

# Longevity

**Greater life for ground engaging tools (GET), wear surfaces, crushers and more – *IM* looks at some of the new ideas**

**O**n November 18, the international Swedish Steel Prize will be awarded. Four products have been nominated for their high strength steel designs including a South African truck body, and Australian bucket teeth.

Van Reenen Steel has developed a truck body with more torsional stiffness and impact resistance in a new structure made of steel with high wear resistance and strength. A new bottom profile and rounded corners provide more even wear and faster tipping, SSAB says. The result is longer durability, lower weight, improved environmental performance, and greater productivity.

Hardox 400, Hardox 450, Hardox 500 and Weldox 700 are used for these truck bodies. SSAB says the design has enabled Van Reenen to reduce the weight by 8 t (from 43 down to 35 t) and to substantially increase the life of the body. The body has a ridge down the middle of the bottom in the direction of the vehicle, which has the following functions:

- Makes the body more rigid near the fittings, which reduces stress concentrations
- Reduces impact when loading
- Spreads the flow more evenly when unloading, resulting in less wear
- Strengthens cab protection.

The old body handles 700 loads (133,033 t) per month, while this body handles 726 loads

per month. The old body requires minor maintenance after about 6,000 hours and total renovation at 12,000 hours. So far, this body has been running for 17,000 hours without maintenance shutdowns. The manufacturer expects the first maintenance break at 25,000 hours and the total lifetime of the truck body to reach 50,000 hours.

Australia's BluPoint has developed a cost-effective solution for renovating worn teeth on mine excavators. In this solution, a new tooth tip made of high wear-resistant steel with good weldability is welded to the remaining

*The Van Reenen Steel truck body is optimised for even flow to reduce wear and allow faster unloading and thus higher productivity*

*Worn shovel bucket teeth in an oil sands mine, photograph from Motion Metrics International*

part of the cast tooth. Since bucket teeth for mining shovels may need to be replaced several times per day, the solution significantly reduces operating costs.

BluPoint says the refurbished teeth last as long as, or longer than, the original teeth. All bucket-users want to optimise the shape of the teeth to suit different applications. Trying new shapes of refurbished teeth is efficient in terms of both cost and time compared with developing new moulds. The same plate can be used for a variety of tooth models or for completely different wear-plate components. The need to have spare teeth in reserve is





BluPoint uses Hardox 500 abrasion resistant steel, thickness 50/60 mm. The sheet, which can be shaped, allows good adaptation to different tooth geometries. Extreme strength and toughness are essential properties for the design

minimal since refurbishing time and any associated downtime only involve a matter of hours.

Also winning awards, Duratray International - the manufacturer and distributor of the Duratray Suspended Dump Body (SDB) for off-road heavy haulage trucks - has capped an excellent year by winning the Minerals and Energy Award at the 2010 Governor of Victoria Export Awards in Australia. The win is testament to Duratray International's continued international success in the export sector with sales of the Duratray SDB increasing by 57% over the past 12 months with 48% of growth attributed to export markets alone and total sales of A\$5.2 million.

The Duratray SDB at work



According to Duratray International CEO Marco Medel, the strong figures are a result of an increased focus on export markets with the company recently entering Africa, Mongolia and Israel. "2009/2010 has been the company's strongest year yet and we are delighted to be acknowledged as a leading industry innovator in the global mining sector," said Mr Medel. "We are committed to continuously working to refine and further develop the sustainability and effectiveness of the Duratray SDB. The increasing international demand for our unique product has meant that we will also be expanding our manufacturing facilities over the next 12 months- doubling our production capacity."

global mining industry through continuous innovation and manufacturing excellence.

The SDB is a unique flexible rubber tray for mining trucks which is a long-lasting, cost effective and environmentally responsible alternative to traditional steel trays and is currently exported to around 30 countries across Asia, Europe, USA, South America and Africa.

