

# Splice of life

**Flexco** discusses output and uptime gains with new conveyor belt fasteners and cleaners

Mexico's newest underground mine is finding that it can reduce conveyor downtime by an impressive 5%, allowing it to achieve 85% belt availability by using new mechanical belt fasteners and belt cleaners. The key to this performance improvement is with increased fastener/cleaner compatibility, which extended the life of both, as well as improving cleaning efficiency and eliminating hazardous water pooling around transfer points.

The new underground mine is part of a big mining operation and its efficient production is of direct benefit to the country's economy. Located in Mexico's northeastern state of Coahuila, the country's largest coal mining complex supplies nearby generating plants that produce about 10% of Mexico's electrical power, primarily serving the major industrial centre around Monterrey and the surrounding area from Tampico to Ciudad Juarez. Known as MICARE, which stands for Minera Carbonifera Río Escondido, the complex was begun in 1977 as a government project to guarantee a coal supply for the 600 MW José López Portillo Power Plant. This power plant is owned and operated by the Comisión Federal de Electricidad (CFE), now upgraded and renamed Carbón I. Privatised in 1992 as part of governmental preparation for NAFTA, MICARE now is part of the Coal Division of Altos Hornos de México, SA de CV (AHMSA), which in

turn is a Division of Grupo Acerero del Norte (GAN). This organisation also owns and operates a second coal mining complex farther west, Minerales Monclova, SA de CV, known as MIMOSA, which produces both thermal and metallurgical coal.

Committed to continuous improvement, MICARE's private ownership has since invested over US\$250 million in new technology for increasing production, quality, safety and environmental control. Some improvements were prompted by the increased fuel demand resulting from upgrading Carbón I to 1,200 MW, then adding a second CFE power plant - the 1,400 MW Carbón II completed in 1993. Other improvements were essential to the company's pursuit of ISO 9002 (quality and security) and ISO 14000 (environmental) certifications, which were gained a few years later and recertified each year since. Among the notable results of these efforts are an 80% over-all uptime, productivity reaching a monthly 150 tonnes/miner, and an 83% reduction in both accidents and production delays, with four consecutive National Safety Awards received from the Mexican Chamber of Mining.

Working the Río Escondido coal seam, beneath a surface area covering about 120 km<sup>2</sup>, MICARE produces sub-bituminous, long-flame thermal coal with a low 1% sulphur content. Samples are drawn from mine output every four hours and analysed in on-site laboratories to confirm client



**REMOVAL MEN:** the MICARE belt crew cuts out a damaged Flexco RAR6LP splice for replacement



**SCALLOP DIET:** a strip of new scalloped edge belt fasteners is fitted to square-cut belt end, ready for hammer-driven rivets

specifications for moisture, sulphur, ash and thermal value, and to direct any corrective blending or washing necessary.

Current operations comprise three underground and two open-pit mines, jointly served by a single blending/washing plant. Together, they produce 6.3-7.2 million tonnes/year - an increase of about 50% over the last decade and around 70% of all coal mined in Mexico - with proven reserves to guarantee at least 25 years of coal-fired electrical generation.

Nearly half of MICARE's current annual output comes from two underground mines, #4 and #5, with Mines #1 and #3 already worked out, Mine #2 winding down to a trickle and a new Mine #6 in early stages of development.

The other half, from the open pits, is extracted primarily by a 4060 tonne walking dragline, the largest of its type in Latin America. Perhaps the most visible evidence of GAN's modernisation programme, and called Doña Zita, this impressive machine has become something of a company symbol. A scale model graces the courtyard fountain in front of MICARE headquarters in the nearby municipality of Nava.

MICARE's Mine #5, opened in late '97, is the newest in full operation (and in Mexico). Here, one longwall and four continuous miners pursue a 2 m thick seam ranging 78-127 m down, beneath an overburden approximately 1/3 limestone/sandstone and 2/3 shale. The continuous miners - one Joy 440 kW and three Voest Alpine 170 kW units - contribute approximately 15% of mine output, primarily developing longwall panels. Producing the other 85%, the longwall operates a Joy 746 kW double-drum 81.3 mm diameter shearer that shaves about 680 mm off the face with each pass. Ten parallel panels ranging from 200-250 m wide, and from 400-1,300 m long, are anticipated in the plan for this mine.

