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Tyre recycling's contribution to sustainable mining



The facility can recycle OTR tyres used in mining

Kal Tire's off-the-road (OTR) tyre recycling facility in Antofagasta, Chile, has proven that tyre recycling is a major factor in ESG mining due to its largely positive impacts on the environment, mine host communities and the economy. **By Dineo Phoshoko**

per annum. Each tyre typically weighs about 4.5 tonnes.

"The Chilean plant has been constructed with two chambers (or reactors).

The annual capacity of the plant is approximately 7 500 tonnes," explains

John Martin, vice president Southern Africa: Mining Tire Group, Kal Tire.

"These tyres get sized down into smaller pieces and then get put into each chamber, which then gets processed," he adds. Each chamber can handle 20 tonnes. "The design of the plant is scalable, so it can work with one chamber, or it can work with additional chambers depending on the demand and depending on the volume of product or feedstock that goes into the plant." For example, it can go to 15 000 tonnes per annum with four chambers or 22 000 tonnes per annum with six chambers. "That all depends on agreements with buyers and offtake

located in the heart of Chile's mining industry, the 20 000 m² Antofagasta plant consists of an area to inventory scrap tyres, cutters to reduce them in size, two reactors, oil storage tanks and carbon storage. The plant can recycle approximately 1 600 ultra-large mining tyres

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John Martin has extensive experience in the mining and metals industry

agreements with those companies that are interested in taking the products," he explains.

According to Martin, the facility uses a thermal conversion process, which can process any tyre that can be returned to its original composition. "Up to a certain size, we have to start reducing the size of the tyre pieces that you put into the chamber. The smaller the pieces, the quicker the process takes to turn the tyre into its original product."

Martin, however, cautions against introducing other rubber products such as truck or car tyres, as they may contain other products such as nylon, which could potentially affect the quality of the products derived from the recycling process. "There are no limitations essentially on what tyres one can process in this chamber; it simply affects the quality of a product that comes out to a lesser or greater degree depending on what you put in. We found that with the mining tyres, we are getting a very good quality of product coming out of the process as designed," Martin says.

Saving the environment through tyre recycling

Martin explains that tyre recycling touches on various aspects when it comes to sustainability in the mining industry, adding that Kal Tire's mining tyre recycling looks at sustainability targets and requirements articulated in ESG (environmental, social and governance). According to Martin, the recycling process falls within the environmental part of ESG. "It addresses the targets that include carbon footprint and greenhouse gas emissions, as well as the much-needed environmental stewardship."

To manage and dispose of mine waste tyres, some mines have resorted to burying mine waste tyres or having them sent to a storage facility where they were stockpiled. Neither of these methods are sustainable in the long term and are potentially harmful to the environment. In September 2022, NSW Environment Protection Authority (EPA), the primary environmental regulator for New South Wales in Australia, issued a fine to a refinery for stockpiling approximately 74 tonnes of waste tyres on its premises. In a statement released, Stephen Beaman executive director: Regulatory Operations Metro, NSW EPA, said stockpiled tyres were a potential fire hazard and strict conditions applied to their storage. "Once alight, rubber tyres are extremely difficult to extinguish, generating a large amount of heat and smoke," Beaman said.

Mpanyana Lucas Mahlangu submitted a research thesis for a Master of Arts in Environmental Management at the University of South Africa. Titled 'Waste tyre management problems in South Africa and the possible opportunities that can be created through the recycling thereof', the paper mentions some of the environmental impacts of burning tyres. These include air pollution caused by carbon dioxide that is produced by burnt tyres. Referring to water pollution, in his thesis, Mahlangu writes, "Tyre combustion causes pyrolysis of the rubber, resulting in oily decomposition waste. The oily discharge can flow into nearby streams, ditches and waterways, or can leach into the groundwater. In cases where water is used to put out the fire, chemical compounds like aromatic liquids and paraffin may be carried by the water." The thesis

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also notes the risk of soil pollution that can occur when residues remain on the soil after a fire. Martin highlights that long-term sustainable tyre recycling needs to be done ethically and that the Chile recycling facility is one of the ways to go about it.

Recycling process and the circular economy

Martin explains that, upon arrival at the facility, the tyres are recorded in terms of their weight, and they go over a weighbridge. Serial numbers are also recorded. Processing of such information is done to provide documented evidence back to the mine companies who own the tyres to provide chain of custody evidence that the tyre has been recycled ethically.

Once processed, the tyres are then cut into pieces and put into the chamber where they are processed for approximately 14-16 hours. Times for heating and cooling off, as well as packing and unpacking the chambers, are included in this timing. "The plant processes about 20 tonnes a day, so each chamber is loaded and processed once in two days – 24 hours to essentially load the chamber, process the tyres and obviously unload it at the end of the process," explains Martin.

