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CONTENTS

ISSUE 1 2024

ON THE COVER

Hauhinco Mining Technology (HBT) is a world-class machine manufacturer and fully integrated single solution provider – specialising in systems and equipment for underground coal mining. The company exports high-performance equipment for longwall mining and roadway development to all major mining markets worldwide.
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This is the year where we stop apologising. Advocating for 'coal elimination' is irresponsible and it makes vulnerable nations more vulnerable. It is time people understood the facts.

In November 2023, the World Coal Association rebranded to 'FutureCoal: The Global Alliance for Sustainable Coal'. Why did we do this? To shed a misaligned negative perception of coal and unite the global coal value chain under a shared vision.

FutureCoal reminds us that coal offers us solutions to achieve both economic progress and emissions reductions. It is easy to say that eliminating coal automatically leads to zero emissions, or that installing renewables automatically leads to 100% clean, affordable, and reliable energy; but both statements are incorrect.

Instead, we have created a roadmap that charts the course for the global coal value chain to navigate to a future of sustainability, technology (much of which exists today), innovation, and resilience. We call this Sustainable Coal Stewardship (SCS). SCS redefines the role of responsible coal participants across the mining, utilisation, and recycling sectors – empowering innovative stakeholders to lead the charge towards a sustainable society.

SCS encompasses three phases: Pre-Combustion, Combustion, and Beyond Combustion.

- Pre-Combustion refers to the abatement opportunities in the upstream sector of the coal value chain. This encompasses efficient mining practices, digitalising operations, waste management and reuse, and land rehabilitation and restoration (among other initiatives).
- Combustion describes the range of efficient technologies, which, when combined, support power and heat utilities to abate and capture up to 99% of emissions. Technologies include Carbon Capture and Storage (CCS), High Efficiency Low Emissions (HELE), and co-firing with carbon neutral fuels.
- Beyond Combustion embodies our vision of pioneering business opportunities that convert coal into high-value products. These encompass Coal-to-Liquids (CTL), synthetic liquid hydrocarbons, hydrogen, methanol, steel, cement, and critical minerals for our digitised and electrified future.

During my conversations with governments, CEOs, journalists, investors, and other stakeholders, a prominent trend is emerging where countries are rethinking their stance on coal, being challenged to view this critical resource as strategic and not stranded.

For India and China, who already have the SCS mindset, investment to the tune of billions is already underway in abated coal technology (including coal gasification, coal-to-liquids, coal-to-hydrogen, and more), in order to meet environmental goals, create quality employment, drive economic growth, and stimulate innovation – all while retaining coal in their mix.

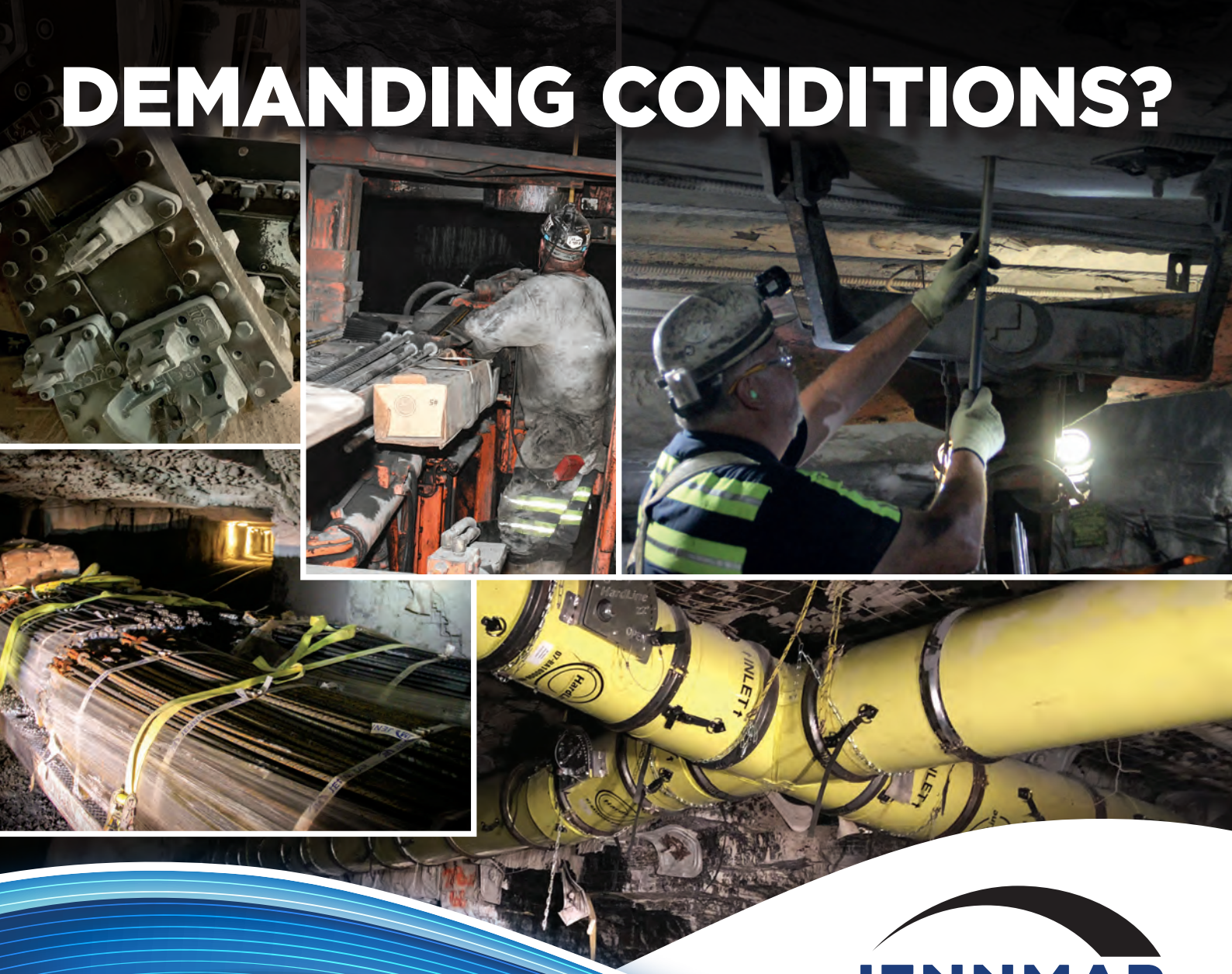
Other developing nations see the strength in this. They know that conversations about moving away from coal are unrealistic and Global North 'conditional' funding does not always support a nation's right to leverage its natural resources and extract maximum value from them.

