As seen in the August 2010 issue of
Modern Metals®

A recently debuted process for pickled-and-oiled steel improves laser cutting and welding, and creates a more compatible surface for painting and plating

The finished product. This bundle of 11-gauge sheets cut from brushed P&O coil has a surface finish resembling stainless steel.

Brushing bolsters P&O performance

BY J. NEILAND PENNINGTON

Four months ago, JDM Steel Service Inc., an independent service center and member of the North American Steel Alliance, introduced a new variation on hot-rolled pickled-and-oiled steel that provides the cost advantages of hot roll with forming and fabricating characteristics more closely resembling cold-rolled steel. In a classic case of adaptive use, the Chicago Heights, Ill., coil processor is running P&O up to 0.25-inch thickness through the same coil-to-coil corrective leveling and rotary power brushing line it also uses to process dry hot-rolled steel.

Vigorous wet brushing of P&O yields a surface that seems oil free to the touch, but enough oil is retained to inhibit corrosion. Eighty-five to 87 percent of the mill oil is removed, averaging 13 to 15 milligrams per square foot, down from the typical 100 milligrams per square foot. This cleanliness makes brushed P&O a practical alternative for laser shops, fabricators who transfer blanks with automatic feeders and anyone who applies finishes.

Reduced oil is a boon to laser operation because it permits faster cutting speeds and reduces smoke. The first customer for JDM's brushed P&O—it has no trade name yet—increased cutting rates by 25 to 30 percent.

"Say the recommended cut rate on quarter-inch plate is 100 inches per minute," says Stan Loewer, president and CEO of Precision Cutting Specialties, Eunice, La. His company is a laser and press brake house and the first fabricator to run brushed P&O in production. "At 125 inches per minute, the cut looks identical," he says. "We see no change in cut quality.

"There is a bit of degradation in cut quality at a 30 to 35 percent increase," he continues. "When you get into that range, you start seeing what we call drag lines, striations that have a tendency to lean a bit because you are running quickly. But they are still acceptable parts for most customers."

Small-hole piercing also has been improved by eliminating blowouts. "Anytime you have oil and other impurities on the plate and you are trying to cut small-diameter holes, it is critical that piercing produces no blowouts," he says. "A blowout occurs when you get a really ugly hole that is not round and is not accurately sized.

"This material has been phenomenal in eliminating blowouts," Loewer adds. "We're cutting quarter-inch-diameter holes in quarter-inch plate, and they are close enough to drill quality that we can tap the holes."

Hagel Metal Fabrication Inc., a full-service forming and finishing operation in East Peoria, Ill., is another early adopter of brushed P&O, cutting its first load three months ago. The company's laser cutting rate gains haven't been as dramatic as Precision Cutting's, but David R. Wrigley, Hagel president and CEO, is satisfied with the 6 to 7 percent increase he has made thus far.

"When you run 24- to 30-hour part nests, 6

to 7 percent can be a significant increase," he says. "Our laser operators noticed much better cut quality, largely because they weren't burning through as much mill oil. The cut was cleaner and more precise."

Running lights-out

Both companies run lights-out production. At Precision Cutting, the 4-kilowatt Mazak laser operates around the clock Monday through Friday, attended for one 10-hour shift per day.

The two Bystronic lasers at Hagel also run continuously. "We have a first shift and a skeleton third shift for all other operations, but we manage our lasers only on the first shift—five days per week," Wrigley says. "We run the lasers 24 hours a day, six days per week. The second shift is unmanned."

To run unattended, both companies require absolute reliability from their sheet feed systems. Reducing oil on the laser blanks means less possibility of sheets clinging together and causing a double feed.

"With hot-rolled P&O, you get a great deal of surface tension between the sheets, and they don't separate as well," Wrigley says. "The reduced amount of mill oil on the brushed P&O allows the sheets to separate very well.

"We're not using magnetic sheet fanners on thicknesses up to ⅜ inch," he adds. "We previously had fanners on sheets down to 14 gauge—0.075 inch."

Although a high percentage of the mill oil is removed in the brushing process, brushed P&O is highly resistant to corrosion. JDM has seen positive results from its salt spray tests, with brushed P&O outperforming regular P&O in independent lab tests. On iron phosphate pretreated painted samples at 1,032 hours, brushed P&O showed no signs of rust, and regular P&O showed traces of red rust.

There is no better real-world test than storing metal at Precision Cutting, located in southwestern Louisiana, where constant wilting humidity hangs like a soggy blanket.

"The oil evaporates on standard P&O, and in a very short time, you see surface rust," Loewer says. "But we have brushed plates that sit for weeks and get no surface rust whatsoever.

"The material is stored in an air-conditioned facility, but there is a lot of humidity from doors being opened and bringing material in and out. So you do get some condensation on the metal from time to time. But the brushed P&O holds up considerably longer than the other products."

