

# International mining

Informed and in-depth editorial on the world mining industry

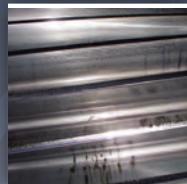


**MODERN OPEN PITS**  
**GERMAN TECHNOLOGY**  
**DRIVES AND CONTROLS**  
**HEAP LEACH AND SX-EW**  
**ROCK TOOL DEVELOPMENTS**  
**OPERATION FOCUS:**  
**Talga Vittangi**

 **GEKKO**

# Do More with LEss

INCREASE UPTIME & PROFITS WITH  
PYROSHIELD FOR BALL MILLS & KILNS



## LUBRICANTS

Save time and money by protecting your valuable equipment with LE's Pyroshield® open gear lubricant, a long-lasting synthetic solution for high-load, heavy-shock applications. High film strength allows Pyroshield to redistribute loads over the surface area of large open gears. Its powerful formulation includes EP additives and Almasol®, LE's exclusive solid wear-reducing additive. Converting to Pyroshield is simple, with no production interruption. Even better, Pyroshield is clear during use, so you can inspect gears without downtime.



## RELIABILITY

More than a lubricant supplier, LE is a one-stop shop for reliability solutions. An authorized distributor of Bijur Delimon, Interlube and Redi-Mount centralized lube systems, LE can help you plan and implement the best system for your needs.

## SUPPORT & SERVICE

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If you're ready to experience LEss downtime, LEss maintenance time and LEss need for parts replacement, act now. Visit [www.lelubricants.com/open-gear-lubricants.html](http://www.lelubricants.com/open-gear-lubricants.html) to learn more about Pyroshield and to request a consultation.

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LUBRICATION ENGINEERS  
INTERNATIONAL LTD.

The Lubrication Reliability Source™

## Motor braking systems

**Twiflex** offers the largest range of industrial disc brake calipers in the world. Spring applied units may be retracted pneumatically, hydraulically or electrically (depending on caliper design) while most direct acting brakes have some form of positive retraction device. A key market for the company is mining, including brakes for large dragline motors.

A major Australian coal mine operator needed to replace the brakes on the dragline at their mine in the Bowen Basin. In constant operation since 2011, the dragline's original braking systems had reached their useful service life. With a working weight of 6,950 t and a bucket capacity of 152 yd<sup>3</sup>, the dragline can move 240 t of overburden in a single pass. Twiflex was selected to provide spring-applied, air-released replacement caliper brakes for all the dragline's eight hoist and eight drag 1,450 hp motors. Each have been equipped with multiple GMR-SD 15.6 caliper brakes operating on 46 in diameter discs that provide a combined braking force of 72 kN.

On the eight swing 1,045 hp motors, Twiflex has equipped each with multiple GMR-SD 8.4 caliper brakes operating on 46 in diameter discs that provide a combined braking force of 39 kN.

On the four propel 1,045 hp motors, Twiflex equipped each with multiple GMR-SD 15.6 caliper brakes operating on 46 in diameter discs that provide a combined braking force of 72 kN.

The GMR-SD caliper brake's modular design allows for quick change outs and the ability to use multiple units of varying sizes to meet specific installation requirements. Torque is adjusted in the field to meet operating conditions. The low-maintenance brakes feature easy-to-replace brake pads and low cost spares.

Twiflex recently also provided GMR-SD caliper brakes for use on a new medium-duty 4,500 t dragline at a mine in India. The brakes stop the dragline's load from moving as quickly as possible and bring it to rest in a controlled manner to avoid shocking the drivetrain and machine frame. The GMR-SD brakes are designed to handle the high energy associated with stopping these massive loads.

The GMR-SD caliper is Twiflex's most popular model for draglines and consists of a cast frame with two pivot-mounted arms which are actuated by a spring-applied, air-released thruster. Depending on the peak disc temperature calculated, the calipers can be fitted with either organic or sintered bronze pads which are suitable for emergency stops.

For the Indian project, Twiflex provided GMR-SD spring-applied, air-released caliper brakes for the four hoist and four drag 1,230 kW motors, each with multiple GMR-SD 15.6 caliper brakes operating on 38 in diameter discs that provide a combined braking force of 108 kN; and on four

swing 932 kW motors, each with multiple GMR-SD 8.4 caliper brakes operating on 38 in diameter discs that provide a combined braking force of 58.5 kN

## New options from the majors

The new **SEW Eurodrive P-X** series of industrial gear units combines the advantages of its P planetary gear units with those of its helical-bevel gear units in the X range. "With specially designed housings that integrate the intermediate flange, the result is a series of compact, weight-optimised drive units." These are available in seven sizes and with a torque range of 100 to 500 kNm and a gear ratio range of i = 160 to 560.

Applications include anything from bucket-wheel excavators to apron feeders in mining, where high-power and high-performance is needed.