This year, FutureCoal gives the global coal value chain the platform it called for: to work together, invest, develop, and deploy abatement technologies and multi-commodity products from coal. The funding opportunities exist, the technology is available, and the demand is there. Nonetheless, let us be clear the coal value chain needs to change and align to capitalise on this opportunity. It needs to understand that the new coal era is abated. WC

Notes

For more information, visit: www.futurecoal.org

DEMANDING CONDITIONS?



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WORLD NEWS

USA US Government invests in critical mineral production from coal resources

As part of President Biden's Investing in America agenda, the US Department of Energy (DOE) has announced over US$17 million for three projects that will support the design and construction of facilities that produce rare earth elements and other critical minerals and materials from coal-based resources.

The projects, funded by the Bipartisan Infrastructure Law, may strengthen domestic supply chains, helping to meet the growing demand for critical minerals and materials and reduce reliance on unreliable foreign sources. Rare earth elements and other critical minerals and materials are key to manufacturing clean energy technologies in the US – such as solar panels, wind turbines, electric vehicles, and hydrogen fuel cells. Coal and coal production waste contain valuable rare earth elements that can be used to manufacture clean energy technology components, creating high-quality jobs in communities that have historically produced fossil fuels and helping to combat climate change.

"President Biden's Investing in America agenda is helping narrow the nation's dependence on foreign supply chains, by reimagining the use of coal waste and byproducts as a domestic source of the critical minerals needed for clean energy technologies," said Jennifer M. Granholm, US Secretary of Energy. "The investments announced today will not only increase our national security and ensure a cleaner environment, but will also help deliver high-quality jobs in all pockets of the country."

UKRAINE Metinvest launches new longwall in Pokrovsk, Donetsk Region

Metinvest's Pokrovske Coal has commissioned the 11th longwall for coking coal in Block 10 of Pokrovske Colliery, which will enable the group to produce almost 1 million t of coal.

Pokrovske Coal's enterprises operating near the front line provide jobs for the Donetsk region's residents and internally displaced persons from different parts of Ukraine, as well as develop local communities, pay taxes, and support the country's economy. As such, the launch of the new longwall is a significant event for the region and the entire country.

Commenting on the news, Andriy Akulich, CEO of Pokrovske Coal, said: "The timely preparation of the new longwall is a positive result of the long, hard work of every employee of the business. This is a significant event for the entire team and contributes to a stable, confident future for us. People will be provided with jobs and salaries, which is crucial for teams operating in frontline regions. In addition, this is a significant contribution to maintaining Ukraine's defence capability and replenishing budgets at all levels."

Despite challenging mining and geological conditions, longwall no. 11 is one of the most promising areas of Pokrovske Coal's operations. The 242 m long face has reserves of 993 000 t of coal. The enterprise plans to produce up to 2500 tpd of coal from it. The longwall reserves are expected to last for more than a year.

Since the beginning of 2024, Metinvest's enterprises in Ukraine have mined around 698 000 t of coal, from which almost 373 000 t of concentrate have been produced. By the year-end, the group plans to mine 5.3 million t of coal, produce 2.8 million t of concentrate and commission two more longwall faces.

Pokrovske Coal is the largest coking coal producer in Ukraine. It comprises several enterprises, the main ones being Pokrovske Colliery and Sviato-Varvarynsk Beneficiation Factory. The companies extract and enrich coking coal and sell coal concentrate. They are located on the border of the Dnipro and Donetsk regions. Pokrovske Coal manages Metinvest's Ukrainian coal assets.

COVER PROFILE

HBT: An integrated single solution provider for longwall mining systems, mining electrical engineering, roadway development, and room and pillar mining equipment.

HBT – Hauhinco Mining Technology – is a global machine manufacturer and fully integrated single solution provider for underground mining in all major mining markets worldwide. HBT utilises advanced autonomous technology to maximise productivity and ensure operator safety. Its approach covers the entire mining lifecycle, customising solutions to meet diverse customer needs, whether for low or high seams, varying face lengths, or high production demands.

All core HBT facilities have an in-house capability to research, develop, design, manufacture, and test mining equipment, while also manufacturing high-quality OE parts and providing world-class support for the company's entire product line.

HBT subsidiaries and partner offices are strategically located in all key coal-producing countries, including Australia, China, Turkey, India, and the US. The corporate office of HBT GmbH is headquartered in Luenen, NRW, Germany.

Figure 1. Roof support control.

