Manufacturer uses pretreatment breakthrough to switch to powder

A disabled owner of a company that makes devices to assist people with disabilities converted a small liquid coating system to powder coating by using a high quality, environmentally friendly, and efficient pretreatment process.

In 1973, an automobile accident left mechanical engineer Joel Lerich a quadriplegic. After months of rehabilitation, Lerich mastered most daily tasks. One task, however, proved to be a menacing obstacle: transferring from place to place. Lerich never felt quite safe or stable in a traditional sling lift or on a sliding board. He also became concerned about the long-term effects of lifting on his wife's health. In a hospital setting as many as three people may be available to help with transfers. This is not realistic once a patient moves home. Yet, Lerich noticed that thousands of people put themselves and their caregivers in danger several times a day by improper manual lifting or inadequate use of slings or boards.

Drawing on his engineering experience, Lerich found a better way and in 1980 the EasyPivot lift was born: a streamlined machine for safe, efficient transfers that contributes to the health of the patient and the caregiver. Lerich said that one of the most difficult challenges of limited mobility is health and hygiene maintenance. With this device, daily routine skin checks are quick and simple, clothing removal isn't awkward, stretching is easy and secure, and commode use and bed transferring are fast and comfortable.

With Lerich's device, the size, strength, and agility of the caregiver or patient aren't factors in smooth successful lifts. This product line now includes models to serve a wide range of people sizes, from a small child to a 380-pound adult. The lift exemplifies the application of work improvement techniques (that are commonly used in manufacturing) to the improvement of the daily living tasks for disabled people.

Rand-Scot associate Jim Murphy loads an EasyPivot frame into the metal treatment product's tank for pretreatment.

Today, Lerich acts as president of Rand-Scot, Ft. Collins, Colo. The company manufactures the Easy Pivot™ Lift. In addition, the company also produces the Saratoga Fitness Cycle™ to assist disabled people in health maintenance. It helps maintain circulation, muscle tone, healthy lungs, and cardiovascular health. Both the components of lift and fitness machines need a durable coating. An additional product line, the BBD Wheelchair Cushion™ was added in 2000 through an acquisition.

Going from concept to production

After the accident and rehabilitation, Lerich founded a company to manufacture steel studs for the construction industry. While doing this, he proved out and improved on his design for the EasyPivot. From 1980 to 1990, Lerich produced EasyPivots in small quantities in his steel stud plant, offering the first commercial units for sale in 1982. Local custom coaters finished the components, treating with an iron phosphate and applying a solvent-based liquid coating. Often these coatings posed problems. For example, coating build-up caused interference at the interface between telescoping tubular parts, and the finish wore off quickly in these areas. Possible shipping damage to the coating required extensive packaging, and customers complained of coating damage during everyday use.

Moving to in-plant coating

During the winter of 1990, Lerich sold the steel stud business. As a result, the EasyPivot became the plant's sole product, manufacturing under the Rand-Scot name. In addition, the company decided to bring coating in-house to remedy the coat-

After outsourcing and applying liquid coatings in house, the company outsourced powder coatings and still had issues with coating adhesion and durability. As a result, the company decided to apply powder coating in house.

An operator applies a triglycidyl isocyanurate-based polyester powder coating to brackets for the EasyPivot lift.

The company manufactures the Easy Pivot™ Lift and the Saratoga Fitness Cycle™.

ing quality issues resulting from outsourcing. The applied coating changed from a solventborne liquid to water-based enamel. Although water-based coatings were continually getting better during the '90s, some durability problems remained.

In addition to designing the coating operation, Rand-Scot applied for permits from local authorities. The company quickly discovered that Ft. Collins monitors industrial effluent closely, especially metal finishing by-products, such as zinc phosphate and chrome treatments. As a result, Lerich decided to stay away from zinc phosphate and chrome.

The plant had approximately 1,800 square feet of available space to accommodate the coating system. Therefore, the process had to be kept simple. The parts were degreased in a batch-type pressure washer, coated with a water-based primer followed by a water-based enamel, and oven-dried. The company used this process for several years. Despite coating in-house, the same issues of durability and toughness originally associated with outsourcing the coating remained. Coating quality and warranty issues had yet to be corrected.

Outsourcing and finally converting to powder coating

In January 2000, Rand-Scot decided to have its parts powder coated by a custom coater. The coater used a typical three-stage alkaline cleaning and iron phosphate pretreatment system. Coating adhesion, durability, and salt-spray test performance were very good. However, heavy film builds in the areas of the tubular interface appeared again because of operator technique. Low production volume and the inability to maintain consistent operator technique made it difficult to correct. In addition, erratically scheduled lots that needed four different colors complicated matters even further for the custom coater.

After 4 months of outsourcing powder coating, Lerich decided to convert the in-plant coating line to powder coating. Converting the coating booth from liquid to powder wasn't a problem. However, the oven posed a challenge. The company needed to figure out how to cure powder coatings in a curing oven designed for a liquid coating process. The oven was shorter and of a lower temperature rating than ovens normally used to cure powder coatings. By slightly rebuilding the oven and slowing the line speed, however, tubular and sheet metal parts could be cured nicely at 400°F. However, the Saratoga Cycle flywheels presented a problem. They're more massive than other parts and the part temperature couldn't be elevated enough for adequate cure with the allotted oven time. At the suggestion of a powder supplier, the company tested a low-bake polyester powder coating on the flywheels and it worked.