Motion Metrics International offers automated tooth-wear monitoring for mining shovels. Continued operation with worn shovel teeth reduces the effectiveness and efficiency of a shovel, resulting in increased digging forces, longer fill times, and an increased likelihood of missing teeth or adapters. An



Australian Industry and Trade Minister Jacinta Allen said the award recognised Duratray International's continual commitment to creating cutting edge technology for the

The WearMetrics operator interface

unplanned change-out can result in up to two hours of unexpected downtime. According to a 2009 case study of an American copper mine, when factoring in the opportunity cost of lost production, an unplanned change-out of shovel teeth can cost the mine 13.8 times more than a planned change-out. To prevent loss of productivity due to tooth failure, careful monitoring of the shovel teeth and an optimal change-out strategy is crucial.

Motion Metrics International's WearMetrics™ system is an automatic system that continuously monitors each tooth on the shovel dipper, providing the mine engineers and the shovel operators with valuable feedback on the status of the shovel. The system uses a rugged camera mounted on the shovel with a clear view of the dipper and implements advanced image processing



*When the GIII bucket is equipped with GET ground engaging tools it "cuts like a knife" through the muck pile*

algorithms to automatically monitor the shovel tooth-wear status.

The WearMetrics system periodically logs the status of each shovel tooth in terms of the percentage of the metal remaining on the tooth, with a new tooth being 100% and a completely worn-out tooth being 0%. This comprehensive data permits trends in the wear rate and the estimated lifespan of the shovel teeth to be determined.

The system is particularly effective in oil sand mines where, due to the extremely abrasive nature of the material being extracted, the wear status of the shovel teeth can change substantially over a short period of time. It is not uncommon for a tooth to wear down in less than a day. Using WearMetrics, the GET engineers have direct access to the tooth status for a specific shovel, eliminating judgement calls and communication errors. Taking into account the historical wear rate, GET engineers can proactively plan tooth

change-outs to find the perfect balance between shovel downtime and teeth utilisation, thereby, maximising shovel productivity and minimising maintenance costs.

### Better bucket loading

Mines using Atlas Copco Scooptram loaders can now raise productivity and lower fuel consumption thanks to two new GET design improvements. A new generation bucket that is lighter, shorter and faster combined with new ground engaging tools has been launched by Atlas Copco for its LHDs.

According to Peter Trimmel, Product Manager at Atlas Copco, tests of the new third generation bucket (GIII) and Atlas Copco's GET, have produced excellent results. Operating time in the test muck pile was cut by 7% while fuel consumption was reduced by 8%. An added benefit is that the bucket is more robust than previously and is designed to withstand extreme wear.

Throughout the test period, the same loader and driver were used. Driver Totte Nilsson, who has been driving different types of LHDs in different mines and countries for 20 years,

says: "I think this new GIII bucket is remarkable. Just upgrading your Scooptram ST1020 or ST1030 with the new GIII bucket will be a great improvement. And if you equip the GIII bucket with GET you gain even more."

The GET are bolted on to the front edge of the bucket, and sometimes also on the sides, in order to increase the bucket's ability to attack and penetrate different muck pile formations. "The penetration is fantastic," Nilsson continues. "It cuts like a knife through butter. The job gets done much easier with the new GIII bucket."

"Our team has put a lot of effort into testing and choosing the best steel available for the new GIII bucket," says Anders Persson, Manager of the Atlas Copco Materials & Rock Drill Laboratory. "The GIII bucket is now made of very wear resistant steel which will reduce maintenance costs."

GET's designer Kjell Karlsson says: "We have made the Atlas Copco GET very sharp and aggressive, and because of this it will stay sharp all the time until it is time to change the parts. We believe the user can wear off almost 50% of the material on each shroud until it is time to change the parts."

During loading and unloading of skip cars (used underground to transport ore from one station to the Next) wear plate inside the cars are exposed to sliding abrasion and impact. In a gold mine in Canada, 20 t capacity skip cars transport ore between two levels. During loading, ore drops 9 m onto a wear plate deflector and slides into the car. During unloading, the skip car is tilted at a 30° angle on one side and the ore slides over the wear plate deflector onto a belt conveyor for transport to the next station.