Precision Cutting's press brake department also has benefited from the cleanliness of brushed P&O. "We had about 25,000 pounds of quarter-inch standard P&O left over from a different vendor, and we put the brushed metal onto the rack next to it," Loewer notes. "We had a job that required press brake work on 30 sheets of quarter-inch. So we took 15 sheets of the new, brushed plate and 15 of the old plate and ran them side by side.

"The brake operators commented that with the oiled metal, they were constantly replacing their cotton gloves, and the press brake tooling was always dirty. There was debris everywhere," he says. "But when they use the brushed metal, they didn't have to clean the press brake as often, and their gloves lasted much longer. It was night and day."

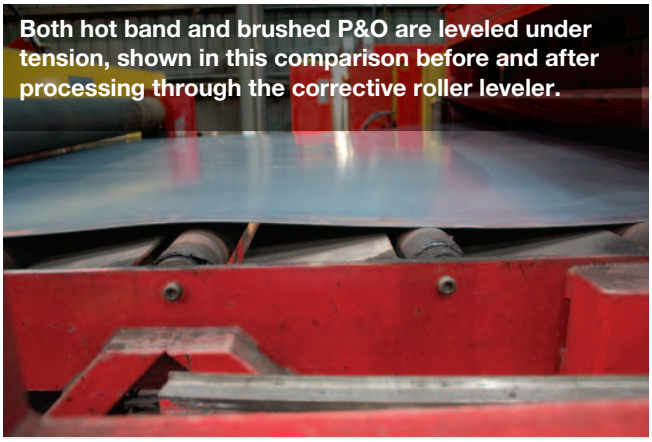
BEFORE AND AFTER. The coil above is conventional pickled-and-oiled steel, with a typical surface of 37-41 Ra. The same coil, below, which has been brushed, has an oil level reduced by 85 to 87 percent and a 28-33 Ra surface, comparable to cold-rolled matte.

Facilitates finishing

The brushed surface also facilitates finishing, according to Richard "Rich" Merlo, JDM president. "On the P&O strip, you can see the brush strokes," he says. You get a surface smoothness of 28 to 33 RA. It looks similar to a cold-rolled matte finish."

Brushed P&O must be phosphated before painting, the same as conventional P&O, but the process is more efficient. "We've learned that the smoother surface finish absorbs less of the phosphate chemicals, yet there is improved salt spray performance," Merlo continues. "We believe that brushing improves adhesion due to the greater tooth on the surface."

Hagel Metal Fabrication operates a high-capacity powder coating line, and Wrigley has seen a decrease in iron phosphate bath consumption. "Our phosphate section is set up so that the alkaline wash removes the oil," he says. "With the small amount of residual oil



Both hot band and brushed P&O are leveled under tension, shown in this comparison before and after processing through the corrective roller leveler.

on brushed P&O, the oil does not build up in our alkaline tank. We're getting longer life from our chemicals."

JDM has independent lab tests that show 47 percent less iron phosphate consumption. Brushed P&O is listed at 40.8 milligrams per square foot, down from 77.6 milligrams per square foot for conventional P&O steel.

Precision Cutting does no finishing, but the majority of its customers do, and their results have been the same. "Most of our customers use one of two finishing processes," Loewer says. "They are either zinc plating or powder coating.

"The feedback that we've gotten is that the surface quality is tremendous. Customers have also cut back on the strength of the cleaning chemicals. They can reduce their phosphate concentration levels for this plate."

Surface adhesion is also improved. "We had been noticing some issues with powder coating hot band," Wrigley says. "The chromate treatment was getting under the scale and popping it loose after the metal went through the curing oven. The finish would blister."

The JDM brushed P&O brain trust. From left: Gene Puk, vice president of operations; Rich Merlo, president; and Roushan Parham, brushing line operator.

Clean strip exits the air-knife drying section of the brushing line. Oil remaining on the metal protects against corrosion without compromising laser cutting.

The look of CRS

There is no such problem with JDM's brushed P&O steel. "This material looks as if we were using cold-rolled steel," Wrigley says. "We have no blistering whatsoever, and the powder flows more smoothly.

"There is a very fine tooth on the metal from the brushing that actually gives more adhesion. But because of the surface, the powder flows into those low spots and looks like glass."

One of Hagel's products is an engine enclosure for a forestry machinery manufacturer. The housing is an appearance item, directly at the operator's eye level. Hagel converted the component to brushed P&O without telling its customer.

"We didn't share what we were doing at the beginning," Wrigley says. "We sent brushed P&O to them unannounced. Our salesman had a walk-through at their plant about two weeks after that, and their buyer took him out to the assembly line. Our product was sitting next to a competitor's component, and they said, 'Your finish is considerably better. Your surface is by far the best we've ever seen.'

"They asked what we changed in the process on the paint line because the finish was much better than it was when we started. We told them that we were using a brushed metal that has a superior finish before we start our powder coat process."

Although JDM's Merlo is not promoting brushed P&O as a replacement for all cold-rolled steel, he offers it as an option for general applications requiring the appearance of CRS. "But I would not suggest it for surface-critical cold-rolled fabrication," he says.