Legacy foundations

HBT's ancestry is ingrained in the longwall mining industry, with roots going back to the very beginning of mechanised longwall mining in the 1800s. Over the last 200 years, HBT has driven innovation and performance while being shaped by several industry leaders – most notably Hauhinco, DBT, and Caterpillar.

Product portfolio

Longwall mining technology

The heart of HBT's prowess lies in its longwall mining technology, integrating advanced automation systems that optimise the extraction

process while ensuring safety and reducing operational costs. The company's complete line of longwall mining equipment includes high-horsepower shearers, automated plow systems, armoured face conveyors (AFCs), beam stage loaders (BSL), intelligent drive systems with gearboxes, motors and VFDs, hydraulic roof support legs and cylinders, programmable mining controls, face automation sensors, actuators, microprocessors and computers, and high-pressure pump stations.

Mining electrical engineering

HBT specialises in tackling complex electrical engineering challenges across raw materials and heavy industries, such as mining, tunnelling, raw materials extraction, and oil and gas production. From mobile machines to permanent installations, whether in tunnels, mines, hazardous gas fields, or offshore setups, HBT offers expertise in advanced power distribution and automation systems to meet your needs. Product offerings include measurement and control technology systems, power distribution and drive technology for harsh environments, explosion-proof/flameproof power distribution, explosion-proof/flameproof motor switching devices, and drive technology in flameproof design – motors/frequency converters.

Roadway development/room and pillar equipment

HBT, in collaboration with its partners, supplies equipment for roadway development and tunnelling projects. The portfolio includes ADVANTEC roadheaders, shuttle cars, feeder breakers, and bolter miners for safe and efficient excavation and bolting. This equipment suite enhances mining and tunnelling operations' productivity and safety.

On 20 July, HBT acquired Australia-based Waratah Engineering. Known for remanufacturing longwall roof supports and overhauling continuous miners and roadheaders, Waratah also produces its own equipment. This acquisition enriches HBT's distribution capabilities and diversifies its product portfolio.

HBT's line-up includes the Waracar shuttle car, WARABOLTER miner bolter, and WARABREAKER for material transport and breaking. Customised continuous miners are designed electro-mechanically to meet specific customer needs.

In partnership with ADVANTEC, HBT is revolutionising product development in tunnelling and mining with the ADVANTEC Roadheaders boom-type excavation machines that offer advanced technology and excellent value to customers. The ADVANTEC machines are part of the TDR series (tunnel-digging roadheaders) and can be easily adapted in size and design for mining and tunnelling applications.

Aftermarket services

HBT ensures top-notch support for enhanced productivity, extending far beyond the quality and efficiency of its machines. Its aftermarket service network offers high-level support, backed by the tools, processes, and expertise of HBT service staff. This unique support system provides integrated solutions, fast parts fulfilment, remanufacturing capabilities, and more. WC

Figure 2. Electrical engineering.

Figure 3. ADVANTEC – TDR100 Roadheader.

Figure 4. HBT Waracar Shuttle Car.

WORLD NEWS

DIARY DATES

Electrification in Mining
16 April 2024
Online Conference
www.worldcoal.com/events/electrification-in-mining-virtual-conference

Coal Processing Technology 2024
29 April – 01 May 2024
Kentucky, USA
www.coalprepsociety.org

MINExpo International
24 – 26 September 2024
Las Vegas, USA
www.minexpo.com

To stay informed about the status of industry events and any potential postponements or cancellations of events, visit World Coal's website: **www.worldcoal.com/events**

INDONESIA Bedeschi announces new coal transshipment

Bedeschi S.p.a. has announced the finalisation of a new contract for a coal transshipment system, gaining the trust of a new customer in Indonesia.

An important shipyard will build this tailor-made solution in the Guangdong district, with its final destination in Indonesia.

The scope includes two receiving hoppers with associated belt feeder extractors, one coal blending mixer, belt conveyors, and one slewing luffing telescopic shiploader.

The system is controlled by multiple levelling sensors to monitor the quantity of coal in the hoppers and optimise the blending performances.

This is another important step in Bedeschi's globalisation strategy with Bedeschi Far East, its widespread network in the Far East, and its team based in Hong Kong with Indonesia and China Mainland offices.

AUSTRALIA AQC finalises Dartbrook Mine restart funding package

Australian Pacific Coal Limited (AQC) has announced that the Dartbrook Joint Venture, comprising AQC and Tetra Resources Pty Ltd, has finalised a 3-year US$60 million debt facility with Vitol Asia Pte Ltd, a leading global energy and commodities company.

The terms of the binding debt facility agreement, first announced on 30 November 2023, were finalised and executed following a substantial period of due diligence. The US$60 million facility will cover forecast restart expenditure at Dartbrook through to first coal, including equipment acquisitions and completion of remediation works, and the acquisition of additional mining systems during ramp-up to achieve full capacity.

Australian Pacific Coal's Interim CEO, Ms Ayten Saridas, said: "This is a landmark event for Australian Pacific Coal, our shareholders, and the Dartbrook mine. The US$60 million restart funding package we have agreed with Vitol opens the door for Dartbrook to restart production after 18 years in care and maintenance.

"Our ability to secure debt funding for Dartbrook during a period of high inflation and global tension is testament to the quality of the project, the vision, and work ethic of the team of people bringing it back to market, as well as the commitment of our shareholders."

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BACK ON A *downward spiral*

Sreejeet Barik, Rystad Energy, India, reviews the state of the European coal industry and provides an outlook for the future.

