

The urge for uptime



In this prolonged low commodity price environment, the importance of new and innovative maintenance strategies, tools and approaches is increasing, reports Paul Moore

Mining has much to learn from other analogue industries, and this includes in maintenance. The low minerals prices have forced the mining industry to rethink the viability of its operations. In some cases this has forced companies to divest, or put an operation on care and maintenance. In each case mining companies tend to put a stop to all capital expenditures, but in most cases this only frees up cash on a short term basis whereas it fails to remove costs on a structural basis permanently. **C.C. JENSEN A/S**, the designer and manufacturer of oil filtration systems for removal of particles states: "This is where successful mining companies have looked to other industries for inspiration. Some of the mining companies which have responded most successfully to the low mineral prices, have done so by copying an industry which is designed to operate with permanently low commodity prices and a need for reliable and cost efficient equipment – the global wind turbine market."

The global wind turbine market has at least three things in common with the mining industry in that it is capital intensive, using expensive equipment; often has low commodity prices, which is a permanent given in the wind industry; and requires constant uptime from reliable equipment with throughput critical to success.

For years, the mining industry has been all about increasing throughput. A key factor to achieve this is to ensure maximum uptime of equipment; sometimes at a high cost, but as long as the minerals prices are high, then the

cost of keeping equipment in operation has had less focus. With low commodity prices, mining companies now have to reconsider the idea of focusing purely on throughput, but also consider cost per tonne/ounce/kilo.

CCJ states: "Unlike mining, the global power market has always been characterised by low margins on the commodity they sell. This has forced the stakeholders to focus on cost efficient and predictable/reliable production; but also to focus on maximum output. Windfarms are located in isolated areas; and today more and more of these are offshore. Unforeseen breakdowns, too frequent service shutdowns or unreliable equipment are catastrophic in this industry and can literally undermine the profitability of a windfarm. Like mining, costs associated with a breakdown or a shutdown are extremely high in the wind industry; this is why the wind industry is geared differently than the mining industry, and there are valuable benefits from the wind market which can be applied to the mining industry."

While mining companies tend to have high operational budgets in order to keep the equipment running, the wind market has focused on measures which keep the equipment in operation cost effectively and reliably. "Today the wind industry is working toward two-year service intervals of critical equipment and complete elimination of unforeseen breakdowns. The mining industry is used to monthly – sometimes weekly – service intervals and unforeseen breakdowns or unplanned work orders are industry accepted standards. The

Mining is a uniquely extreme environment where the right maintenance approach can make a huge difference. Petro-Canada Lubricants, a Suncor business, has launched a new API CK-4 and FA-4 information hub, creating a comprehensive online guide to the new heavy duty diesel engine oil categories

interesting thing is that equipment in the wind industry operates under significantly harder loads than it does in the mining industry – in fact more than 60 times the load – and still they manage to keep the equipment in operation for a full year without shutdowns or service intervals."

One of the differences between the two industries is the working environment. While wind has a much higher load, mining equipment operates under much dirtier conditions given the nature of the operation. But this is exactly where some mining companies have been successful; by trying to create similar environments.

Although the operating conditions will never become similar, the mining operations which have implemented technology from the wind industry have seen significant and measurable benefits within a matter of weeks. BHP Billiton's Escondida saved \$445,800 and eliminated three out of four shutdowns per crusher per year by installing a CJCTM HDU 427/108 Fine Filter to remove up to 150 kg of dirt every two months. The continuous operation of the CJCTM HDU 427/108 kept the contamination out of the oil system. This led to increased oil lifetime and reduced cost for component change. After the



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Left: One of the primary crushers at BHP Billiton Escondida. Right: CJC™ Fine Filter HDU 427/108 installed, which saw 87% less downtime and annual savings of up to \$479,600

CJC™ Oil Filter was installed, the inline filter consumption was almost eliminated and three out of four of oil changes were avoided. Avoiding shutdown costs of \$10,600 per hour for each standstill, resulted in a direct impact on the bottom line, with 87% less downtime.

Kinross' Chirano gold mine went from 24 to 4 service shutdowns per year on each of their Volvo mining trucks. For their entire fleet this equals 320 less service intervals per year, with nine major overhauls eliminated per year, or \$681,000 in annual savings on their fleet of 40 trucks.

CJ argues that these mining groups are using technology which has successfully kept wind turbines in operation without breakdowns and only one annual service interval for decades. "Ten years ago, this was unknown in the mining industry; today it is standard equipment on new Sandvik and Metso crushers. The solution is in-depth CJC™ Offline Oil Filtration. Despite how dirty and tough the operating conditions are, mining companies are able to save 50-75% of their oil consumption; eliminate three out of four oil service shutdowns of equipment; and reduce running costs by around 50-60% by implementing CJC™ Offline oil filtration because it ensures much cleaner and lower stress operating conditions for gearboxes, bearings, hydraulic systems – for any oil system; and in the mining industry these are everywhere."

A new era of wear protection

As heavy materials pass from station to station in a minerals processing plant, processing equipment is stretched to the limits of its capabilities. The wear rate of components, typically in chutes and hoppers, is very high. The costs of replacing worn equipment typically makes up a substantial proportion of total maintenance costs, so anything that can be done to reduce wear and increase equipment lifetime will have a significant impact on

operating costs. Protecting the metallic plates of specific equipment is one important area that can contribute significantly to reducing maintenance costs and equipment downtime.

Helgi Gudbjartsson, Global Launch Manager, **FLSmidth** argues that current practice for wear protection usually involves wear liners or panels, which are bolted or welded onto the equipment. Different wear liners are applied in different situations, depending on factors such as type of ore, drop height, material lump-size distribution, and angle of impact. Traditionally, the minerals industry has used either metallic wear liners or ceramic wear liners. Each has its own advantages and disadvantages.

"High in density, metallic wear liners are heavy – up to 40% heavier than ceramic. The hardest metals are particularly expensive and difficult to work with. They have significant limitations in different temperature extremes, too. While hardness is reduced at higher temperatures, impact strength is reduced at lower temperatures. On the other hand, ceramic wear liners are difficult to attach to existing chute work, requiring special adhesives or suspension within an elastomeric matrix. They

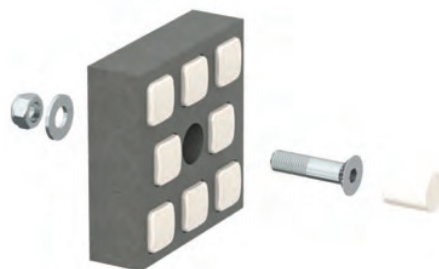


can also detach easily from the substrate if surface preparation is poor or if the adhesives and elastomers are incorrectly prepared. They are extremely difficult to cut and cannot be bent or formed."

Such challenges have had a significant impact on maintenance procedures and costs. A general issue facing the industry is the loss in production time because of wear liners needing to be changed often and the time it takes to install new liners.

"A typical example could be for material of a common ore, such as gold, copper or nickel, with a hard impact velocity of more than seven m/s. In such a situation, the wear liner may have an average lifetime of one or two months at most. The replacement procedure can take a whole shift, putting the process flow on pause for several hours resulting in significant production losses. Safety is a real concern, too. The units of wear liners can weigh between 20 and 40 kg apiece and sometimes require a special lifting mechanism in addition to the scaffolding, allowing maintenance personnel to safely access the installation points."

FLSmidth has developed a wear liner solution specifically to address the challenges of protecting crushing equipment, particularly related to wear liner longevity and installation time as well as the safety of personnel involved. Gudbjartsson says: "A unique composite structure of steel and ceramic components, the patent pending FLSmidth FerroCer® Impact provides advantages of both ceramic and metallic materials. Combining the superior abrasion resistance of a ceramic with the strength, toughness and malleability of a metal, it handles hard and abrasive materials in high-impact applications. Traditional metallic liners wear too quickly and ceramic liners crack or disintegrate. With a wear life of more than double that of a high-end metallic liner, FerroCer has been tested to increase wear resistance by a



The FLSmidth FerroCer® Impact panel is attached using a single countersunk bolt

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factor of up to 15 times compared with traditional wear solutions, depending on the ore type and application. This allows mineral processing plants to achieve a total cost of ownership less than half that of other liners.”

Depending on ore type and application FerroCer increases wear resistance up to 1,200% says FLSmidth and FerroCer Impact is effective in temperatures down to -40°C and has been tested in harsh Australian mining sites where ambient temperatures can climb to 50°C.