To increase the life of the skip car deflector and reduce surface material loss, the mine installed a NanoSteel SHS 9800 overlay wear plate, 12.7 mm thickness (4.8 mm overlay on 7.9 mm substrate), for resisting sliding abrasion and impact.

The NanoSteel SHS 9800 overlay wear plate

## DURATRAY



NanoSteel SHS 9800 overlay wear plate, 12.7 mm thickness, after deflecting over 400,000 t and exceeding Q&T plate life by 1.2 times

was removed from service for maintenance after deflecting more than 1 Mt of ore. This represents a service life increase of 2.9 times over 500 Brinell quench & temper (Q&T) monolithic wear plate, 15.9 mm thickness, and up to two times over chrome carbide (CrC) overlay wear plate, 15.9 mm thickness (half overlay and half substrate). Upon being placed back in service, mine engineers predicted that the NanoSteel SHS 9800 plate will exceed Q&T plate life by 4.3 times before requiring replacement.

In March NanoSteel released its first stick electrode for weld overlay hardfacing applications. SHS 9700E, the newest addition to NanoSteel's patented portfolio of Super Hard Steel® (SHS) alloys, is a premium alloy that features an ultra refined, near nanoscale crystalline microstructure which results in very high hardness, up to 70 HRC, and exceptional resistance to abrasive wear.

The SHS 9700E stick electrode is an easy to set up hardfacing alternative to MIG and Open-Arc wire applications with excellent weldability. "We developed this product in direct response to the requests of our customers who use our SHS 9700 alloy in wire form but wish to have the convenience provided by a stick electrode," says Dave Paratore, president and CEO.

Blasch Precision Ceramics has developed a new grade of silicon carbide, ALTRON™ alumina bonded silicon carbide. "The precision cast shapes outlast nitride bonded SiC brick and wear-resistant alloys," the company states. "Field trials in hydrocyclone applications have shown more than three times the life of conventional nitride bonded silicon carbide components. ASTM C704 abrasion resistance testing has verified this."

The new composition creates a unique interaction between constituent materials, yielding a body with refractory-like densities, which allow the shapes to be thermal-cycled repeatedly without damage due to thermal shock, but with a very closed porosity, normally found in fully dense, advanced ceramic bodies. The new material can be formed and

processed like conventional nitride bonded silicon carbides, but exhibits greater abrasion resistance, in line with much more expensive and difficult to form advanced ceramic materials.

Applications for this composition include: slurry, ore, and coal; in high temperature, abrasive and corrosive environments. Typical components include pipe linings, elbows, burners, valves, cones, vortex finders, nozzles and pump components.

### Crusher/mill wear studies

Columbia Steel says its on-site crusher wear studies "take the guesswork out of cone liner and jaw plate choices, benefiting your operation with better production and less downtime. A Columbia wear study on your crusher can answer the question, 'Are you using the right wear parts?'"

Cone crusher wear studies include measuring expended bowl liners. Jaw crusher studies are the first step to finding the best design solution. The mine then receives recommendations for parts best suited to its specific situation.

Columbia Steel, a replacement wear parts specialist, says the "right design can make a big difference. Crusher OEMs generally offer a limited choice of wear part designs, and these are usually based on average conditions. But few crusher operators work under 'average' conditions!" The right cone liners or jaw plates can mean:

- Improved production
- More accurate product sizing
- Better wear metal utilisation and lower discard weight
- Longer wear part life
- Lower overall operating costs.

Columbia Steel can recommend alloys that make a difference, as well. Its Xtralloy® premium manganese steel is a great cost-effective choice for many hard rock crushing applications.

A wide variety of wear part



Columbia Steel's district managers and engineers begin by collecting real-world data on the equipment – feed and discharge information, throughput rates, change out records, and measurements on worn parts

improvements are available for virtually every popular jaw crusher. Among the jaw options are curved, smooth, and corrugated designs. More specialised recommendations for customers have included toothed jaws with smooth ends; concave/convex jaw

## MOTION METRICS

Wear rates and curves based on calendar days or - as shown above - on throughput tonnage, using MILLMapper. Two separate liner lives are shown

combinations; and 'slab breaker jaws' with alternating extra high teeth. Based on wear study results, Columbia Steel will assist the choice from many bowl liner and mantle combinations for more efficient crushing, whether it's a stationary or portable operation.