Although coal was the largest contributor to power generation in 2023 – accounting for around 35% of total power supply worldwide – capacity growth is slowing. For instance, the European coal industry is back on a clear phase-out path after a couple of anomalous growth years due to the energy crisis. The region is the front runner of a global trend where coal is likely to have now peaked and is in structural decline due to policy and economics. Overall, Rystad Energy expects coal generation to drop by nearly half in Europe in the next five years; from 356 TWh in 2023 to 185 TWh in 2028.

Driven by efforts to reduce emissions and a push for a cleaner electricity system, coal generation in the EU has been falling over the past decade, from 743 TWh in 2012 to around 350 TWh in 2020. But, as commercial activities picked up again after the 2020 pandemic, electricity demand spiked at a time when renewable generation was lagging and gas prices increased, which made coal a cost-competitive fossil fuel in the region – and its usage surged. This trend was exacerbated in 2022 as energy prices spiralled amid the Russia-Ukraine war.

However, Europe's electricity demand dropped significantly last year due to energy-saving initiatives which, combined with higher renewable energy yields and better gas fundamentals, reduced the need for coal. At present, while overall power demand is likely to recover moving forward, stricter policies and unfriendly economics make a coal recovery highly unlikely.

European coal production fell to a multi-decade low in 2023

With power demand faltering, coal production in the EU saw a sharp decline in 2023 after having an irregular upward trend for a couple of years – rising 10% year-on-year in 2021 and 5% year-on-year in 2022 (Figure 1). The low-CV brown coal (including lignite) took the brunt of

the fall since almost all of it is used in the power sector, which itself had a lean year. The fall in high-CV hard coal, which includes coking coal as well, was much gentler.

In 2023, the EU produced only 224 million t of lignite, 24% (70 million t) less year-on-year, primarily due to a drop in overall coal demand from the region's power sector. For instance, lignite production in Germany fell by 30 million t in 2023 compared to 2022, with production in Poland and the Czech Republic down by 16 million t and 5 million t, respectively. Yet, Europe remains one of the largest consumers of lignite, almost all of which is produced domestically. After closing all its hard coal mines in 2018 due to high costs, Germany at present only produces lignite, while Poland and the Czech Republic continue to produce hard coal and lignite.

All three countries are expected to continue producing coal, albeit at increasingly lower volumes, with Poland likely to see the slowest rate of decrease. Coal generation is responsible for meeting 61% of Poland's electricity needs and plays an important role in maintaining energy supply security. In addition, while Poland's new government – which took power in October 2023 – is looking to put in place a consolidated coal phase-out plan, the previous government agreed with trade unions that coal mining would not be phased out until 2049. Overturning this promise could prove challenging for the new administration. Poland produced a total 40 million t of lignite in 2023, and Rystad Energy is expecting production to fall below 30 million t by 2030.

Beyond the EU, Europe's other major lignite producer Turkey also saw a sharp decrease in volumes from 81 million t in 2022 to 55 million t in 2023, also mainly due to lower lignite demand in its power sector.

Hard coal production in the EU fell 11% year-on-year to 49 million t in 2023. The lower yearly decline with respect to lignite was because coking coal demand (primarily from the steel industry) remained stable year-on-year at around 14 million t. Poland was the largest hard coal producer in the EU, with an estimated output of 48 million t in 2023, down 9% year-on-year.

Plans to develop new coal mines in Europe have mostly been shelved due to a lack of interest from investors and emission reduction policies. The only two upcoming projects are both coking coal mines in the UK: New Age Exploration's Lochinvar coal mine and West Cumbria Mining's Woodhouse Colliery, which is at a more advanced stage.

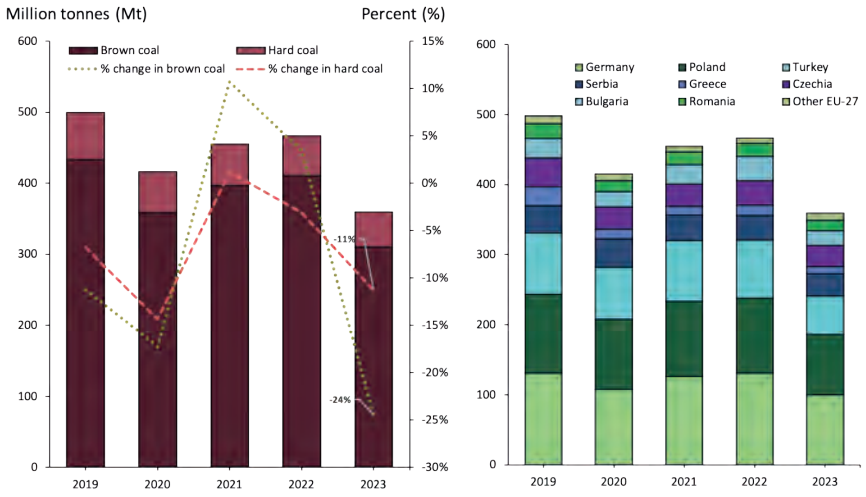

Figure 1. Coal production in Europe, 2019 – 2023. Both charts depict data for EU-27 countries plus Turkey and Serbia (Source: Rystad Energy research and analysis; Eurostat).