With the curing issues resolved, Rand-Scot addressed the pretreatment. The company wanted a process that could provide a high-quality pretreatment for both steel and aluminum. Using the space and equipment available, this surface preparation would yield a coating with excellent adhesion and durability. The only processes recommended to that point were iron or zinc phosphate for steel components and a chrome conversion process for aluminum products. However, there wasn't enough production volume or plant space to facilitate even one, and certainly not both, of those processes. The need for additional steps and equipment to handle the wastewater generated by these processes to comply with local regulations also concerned Lerich. The company tested various nonphosphate and nonchrome processes, but the bonding wasn't good and salt-spray results were unacceptable. Lerich said he needed a breakthrough. See Table 1 for the company's coating process.

Looking for an alternative pretreatment

Lerich searched for phosphate replacements on the Internet, discovering the web site for a chemical pretreatment alternative to acids and

TABLE 1

Coating process used at Rand-Scot

Stage	Equipment	Conveyance	Temperature	Time
Degrease	Batch washer	Manual load	130°F-150°F	5 min
Rinse	Immersion tank	Manual hoist	Ambient	10 sec
Metal treatment product[a]	Immersion tank	Manual hoist	Ambient	90 sec-5 min
Rinse	Immersion tank	Manual hoist	Ambient	5 sec-30 sec
Drying	Gas oven	Monorail	280°F-300°F	15 min-20 min
Coating	Electrostatic spray	Powder booth	Ambient	As needed
Curing	Gas oven	Monorail	280°F-300°F (low-temperature-cure polyester powder) 395°F-415°F (standard TGIC[b] powder)	15 min-20 min

Notes: [a]Picklex®
[b]Triglycidyl isocyanurate-based polyester
This process is used for cold rolled steel, hot rolled steel, and aluminum substrates. The normal immersion time in Picklex® is 90 seconds—time enough to remove light rust. The time might be extended up to 5 minutes to remove heavier rust. The 90-second immersion has yielded salt-spray results of more than 500 hours. However, testing has revealed that extending the time in the Picklex® tank by a minute or 2 will increase the hours of salt-spray resistance by several hundred hours.

phosphates. The site had a link to a test report by the EPA and Battelle, Columbus Ohio, detailing the positive test results of this pretreatment approach. [Editor's note: See "Nonpolluting replacement for chromate conversion coating and zinc phosphate in powder coating applications," *Powder Coating*, vol.12, no. 7 (October 2001) or check the Powder Coating Web site [www.pcoating.com] under Article Index.] The process interests the EPA because it's environmentally friendly, void of heavy metals, and a replacement for phosphates and chromate conversion coating.

The EPA wants industry to find a replacement for chromate conversion coating. Finishers could further benefit by replacing phosphates used in surface preparation. This metal treatment product is a water-based conversion coating chemistry. However, it isn't just a phosphate or a chromate conversion coating treatment. It removes rust and scale, and deoxidizes and converts the substrate. It also leaves a thin film that seals the surface, prevents further oxidation, and provides good bonding of the coating and protection from corrosion. Lerich noted that the bonding tests and the salt-spray results were equal or superior to the high-grade zinc phosphate treatment on steel as well as the chromate treatment on aluminum. Other reports stated that this metal treatment product removed rust and, if heated slightly, could effectively remove heat scale from hot rolled steel and provide a one-step descaling-pickling-protective coating.

Test reports demonstrated the corrosion resistance this surface preparation can achieve on both steel and aluminum substrates. One test report showed the metal treatment process passing 1,500 salt spray hours (ASTM B-117) when used as a pretreatment over steel before electrocoating. The EPA determined that this metal treatment product on a powder-coated aluminum substrate met architectural salt-spray test requirements of 4,000 hours (ASTM B-117). The report stated that the powder coating used was a hybrid designed for use on computer components and a lower grade than the material that would normally be used in architectural applications. Lerich later learned that several companies that make powder coatings are now testing their materials on aluminum treated with this chemical to obtain approval from the American Architectural Manufacturers Association (AAMA) for use in architectural applications.

The composition of the proprietary chemical intrigued Lerich, but he wanted to ensure that he and his associates wouldn't be exposed to dangerous chemicals. The product has a specified pH level of 1.0—a value normally associated with very dangerous acids. Lerich contacted the EPA and spoke with David Ferguson who directed the testing and evaluation of this alternative process and others who had worked with it. These individuals dispelled Lerich's concerns. He learned that the EPA has classified this metal treatment as nonhazardous and environmentally safe. One person he spoke with talked about how he could put his finger in the chemical, swirl it around a few times, then rinse it off without any effect to his skin in spite of its low pH.

Making the powder conversion possible

After this research, Lerich became convinced that the pretreatment product didn't represent a significant hazard. Next, he sought out the developer of this process. In June 2000, Lerich made arrangements with the supplier to fill a small pretreatment tank with the metal treatment product in the Rand-Scot plant and operate his production system as an informal field test site.

