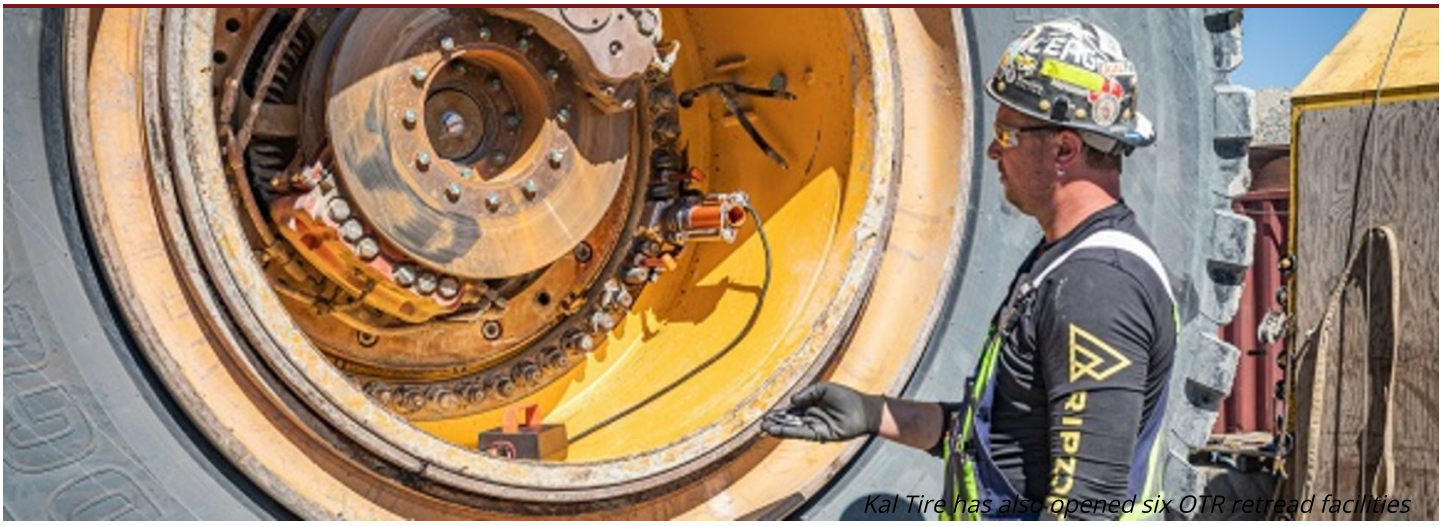
Mining Magazine

Tyres go circular

Tyres are a critical component of every mining operation, and are also a major expense



Kal Tire has also opened six OTR retread facilities

Surface Mining > Fleet

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Jax Jacobsen

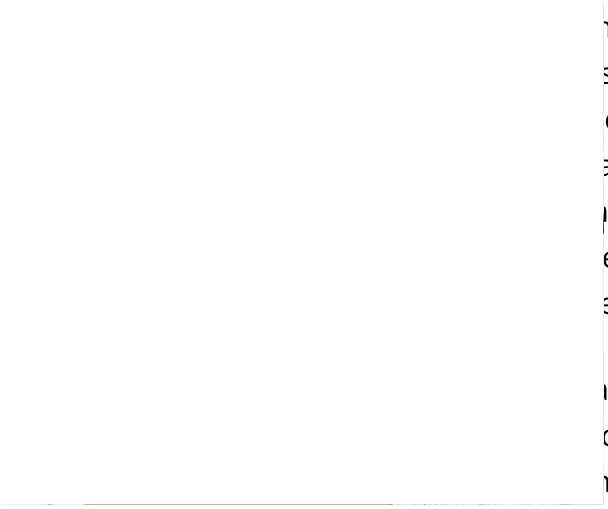
Mining companies are faced with the challenge of maintaining tyre quality for as long as possible and managing the waste created by used tyres.

Hundreds of thousands of tyres are estimated to be in operation on mining sites worldwide by tyre experts.

Increased ESG demands on the sector have made action on this issue necessary, SVP Dan Allan of the Kal Tires' Mining Tyre Group told *Mining Magazine.*

"It's becoming more and more evident in more geographies that the issue of tyre recycling is important," Allan said.