FerroCer Impact consists of panels that are lighter and less bulky than metallic liners. Each panel comprises a number of ceramic inserts enclosed within a matrix of cast metal. The matrix protects the more vulnerable side faces of the inserts and ensures that only the wear face of the ceramic is exposed to material impact. Tapers on the sides of the inserts and corresponding holes within the matrix act to wedge the ceramic inserts within the matrix and prevent material particles and fluids from causing the inserts to be ejected from the matrix. The matrix protects the more vulnerable side faces of the inserts and prevents them from being prised away from the wall of the chute. The inserts and matrix holes are tapered to ensure positive location.

“The tapered geometry of each ceramic insert enables its remaining wear life to be visually assessed. As the exposed surface of the insert is progressively worn away, its area and face width increase. There is a direct correlation between an insert’s face width and height so that the one can be readily calculated from the other.” The panels’ low weight (approximately 5 kg) and compact shape make them quick and easy to install using standard hand tools. They are also compliant with the manual handling requirements of occupational health and safety organisations. Each panel is attached using a single countersunk bolt. The mounting hole for the bolt is then closed using an adhesive coated ceramic plug.

An entire chute can be lined with just two different types of FerroCer Impact panel. The “Standard” panel is installed over most of a chute’s surface, while the “Edge” panel has an elongated end of solid metal and can be installed at the chute’s entry and exit points. It can also be trimmed to a specific length or angle to accommodate chutes with irregular shapes or corners.

In one nickel processing plant, the FerroCer panels were installed in a conveyor discharge chute, downline from the primary crusher unit where the material drops 6 m from one conveyor belt down to another one, where it is transported onwards to the secondary crusher. The hardness of the nickel ore is approximately 5 on the Mohs scale. After installation, the plant operated for 270 days, and it operated at full production of



Under the Forever Belt Cleaner Guarantee, Martin Engineering will provide replacement parts as required, for all cleaner assemblies using its urethane belt scrapers, regardless of model or blade type

900 t/h with lump sizes of up to 250 mm in diameter. This was a big step up from the previous liner, which had lasted less than three weeks on average.

In another gold processing plant, FerroCer panels were installed in a chute downstream from the primary crusher where the drop height is 2 m and the lump size up to 400 mm in diameter. The previous liner type, consisting of heavy-duty rubber and steel bars, typically lasted no longer than six weeks. After the first 17 weeks in operation, the wear measurements taken on site indicate that the new FerroCer panels will last at least another 80 weeks, making them at least 10 times better than the previous liner solution. “FerroCer Impact answers an important need in the minerals processing industry. It combines long wear life, ease of installation and affordable pricing to achieve a total cost of ownership which is less than half that of other liners. Its low replacement rate results in greatly reduced lost production time for mines.”

Conveyor belt maintenance

Flexco recently released the newest cleaner in its line of belt conveyor products, the MXP Extreme Duty Precleaner. Available for use with belts ranging from 1,050 mm to 3,000 mm wide, pulley diameters 1,200 mm and up, and belt speeds up to 10 m/s, the MXP is the largest, most rugged

cleaner in the Flexco offering. The new MXP is described as ideal for use in copper, coal, iron and oil sands applications and is designed for easy installation. Designed with heavy-duty construction throughout, the MXP boasts an oversized 200 mm diameter centre pole and 490 mm blade height, ensuring optimal cleaning on large pulleys and wide belts.

“One of the big advantages to the MXP Extreme Duty Precleaner is that it is designed with a three-piece pole, making it easier to transport to the head pulley and install,” said Kevin Fales, Product Manager at Flexco. “Instead of trying to lift one large pole into place, the cleaner can be placed in sections and assembled on site.” The MXP is available with 150 mm and 300 mm wide blade segments for varied material paths and easy replacement.

The spring tensioner on the MXP makes the cleaner compatible with mechanical splices, allowing the blade to move away from the belt when a splice passes.

Flexco says: “the MXP Extreme Duty Precleaner is a Mineline® – endorsed cleaner – designed and engineered to work – day in and day out – in some of the toughest applications in the world.”

In what it says is “a first for the bulk material handling industry”, a global manufacturer of conveyor belt cleaning systems is offering lifetime no-cost replacement of tensioners and

mainframes for belt cleaners that are fitted exclusively with the company’s cleaner blades. Under the Forever Belt Cleaner Guarantee, **Martin**



Flexco recently released the newest cleaner in its line of belt conveyor products, the MXP Extreme Duty Precleaner



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Engineering will provide replacement parts as required, for all cleaner assemblies using its urethane belt scrapers, regardless of model or blade type.

The company's replacement blades are mixed, formed and cured in a computer controlled, modular work station designed and built by the company's engineers, rather than subcontracting the production as some suppliers do. This process allows for the highest quality control and a one-day turnaround on most orders.

Engineered to effectively remove carryback, reduce material loss and provide longer belt life, the six colour-coded blade types "allow operators to perfectly match urethane compounds to the specific belt, speed and types of material." Some blade types are designed to perform under extreme temperatures as low as -40°C and as high as 150°C, and others are best suited for specific cargo such as hot slag and clinker, or moist materials. Martin Engineering primary cleaners are produced using the patented Constant-Area Radial Pressure (CARP) curved design, first introduced by Martin, to deliver consistent cleaning throughout all stages of blade life. The assemblies allow one-pin replacement, making maintenance a safe, no-tool operation performed from outside of the transfer chute.

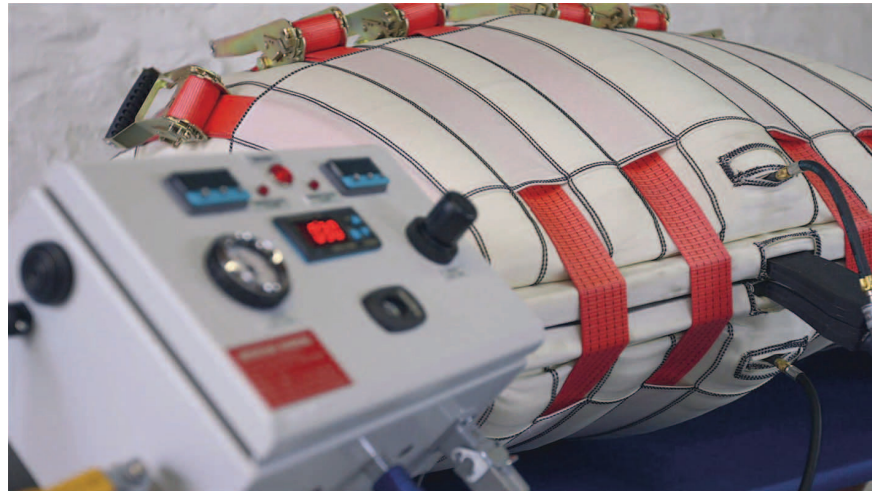
In coal, the **ASGCO® One Sided Slide-ler™** helped a customer solve a load zone maintenance problem at a coal handling facility.

The One Sided Slide-ler is designed to be maintained from one side of the conveyor, allowing you to replace the rolls with minimal downtime



The challenge was to be able to remove and to replace the impact rollers in the tail section with access limited to only one side, while providing an easier alternative to servicing them in the future. Many of the existing impact rollers had already failed. Some were stuck, worn flat, with shafts broken, and some were even missing.

downtime. This is the ideal system when access is only on one side of the conveyor or where a conveyor is located against the wall or high in the air with the catwalk on one side. The installation was problem free, even though the clearance was at a minimum. Due to the modular design they are now able to change out the rolls without



The Monaflex system can be used on belts up to 1,300 mm wide and operates effectively at 30 psi

These impact rollers were at a 10° trough, like many of the tailpiece style sections, where changing one of the impact beds was very difficult. The 'off' side of the transfer was blocked by a concrete footing or pillar. Any servicing that needed to be done on this side was cumbersome and in some cases depending on the problem, impossible.

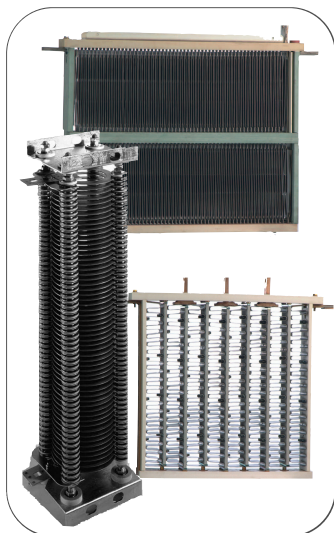
The suggested solution was to remove the old impact rollers that were already deteriorated and to install One Sided Slide-lers. "The One Sided Slide-ler is designed to be maintained from one side of the conveyor, allowing you to replace the rolls with minimal

having to remove adjacent idler frames. The 'off' side, middle and near impact roller can now be changed by removing four easy to reach bolts."