Mine #5 operates with nine conveyors. Longwall and continuous miner

production moves out on three 1,016 mm wide panel belts rated for 1082 tonnes/hour at speeds of about 2.5 m/sec. These transfer at 90° onto a straight mainline conveyor, on which a 1,219mm wide belt can carry 1443 tonnes/hour at about 3 m/sec. A final transfer turns the coal onto the exit belt, which is 1,372 mm wide, rated for 1804 tonnes/hour at 3.5 m/sec., spans 550 m between end pulleys, and rises to the surface at a 16° incline.

Panel belt lengths, varying with the stage of panel development and longwall retreat, can range up to 1,300 m between end-pulley centers. The mainline conveyor ultimately will extend to 1,600 m between end-pulley centers, by adding segments later as longwall panels are developed farther away from the exit belt transfer. Throughout the mine, belts are 12 mm thick, solid-woven PVC construction with 140 kN/m mechanical fastener rating, generally running troughed at 35°.

### Rivets favoured

By the time MICARE engineers developed Mine #5, they'd learned some valuable lessons from Mines #1 through #4, says conveyor belt maintenance Chief Faustino Rodriguez. "From the experience of Mine #1, back around 1980, there was no question about the advantages of mechanical belt splicing as opposed to vulcanising, especially on longwall panel belts that need frequent length changes, and we have trusted mechanical fasteners ever since. But with Mine #4, we began to see new improvements in mechanical fasteners that made them serve our needs even better."

Prior to Mine #4, he explains, MICARE had relied on a rivet-attached, hinged-plate belt fastener that allowed easy splice separation for removal of panel belt sections to shorten the belt as the longwall retreated. Equally important, its installation with hammer-driven, self-setting rivets made replacement of worn splices quick and easy for mine maintenance crews,

without requiring any outside contractors.

Known as the Flexco SR Rivet-Hinged Fastener, it consisted of 38 mm wide top and bottom plates joined at one end by two broad hinge loops. Each pair of plates sandwiched the belt end, and was secured to the belt with a staggered pattern of five rivets. These fastener segments were fitted side by side across both belt ends. When both belt ends were brought together, the SR hinge loops meshed and a hinge pin was inserted to complete the joint.

The rivets were a special Flexco design, preassembled with patented, breakaway pilot nails that let the rivets penetrate the belt easily, without requiring holes to be punched or drilled first, which conserved full belt carcass strength and helped shorten installation time.

The same hammer blows that set the rivets also compressed the top and bottom fastener plates into the belt cover, giving the plates a tight, wide grip that helped keep the belt from pulling solely against the rivets. Simple portable tooling included an anvil plate that captured the nails beneath the splice and allowed the hammer blows to automaticallypeen the rivets on the underside of each plate.

"In Mine #4," Mr Rodriguez recalls, "we started with the largest size of SR fastener available at that time, anticipating heavier belt loads and higher tensions. These were called R6, and typically lasted about five months in normal operation under our conditions. Then our Flexco distributor, Tec nibandas de Coahuila, located in Monclova, told us about a new version called RAR6LP. We tried these, found that they lasted nine months, and didn't hesitate to switch. Naturally, when Mine #5 opened, we used RAR6LP there from the start."

The RAR6LP has the same dimensions as standard steel R6 fasteners except in plate thickness, which is reduced to 2.4 mm, 24% less than the standard R6. Reduced thickness gives the RAR6LP a



**JOIN THE DOTS:**  
Oscar Casas of Flexco distributor Tec nibandas de Coahuila assists in joining the Flexco scalloped edge splice with insertion of the armored stainless cable hinge pin



**AN INSPECTOR CALLS:**  
MICARE conveyor belt maintenance chief Faustino Rodriguez inspects the finished installation of the Flexco scalloped edge splice



**BACKGROUND CHECK: MICARE conveyor belt maintenance chief Faustino Rodriguez checks the Eliminator H-Type belt cleaner's segmented blades**

lower profile splice that is less stressful to belt cleaner blades, pulleys and idlers. The reduction in thickness is compensated by an increase in toughness, using a special low-chrome stainless steel called RustAlloy, developed for high resistance to acidic mine water and abrasion from compacted wet coal or fines.

"The RAR6LP also uses a much tougher hinge pin," Mr Rodriguez adds. "It's made of stainless steel cable armoured with a flat stainless wrap, and lasts about 60% longer than the bare steel pins we used earlier with R6 fasteners."

While longer splice and hinge-pin life was enough of an advantage at first, he points out, lowering the splice profile was starting to become important as well. "We were beginning to want better belt cleaning, and it seemed obvious that a lower splice profile would allow tighter fitting cleaners. Until then, our mines used homemade cleaners with blades made of rubber strips rated at 60 duro shore hardness. We needed to adjust them a lot and replace the rubber strips very often. Although PVC belt cleans more easily than rubber belt - it seems that coal fines don't stick to the PVC as much - those cleaners never worked very well. So when Flexco came out with the Eliminator belt cleaners, we agreed to try them based on the good experience we've had with Flexco splices."