"Now we have a very good powder coating on our products," said company operations manager. "We can control our own production schedules. The shipping damage problem has all but gone away. Our customer complaints about coating damage during use have ended, and there have been no warranty issues related to the coating since we started our powder coating system."

The metal treatment product doesn't need any bath monitoring and process control charts. It needs only a simple pH check occasionally. The chemical bath is used as is, and the strength of the bath is not weakened with use. The product generally just needs to be replenished as it is applied to the parts. However, the bath might need filtering if it is used for pickling surfaces to remove heat

How did he do that?

You might be wondering how Lerich does all of this since he is a quadriplegic. Through rehabilitation, he has gained some arm movement and control. He worked with his doctors to design and fit some orthopedic devices for his hands and fingers. These devices allow him to manipulate the thumb and forefinger of his left hand by using certain arm movements where he has limited control. Lerich also has a dedicated and loyal team of associates that are ready and eager to help develop his ideas. He also has an administrative assistant who helps with the office tasks, filing and handling of routine paperwork for him. Computer technology also plays a part. For example, he uses an IBM voice recognition program for dictating directly to the computer.

Coating Associate Jim Murphy reports adhesion test results to Joel Lerich.

scale or heavy rust. Furthermore, the pH can rise above the recommended 1.0 if a significant amount of water is carried over from the cleaner and rinse tanks. The pH can be brought back under control by applying a heater to the bath and evaporating excess water.

Lerich said he likes the process because fewer tanks are involved compared with conventional phosphate systems, and that fact allowed his powder coating conversion to work. Moreover, heating cost little, and environmental issues are essentially nonexistent. The capability to reclaim the carryover chemical in the final rinse tank makes transfer efficiency close to 100 percent. "I have worked in plants that utilized paint systems with iron phosphate and zinc phosphate," said Larry Beshore, operations manager. "I would much rather manage this ... process. This is a great process! It is so easy to control."

Rand-Scot has been using this metal treatment product for more than 3 years. To date, the company hasn't had any waste disposal. The local environmental authorities approved the process because none of this chemical would be going to drain. After immersing parts in the metal treatment product's tank, workers let parts hang over the tank for a few seconds, allowing most of the excess chemical to drain off. The final immersion rinse removes the balance of the excess pretreatment product and is allowed to absorb the excess. This is not detrimental to the final rinsing with this process. That excess chemical then can be reclaimed by transferring liquid from the final rinse bath to a holding tank and applying heat to evaporate the water. The residue will be the chemical concentrate that can be added back into the metal treatment product's tank.

However, Lerich said he later discovered that the final rinse could be put to drain if he didn't want to reclaim the metal treatment product from it. A powder coater in nearby Colorado Springs, Colo., had applied for a permit to discharge the chemical to drain. As part of that process, a local independent laboratory performed a test of the final rinse solution, immersing clean test panels into a bath containing the metal treatment and then rinsed them to remove the excess. Lab personnel captured the rinse water and tested it against local limits. It contained no heavy metals and passed in every category.

Meeting low volume and tight schedules grows business

The capability to get the coating quality needed with an in-house powder coating operation solved a lot of problems for Rand-Scot. The scheduling of the various manufacturing steps, staging areas for work in progress, and coating lot sizes are much easier to control now than they were in the past. The shorter lead-time allows the plant to satisfy more build-to-order requirements. When Rand-Scot started using the metal treatment product, the production level of the EasyPivot lifter and the Saratoga Cycle was under 1,000 per year for each. Today, that volume has grown to more than 2,000 per year for each product. Forecasts and trends indicate the volume could exceed 6,000 units of each product within the next 3 to 4 years. Lerich said he sees no problem in meeting the forecasted volumes with the coating system now in operation.

In addition to working with the company's schedule and coating system, the metal treatment process provides saving in materials use. Rand-Scot tracks the amount of square footage that is coated. The plant also records the amount of metal treatment product used. From that data, Lerich has calculated the coverage of the cleaner to be more than 10,000 square feet per gallon. Therefore, at an average cost of less than $30 per gallon, Lerich figures his total applied cost per square foot is around $.003 per square foot. Many estimators quote $.010 as the applied cost per square foot for a conventional zinc phosphate system and slightly more for a chromic acid treatment for aluminum.

Even though the coating system is small, it can significantly out-produce the company's fabrication and assembly operations. This provides the time between runs for clean up and to make color changes. However, sometimes a low-volume run with a special color must be worked in quickly. When this occurs, the powder is sprayed to waste for that lot.

The in-house powder coating system produces a finish that remedies the previous quality concerns. The metal treatment allowed the company to do its own coating, providing a versatile and high-quality pretreatment system without a large investment in equipment and manufacturing space. "Now we have a very good powder coating on our products," said Beshore. "We can control our own production schedules. The shipping damage problem has all but gone away. Our customer complaints about coating damage during use have ended, and there have been no warranty issues related to the coating since we started our powder coating system." PC

Pretreatment: ***International Chemical Products, Huntsville, Ala. 256/650-0088. www.picklex.com***