The pressure on organisations to minimise downtime and decrease expenditure is ever increasing and to many the essential, yet costly and time-consuming, area of conveyor belt maintenance is a challenging area. **Monaflex** says it has utilised 40 years' experience in the tyre repair industry to develop "a radical, lightweight conveyor belt maintenance system that changes everything. The Monaflex system can be used on belts up to 1,300 mm wide and operates effectively at 30 psi, rather than the traditional 100 psi, meaning no specialist equipment is required. The lower operating pressure means the bulky, heavy duty frameworks of traditional systems can be abandoned and the system can be transported in any standard vehicle and installed by a smaller than usual number of people. This means that you can achieve the same quality finish but the system itself is more cost-effective as there is no investment in pricey heavy metal work and assemblies. There is also reduced capital outlay due to the lack of specialist vehicles or lifting equipment; and a reduced core maintenance team size with no more need to utilise valuable resources to lug

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exceptionally heavy equipment by foot to remote locations.” The company says large corporations seeking to optimise their operation, those hoping to set up as independent contractors or those expanding their small business can all benefit from the cost-saving benefits of the Monaflex system.

Maintenance software

New software that enables an optimal, streamlined approach to mine plant shutdown scheduling to fast track maintenance was the overall winner at last year’s Curtin Commercial Innovation Awards, resulting in A\$15,000 for its inventors.

Shutdown maintenance optimisation was a

research project involving Curtin researchers Associate Professor Ryan Loxton, Dr Reza Parand, Dr Yufei Sun, Mr Chongyi Liu and Mr Praveen Jayakumari. The project was initiated and funded by **Linkforce Engineering**, one of the largest engineering services companies in Western Australia.

Loxton explained that the project team developed unique mathematical algorithms for scheduling maintenance activities in mine plant shutdowns. “Scheduling shutdowns is currently a time-consuming manual process. These algorithms take just seconds to run and consider a range of factors such as activity workflow, plant access restrictions, safety regulations, and personnel and equipment availability with the

aim of creating an optimal schedule that minimises maintenance downtime.”

Linkforce Engineering is developing a professional shutdown planning system based on the Curtin team’s algorithms, and is exploring commercialisation opportunities across the mining and resource sectors.

Also in 2016, **RungePincockMinarco** completed its acquisition of iSolutions, bringing iSolutions’ entire suite of products specialising in asset management, life cycle costing, maintenance shift scheduling and budgeting within RPM’s technology business. “With the acquisition of iSolutions, RPM will provide the missing link between maintenance and production for mining companies and a strong platform for OEMs globally. RPM is now the sole provider of a technology solution that bridges the gap between production and maintenance – that will take mining companies and OEMs into the next era of mining.”

Chief Executive Officer of RPM, Richard Mathews said: “We now provide the mining industry with a fully integrated production and maintenance planning solution – the next level of productivity that will redefine how the industry operates. RPM is now the only single vendor of a production and maintenance execution software solution in the mining industry. We are providing the technology needed for the next level of productivity to fundamentally change the way mining companies and OEMs operate their businesses. Combined, our solutions will reduce the cost of mining as both the production and maintenance teams will be using the same software applications to maximise the operational efficiency and productivity of their mobile mining equipment. This also further strengthens our relationship with SAP as it extends the value our customers get from their ERP implementations.”

While there are external economic forces mining companies cannot control, RPM says that the one thing they can now control is the productivity of their production and maintenance businesses. RPM will now be able to “provide integrated technology solutions to bridge the gap between production and maintenance; reduce exorbitant cost discrepancies between production and maintenance departments; provide mining companies with in-depth knowledge of the real costs associated with maintaining production and equipment; and provide mining companies with a formula for success in optimising maintenance strategies and increasing production.”

Co-Founder and Managing Director of iSolutions, Graeme Elgie said: “RPM is truly driving change in the mining industry and iSolutions has always adopted a similar vision. The fit between both companies was right. iSolutions is the trusted leader in asset



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management solutions for mining equipment and is the clear leading provider for both OEMs and mining companies globally. With iSolutions forming part of RPM, we will offer customers around the world – from mining companies to OEMs – unrivalled technology solutions to meet the existing demands of the industry and take them into the next era of mining.”

iSolutions offices in Brisbane, Santiago and Johannesburg have amalgamated with RPM’s existing offices in those locations and employees of iSolutions have joined the RPM team to propel sustainable growth.

An Asset Maintenance program is essential in the everyday demands of the mining industry. Australia’s MEX says it understands this and this is why it ensures “that you are able to maintain costs and improve margins through strategic asset maintenance guided by the MEX Maintenance Software. From facilities to manufacturing and everything in between, companies are looking to more effective and productive ways to utilise their equipment and facilities, and keep it running in peak condition. MEX Maintenance Software is one of the major tools enabling this visibility and control, and can form the core of maintenance operations for a wide range of industries.”

The company adds: “By providing an accessible and easy to understand maintenance management platform, operators can now

breakdown ongoing patterns in machinery wear and usage, and access granular data to know when machines will breakdown, and organise their operational schedule ahead of time to take the equipment out for repair at the optimal time, eliminating unscheduled downtime and unexpected hits to the bottom line. With this capacity for forward planning, implementing MEX also leads to a range of added benefits, such as reduced costs and more flexibility in supply chains, as it allows for more predictive operations and in turn the ability to follow this predictive capability down the line. This leads directly to cost savings on purchases as stock levels can not only be maintained, but more forward-thinking purchasing can be carried out, eliminating unscheduled downtime which is further compounded by having to wait for critical parts. All supported by the total portability and accessibility of MEX through hand-held devices.”

From requests, entire days’ worth of work orders and history, to the ability to plan and schedule maintenance, MEX says it is giving businesses the ability to gain an edge in a competitive environment. “MEX is Australia’s leading CMMS provider, and any company needing to track assets, parts, and labour, while



Over the years MEX says it has forged a number of long standing relationships with some of the largest mining operations in Australia and around the world

managing their Preventive Maintenance workload, will save money by using MEX.”

Over the years MEX says it has forged a number of long standing relationships with some of the largest mining operations in Australia and around the world. “MEX is a tried and tested maintenance software that has over the years developed into a well-rounded maintenance management system. Incorporating an Asset Register, Work Order and History recording, coupled with a fully functional Preventive Maintenance module, Inspections, Inventory, Readings and an iOS App for the iPhone and iPad, MEX provides a fully functional off the shelf CMMS for the mining sector.” For fleet

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“There are a number of features in MEX that help you take control of your mining maintenance operations. One in particular, The Asset Register, allows users to easily identify where an asset is located with its hierarchal structure. This ability to set up your assets in a tree structure, allows the asset to be laid out in the same manner as the physical organisation of the mine. This makes it easier for the users to locate the assets in MEX as they will already be familiar with the physical layout of the mine and vice versa.”

The MEX Resource Scheduler has the ability to schedule the whole backlog of work with one click. “Easily customisable to suit your working week, or by daily schedules, the scheduler will eliminate those long hours spent working out which resource does what job. Create multiple schedules, schedule over multiple days and shifts, by percentage or by priority.” Contractors that only need to view and submit specific data into MEX can also now do so via the Contractor portal. This feature ensures that the contractor only views the information and assets that are relevant to the job they have been contracted to carry out. All other information is hidden and inaccessible to the user.

TAFE Queensland, the State’s largest and most experienced provider of vocation education and training, along with **Dingo**, the leading

Queensland-based asset health software company, have announced a partnership which will give students the opportunity to use Dingo predictive maintenance software to monitor, analyse and conduct repairs on automotive assets, including mining machinery, within an interactive and live classroom environment.

Dingo says it “blends expertise with proven technology to help mining and other customers implement proactive condition management programs that focus on maintaining the health of their equipment.” Currently managing over A\$7 billion worth of assets, they have saved customers over A\$300 million by helping them implement a systematic approach for managing the health of their assets.

General Manager of TAFE Queensland SkillsTech Mary Campbell said the introduction of Dingo software in the classroom will allow students to gain an understanding and knowledge of an innovative model that provides a proactive approach to asset maintenance. The software will be introduced into the curriculum of Dingo’s Heavy Vehicle apprentice students in 2017 with plans for further inclusion among other apprenticeship and higher education programs.