Part of the reason that tyres cannot be left in piles is due to how these piles can create pools of standing water, which can then lead to mosquitoes, malaria, and other forms of bacteria, Allan said.



n many cases, mining companies will st bury tyres. But in mining board oms, they're acknowledging that this asn't the best disposal route to take. here's a lot of pressure to find eaningful alternatives on end-of-life ewardship" of tyres.

l Tire decided to construct a tyre cility in Chile, spurred by recent ilean legislation to ensure that 100% of mining tyres are recycled.

Kal Tire uses thermal conversion for its recycling process, to create usable products that can be used to manufacture additional tyres, Allan said.

"Forty percent of a large tyre is comprised of oil, and the rest is carbon black and steel," Allan said. "By inducing the reaction, we can produce clean steel to be mixed into other things. The oil that comes out is highly sulphuric, but we can blend it with existing refineries into oil, so that additional oil doesn't have to be produced."

The 20,000-square-meter recycling successfully trialled its first tests in the spring of 2021. The off-the-road (OTR) tyre recycling facility can convert five 63" tyres weighing nearly 20,000 kilogrammes into 6,500 litres of alternative fuel, 4,000 kg of steel and 8,000 kg of carbon black, another component in the tyres.

The facility's capacity is limited to 7,500 tons of tyres annually, Allan said. "Mines don't tend to be in the middle of a country's capital, so we designed the plant to be close to customers at a capacity that made it attractive."

Outside of its recycling efforts, Kal Tire has also opened six OTR retread facilities for the larger tyres used at mining operations.

"The challenge has always been that working with smaller tyres is ok, and up to 49 inches has been the sweet spot in retreading," Allan said.

Kal's Ultratread services are designed for tyres approaching end of life. Tyres are removed from the vehicle before the tread is worn completely down, so that a layer of rubber can be added. Tyres can be retreaded several times before they reach their end of life, Allan said.

"The challenge is to get a customer to take the tyre off at 10,000 to 12,000 miles," Allan said. "It's a trade-off, but it comes down to the what the customer wants from the fleet."

Kal Tire has also moved beyond physical tyres and is offering customers services to allow them to be more forward-looking when it comes to maintenance. The company launched the Tire Operations Management System in 2018.

"Linking up the heavy equipment maintenance schedule with tyre maintenance can be a huge advantage," Allan said. "This way, you only have to take [the machine] our once, and do the preventative maintenance and change the tyres, which represents savings in down time."

Using TOMS allows operators to plan equipment maintenance far in advance, while also increasing the amount of data available to Kal.

"We started to collect a lot of information on wear rates, tread designs, applications, at what altitude and ambient temperatures - how tyres behave in specific scenarios," Allan said.

"We take all that aggregated data, and try to learn from aggregation of the information how to advise the customers better at using the tyres and extend their timelines."

Circling on recycling technology

Salvadori, a subsidiary of Technical Rubber Company, has developed a recycling process for tyres which results in reusable materials, TRC Head of Business Development & Government Affairs Genti Bardhi told *Mining Magazine*.

"We're trying to help the mines come up with solutions in order to address the issue of end-of-life tyres," he said.

Mining projects will differ in their tyre needs, requiring different tyre sizes and tyre composition depending on the environments in which they are active, Bardhi said.

"As a result, we as a recycler have to come up with the ultimate technology to predict these challenges" presented by the varying types of tyres that mining companies will need to recycle.

Every year, new types of tyres are made which include a new component of innovation, whether it's to improve performance or durability or flexibility, Bardhi said. This requires tyre recyclers like Salvadori to invest heavily in research and development and keep their recycling processes up-to-date.

Salvadori's recycling process involves reducing the size of the tyre, first by shredding the steel out of the tyre concentrated in the beads, and then breaking down the remaining rubber pieces. As steel is in high demand, the steel salvaged from mining tyres can be sold separately, Bardhi said.

Debeading and cutting are completed using the Wolverine 18-51R, which works without requiring bead removal. Fully automated, the machine is capable of shearing 30 OTR tyre cuts per hour. The Hercules 90 machine breaks steel beads that are contained within the tyres, and allows the shredding blades to last longer.