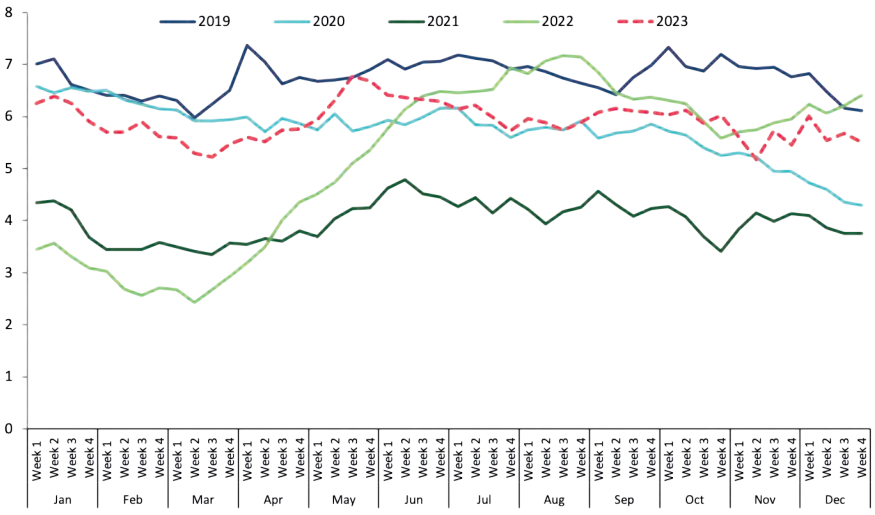

Figure 2. ARA coal stockpiles – million t (Source: Rystad Energy research and analysis; Argus).

Thermal coal imports take a big hit amidst soft demand, fall to 2020 levels

Following production, thermal coal imports into Europe took a big hit in 2023 too on softer demand, high stockpile levels, and above-average generation from renewables. Overall, thermal coal imports are estimated to have reached decade-level lows of around 80 million t last year, down 30% on 2022 and marginally down on 2020 levels when the pandemic hit demand. While thermal coal imports may remain stable in 2024 as European industrial demand recovers, an uptick in imports is unlikely over the longer term.

A comparison with 2021 stockpile volumes indicates how well-stocked Europe was for 2023. Except for a few instances, Europe's weekly coal stock

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volumes at Amsterdam-Rotterdam-Antwerp (ARA), one of the region's main ports, remained at healthy levels at around the 6 million t mark, even rising as high as 7 million t in May 2023 (Figure 2). While these numbers are lower than stock volumes seen for most of 2022, that year's level was mostly due to a brief panic following the start of the Russia-Ukraine war.

Prior to the conflict, Russia supplied over 50% of Europe's thermal coal needs, but has since been replaced by other major exporters – including Colombia (20%) and South Africa (15%). Colombia was Europe's dominant thermal coal supplier in 2023 due to its competitively priced volumes, which were offered to European buyers at a discounted price (even at a discount to the ARA benchmark prices).

Europe's coal imports from Australia and Kazakhstan have also increased in recent years. Australian thermal coal volumes have risen from 2.4 million t in 2021 to almost 7 million t in 2023, with Kazakh coal imports up from 1 million t to 7 million t over the same period (Figure 3). Most Kazakh coal is destined for Poland for household use.

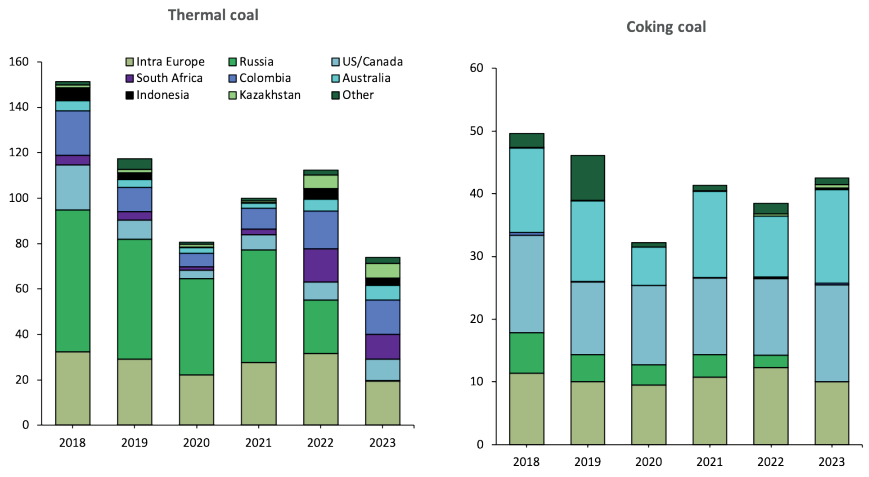

Figure 3. Coal imports into the EU-27 and the UK by source country – million t (Source: Rystad Energy research and analysis; Eurostat; Argus).

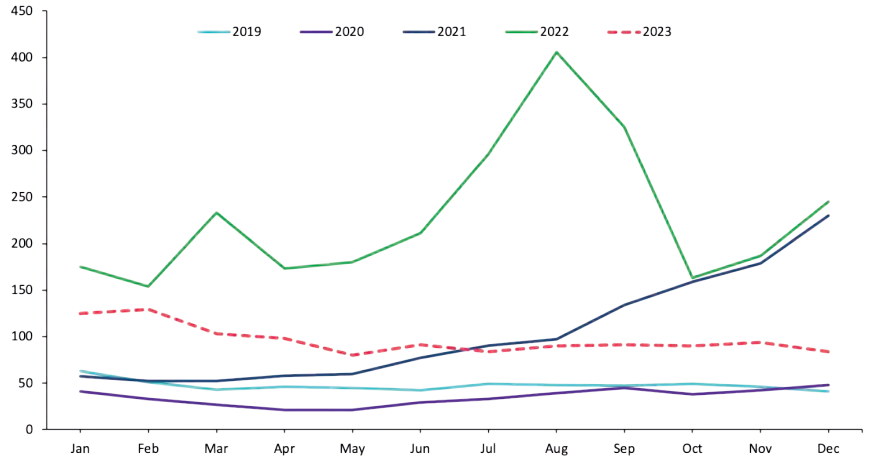

Figure 4. Monthly average power prices in major markets in the EU – €/MWh (Source: Rystad Energy research and analysis; Eurostat).