The sophisticated predictive maintenance software is able to collect and monitor data received from the equipment, operators and third party vendors. The software then uses data

analysis to quickly identify the corrective work necessary to keep assets healthy, thereby reducing the costs and improving productivity. The software will provide students with experience in condition monitoring and allow them to work towards a

more informed future as a technician, including those aiming to work in mining maintenance roles.

“This partnership will not only provide benefits to TAFE Queensland’s local students but also the vast network of students globally including Latin America, India, Indonesia, and the Pacific region”, said Campbell, regions where many of the world’s most important mines are located.

CEO of Dingo, Paul Higgins said that equipping the next generation of skilled technicians with the tools and expertise they need in the fast changing world of Big Data and predictive analytics is core to the mission of both Dingo and TAFE Queensland. “With Dingo software fast becoming an industry leader in the predictive maintenance field, this partnership not only allows TAFE Queensland to deliver the latest developments in technology but provides its students with a competitive edge within a demanding industry.”

Mesh network maintenance with Rajant BC I Enterprise

In today’s digitally equipped mines, maintenance of mine broadband networks is arguably just as important as maintaining the machines themselves. **Rajant Corporation** says that its new BC I Enterprise offering together with the BC I Commander® system “offer a comprehensive monitoring and management solution for your Kinetic Mesh® network, providing both historical and real-time information for efficient network diagnostics and troubleshooting.” BC I Enterprise delivers strategic data on historical network performance with live updates to complement the real-time, tactical mesh network views available from BC I Commander. The Rajant Kinetic Mesh® network is a fully mobile private wireless broadband solution very widely used in mining.

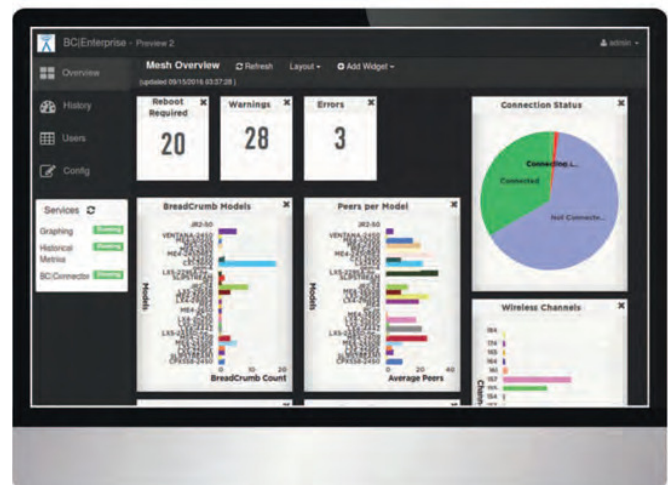
“The system allows you to view network conditions showing what has transpired on your



APPOINTMENT NOTICE

Walter Siggelkow, President of HLS Hard-Line Solutions (Hard-Line), is pleased to announce the appointment of Lyle Hobbs as General Manager of Hard-Line’s U.S. Operations.

Mr. Hobbs brings a wealth of experience in the mining industry to the position, and will be responsible for the establishment of Hard-Line’s operations to be located in Salt Lake City, Utah.



BC I Enterprise is a web-accessible application to monitor and manage network performance

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Kinetic Mesh network. To maximise ease of use and provide relevant information to network managers, data is visualised through a number of customisable dashboards. These customisable dashboards allow you to obtain graphs that illustrate virtually any aspect of your mesh network for any chosen time period – now, a few minutes ago, last week, or a few months ago. Having fast access to critical performance, traffic, and configuration data can be a real time-saver to identify and diagnose potential problems before they impact users, while giving you the insights needed to optimise your mesh network for peak performance.”

Rajant adds: “The BC I Enterprise application is installed on its own locally-hosted web server,

so an Internet connection is not required and no data ever needs to leave your network. The software provides fast access to strategic data from individual nodes and/or groups of nodes on trucks and shovels, a specific loading dock, or a specific set of sensors, for example.

While operators of smaller networks may prefer to monitor and manage their mesh networks using BC I Commander alone, those with larger enterprise networks will find BC I Enterprise indispensable to reduce troubleshooting man-hours and increase productivity.”

Industry research estimates that a trouble ticket can cost \$60 to resolve, including IT staff time and loss of productivity. As a result, a

wireless network could incur \$30,000 annually in troubleshooting costs. Monitoring and management solutions can reduce operating costs by as much as 70% – saving an estimated \$21,000 annually.

Oil analysis next generation

ExxonMobil has launched Mobil ServSM Lubricant Analysis, a next generation used oil analysis service. The company says the service can help mining companies to reduce unscheduled equipment downtime. In the extreme conditions and rough terrain typical of mining sites, machine failure is a common problem, with the associated expense of equipment downtime impacting on operator profitability.

As a result, it is critical that operators use high performance lubricants, in combination with regular oil condition monitoring, to help reduce downtime of both stationary and mobile equipment. Mobil Serv Lubricant Analysis can help engineers address operating challenges and help them take a proactive approach to maintenance. By examining changes in oil analysis data over time, also known as ‘trending’, it is possible to better assess the condition of both the oil and the machine. This can help to proactively address undesirable conditions before they become serious problems.

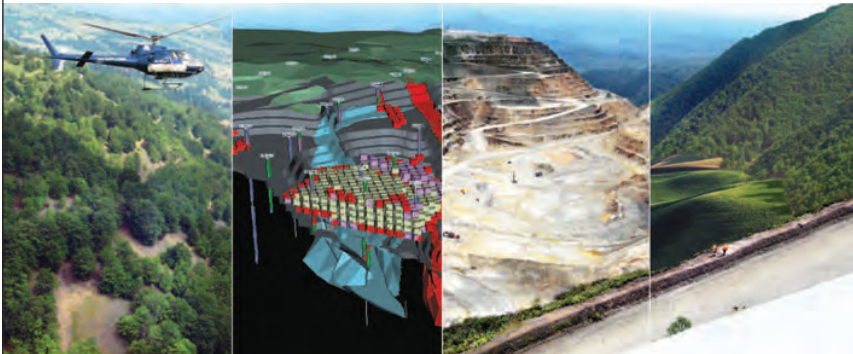
The program replaces ExxonMobil’s SignumSM Oil Analysis and offers a comprehensive range of 25 different analysis options, allowing customers to track productivity and spot anomalies. When monitored regularly, the service can help to enhance equipment reliability and lubricant consumption. It can also help to extend oil drain intervals, which can reduce operational costs and improve safety through less intervention with machinery.

Mobil Serv Lubricant Analysis takes predictive maintenance to the next level by offering features such as a mobile app, scan-and-go bottles and flexible analysis capabilities. The introduction of the paperless scan-and-go technology with QR Codes means that customers can now more quickly and easily deliver samples to ExxonMobil’s oil analysis laboratory.

Results and customised equipment recommendations can now also be accessed via mobile or tablet devices using a cloud-based app. In addition, regional and global operations can monitor performance virtually regardless of where they are based. *A detailed article on Mobil ServSM is included in this issue’s High Profile article, based on a visit by IM to one of ExxonMobil’s oil analysis facilities in Pernis, The Netherlands.*

“With the availability and output of mining machinery directly linked to the overall productivity and profitability of a mining site, effective maintenance is critical.” said Ayman Ali,

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ExxonMobil has launched Mobil ServSM Lubricant Analysis, a next generation used oil analysis service


ExxonMobil's Industrial Marketing Adviser for Europe, Africa and the Middle East. "Our next generation used oil analysis service enables mine site operators to proactively monitor equipment operating in challenging conditions, helping to reduce equipment downtime and improve productivity."