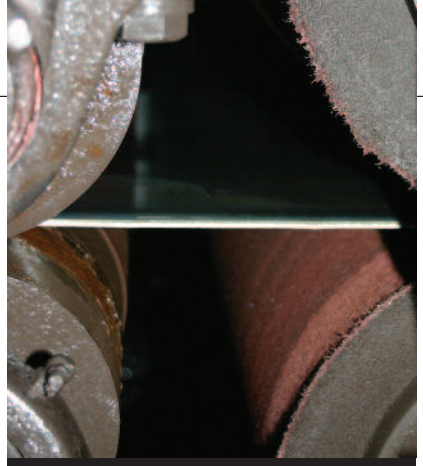
When brushed P&O can replace CRS, the saving is considerable. Brushing adds 2 to 3 percent to the cost of P&O steel, and according to a JDM study, converting to the brushed product can save $40 to $60 per ton. If the reduction is $50 per ton, a company buying 5,000 tons per year would save a quarter-million dollars annually.

It's a small premium to pay, according to Precision Cutting's Loewer. "The additional cost for brushed P&O has been negligible," he says. "It's perhaps 2 cents a pound—$2 a hundredweight. Compared to what we're saving, the additional cost is a non-issue."

Leveled for lasering

Although the product is called brushed P&O, Merlo reminds his customers that it is also precision-leveled metal. This is of particular importance to laser processors, who need material free of internal stresses that can cause deformation during cutting.

"We aren't experiencing the stress in the metal that we've found in other materials," Wrigley says. "We're receiving a flatter material from JDM, and we also aren't having crash issues.



Key to the surface finish of brushed P&O are top and bottom 3M Scotch-Brite brushes that process both sides of the strip simultaneously. During operation, spray nozzles flood the strip with wash water.

"Because we run lights-out, the material has to be flat. Especially with thin strip, if you have the metal bow up and cause a head crash in the middle of the night, you lose a lot of production. With only two lasers and the workload we have, a laser being down for even a few hours would create quite a bottleneck."

Wrigley introduced brushed P&O at Hagel both literally and figuratively through the back door. "I didn't tell anybody in the facility that I was bringing it in," he says. "But within hours of starting to laser-cut the metal, I had my lead people and laser operators asking where I had gotten the steel. Our paint supervisor also checked it out, pulling scrap from the laser line and putting it on the paint line to test the metal.

"If you had been here the day we started cutting that material and heard the reaction from the people on the shop floor, you would have been amazed," he continues. "My supervisors were coming up to me saying, 'Don't buy anything else.'"

It is no surprise that Loewer reports the same reaction. "Two of the laser operators came to me and said that we shouldn't buy anything else. 'If we have our pick, can you buy only this metal?'

"We basically consolidated all our decoil [sheet] purchases with JDM, 16-gauge through half-inch," Loewer adds. "We are using their steel exclusively through half-inch. I know that brushed P&O is available only through quarter-inch, but the surface quality of their three-eighths and half-inch is second to none. It has made purchasing a whole lot easier."

Brushed metal is about 10 percent of JDM's P&O business, but that may climb steeply. Its largest P&O customer is in the midst of 4,000-hour salt spray tests. Positive results could increase brushed metal to as much as half its total P&O production.

Like many innovations, brushed P&O began almost by accident. "We had a coil that had excess oil on it," Merlo says. "It needed to be cleaned, so we tried putting it through the brushing line.

"Two or three of us were watching the strip, and we said, 'Wow, what a difference between the coil going in and the coil coming out.' We had a toll processing customer here who operates a pickling line. When he saw the results of the run, that customer said, 'You guys have no idea what you're on to here. We constantly fight with controlling mill oil because no matter how lightly oil is applied, customers want it lighter.' I think that was our ah-ha moment." ■

DOUBLE DUTY

JDM Steel Service Inc.'s leveling and brushing line for both hot band and P&O consists of an uncoiler, X-ray thickness gauge and a cassette-type corrective roller leveler with two sets of rolls—one for 0.04- through 0.171-inch thicknesses and the other for 0.171- through 0.25-inch thicknesses.

The leveler is followed by an edge trimmer, the brushing and washing station, an air-knife strip dryer and the recoiler. Maximum coil width and weight are 74 inches and 60,000 pounds. The line speed for processing dry hot band is 150 feet per minute, reduced by 25 percent when running brushed P&O.

Although the washer in the 3M Scotch-Brite roll brushing station originally was designed to process dry hot band, JDM readily adapted it to the oiled strip, and the same brush rolls process both materials.

"An issue with running P&O is the fact that the oil would get into the water filtration system," says Rich Merlo, JDM president. "We had to come up with a method of removing the oil. Once we figured that out and tried it, we were amazed at the surface quality and what the product looked like."

The original hot band line was designed to filter mill scale and other solids from the wash water. "With P&O, we have to filter oil, as well," Merlo says. "Oil is absorbed by the filter media and is disposed of as hazardous waste. Assuming we increase our volume of brushed P&O, we will have to add a skimmer, which is inexpensive."

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