Despite Europe's ban on Russian coal imports, utilities in Turkey are continuing to import Russian volumes at heavily discounted prices, although inexpensive Colombian coal started undermining some of this in 2023. Cheap available thermal coal means that, while Turkey's overall coal consumption has been falling, hard coal imports have remained high as imported hard coal proved to be more economically viable for generation at this price point than domestically produced lignite. This in turn impacted Turkey's lignite production which was down 30% year-on-year in 2023.

At around 43 million t, Europe's imports of coking coal last year remained at similar levels to 2022. The bulk originated in the US and Australia which supplied around 15 million t each. Europe's coking coal imports are likely to remain stable in the medium future due to continuing demand from the steel industry.

Coal prices dip sharply for a brief period, mostly staying above US$100/t

With high levels of stockpiles for most of the year, the ARA 6000 kcal/kg NAR CIF benchmark price averaged approximately US$128/t in 2023, down from an average US$292/t in 2022. Although prices fell sharply at the end of 2022, they remained mostly range-bound at just over US$100/t for most of 2023 – although falling below US$100/t for a brief period over the European summer as demand dwindled to record lows. Nevertheless, European thermal coal prices remain significantly higher than prices in 2020, when the pandemic-related demand drop led to prices falling to around US$50/t (Figure 4).

Puerto Bolivar 6000 kcal/kg NAR FOB was sold at large discounts for much of 2023, as Colombian suppliers targeted increased sales to European utilities. The spread between the Richards Bay 6000 kcal/kg NAR prices and the ARA benchmark remained at similar levels for most of 2023, with the spread starting to widen (with ARA being at a premium) moving into 2024.

Subdued industrial output takes toll on thermal coal demand in 2023

Coal-for-power demand in Europe has fluctuated in recent years. The outbreak of the Russia-Ukraine conflict in early 2022 hit imports of Russian gas and coal, with Europe opting for alternative sources

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of supply. This increased demand for coal imports, pushing up NAR benchmark prices for ARA 6000 kcal coal over US$400/t at one point, compared to pre-conflict prices of around US$130/t. During 2022, maintenance outages at several hydropower and nuclear plants also meant Europe had no option but to ramp up fossil fuel generation, which, combined with the high coal and gas prices, pushed power prices through the roof. Many heavy industries had no choice but to pull back on their production to lower energy costs. This dampened industrial output continued during most of 2023 as well.

Subdued industrial output had a major impact on overall power demand in Europe. Net electricity demand in the EU totalled 2435 TWh in 2023, down 3% on 2022 levels, and its lowest level in almost 20 years. The return of French nuclear power plants after prolonged maintenance, higher output from wind, solar, and hydropower, coupled with higher-than-average temperatures, reduced demand for fossil fuels significantly. Coal and gas-fired generation were responsible for 28% of total generation in 2023, compared to 35% in 2022. Lower demand reduced coal and gas prices, with better gas fundamentals making coal-to-gas switching cost-effective again. Data shows gas-fired generation was higher in the EU for 10 out of 12 months in 2023, compared to six months in 2022 – thereby lowering coal-for-power demand for the year (Figure 5).

Europe back on track for a clear coal phase-out path

Moving into 2024, power demand in Europe is likely to recover slightly as industrial output revives itself amid a drop in power prices, an ease in inflation, and expectations of lower interest rates. Key power agreements made in France and Germany in November 2023 to reduce energy costs are also expected to play a role in this.

Rystad Energy expects this increase in power demand to be between 1 – 3% compared to 2023 levels. Although still lower than 'pre-energy crisis' levels, this would be a crucial step towards normalisation. Even though high growth in solar, wind, and a considerably stable output from nuclear and hydro seems to be the main theme for Europe in 2024, year-on-year coal and gas generation reduction is likely to slow down quite a bit compared to last year due to increased demand. At present, gas seems to be more cost-competitive out of the two, and this dynamic is likely to remain the same for the rest of the year. Hence, the reduction in coal generation is likely to surpass reduction in gas generation for this year.

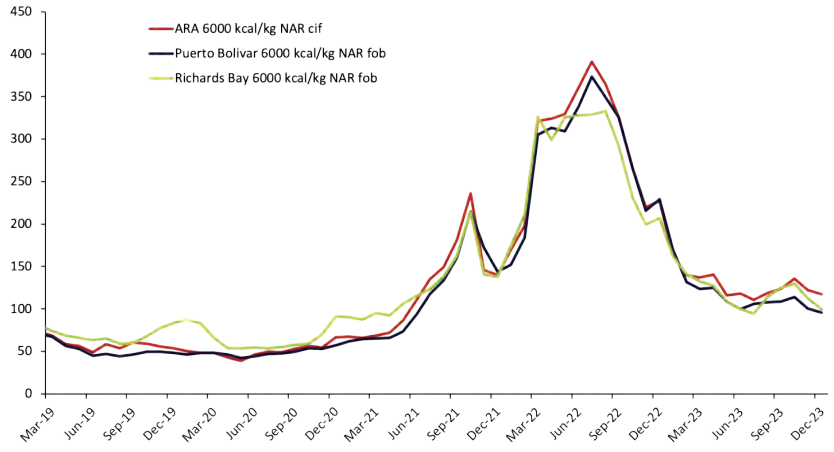

Figure 5. ARA vs Colombian vs South African benchmark coal prices (monthly averages) – US$/t (Source: Rystad Energy research and analysis; Argus).

