Universal-Cyclops gives Z-Hi retrofit scheme its first big break in the US

Sometimes it's better to switch than fight. Take the case of the Coshocton plant of Cyclops' Steel Div which converted a vintage 4-Hi mill to a Sendzimir type by adding sets of cluster rolls in place of conventional work rolls

At its "showcase" sheet and strip plant in Coshocton, Ohio, Universal-Cyclops' Specialty Steel Div of Cyclops Corp is testing a rolling method that may substantially influence the way stainless and alloy sheet is produced in the future. The Coshocton experiment involves the conversion of a standard 4-Hi reversing cold rolling mill to a quasi-Sendzimir mill by replacing its regular 7-in. work rolls with a cluster-roll set, featuring 3-in. work rolls, and designed by T. Sendzimir Inc, Waterbury, Conn.

Coshocton operators are counting on the rejuvenated unit—dubbed a Z-Hi mill—to "approach a regular Z-mill in performance," Thomas O. Winans, operations superintendent, reports, "in terms of better gage control, more reduction capacity, and enhanced surface luster."

If it does, Universal-Cyclops will have acquired a bargain. The Z-Hi retrofit package sells for about 10% of the cost of a new Z-mill of comparable size. At the moment, the Sendzimir organization is quoting an average price of $15,000 per inch of strip width to convert a 4-Hi mill to the Z-Hi configuration.

In Coshocton's case, the tab comes to approximately $450,000 for its 20-yr-old, No. 2 finishing mill, which can now handle 30-in.-wide stainless sheet instead of 26 in. A new Z-mill capable of rolling 30-in. material would cost $3-million to $4-million for the mechanical and electrical installation alone, a Sendzimir official reports.

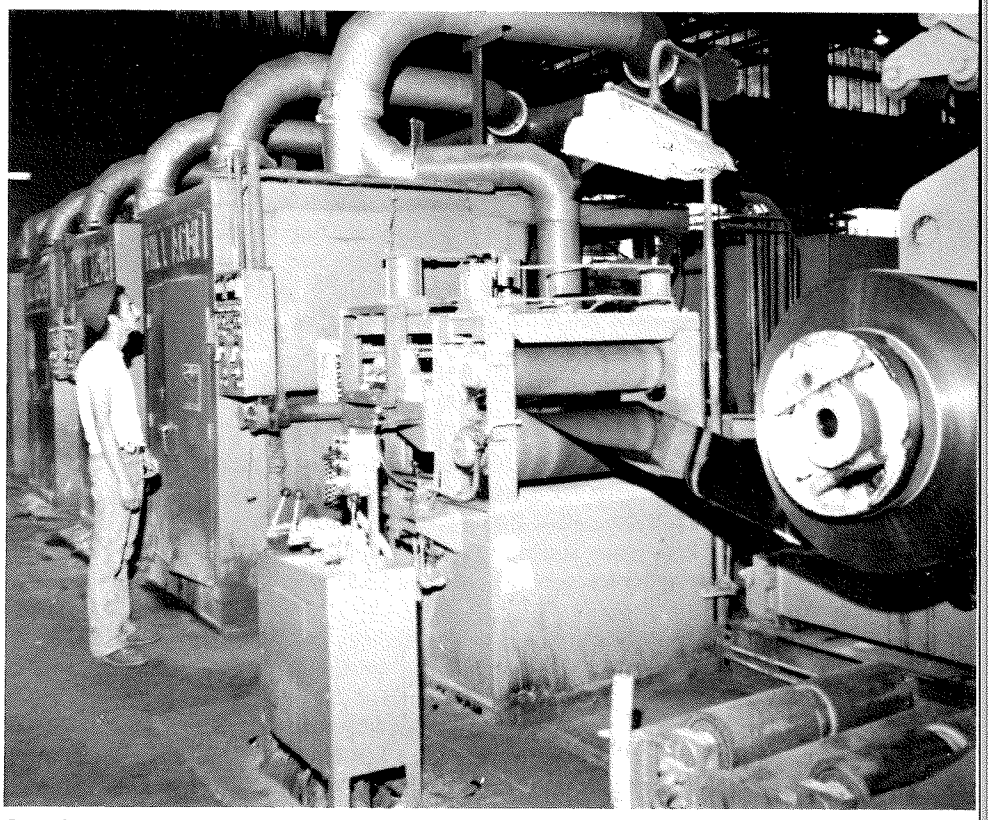
Other steel producers who have been using 4-Hi mills to roll stainless and alloy grades are said to be eyeing the Coshocton trials with great interest. And if Universal-Cyclops can indeed upgrade product quality for a relatively modest capital investment, the rest of the domestic industry can be expected to join the parade. At least that's the view from Sendzimir headquarters.