TOTAL Mining Solutions argues that while maintenance strategies and practices have been around for many years, early maintenance practices of when it breaks 'we'll fix it' have progressed to preventive, predictive and even proactive maintenance strategies. "Identifying the correct maintenance strategy for your equipment can reduce overall operational costs as well as add significant value to your mining operations." Total breaks down the four main maintenance strategies as follows:

- Breakdown maintenance – basically, fix or repair the equipment when it breaks
- Preventive (routine) maintenance – the service, replacement or overhaul of the equipment at predetermined intervals according to a defined set of criteria with the aim of avoiding unwanted failures
- Predictive maintenance – identified maintenance activities incorporating condition monitoring techniques (such as oil analysis), preventive maintenance and equipment test measurements aimed at making informed decisions as to the overall health of the asset and any associated risk.
- Proactive maintenance – the use of both preventive and predictive strategies for improving equipment reliability by identifying root cause of failure and utilising engineering solutions to address the root cause. "As in most cases, there are pros and cons with each type of maintenance strategy. The best

approach is to identify the most cost effective maintenance strategy based on risk and cost of the asset, the risk and consequences in the event of a failure, and how both of these relate to your company's goals. Each piece of equipment should be reviewed, assessed and treated on its own merits. A breakdown maintenance strategy, (that is to only repair the equipment when it breaks down), is sometimes applied to non-critical equipment so that if a failure occurs, it has minimal disruption to production, is relatively cheap, is quick to replace and will have no impact on safety. Some equipment, such as an excavator, can be identified as critical to your operations and where a breakdown or failure is extremely costly to the company. This could be due to production downtime or a long replacement time, or where safety may be compromised. When it comes to these critical pieces of equipment the maintenance strategy that should be applied would be predictive or proactive so as to reduce the possibility of failure, thereby ensuring maximum value from the equipment.

Oil analysis is a condition monitoring tool that involves taking approximately 100 ml from an oil wetted compartment while it is in use and subjecting it to a variety of chemical and physical tests. In the case of used oil, these tests provide a snapshot as to the current health of the asset, the general health of the oil and any contamination issues that may exist. The practice





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

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ANAC is a service of TOTAL that provides a complete range of analytical monitoring systems for in-service oils



has proven to be a very successful and cost effective condition monitoring technique for companies that operate large intensive capital equipment such as in mining.

TOTAL adds: "Oil analysis as a conditioning monitoring tool has one foot each in predictive and proactive maintenance strategies. The results from the oil analysis can be used as a predictive tool for identifying adverse wear trends and their likely causes such as coolant leaks, fuel dilution or environmental dust entry issues etc. The information from the oil analysis results can then be used to aid in planning and performing appropriate maintenance activities

that will reduce the total operating costs arising from premature equipment failures, as well as to optimise oil usage through oil drain extension programs.

In addition, oil analysis can assist in identifying whether proactive strategies such as improvements in filtration have achieved the cleanliness (ISO code) target. It can also be used to establish if changes in the maintenance activities have had the overall desired effect of generating equipment improvements over past performance.

"Unfortunately, there are many occasions where oil analysis is used on an ad-hoc basis,

such as a yearly sample on a main conveyor gearbox, or after a failure. Whilst this could be used to provide a one off indication as to the health of the oil and the amount of contaminants that has accumulated in the oil since the last oil change, it cannot be used to ascertain overall equipment health or performance. This type of practice leads to little or no value being realised from this very useful condition monitoring technique. On other occasions, oil analysis may be viewed as a work management tool to drive work maintenance activities rather than using the results as a tool to assist in work maintenance practices. This strategy should not be viewed too favourably either as oil analysis does not cover every technical angle. The point is not to confuse a condition monitoring tool as the main driver for maintenance activities. Rather, it should be used to compliment maintenance procedures and allow for forward planning."

To get the best information from ones oil an analysis program, TOTAL argues that mines must take oil samples in the same manner and at the same identified scheduled intervals, continuously over an extended period. The ideal oil sampling period will vary depending on the identified criticality of equipment. If the maintenance strategy has been identified as predictive or proactive, then the associated oil analysis sampling regime established may be to sample the equipment/compartment every 250 or 500

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hours. The benefits of regular oil sampling and analysis thereof to mining operators for the purposes of predictive and proactive maintenance include monitoring wear (iron, chromium, copper etc) trend deviations; identifying any contamination issues early (dirt, moisture); confirming the health of the lubricant (extend or drain the oil); and evaluating effectiveness of filtration upgrades or changes in maintenance activities.”

Because it is crucial for mining companies to have access to reliable oil analysis laboratories, TOTAL views its ANAC oil analysis program as an integral service to its clients. ANAC is a service of TOTAL that provides a complete range of analytical monitoring systems for in-service oils, available for any automotive application (vehicles and moving machines). “The analysis gives you objective and scientifically proven answers that are easy to understand and exploit.”

TOTAL ANAC PRO is a solution for fleet managers to accurately identify the wear condition of vehicle driveline components. This is a tool that uses the TOTAL ANAC database to provide answers about the source of a failure or about any specific question regarding lubricants in service.

Petro-Canada Lubricants, a Suncor business, has launched a new API CK-4 and FA-4 information hub, creating a comprehensive online guide to the new heavy duty diesel engine oil categories from their first official licence date of December 1, 2016. *DURONthetougherthebetter.com* “provides unique insights, background, videos, technical overviews and clear answers to the most frequently asked API CK-4 and FA-4 questions; including how the new oils compare to the previous API CJ-4 category oils.

“We believe that API CK-4 and FA-4 will deliver major efficiency and operational benefits for businesses operating heavy duty vehicles in North America, but more needs to be done to raise awareness of this, which is why we have introduced the *DURONthetougherthebetter.com* website,” said Howard McIntyre, Vice President, Lubricants, Suncor. “End users will need to consider which oil category is most suitable for their vehicles depending on age, application, and operating conditions. The new DURON website will help them choose with confidence and understand the enhanced benefits such as extended drain intervals, higher fuel economy or extreme temperature protection they will receive.”

Petro-Canada Lubricants’ API CK-4 and FA-4 product line, DURON™ next generation, “has been formulated using leading-edge lubricant technology to combine the best additives with the purest base oils. It is available on the market in four performance tiers: DURON HP (High Performance); DURON SHP (Super High Performance); DURON UHP (Ultra High Performance); and DURON Advanced (API FA-4). DURON ADVANCED will stand as Petro-Canada Lubricants’ fully API FA-4 approved product and is specifically designed to maximise fuel economy without sacrificing any engine protection.”

To help industrial operators find the information they need to properly protect their equipment more easily, ExxonMobil has also introduced a new digital knowledge centre full of educational content on its redesigned Industrial Lubricants website, *mobil.com/industrial*. Available via the website’s Technical Resources section, visitors have access to best practice maintenance tips and key insights on industry trends that are impacting a wide range of industrial sectors, including mining.

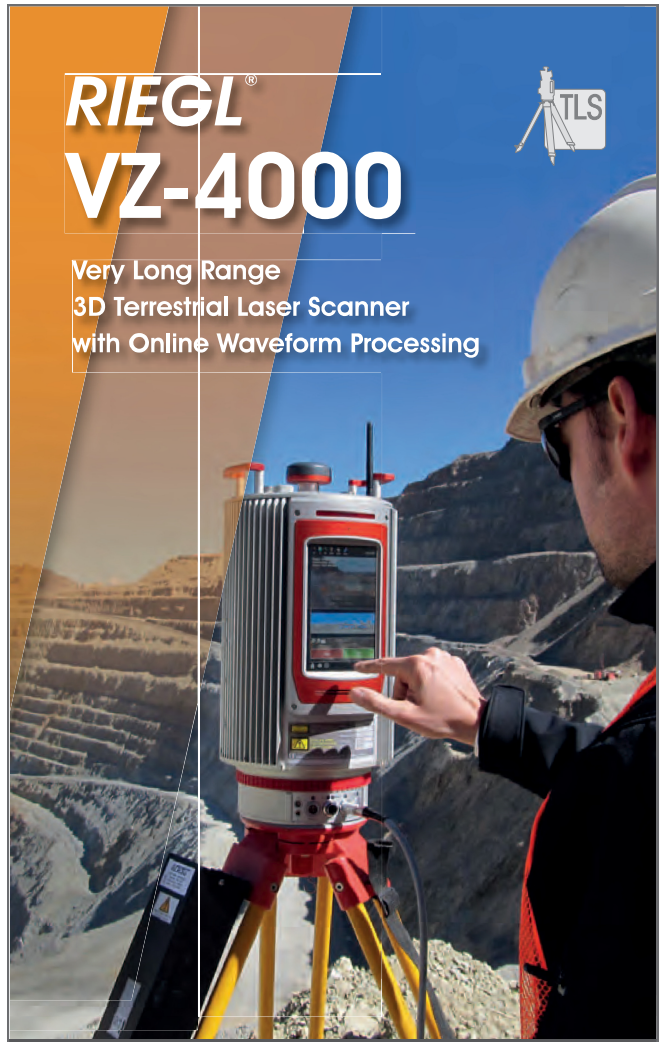
This content includes expert answers taken from ExxonMobil’s Mobil SHC™ Club industrial lubricants community, with short articles answering a range of lubrication-specific questions from real customers. ExxonMobil field and technical experts provide best practice guidance on critical lubrication topics, such as safety, used oil analysis and lubricant selection. Industry insight articles, also authored by ExxonMobil experts, outline “big picture” considerations that can help industrial operators enhance productivity and profitability, while success stories cover real-world case histories showing how customers across a range of industries captured substantial benefits with Mobil-branded lubricants and ExxonMobil’s field engineering support.