The MT-Rex machine can downsize a tyre weighing 5,000 kg or more in one hour or less, and generates nearly 1 million kg of downsized rubber in one week's time, Bardhi said. The machine only requires one operator, and is able to load tyres with a forklift. The process runs autonomously and can be monitored remotely with real-time technology.

The pieces of tyres that have been broken down in the first phase are submitted to a process known as ‘crumb rubber.' After this is completed, the company colours the rubber in different colours depending on its end solution, Bardhi said.

The rubber is then transformed into a variety of items, which can include moulding for playgrounds, gyms, hospitals, and hospital flooring.

Each process is a bespoke process, Bardhi said.

"We work 99% on tailor-made solutions," he said. "We start with a discovery phase - which could be a trigger of legislation, or having large amounts of tyres that no one knows how to address."

Then, the company brings together its engineers and R&D team to evaluate in what kind of market the end product can be applied. After that, Salvadori designs the process, and the tyres are transformed into another usable product.

Salvadori has 300 plants around the world, and operates in 47 countries, Bardhi said.

Rolling out new wheel tech

One company in Texas is making significant advances in rubber technology, which may elongate the lives of OTR tyres.

Austin-based Molecular Rebar is developing a carbon nanotube product that aims to de-clump the nanotubes and individualise them, Director of Rubber Development August Krupp told *Mining Magazine.*

Carbon nanotubes are akin to graphene, nano-scale tubes, which have a thickness of a single atom. The layers are wrapped to form a hollow core which is made of carbon, according to *Rubber & Plastics News*.

Molecular Rebar's technology is able to de-clump the nanotubes in a high-sheer process, adding chemical functionality to the nanotube.

When applied to mining tyres, the substance improves resistance to cuts and chipping, Krupp said.

"We can do that without adding to the heat buildup that's inherent in moving tyres," Krupp said. "Usually, you'd have to sacrifice [tyre] longevity in heat and fuel economy."

This technology could be useful in both the upstream manufacturing of the tyre, as well as for retreading on older tyres, Krupp said.

Krupp said that Molecular Rebar has had a successful trial with OTR tyres in Asia and is now working with dominant OTR tyre manufacturers. The trials have shown the company that using the carbon nanotube technology is extending tyre lifetimes by higher than 30%, Krupp said.

The rebar technology also inhibits the growth of cracks in tyres, he added.

"The rebar creates a crack bridging mechanism," he said. "If a crack occurs and starts spreading, it will run into a nanotube. The crack will either attempt to get around or through the nanotube, and this takes more energy than if the nanotube weren't there."

For that reason, the technology is more effective on rough track as opposed to smoother track such as sand.

"[The technology] will always improve the lifetime of the tyres, but less so over sand."

Reinventing the wheel

Phoenix-based Global Air Cylinder Wheels is trying to re-imagine the very concept of the wheel.

GACW's Air Suspension Wheel does away with the rubber tyre, rim, and chain of traditional tyres, to be replaced with an inner steel hub and outer steel drum. These are connected by 12 cylinders filled with nitrogen to provide suspension, Director Harmen van Kamp said.

"This takes the dangerous part [air] out of the wheel," van Kamp said. "Steel is a lot stronger than a rubber balloon, and on the outside of the steel, you can add rubber padding and steel."

This type of tyre is based on technology already used by wheelchairs.

The tyres also benefit from better weight distribution, van Kamp said.

"With better weight distribution, you get better grip. The same goes for cars, trucks and bridges," he said. "With traditional tyres, when you put weight on it, it flattens out and gives more rolling resistance. But because our outer drum is rigid, the contact area with the ground is always equal, whether it's loaded or unloaded."

This results in fuel savings, van Kamp said.

When trucks are operating at speeds less than 15 miles per hour, the engine spends half of its energy to overcome mechanical force and half of its energy overcoming rolling resistance, he said.

GACW's wheel has been designed to allow the torque to move freely within the wheel, propelling the equipment into motion. Engineers at the company have calculated that this change significantly cuts down the amount of fuel used in vehicles, van Kamp said.

"The conservative estimate shows we save about 8% of fuel, up to 30% under ideal conditions," van Kamp said, adding that ideal conditions include asphalt roads, how many stops the vehicles make, and speed.