U-C's decision to become the first major steel company to try the Z-Hi concept can be attributed to increasing customer demands over the last few years for better surface quality and flatness, closer tolerance control, and thinner gages. Coshocton has met stricter quality standards by processing critical products on its two Z-mills. "Like other specialty steel producers with both types of mills available," John G. Sewalk, plant manager, explains, "we were running our Z-mills seven days a week while our 4-Hi mills were idle a fair amount of time."

The day finally came when Coshocton simply had to add more high-quality rolling capacity or face the loss of some of its business. General Motors Corp furnished the final impetus by tightening its standards for stainless steel trim stock as part of an overall program devised to improve the "fit and finish" of its autos in the face of strong competition from abroad.

"We had to upgrade more of our output if we were going to continue to supply GM with stainless," Winans concedes, "but we could not do it with the 4-Hi." (Coshocton is equipped with two practically identical 4-Hi's—No. 1, which serves as a breakdown mill and No. 2, which acts as the finishing half of the pair.) "A 4-Hi mill is a fine general-purpose mill," Winans continues, "compared to a Sendzimir mill, however, it has many limitations."

Counted among the advantages a Z-mill holds over the 4-Hi,



One of the first of its kind in Steel, Coshocton's Unibrite℠ buffing line puts the final shine on Cyclops' "new" bimetal product

as listed by Winans, are greater reduction per pass, thanks to smaller work rolls; greater total reduction without the need for intermediate annealing; quick roll changing just before the final pass to yield better surface quality; and improved flatness control via the axial shifting of tapered intermediate rolls. The latter feature also enhances the mill's ability to accommodate changes in product width.

When Coshocton operators learned that Sendzimir had designed a retrofit package to convert 4-Hi mills into the Z-Hi type, they visited Waterbury Rolling Mills, Waterbury, Conn, where a nonferrous strip mill had been given the cluster-roll treatment. In the words of a U-C internal assessment, the mill "was only 14 inches wide, but the results were excellent." "We evaluated the advantages of cluster rolling over 4-Hi and decided to go that route," Winans adds.

Sendzimir designed the equipment required to support the conversion of the No. 2 strip mill, and a subcontractor fabricated and delivered the components. Coshocton people installed the new equipment on the No. 2 mill while the plant was closed for a vacation shutdown during the first two weeks of July, 1981, just about a year after the order was placed. Coshocton's mechanics adhered to the installation schedule originally established for the conversion and the mill was ready for its first coil on July 14.

The physical alterations the 4-Hi mill structure was required to undergo to accommodate the new cluster-roll set were not extensive. Backup roll chucks were remachined to open a wider gap between the 30-in.-dia backups to allow the top and bottom clusters to be installed, housing "windows" were enlarged and lateral beam supports were installed. A mechanism for axially moving the intermediate rolls was set in place, as were the thrust bearings that keep the new work rolls in place while the mill is operating.

Coshocton operators chose to stay with the existing electromechanical automatic gage control, calculating that the mill housing would have had to be modified so extensively that installing a new hydraulic AGC would be more trouble than the end results would justify.