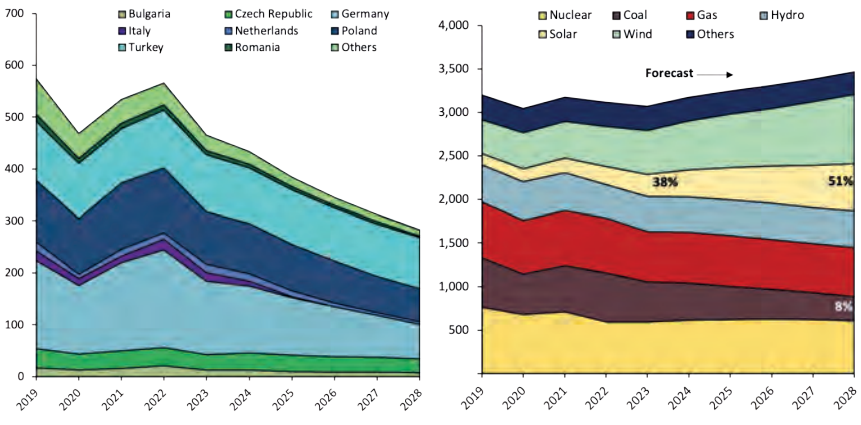

Figure 6. A) Coal-fired generation in EU, Turkey – TWh (Source: Rystad Energy research and analysis); B) Generation trends in EU, Turkey – TWh (Source: Rystad Energy research and analysis).

While major coal-consuming countries Turkey and Poland have yet to make any big strides on the energy transition front, Germany has shown steady progress (Figure 6). When the last three German nuclear plants were shut down in mid-2023, it was expected that Germany's lignite-fired power plants and newly added solar capacity would be the way forward to fill this gap. However, it turned out to be more cost-effective to import power from neighbours France and Denmark than run their underutilised coal fleet. This, combined with lower-than-expected solar output, turned a big-time power exporter like Germany into a power importer in 2023. Consequently, thermal coal consumption in the country was an estimated 23% lower than the previous year.

Moving forward, thermal coal demand in Germany is expected to be halved by 2028, with large solar PV capacities coming online at a rapid pace.

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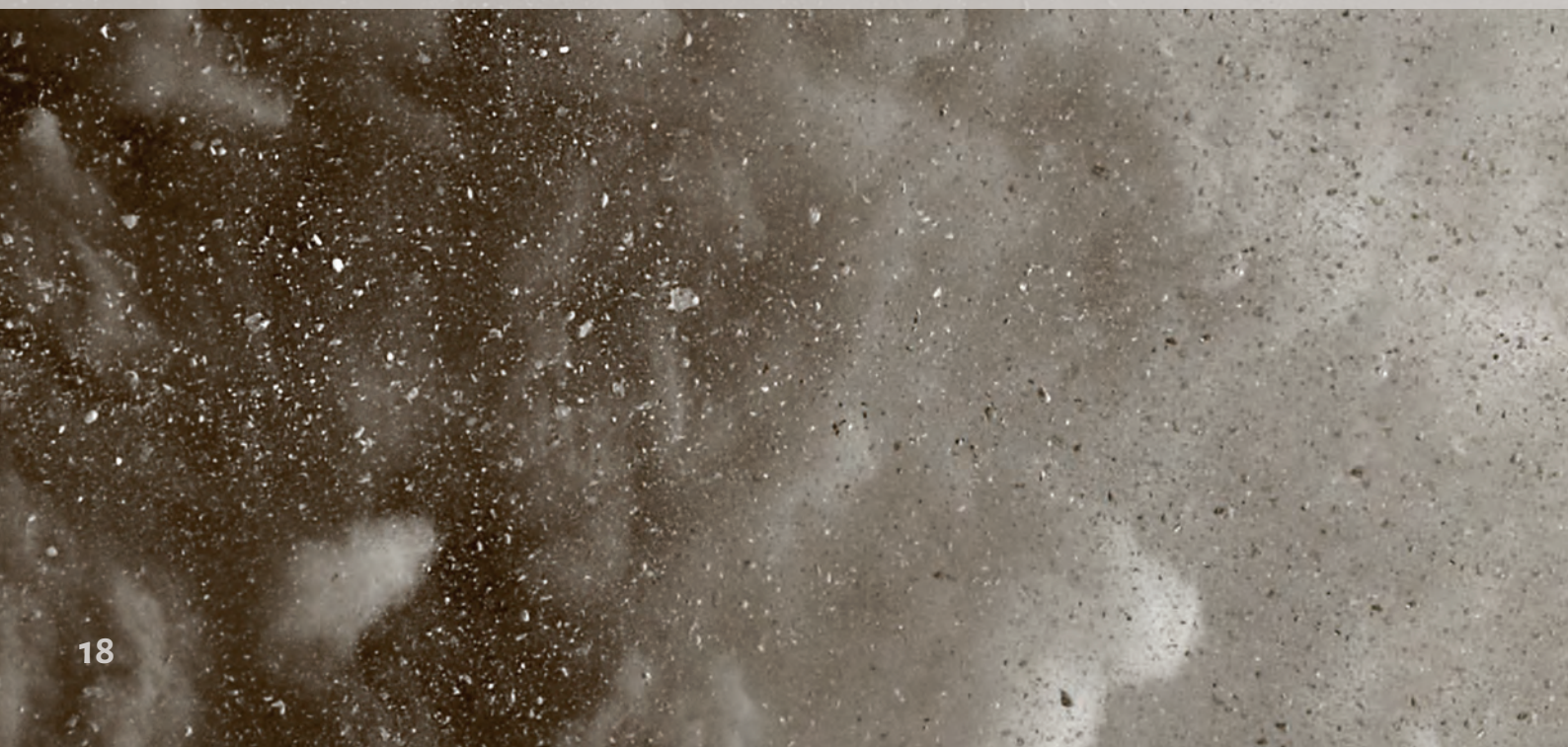


Mike Lewis and Michael Kelley, BossTek, USA, explain the power of atomised mist in controlling conveyor dust.