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because they know we have the expertise to help them make informed maintenance decisions that can enhance operational safety, reduce environmental impacts and boost their productivity,” said Chima Eze, Global Industrial Lubricants Brand Manager at ExxonMobil.

“The new educational content available in our redesigned Industrial Lubricants website supplements our field engineers’ work to help industrial operators, managers and equipment maintenance professionals to stay on top of current trends and achieve their equipment goals,” Eze said.

This new content is part of a wider range of enhancements to the new Industrial Lubricants website. For example, the site offers improved search functionality that allows visitors to search easily for equipment builders, lubrication specifications, and topics, to find the product and service information they need. The site also includes responsive design to optimise the viewing experience on any device.

Maintenance tools

At a large US gold mine, routine maintenance is required on a P&H 4100XPC electric rope shovel after every 30,000 hours of operation. The maintenance activities require the upper section to be lifted off the car body to machine bearing surfaces and inspect and repair structural



The Enerpac Pow' R-Lock offers continuous load locking technology and provides locking protection during lift, lower and hold functions

components. Weighing approximately 1,000 t, lifting the upper car body requires a significant amount of force and control. The maintenance team at Joy Global reached out to **Enerpac** to deliver a shovel lift system to undeck a shovel in approximately one hour and be transported on the highway without oversized load permits. The speed and safety of the lift were critical components to reducing labor and equipment downtime.

Enerpac states: “We had previously built a similar shovel lift system for Joy Global’s

maintenance team in Chile. The second generation system built for Joy Global’s service team in Gillette provided significantly more speed. The system included four 500 t cylinders with 72 in of stroke, an EVO synchronous control unit and four custom 8000 series hydraulic pumps. Each pump was built to operate in extremely cold or hot environments. The EVO synchronous control unit enabled a single operator to control the entire lift and ensure each lifting point remained within 3/8 of an inch. The shovel was successfully undecked in

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approximately one hour and the entire system was transported on the highway without oversized load permits.

For Kal Tire and Komatsu dealer SMS in Fort McMurray, Canada, lifting trucks for maintenance and repair as well as tyre work is a common occurrence in oil sands and other mining sites. Safety while performing these operations is always a concern, and it's also important to do the job efficiently and quickly. The Enerpac Pow'R-Lock offers continuous load locking technology and provides locking protection during lift, lower and hold functions. It is easily manoeuvred into position and with a simple two-button remote pendant it can raise and lower from up to 20 ft away. The unit also meets the standards required to be used as a jack stand, which means no secondary jack stands need to be moved into place under the truck after it is lifted by the Pow'R-Lock. This makes the process more efficient, thus saving time and money.

The JD Neuhaus extensive range of handling equipment, including hoists and cranes, are all engineered for extremes, providing safe operation in dust laden atmospheres or other explosion-hazardous areas such as chemical manufacture and mineral processing environments. All the JDN products, which include both compressed air and hydraulically operated units, are Explosion Protected as standard.

This ensures that all JDN products are safe for continuous and long-term operation in potentially explosive chemical atmospheres as well as the more insidiously dangerous conditions where high levels of airborne dusts exist such as in mining. This can include combustible dusts, high concentrations of airborne dusts, or wherever a dust cloud is confined with an oxidant present (ie typically atmospheric oxygen) and particularly where there is an ignition source. The oxidation of other commonly known materials such as coal can also be the source of a dust explosion.

JD Neuhaus says its easy to use Profi TI hoist range is "the workhorse of the industrial world," and the operating air supply can be set at 4 or 6 bar pressure, with a standard load lift height of 3 m being provided throughout. Other optional lift height requirements can also be specified and accommodated as required.

Their Profi TI range of air operated hoists includes a total of 19 models providing lift capacities from 250 kg up to an impressive 100 t. These incorporate many years of design and development, and have successfully proved their versatility and universal reliability following installations within a wide range of light, medium and heavy duty industrial workplaces. Their compressed air power supply is also utilised for control functions. "It does not initiate sparks, so providing an unbeatable advantage when hoists are operating in potentially explosive atmospheres. Even greater safety can be achieved by the prevention of sparks generated by static discharges or metal to metal friction contacts."

Standard versions of JDN hoists and crane systems (which utilise Profi TI hoists for lift operations) have the explosion protection/classifications and markings EX II 2 GD IIA T4 / II 3 GD IIB T4. Increased spark protection can be achieved, which involves copper galvanisation plating of the hoist bottom block and load hooks, together with fitting brass safety catches to achieve a rating of EX II 2 GD IIB T4.

"With even further increased spark protection for explosion group IIC, the hoist horizontal movement trolleys incorporate running wheels and travel gearing which are manufactured in bronze for an impressive EX II 2 GD IIC T4 rating."

All Profi TI hoists incorporate a top suspension hook, with optional overhead trolleys also available to accommodate lateral movement of suspended loads. Three trolley options incorporate load traverse movements combined with precise load positioning. One trolley is manually operated for horizontal movement of the suspended load. A second trolley has a manually operated reel chain mechanism for lateral load movements. The third motorised trolley provides traverse as well as load raise and lower movements, together with precise load positioning, utilising compressed air power. All trolley systems can



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The 2016 release of the MacLean 975 Omnia Bolter responds to mining companies' evolving ground support needs, including the demand for increased versatility (bolt type and length, deck height), increased productivity (compressing the mining cycle), improved worker safety (face bolting, resin injection and single-bolt handling), and the option of a diesel-free work environment (battery propulsion).

We are proud to support the South African mining sector out of our branch in Parys, where MacLean technical, aftermarket, and account management teams provide RSA customers with in-country service and support.

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negotiate overhead rail curvatures, with trolleys optionally fitted with rack and pinion drives for safe load handling on offshore platforms and sea going vessels. For installations with overhead space constrictions, a low headroom trolley option is also available, suitable for loads up to 6 t.

The hoists are all 100% duty rated with unlimited duty cycles, so minimising any downtime conditions. Their compact modern design eliminates any protruding control hoses or similar external parts susceptible to damage, emphasising the suitability of the Profi range for even horizontal pulling. These standard hoists are also insensitive to atmospheric dust or humidity and can withstand working



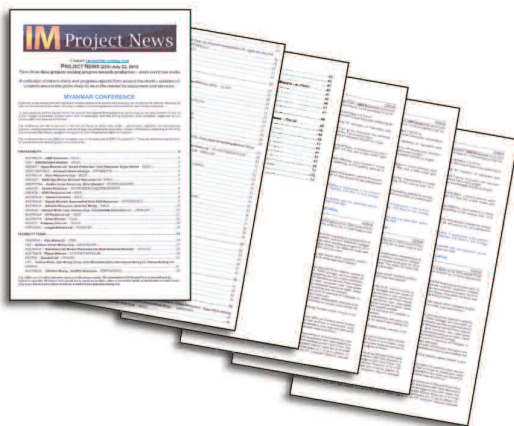
temperatures ranging from -20°C to 70°C. Their patented, low maintenance vane motor brake

The Pakka Jacks patented system has been developed and tested for over a decade, in some of the harshest mining conditions in the world



Photo courtesy of Centrex Metals

IM Project News, which includes hardrock mining, fuel minerals and industrial minerals keeps you updated completely and succinctly on the latest:



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systems ensure fail-safe starting and positive braking, while also being low maintenance as well as providing lube-free operation. Various pendant controls can be fitted for sensitive, single speed, multi-function or remote control operation. These design-led hoists also provide strong, fast and silent operation combined with high performance efficiency and reliability even when operating at high lifting and lowering speeds. The compact hoist designs ensure minimum product dead-weight, and when operating with loads from 1 tonne upwards also feature overload protection as standard.

Overhead monorail air hoists having air or hydraulic drives can also be supplied with 11 models in the range covering lift capacities from 10 to 100 t. Further ultra low headroom versions are also available for lifting operation up to 100 t

All JDN products are covered by a worldwide service for annual checks, inspection and repair together with complete overhaul and installation facilities.