The workers who ran No. 2 when it was a 4-Hi mill were retained—and retrained—to operate the facility after its emergence as a Z-Hi. Maintenance people familiar with regular Z-mill requirements were expected to service the hybrid without a hitch, as were roll shop employees knowledgeable in dressing a Z-mill's small work rolls.

All systems are go!

While it's still too early to determine the final fruits of the retrofit project, first reports out of the east-central Ohio plant were optimistic. "The mill is fully operational now," Winans said a few days after startup. "Aside from a few minor problems, everything has gone according to plan. The first coils looked good."

Should the shakedown rollings now under way and slated to continue for several weeks show continued satisfactory results, it's expected that the No. 1 breakdown 4-Hi mill, now employed to initially roll stainless hot-rolled coils received from other U-C plants, will also be converted to a Z-Hi.

"Coshocton's emergence as the first US steel plant to adopt the Z-Hi concept, the first anywhere to apply it to stainless strip production, and its decision to undertake the largest retrofit project since Sendzimir introduced the idea in 1979 (the next biggest Z-Hi mill is geared to roll 16-in. wide material) is not surprising," Alan M. Smith, U-C Specialty Steel Div president, insists.

Calling Coshocton the "showcase" of the division, Smith is lavish in his praise of the plant's achievement record since the facility was built in the late 1950s. "I can hardly say enough about the creativity and dedication of the people in Coshocton," he comments. "They take on tough jobs routinely and innovate in an atmosphere of 'can-do.' I am very proud of Coshocton and its contribution to our division and corporation," Smith continues.

Bimetal rolling takes a bow

An earlier example of how the 377-person work force at the east-central Ohio plant successfully responded to another challenge is its production of stainless-aluminum composite strip for use as automotive trim.

When GM started looking for a steel company to enter the market as an alternate source of the two-metal strip (Texas Instruments' Metallurgical Materials Div, Attleboro, Mass, was the prime supplier), U-C was the only firm willing to invest the time and effort needed to develop its own technology to do the job.

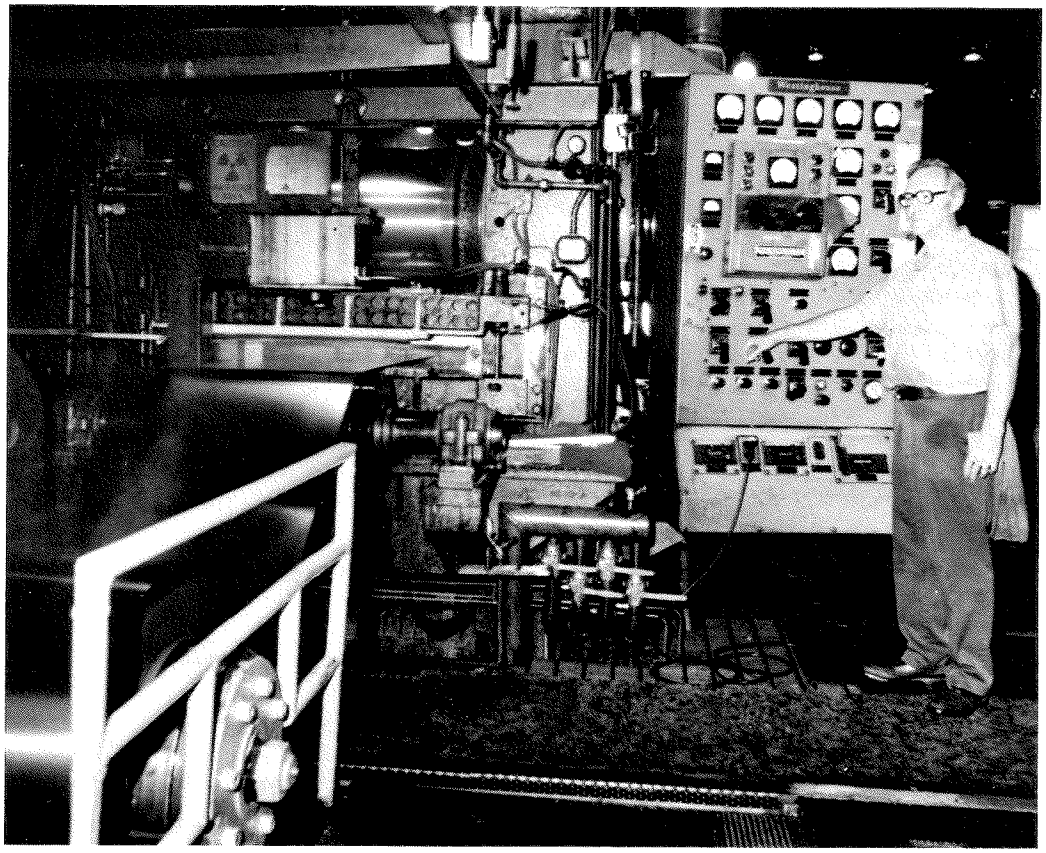
By way of background, the stainless-aluminum strip is considered to be a far better trim material than either metal used by itself. Stainless is corrosion free, dent resistent, and holds its bright finish almost forever. On the other hand, auto body sheet steel rusts when road salts create a galvanic action between the "noble" stainless and the "base" body steel. Conversely, aluminum has a tough time when assigned a solo role in a trim application. It loses color and is quickly damaged by the casual hazards of everyday motor vehicle operation.