In his paper, Mahlangu highlights that waste tyres can potentially lead to wealth and job creation opportunities. "It is firmly believed that waste tyres have an inherent value that can be enhanced commercially to yield viable products and by-products," the paper states. Cement kilns, electricity generating utilities, brickmaking and boiler systems are some of the markets that could benefit from waste tyres.

However, recycling of these tyres is a costly service. While downstream opportunities are possible, they are not guaranteed, and it requires great effort to ensure they are suitable for various applications. Due to the high capital investment in the infrastructure and technology to build and operate a mining tyre recycling facility, there isn't enough value in downstream products that come from recycling at this moment to cover the cost. As such, there is a cost to owners or importers of scrap tyres to recycle them.

Martin adds that products that are generated out of the thermal conversion process are fully subscribed to the circular economy. "Everything can get reintroduced into the economy in some form and reused in many different applications," he says.

The three main products that are derived from Kal Tire's tyre recycling facility and get reintroduced back into the economy are heavy fuel oil, carbon black, steel and synthetic gas. Uses include the following:

- Oil can be used in many applications such as generators and other machinery. It can also be refined into alternative fuel for reuse in mine site equipment.
- Carbon black can be used in batteries, pigments,

- paints, plastics and new rubber and tyre production.
- Synthetic gases are fed back into the reactor and make for a self-fuelling, low-carbon output solution.
- High-quality tensile steel found in OTR tyres can be recycled for a variety of purposes. Steel is easily tradeable, therefore there is a huge demand for it in the market.

"This is genuine support of a circular economy, [in] that we take a waste product and we transform it back into its original component so that it can be reintroduced into the economy, hence reducing waste and reliance on new products – and essentially reducing carbon footprint," says Martin.

Waste tyre recycling in South Africa

Currently, the Chilean tyre recycling facility is the only one of its kind operating in the world. It is purpose-built to accommodate ultra-large mining tyres. "There is no doubt that there are other pyrolysis solutions around the world, but there is nothing that we know of at the moment that accommodates these very large tyres and the bulk handling of these massive mining tyres," explains Martin.

'A Benchmark Study of Waste Tyre Recycling in South Africa to European Union Practice' revealed that South Africa stands to benefit from waste recycling facilities. Authored by Paul Mativenga, Jan Pretorius and Rebecca Sebola, the study states that job creation and assisting disadvantaged communities in South Africa is a "key aspect for third-party waste tyre recycling companies to get approved".

The Recycling and Economic Development Initiative of South Africa (Redisa) used to be responsible for the Industry Waste Tyre Management Plan (IIWTMP). According to the study, the plan not only supported and promoted tyre recycling, but it also provided collection and depot infrastructure needed to collect waste tyres in South Africa to have them delivered to approved recyclers. In 2017, the then Minister of Environmental Affairs, Dr Edna Molewa, announced the withdrawal of the IIWTMP. This ultimately led to the withdrawal of the Redisa plan and the promulgation of the Waste Tyre Regulations.

During a portfolio committee meeting of the Department of Forestry, Fisheries and the Environment (DFFE), Obed Baloyi, acting head: Waste Bureau at the DFFE, explained that since the withdrawal of the Redisa plan, the Waste Bureau was mandated to manage waste tyres temporarily until a new Industry Waste Management Plan for waste tyres is approved. The Waste Bureau has been responsible for the management of waste tyres since 1 October 2017. Baloyi explained that the Bureau is mainly responsible for servicing tyre dealers and other collection points where waste tyres are generated.

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A view of Kal Tire's Chile recycling facility

It is also involved in developing processing capacity (tyre-derived fuel, crumbing, pyrolysis), and supplying processors with waste tyres.

The Waste Bureau being responsible for waste tyre management is a short-term solution until the Section 29 Industry Waste Management Plan (IndWMP) is finalised. According to Baloyi, once finalised, the Section 29 IndWMP will have the following objectives:

- support the establishment of a viable waste tyre processing sector in South Africa that will reduce the negative environmental impacts of waste tyres and support enterprise development and job creation in a circular economy
- waste tyre processing capacity of South Africa
- develop monitoring systems to enable assessment of progress against targets.

The study also highlights that waste processing is an opportunity for community engagement, job creation

and new industrial systems.

As such, a tyre recycling facility like the Chilean one could have multiple benefits for South Africa across various sectors in addition to the mining sector.

Martin explains that Kal Tire is open to engaging with stakeholders in the South African mining environment to build and operate a similar facility of this kind. The plant's modular and scalable design makes it possible for it to be built just about anywhere. Ultimately, waste tyre recycling addresses various critical ESG-related challenges faced by various stakeholders in the mining value chain. "It is a critical issue that society, government and the mining industry need to address as a matter of urgency," concludes Martin. **35**