Australia's TFP Engineering says its Pakka Jacks system has revolutionised machine maintenance on mine sites across Australia, for a wide range of machines and procedures. This patented system has been developed and tested for over a decade, in some of the harshest mining conditions in the world. The company says it has successfully completed projects on over 80% of all major open-cut machines in Australia.

"In that time, the system has established itself as vastly superior in terms of safety, speed and cost-effectiveness. It has completely changed machine maintenance for some of the world's largest mine site operators."

TFP has been in operation since 2001, providing maintenance services to various industries, with a major focus on open cut mining. In 2004, TFP started to specialise in major shutdowns on shovels and draglines. The Pakka Jacks system was part of a revolutionary suite of machines and procedures that were

MAINTENANCE

created to make this work more efficient and safe. In 2007 Pakka Jacks was established as a separate enterprise and TFP started preparing the system for the international market. The company has successfully completed work for most of the major mining companies, including BHP Billiton, Rio Tinto, Newcrest, Glencore, Sojitz Minerva Mining, Theiss Australia Mining and Coal & Allied.

Pakka Jacks perform two critical roles; lifting and supporting. “The patented automatic mechanical packing mechanism is the key to this incredible combination. At every point in the lifting operation, the load is supported. Failure of any component will result in a maximum drop of 0.25 in. This simple fact has enormous implications for site work, given that it is illegal (and dangerous) to work under suspended loads.”

Each Pakka Jacks unit has four packing mechanisms, allowing for three units to be taken out of commission under load. Each unit also has capacity for secondary hydraulic input in the case of primary hydraulic pump failure. “The load is fully supported at every point of the lifting operation, this has huge implications for site safety and project cost and duration. From 165 t to 2,200 t, the Pakka Jacks lifting systems offer a huge range of capabilities across a broad spectrum of applications.”

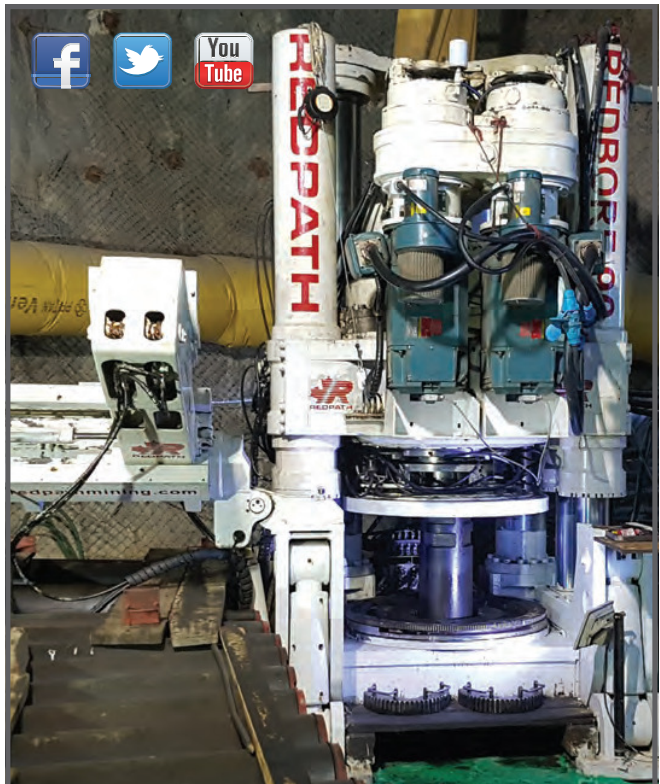
The Pakka Jacks lift units are self-contained, with all lifting hydraulics and packing mechanisms packaged in a solid, compact casing with excellent intrinsic stability. Certified lifting lugs, control input points and secondary hydraulic input points complete the general description of the lifting units. The system is controlled from a fully enclosed, air-conditioned control console.

Bearings and seals

The Timken Company, a global leader in bearings and mechanical power transmission products, has released new catalogues for housed units, seals



Now Timken customers can access the company's catalogues through a new mobile app for smart phones



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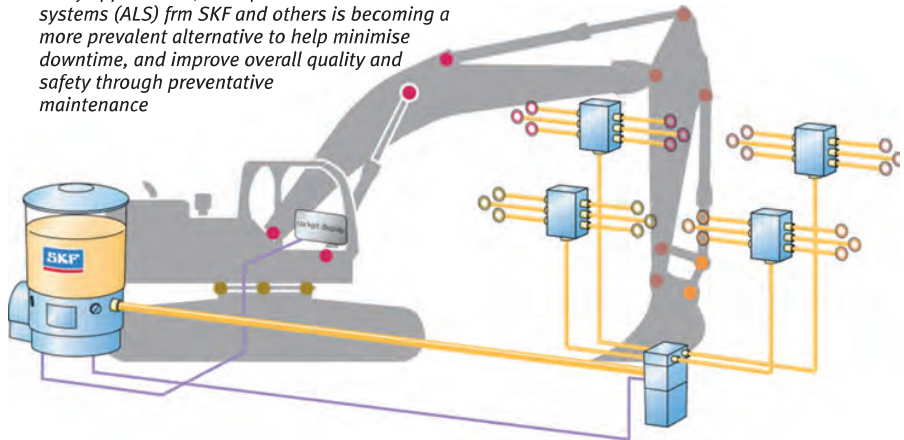
and tapered roller bearings. The catalogues feature expanded offerings, more technical information and the latest on the company's growing product offering. Recent updates for each catalogue include:

- **Housed Units:** Complete listing of Revolve split cylindrical roller bearing housed units available in Canada, Mexico and the US
- **Seals:** Expanded offering of 1,500 new small bore metric seals
- **Tapered Roller Bearings:** Updated with more metric tapered roller bearing part numbers

"Timken catalogues combine the product information and industry knowledge our distributors and customers need every day," said Mike Connors, Vice President, Global Marketing. "Our catalogues, along with our global network of expert field sales and service associates, provide technical product support to help our customers select the right part for their application. Bringing the latest to our customers includes how we deliver the information. Now Timken customers can access the company's catalogues through a new mobile app for smart phones."

The Timken catalogue app can be downloaded from a QR code or through www.timken.com/catalogs. Mining customers can go to <http://timkencatalogs.squawqr.com/> to access the app. A two-minute video tutorial walks users through the many ways to use the tool.

While manual lubrication is still the norm in many applications, use of automated lubrication systems (ALS) from SKF and others is becoming a more prevalent alternative to help minimise downtime, and improve overall quality and safety through preventative maintenance



"Our distributors and customers expect to find basic product information quickly, from any device," said Connors. "The ease of use offered by mobile devices makes them an obvious platform for providing access to our catalogues. This 'Timken catalogues' app provides an efficient, direct link to searchable data we've historically provided in our printed catalogs and online at timken.com."

SKF has manufactured and supplied its largest ever spherical roller bearing (bore diameter 1.25 m) to be used within the mining industry. The bearing was manufactured at SKF's factory in Gothenburg, Sweden.

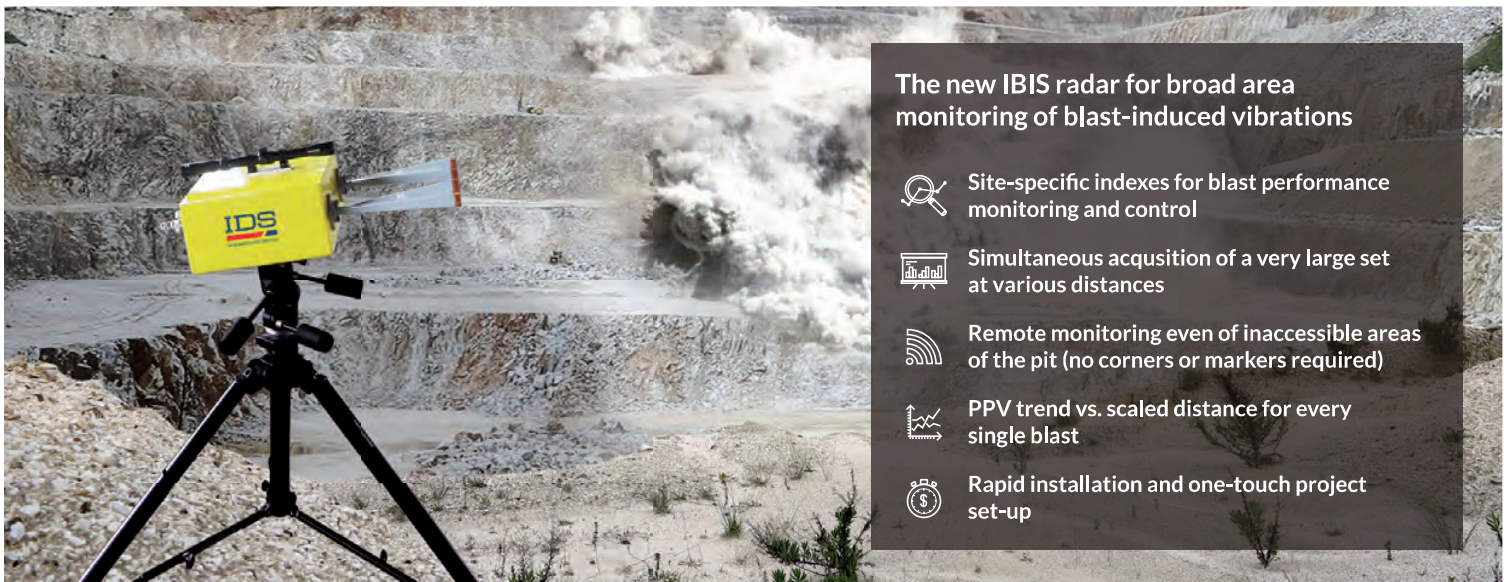
"SKF is a world leader in spherical roller bearings, manufacturing bearings of all sizes and series – from the smallest, with a 20 mm bore size, to this large size bearing that weighs close to 8 tonnes" says Petra Öberg Gustafsson, Product Line Manager for self-aligning rolling bearings at SKF.