Combine the two metals in one product, however, and the whole becomes greater than the sum of its two parts. The stainless withstands the hard knocks of daily driving fortunes essentially unaltered, while the aluminum acts as a sacrificial anode that is consumed by the galvanic action set up by road salts acting on the two metals. Furthermore, the corrosion of the aluminum means that the car's body steel is shielded from harm. Last but perhaps not least, the white corrosion products of aluminum are far less visible than the red rust of steel.

Once again, GM provided the incentive for the Coshocton organization to undertake a new venture. According to Sewalk, General Motors wanted more aluminum-clad stainless strip than Texas Instruments could provide. The Coshocton group saw a gap and set out to fill it. "It wasn't as easy as it might look," Sewalk tells visitors to Coshocton. "It's difficult enough to roll either stainless or aluminum. When you combine the two, you can have trouble with both."

Claiming that U-C was unaware of Texas Instruments' cladding techniques, Sewalk reports that his people designed their own methods for combining the two metals. This involved sorting through and selecting alloys, preparation procedures, rolling arrangements, and post-annealing schedules that would deliver a composite metal ductile enough to withstand severe forming operations but tough enough to provide protection against road service conditions.

Typically, the stainless strip used to produce the product is either a 434 or 436 grade measuring 0.014 in. thick, while the



Cyclops' bargain conversion of a standard 4-Hi mill into a quasi Sendzimir type involved replacing the unit's 7-in. work rolls with a cluster roll set

1100 series aluminum alloy strip is set at 0.011 in. This combo yields a finished product that's 60% stainless and 40% aluminum by volume, but 80 to 20% by weight. U-C claims this particular combination of materials and gages gives its product maximum ductility to promote formability while providing optimum wear resistance. The finished strip is delivered in two gages—0.0235 and 0.0255 in.—at 24-in. width maximum. At the mill, the starting aluminum strip is ¼ in. narrower than the stainless to facilitate tracking. The stainless overlap is trimmed when the finished strip is slit to narrower widths prior to shipment.

Before rolling, the mating surfaces of the two materials are cleaned to remove any contaminants that might interfere with the bond and brushed to increase surface area by creating minute hills and valleys that aid in the formation of a mechanical bond during rolling.

Three important modifications to the temper mill employed in the process come into play when the bimetal strip is being rolled. These include a second payoff reel for the aluminum strip, a swing-away furnace that heats the stainless to 300F prior to rolling in order to promote bonding, and a small-diameter auxiliary work roll on the upper—or aluminum—side of the mill. The rolls are also preheated to avoid chilling the stainless when rolling commences.

