. Water spray/rinse. This step is a continuation of the rinsing process, but it uses a spray of water to more aggressively remove residual paint.

11. Oven cure to 375ø F for 120 minutes.

12. Dip clean and rinse. This station, almost identical to the reverse osmosis process of Station 7, prepares the surface for the finish coat. The primary difference between the two stations is that the second one contains chillers in the tank to cool the trailer after it leaves the oven.

13. Topcoat. Wabash uses PPG Powercron 935-971 black cationic acrylic topcoat. Wabash recirculates the fluids in this tank at 5000 gpm. Permeate sent out from this tank is continuously run through ultra filtration systems at a rate of 10 gpm 24 hours per day. The paint is returned to this tank, and the permeate is returned to the rinse tanks.

14. Water dip/rinse.

15. Water spray rinse.

16. Oven cure to 385ø F for approximately two hours. McKowen says that the plant is fine-tuning the baking process. To fully cure, the coated part or assembly must reach 350ø for 20 minutes. However, the time required to reach this temperature varies with the thickness of the part. Overall baking time equals the amount of time required to reach 350ø, plus 20 minutes, plus a few additional minutes as a safety factor.

Once the trailer or part leaves the oven, it is cooled by being immersed again in the water bath of Station 12. This enables it to cool to the touch as it moves down the assembly line. Trailers requiring a color other than black travel from Station 12 to a conventional paint line to receive the specialized color. Wabash currently applies the electrodeposited topcoat to every trailer, including those that receive special colors.

McKowen explains that the primer gives the trailer corrosion resistance, and that the topcoat provides gloss and UV protection. The topcoat can be painted.

Under Control One of the striking things about the Wabash system is how few people it takes to paint a trailer. The entire line requires only two technicians per shift.

The entire e-coat system is automated, controlled by a series of computers, thousands of limit switches and photo cells, and SCRs-computer-age interlocking relay switches that permit the line to work only as things move through in just the right sequence.

"The master electrical panels have program logic," McKowen says. "The computer that controls the shotblast, for example, is networked to the computers that control the other sequences. And the SCRs are the ladder logic that keeps everything running in the proper sequence. If something gets out of synch, they shut down the line."

Wabash is still experimenting with the exact sequence of events.

"Not every trailer is the same," McKowen says. "For every option we offer, we have to consider how we will e-coat it. How many degrees should we slant it to make sure that it gets complete coverage? What is the material thickness? We have a lot of things to consider for every component that moves through the line, and we have to program the line to perform for each of them."

Taken for a Ride The trailer frame is not touched from the time it enters the shotblast booth until after the topcoat has been baked on. The assembly rides the computer-controlled conveyor on a specially constructed fixture designed to maximize the trailer's exposure to the liquids in which it is dipped.

"It's important that the trailer is completely coated," McKowen says. "We designed a carrier that helps us do that. We also program the crane that carries the fixture to rock back and forth during the time the trailer is submerged. This helps make sure that any trapped air is released."

Assembled trailer frames leave the production line and are placed on a skid that carries them through the shotblast. The skids then slide into a carrier that moves the trailer through the e-coat line.

"Design of the carrier was a team effort," McKowen says. "That's one of the good things about Wabash - everyone gets involved. We needed the input from a number of different people, because designing the carrier was important. The carrier conducts the electrical current that draws the paint to the part; so we had to make sure the carrier provided good conductivity. It also had to maximize the exposure of the part to the paint. And it had to be strong enough. Handling trailers up to 60 feet long requires a long span, and you have to be able to support it. Finally, we needed something that was flexible enough to handle the variety of parts and components that we would put on it."

Wabash personnel toured e-coat lines in the U S and overseas before designing its carrier-based system.

"We saw a lot of hooks suspended from overhead," McKowen says. "But we decided to go with something that could be loaded from the floor because we consider that to be more accessible."

In designing the e-coat line, Wabash tried a variety of things, including dunking trailers in a nearby private pond.

"We wanted to study what would happen when we submerged our trailers," McKowen says.

To simulate a dunk in an e-coat tank, Wabash had to find a pond that was deep enough to sink a dump trailer. It also had to be surrounded by enough flat ground to accommodate the cranes that held the trailers over the water. Flat ground is a rare commodity in Scott County and the nearby Smoky Mountains.

"We dunked platforms, dump bodies, and chassis," McKowen says. "We videotaped the whole thing, studying the flow around each of them, what rate they could be removed, and how much liquid each held when pulled out of the lake. All of this helped us figure out how big the tanks should be and what capacity cranes we needed on the line."

Wabash also had to redesign its platform trailer to make it easier to e-coat.

"We had to make sure we eliminated areas that were inaccessible to the e-coat," McKowen says. "E-coat has to be able to get into every nook and cranny, and it has to be able to drain out."

Keeping It Clean The e-coat line has been designed to minimize the amount of water used and the impurities contained in the wastewater that the system generates.

Each of the tanks in the e-coat process must be kept in balance. If any of these fluids are out of calibration, the tank is partially drained and restocked with new liquid until the mixture is the required composition.

Waste from these tanks flows to a waste treatment area. The effluent goes through a multi-step process that separates the solids and cleans the remaining water sufficiently to meet wastewater guidelines.

The first stop is a pH neutralizer tank, followed by a second pH neutralizer tank. From there, the liquid goes to a holding tank where the solids settle to the bottom.

When the holding tank is full, the slurry is pumped to a filter press. A hydraulic cylinder drives the slurry through a filter at a force of 4,000 psi. This results in two products: water that is sufficiently clean to be sent through the public sanitary sewer system and solid clumps of waste that are stored in bins and easily disposed.

How effectively does the ElectroShield system utilize paint? By late August, Wabash had e-coated 450 platform trailers. The waste from those trailers barely filled two small collection bins.

Expanding the Plant To accommodate the e-coat line, Wabash built a 100,000-sq-ft addition to its Scott County plant, a figure made more significant by the fact that much of the winding e-coat line includes a second level within that 100,000-sq-ft footprint. With the expansion, the Scott County plant now covers 300,000 square feet.

The project included plant expansion, e-coat line, and revision of the assembly line in the existing plant. Wabash began the project in April 1999 and had the system ready for viewing at an open house August 17. However, Wabash continues to fine-tune the system. For example, the company was scheduled to send its first dump trailer through the ElectroShield line in early October.

With the e-coat line in operation, Wabash is dismantling the conventional paint line that previously applied paint to Fruehauf and Wabash trailers. This will free up additional production space.