One key feature comes in the form of the high thermal ratings that these industrial gear units are equipped for as a result of their shared oil chambers and thermally optimised housings – this helps keep down cooling system costs. However, the drive units also function reliably at temperatures of below -25°C if used in conjunction with the relevant heaters and heating mats.

Another important plus-point is that the housings are designed as symmetrical, invertible enclosures and have an inspection cover on both sides. The motor adapters can also be used to connect motors of up to IEC 355 with 500 kW.

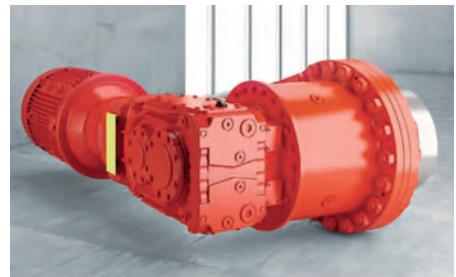
Cited benefits include saving on cooling system costs thanks to the high, gear unit-specific thermal ratings; and reducing costs spent on storing replacement units thanks to the symmetrical, invertible enclosures.

## Gear lubrication success

Large open gears in mining face challenging conditions including a harsh environment, extended service operation, dust, silica, water, extreme heat and extreme pressures. Open gear lubricants must be specially formulated to keep equipment operating at maximum efficiency.

**Lubrication Engineers'** Pyroshield line of heavy-duty synthetic open gear lubricants meets or exceeds all relevant manufacturer specifications for open gear applications, providing "reliable lubrication in coal power generation facilities, cement kilns, and metal and mineral mining operations." Pyroshield's ability to protect open gears from extreme pressures, heavy loads and high temperatures is well proven, according to the company.

An improved Pyroshield formula no longer contains any heavy metals or lead. LE also increased the film strength of the lubricants, making them easier to pump - particularly for



*The new SEW Eurodrive P-X series of industrial gear units combines the advantages of its P planetary gear units with those of its helical-bevel gear units in the X range*

automatic lubrication systems. Finally, LE raised the viscosity index, removing temperature-based fluctuations that would be seen during actual use.

Pyroshield does not require the equipment to be shut down during the conversion process. It can be applied manually or through automatic spray systems. It also appears translucent in use, allowing for the visual inspection of the open gear.

Lubrication Engineers South Africa's approved reseller, Filter Focus, successfully converted the girth gear lubricant on the mill drive at Impala Platinum to PYROSHIELD 9011 XHvy high viscosity oil back in 2014. Jaco van Rooyen, Implats Operations Engineer UG2 & Tailings commented: "The mill drive motor has historically operated at between 5.6 MW and 5.4 MW. After the conversion, the mill drive motor is now operating at between 5 MW and 4.8 MW. The preliminary results indicate a significant reduction in energy consumption of approximately 400-600kW or approximately 12% on the mill motor, while maintaining the same production output."

Since converting to PYROSHIELD 9011, Impala had also recorded a reduced Delta T across the face of the pinion gears. Vibration analysis indicated an improvement in vibration, with the historical vibration already very low prior to the conversion.

After converting to PYROSHIELD 9011, Impala reduced its lubricant consumption from 800 kg per month, down to 80 kg per month, equating to a 90% reduction in usage, with less friction and greater levels of gear protection. "We no longer have to dispose of large volumes of used lubricant, which assists Implats carbon reduction targets. Housekeeping and onsite pollution on the mills has improved dramatically. We are very impressed with the preliminary results achieved thus far and would therefore recommend PYROSHIELD 9011 on similar applications."

Several years ago, chromite miner Hennic Ferrochrome, which mines on the western limb of Bushveld Igneous Complex in South Africa, encountered a number of failures at the plant owing to inadequate lubrication, incorrect lubrication and dirty oil on critical components



such as gearboxes and bearings. As a result of these failures, Hernic Ferrochrome contracted Filter Focus to run comprehensive oil analysis and condition monitoring, whereby all critical components within the plant were fitted with sampling points. The oil analysis programme enabled Filter Focus to identify problem areas and recommend the correct solution before any further costly failures occurred.

The company's involvement with Hernic Ferrochrome initially began through the implementation of a basic lubrication programme and evolved to include the supply of specialised Filter Focus filtration units and automatic lubricators for critical equipment. In May 2012, Filter Focus installed automatic lubricators for the majority of conveyor systems at the plant, which currently provide frequent and exact quantities of lubricant for critical bearings.

Hernic Ferrochrome Plant Manager Jannie Mostert stated that since these systems have been installed, bearing failures have decreased dramatically, which has resulted in reduced unscheduled downtime. With regard to the lubrication of the girth and pinion gears of pelletising and sinter plants PS1 and PS2, Mostert says that, since the introduction of Lubrication Engineers' Pyroshield Syn XHvy Open Gear Lubricant (9011), overall lubrication consumption has been reduced from 400 kg/mth to 60 kg/mth, equating to an 85% reduction in consumption. "In addition to a reduction in lubricant consumption, there was also a significant reduction in vibration, a 20% reduction in temperature across the girth gear face and a 22% reduction across the pinion gear face," he pointed out.