Thanks to the action of the smaller work roll, the aluminum strip takes nearly all of the reduction imparted to the two metals during rolling. When the 0.0235 finished gage is being produced, the 0.014 stainless remains practically the same thickness while the 0.011 aluminum is squeezed down to 0.0095. This arrangement prevents work hardening of the stainless, a condition which would be difficult to correct downstream.

Annealing makes the difference

After rolling, the bimetal coils are annealed at the recrystallization temperature of Al. While this heat level has little effect on the stainless, it does fully anneal the aluminum and restores its original properties. More importantly, the annealing process over time establishes the metallurgical bond between the two metals through what is described as a diffusion effect, leaving each wedded permanently to the other.

The final step in the bimetal production process, other than trimming and slitting, is the polishing of the stainless side of the finished strip to restore luster degraded in the rolling mill. The polishing is performed automatically in the plant's six-stand Unibrite℠ buffing line, one of the first of its kind in the steel industry.

While the auto industry is Coshocton's only customer for its stainless-aluminum strip, plant management is confident that other markets for the product can be found even if Detroit decides to try something different for trim application.

"As chromium continues to increase in price, the use of stainless steel for decorative purposes will be weighed against its use for more functional purposes," Sewalk predicts. "And since it's likely that there will always be a strong demand for decorative stainless," he reasons, "availability of a product such as ours will help meet that demand while conserving chrome. If that happens, we have the technology in place to preserve stainless steel's traditional markets." **33**

Sendzimir aims its Z-Hi at HSLA sheet rolling

While Universal-Cyclops is busy breaking in its newly-established facility for stainless strip rolling, executives at T. Sendzimir Inc, Waterbury, Conn, are looking forward to applying their retrofit concept to the production of high-strength/low-alloy sheet for the American automotive market.

One staunch proponent of just such a prospect is Michael G. Sendzimir, president, who is convinced that adding cluster roll sets to 4-Hi mills originally designed to cold roll ordinary carbon steel will allow those facilities to handle tough HSLA grades with ease.

Addressing a seminar sponsored by the Association of Indian Engineering Industry in Bombay this spring, Sendzimir noted that American automakers are turning to stronger steels in thinner gages to make their products lighter and more fuel-efficient. This shift has created a problem for steel producers, who are being asked to roll low-alloy steels with strength levels up to 90,000 psi on conventional mills.

Tandem mills are fixed in their pass schedules, Sendzimir said, while production of one-way and reversing mills is balanced for the end product, all considerations which make accommodating tougher material difficult.

"It was obvious," Sendzimir emphasized, "that in order to convert to higher strength steels, a revolutionary upgrading had to occur in the production of flat products to satisfy the 'new' automotive customers of the steel industry.