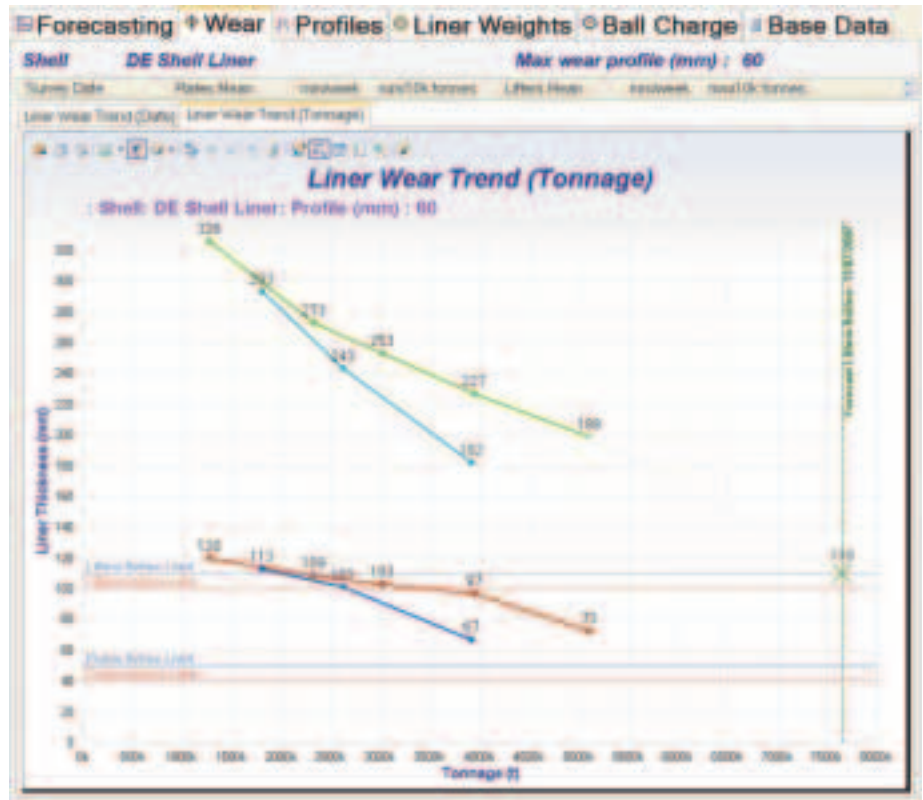
Many customers have improved their cone crusher performance with Columbia Steel's IFOR, (Increased Feed Opening Relief) bowl liners. By designing feed opening relief areas into the parts, a solution is provided that allows operators to handle top size material while reducing skidding, maximising throughput, reducing blockage, and maintaining feed openings as liners wear.

Over the past three decades, Columbia Steel has applied the same engineering solutions to gyratory crushers which have proven so effective on cone crushers. Field studies were made of the many areas for potential improvement: poor nip of feed material, excessive wear in the lower crushing chamber, poor production from partially worn parts, excessive wear metal discard costs and problems with uneven or localised wear.

Scanalyse's MillMapper™ is an innovative condition monitoring tool for grinding mills. It enables improved liner wear performance and production optimisation by 3D data collection using a laser scanner and then data processing using the proprietary MillMapper processing software. Scanalyse says the system offers increased mill availability due to:

- Minimised inspection shutdown duration (~ 20-30 min using MillMapper versus 1.5-2 hours using traditional condition monitoring methods)
- The potential of safely extending reline schedules, with more definitive knowledge of liner wear
- The potential for combining reline of all segments in a mill based on optimised liner design using MillMapper shape data
- The potential to reduce unscheduled shutdowns
- Optimised liner design, resulting in fewer reline shutdowns.