Since being lubricated with Lubrication Engineers' (LE) Almagard Vari-Purpose Grease (3752), the pinion bearings used at PS1 and PS2 have shown a 12% reduction in vibration and temperature. "LE's Almagard EP Grease has been approved as the only lubricant with advanced-friction coefficient. It dramatically lengthens grease intervals, eliminates bearing failures, extends bearing life by up to threefold and does not harden with age," highlights Fitzgerald.

Hernic Ferrochrome also had problems with its smelter fans and introduced LE's Monolec R&O Compressor/Turbine Oil as a possible solution.

### High speed load out with SR drives

A major potash mine in Canada underwent an expansion on part of their underground and surface processes to increase potash production in 2010. Part of the underground expansion was the replacement of an existing load out conveyor (54 in wide by 130 ft long) that transported the mined potash ore to the production hoist by a High Speed Load Out conveyor 96 in wide by 200 ft long located about 1,000 m below the surface level.

The new High Speed Load Out conveyor transports the entire underground production, in batches, to the production hoist that brings the material to the surface for further processing. The drive system needed to be capable of starting the conveyor 35 times per hour and of operating 20 hours a day, 350 days a year. The system life expectancy is 30 years. The drive system needed to be capable of accelerating the fully loaded conveyor from zero speed to the maximum speed (825 ft/sec) in a maximum of five seconds.

The reliability of the drive system is paramount considering the financial impact associated with the conveyor being out of commission. It is calculated that the value of hourly mine production transported by the High Speed Load Out conveyor when working at its full duty cycle is C\$100,000. The motors are installed in a location where the access to the motors is difficult therefore minimal maintenance on the motors is desirable.

The assembly of the motors, gear reducers and pulley are located at the discharge end of the conveyor which is an area with extremely high levels of potash dust. The drive system components need to be minimally affected by the arduous ambient conditions. Thermal management of installed power components requires special consideration. Four drive technologies most often used in large material handling applications were compared: DC, AC polyphase induction squirrel cage motor and Variable Speed Drive (VFD); hydraulic drive system; and SR drive technology.

The expansion project engineering consulting company recommended that the potash mining company select the fourth option, Switched Reluctance drive technology, supplied by Synergy Engineering Ltd, as the drive system for the High Speed Load Out Conveyor. The criteria driving the consultant's recommendation and mine's decision were:

- Ability to provide the rated torque throughout the speed range
- Unlimited number of repeated starts
- Simple construction and robustness of the motor
- System efficiency.

Synergy Engineering was awarded the contract to supply the complete drive system for the High Speed Load Out Conveyor that was comprised of two Switched Reluctance motors and associated drive units; two gear reducers and a cooling system for the drive enclosures. Synergy Engineering Ltd cooperated in the drive system design for the High Speed Load Out Conveyor, with Nidec SRDL, a UK-based engineering and manufacturing company of Switched Reluctance motors and drives.

Based on the application requirements, a dual



*The drive system supplied by Synergy Engineering in conjunction with Nidec needed to be capable of starting the conveyor 35 times per hour and of operating 20 hours a day, 350 days a year in challenging conditions such as potash dust accumulation on the motor*

drive system has been utilised. One 200 kW (268 hp) SRM449TN-180 motor is coupled through its own 335 hp, 21.88:1 ratio gear reducer to each end of the conveyor pulley for the combined power of 400 kW (536 hp). Each motor is operated by its own individual 225 kW power converter SRC5 (drive).

The plant's main control system (PLC) communicates with the SR drives via hardwired discrete and analogue connections or via ModbusTCP bus. The motors (and their drives) have been assigned master and follower functions to evenly distribute the torque between them. The motor functions can be swapped by setting the proper drive parameters.

If hardwired control of the system is selected, the plant's main control system sends three discrete (run enable, run, local/remote) and one analogue (speed reference) signals to both drives. Both drives provide their status information back to the main control system: running, fault, motor speed.

If ModbusTCP control is selected, the plant's control system sends Boolean and numerical values to the assigned drive's registers to control the run/stop and the speed of the conveyor.

Only the drive that has been configured as the master reacts to the commands from the plant's control system. It operates in the speed control mode. The follower drive operates in the torque control mode and receives the torque reference from the master drive. The master monitors the torques of both motors and dynamically adjusts the torque reference to the follower drive so the torque difference between the two motors is kept below 3%. The communication between the drives is via CAN communication bus.

As it is with any energy conversion system there are losses associated with the operation of the Switched Reluctance drive system. Despite it having one of the highest efficiencies among other drive technologies it still generates a