## Cleaning up

Three Eliminator H-Type pre-cleaners were installed at key transfers in Mine #4 late in 1999. These units are engineered for use against the head pulley, about 15° below horizontal centreline, where carryback is removed most effectively, yet kept easily in the process stream.

Unlike conventional cleaners, H-Type cleaners span the belt with a segmented row of 200 mm wide blades, which are individually mounted on pre-tensioned rubber cushions. Independent tensioning lets blade segments self-adjust at their own

rate to compensate for the irregular and changing contours of belt-surface wear patterns, especially in the heavily loaded trough area of the belt. Self-adjustment also compensates for uneven blade wear across the cleaner and this method of constant, automatic compensation maintains efficient pressure against the belt throughout the life of each blade, and helps to avoid the need for frequent retensioning.

MICARE's cleaners were installed with Flexco's new XF-Tips, then still in a final testing stage and not yet introduced officially. The XF-Tip is designed to double the service life of the H-Type cleaner's standard F-Tips, as well as offering better compatibility with mechanical belt splicing. Molded of a special urethane formulated for high wear resistance, XF-Tips are 86% thicker at the belt-contact point than standard F-Tips, and 30% longer. These are mounted on a more heavily reinforced urethane blade body, which is formulated separately to give the blade greater stability and to serve as a shock absorber for passing splices. The extra length allows XF-Tips to address the belt at a more acute angle, which improves cleaning action while promoting a smoother interface with passing belt fasteners.

"Our H-Type cleaners have reduced carryback by about 80% compared to our earlier cleaners," Mr Rodriguez says, "and their XF-Tips are lasting up to seven months, so they've cut down our blade replacement work a lot."

"Several months after we installed the H-Type cleaners," he continues, "Flexco brought us another fastener improvement they call the scalloped edge, which we were eager to try because it promised to lower the splice profile further."

Also made of RustAlloy, but noticeably different from the earlier SR Flexco fasteners, the new SR Scalloped Edge design features leading/trailing edges formed into a concave, scalloped shape

with more-gradual coining (beveling). These features allow the fastener plate ends to embed deeper into the belt cover more easily, for reduced splice height in installations that do not use skiving. With deeper installation, plus the scallop and coining to reduce the initial leading-edge contact area, the new design invites belt scraper blades to ramp up and over the plates smoothly, without encountering any hard edge impact.

Scalloped Edge fasteners also add a viewport in each top plate that allows the installer to see that the belt end is properly butted against a belt stop formed into the fastener's bottom plate. This promotes accurate, uniform positioning across the squared belt end, which produces a straighter splice that results in longer splice life and a truer-tracking belt. As with earlier Flexco SR fasteners, these are supplied in continuous strips that keep all the fasteners in correct spacing and alignment during installation.

"Making it easier to get a lower splice profile was very helpful for us," Mr Rodriguez explains, "because the surface of PVC belting is harder than rubber cover and doesn't let the RAR6LP fasteners embed well. We couldn't countersink our splices because the solid woven construction of our belts doesn't provide enough top-cover thickness to cut away. So when we saw how well the scalloped design embeds into our PVC belting, we began converting both Mines #4 and #5 as their RAR6LP splices came due for replacement."

"Before long, we started noticing that the XF-Tips on Mine #4's belt cleaners were lasting a bit longer, maybe 5% more. And, although there's no data to confirm it yet, we expect less wear on return idlers over the long term because we're noticing less noise from splices banging on rollers. It also seems reasonable that the lower profile of the bottom plate should reduce the stress on the belt when the splice wraps around the end pulleys, and that should help the belts hold their splices longer as well."

Most recently, he continues, Mine #5 received its first H-Type cleaner with XF-Tips, and found yet another benefit. "The coal here is much wetter than in our other mines, close to 15% moisture when extracted. Combined with the dust control spray used at the longwall, this puts a lot of water on the belts and too much of it has been ending up in pools around the transfers, creating an unnecessary hazard. The way the H-Type blades address the head pulley does a great job of ejecting the water onto the receiving belt along with the coal." With that, he notes, the pool around the test transfer in Mine #5 has dried up, and a second H-Type cleaner has been added where the mainline belt transfers onto the exit belt, to help the belts carry most of the water out of the mine. 