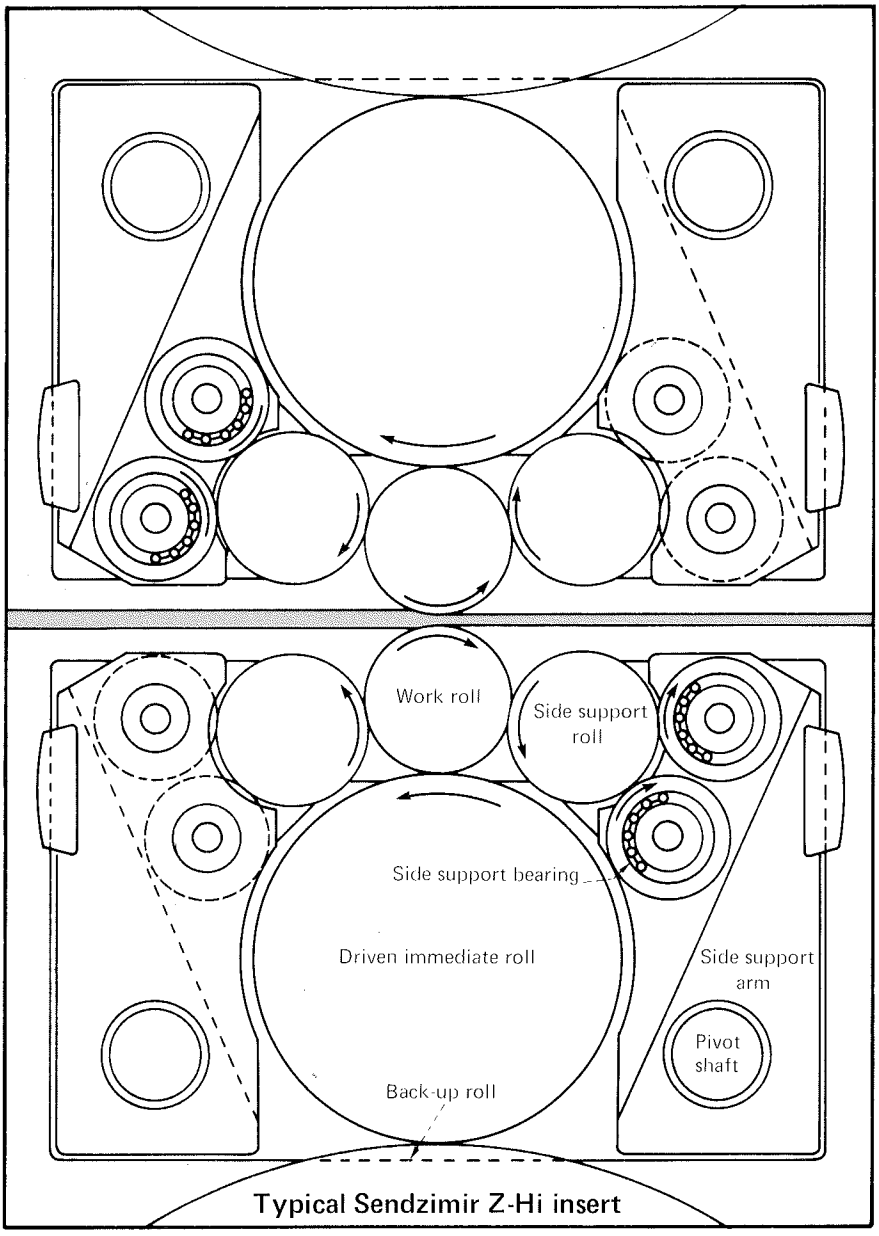
"It is always possible to develop a new mill for any given duty," he continued. "But since the steel industry had already invested tremendous amounts of capital in its existing cold rolling mills and had also encountered more than its share of economic difficulties during the past decade, the logical way to solve the problem was to find a means of revamping existing equipment."

That's why the Z-Hi mill came into being, Sendzimir reports. Smaller work rolls featured in the retrofit package "can give those mills the capability of making greater reductions as well as reduce harder material," he told his Indian audience. "Simultaneously, by arranging for axial displacement of intermediate rolls for shape control, the same mills can produce sheet and strip with better flatness."

According to Fred Krowchenko, project and sales engineer at Sendzimir, the cluster roll sets can be plugged into any and all existing 4-Hi mills, regardless of sheet widths and the number of stands involved. "There is no width restriction on Z-Hi designs," Krowchenko explains. "For wider mills, the work rolls will have to be made larger, but they will still be smaller than conventional work rolls."

When applied to a 4-Hi tandem mill arrangement, a cluster roll set would be installed on the first stand to provide greater reduction of the incoming steel at that point and allow the succeeding stands to make further reductions in the same proportions they always have.

The Sendzimir organization has reportedly not yet tackled the technical problems involved in adapting the Z-Hi idea to hot rolling, mainly because scale might interfere with the operation of the thrust bearings holding the cluster mill work rolls in place. Still, Krowchenko's quick to note, the possibility that the firm will take a hard look at hot mills some time in the future has not been ruled out.



Typical Sendzimir Z-Hi insert