The bearing is equipped with SKF SensorMount, a unique system that measures the actual mounting fit of the bearing onto the shaft. It helps avoid the risk of improper mounting, a major issue for large size bearings. The bearing weighs 7,780 kg. Each roller within it weighs 42 kg.








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The bearing is of the upgraded SKF Explorer class with improved wear resistance, thanks to the patented material heat treatment process that nearly doubles service life in poor lubrication and contaminated conditions.

SKF says it was chosen to supply the bearing due to its Application Engineering expertise and support, and the knowledge and experience in manufacturing large size industrial bearings.

Daniel Ortega, Project Manager at the Gothenburg factory, says: "We have worked in close cooperation with the customer, in order to design an optimum 241/1,250 bearing that is particularly suitable for applications in the mining industry. These applications have extreme operating conditions and are very demanding from a bearing service life perspective."

NSK has developed new spherical roller bearings for conveyor belt drive pulleys used in harsh environment applications that offer simple installation and excellent sealing efficiency. Although ideal for new-build conveyors, the use of standard, ISO-compatible dimensions means they can also be retrofitted to existing conveyor systems.

The service life of roller bearings used in conveyor belt drive pulleys is an important factor in governing system availability and reliability, particularly in the mining and quarrying industry where conveyors can be several kilometres in length. The selected bearings must not only be able to withstand high loads, but resist penetration by fine grains of particulate present in the working atmosphere.

Spherical roller bearings are typically selected for such applications because they can accommodate high loads and compensate for drive shaft deflection. Until now there were two types of design from which to select. One choice was the use of open bearings with no seals, which could be installed easily and without risk of error because the bearing clearance was easy to set. However, early failure was to be expected with this type of bearing due to the penetration of foreign particles, some of which are highly abrasive.

The alternative has been to use sealed spherical roller bearings, but these have the disadvantage that bearing play cannot be measured when being fitted, which increases the risk of installation errors. What's more, the seals require additional space to ensure their load rating potential is maximised.

With these factors in mind, NSK has developed new spherical roller bearings specifically for conveyor belt drive pulley applications in sectors such as mining and quarrying. They offer long service life, high load ratings, excellent sealing and dimensions identical to the bearings that were previously in use. In addition, bearing clearance can be measured at any time during installation.

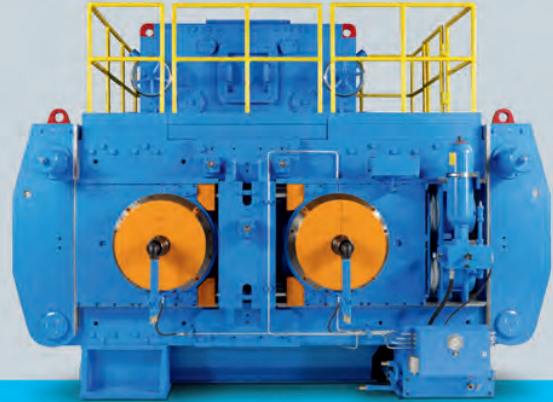
Among the bearing's principal features, NSK has developed special steels for the inner and outer rings, which in combination with a specific annealing process, increase load capacity and make for a very compact design. As a result, the seal can fit within the available space and ensure the new spherical roller bearings are still able to attain higher dynamic load ratings than conventional bearings.

"The special steel materials perform exceptionally well, even when poorly lubricated, while the very efficient seal has proven its resistance in many other harsh environment applications. Importantly, the seal is attached by a bracket screwed to the bearing housing so that it can be removed during installation to measure the bearing radial clearance. This ensures that the clearance is not set too small when sitting tightly in the inner ring, thus preventing early damage to the bearing. NSK estimates that its new spherical roller bearings offer quadruple the service life of conventional alternatives."

Automated lubrication systems

Proper lubrication is also integral to ensuring the functionality of components and systems within heavy-duty machinery. "If there's a bushing, bearing or gear, something that is rotating or sliding in

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agricultural, construction and mining machines, it's going to require lubrication," says Peter Laucis, Director of Portfolio Management – ALS Products, SKF Lubrication Business Unit. "And the heavier the loads, the more aggressive and dirty the environment, the greater the need for lubrication."

While manual lubrication is still the norm in many applications, use of automated lubrication systems (ALS) is becoming a more prevalent alternative to help minimise downtime, improve overall quality and safety through preventative maintenance.

With an ALS, lubricant can be applied exactly when and where it's needed while the machine is running. Manual lubrication, on the other hand, requires the machine to be stopped before

lubricant can be applied, and may require a person to climb onto the machine which can be a safety issue.

In addition to helping increase safety and productivity for equipment owners, Laucis says OEMs can also benefit from integrating an ALS into their equipment. "It can extend warranty and performance, and it can maintain the unit running at various conditions under the design the machine was geared to do."

An ALS consists of a reservoir containing grease or other designated lubricant and an electric, pneumatic or hydraulic pump which activates the system to deliver lubricant from the reservoir to the desired location within the machine. Depending on the design of the machine, lubricant can be dispensed to as many

as 100 or 200 different points. A series of metering valves are used to apply the lubricant in the desired location at the exact time lubrication is needed.

The system knows where and when to apply lubricant due to built-in controls. If the ALS is integrated into a machine at the factory, the system can be controlled by the OEM's programmable logic controller (PLC). The appropriate lubrication intervals are programmed into the PLC, enabling it to turn on the ALS when necessary.

SKF also designs controllers which can be built into the system if it is added to a piece of equipment at the aftermarket level or another point along the OEM channel, such as by a dealer. Laucis says these controllers can provide simple on/off control or be more sophisticated through the inclusion of sensing devices to provide operators with information about when lubrication cycles are occurring, fault indicators and performance attributes.

Single line parallel and progressive are the two main types of lubrication systems used within heavy-duty mobile applications. A single line parallel system consists of a reservoir and a pump connected to a bank of injectors by a single hose line. The injectors are lined up in parallel with one another, like fingers on a comb, and each of the injectors function independently of one another. By doing so, each injector meters the exact amount of lubricant required and can also be adjusted independently if necessary.

The independent functionality is beneficial because if one bearing fails or gets blocked in some manner, it will not adversely affect lubrication of other bearings in the machine. "People like the single line parallel because they can lubricate the entire machine of, let's say 120 points, and when a couple of those points fail, they're still getting lubrication in the other systems," says Laucis.

He notes these systems are often used in heavy mining equipment due to the need to minimise downtime as much as possible. It can also be used in construction equipment to avoid poor operator maintenance and in agricultural equipment for safety and bearing protection.

Progressive systems are similar, except the single line goes to a series of valve blocks instead of a parallel line of injectors. Each valve block meters lubricant to various points within a machine; one block may have up to 12 points to which it provides lubricant, and the next block or zone will lubricate another 12 points, and so on. "The main difference is if you have one bearing that blocks, it literally stops the entire system because the grease is progressing through the system in a series," Laucis says. "If you block one bearing it will actually have a hydraulic lock on every piston in that block in the system, then the whole system shuts down." **IM**

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