Increased mill production can result from better control of mill ball charge content and mill load. There is also the potential to optimise liner shape design for maximum production. Costs may be cut by minimising liner metal wastage and hence liner material cost and reduced reline labour costs. Finally safety may be improved by minimising or



eliminating all aspects of confined space entry, if the remote method of scanning is employed.

Scanalyse's Chief Technical Officer, Jochen Franke, presented the new CrusherMapper™ at the IMPC in Brisbane in September. As he says, the efficiency of processing plants "is entirely dependent on the availability of the plant equipment critical path. This typically concerns comminution circuits consisting of primary crushers and primary grinding mills. Crusher and mill availability are determined by the frequency and duration of maintenance shutdowns, which are primarily driven by the need for replacement of sacrificial liners. The change of crusher and mill liner shape over respective life cycles also strongly affects plant efficiency. It is therefore highly desirable to accurately monitor the condition of mills and crushers in order to optimise plant efficiency through maximised availability and targeted liner shape.

"Traditional comminution liner and other production parameter condition monitoring has been attempted through ineffective methods which prevent satisfactory management of crusher and mill maintenance and reduce operational control. This situation has recently dramatically improved for grinding mills through the development and commercial deployment of MillMapper." Scanalyse now has about 70 mills under regular scanning.

Franke's paper at the IMPC introduced CrusherMapper as the MillMapper equivalent for crushers. It also uses high density, high

accuracy laser scanning data, and features dedicated algorithms for 3D monitoring of wear on crusher concaves and mantles. "It facilitates the detection of wear hot spots or zones or localised liner failures, and accurate forecasting of reline tonnages and dates," Franke continued.

"It also for the first time provides the means to establish optimised concave and mantle shapes in order to achieve production targets. In contrast to any other currently utilised condition monitoring method, CrusherMapper data collection can occur remotely and does not require any shutdown or crusher isolation. This method therefore does not interrupt crusher production while at the same time eliminating any confined space risk normally associated with taking measurements inside "He concluded that this tool, "for the first time enables crusher operators to gain control of appropriate crusher maintenance scheduling, and to optimise associated operational aspects. This is achieved by providing quantitative, complete, accurate, and repeatable 3D thickness as well as temporal tracking results, all presented in a meaningful way within user friendly software."

## Magnetic liner

ACR's Magnaskin™ liner installs without welding, bolting or adhesives, fastening with magnetic force alone. ACR says "bolt on liners have a tendency to allow liquid to find

a way behind them and out of the equipment. ACR liners effectively seal the equipment surface off, since they have rubber on all sides, rather than steel. Bolt on liners rust and are difficult to remove without cutting, making it impractical to reposition them as they wear. Repositioning of the ACR magnetic liners is quick and easy when some have worn more than others, stretching the life of the overall lining. Vulcanised linings require the entire surface to be replaced when only a small section may be worn, which means removing the equipment or bringing contractors in."

Magnaskin wear liners come in 51 mm thick sections for heavy wear areas, and 25 mm thick for side walls and other areas seeing less abrasion or impact. They can also be made to custom sizes.

"Change out time for the ACR liners versus bolt on liners is reduced by more than half, allowing for maximum production. Another feature for these liners is that they can be cut on a band saw to fit odd dimensions, allowing for standard sizes to fit a wide range of surface areas. Used in hoppers, chutes, bins, drop boxes, cyclone under pans and a host of other areas that require constant wear protection, the liners come in various sizes to accommodate any requirement."



Installation of the magnetic liners involves simply cleaning the ferrous metal surface where the liners will be installed and then fitting into place with each pad against the next. It is recommended to start at the bottom of chutes or angled hoppers, fitting the first row of pads against the bottom plate or angle iron and then adding more liners up from

there. Magnaskin liners can be cut to allow for fitting in odd dimensional areas, using a tile saw. To change out pads, insert a pry bar or other thin metal tool under the liner and lift to break the magnetic bond with the steel equipment. **IM**

## COLUMBIA STEEL