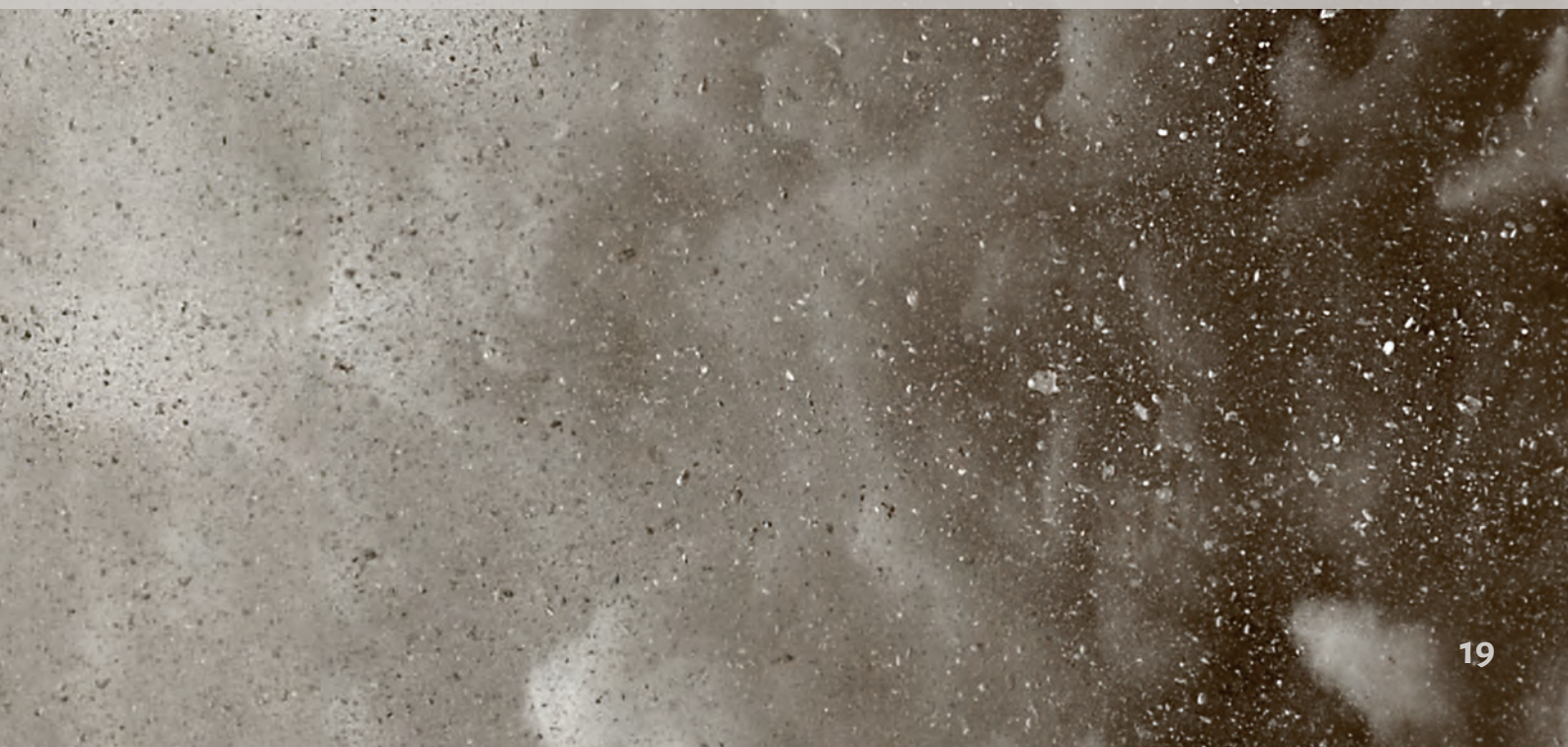
Carrying tonnes of coal per day and travelling at speeds measured in feet or metres per second, conveyors are present at all stages of the coal industry, including mining, transport, and power generation. Greater demands for increased production and efficiency result in faster conveyors carrying more cargo. One of the consequences of increased speeds and volumes is fugitive dust emissions.

Conveyor design plays a large role in suppressing dust, as does where and when control mechanisms are placed. Although the size and mass of the conveyed material play a big role, some types of fugitive emissions, such as respirable crystalline silica (RCS) found in high concentrations in coal, are more regulated than other particulates.

In addition to the health risks, dust has a significant impact on the cost of operation. Low air quality can reduce worker morale and productivity. Dust can clog rolling and mechanical components, increasing labour and downtime for cleanup and maintenance. Ultimately, excessive particulate emissions will result in workplace safety violations and potential fines if they are not addressed. This is why risk managers, compliance controllers, and environmental managers are turning to atomised mist as an affordable and versatile conveyor dust control solution.

How is conveyor dust generated?

Dust is generated by a conveyor in four ways: wind, disruption, transition, and impact. Wind on outdoor



conveyors can be mitigated with coverings, but not completely. Weather conditions are unpredictable, and for longer conveyors that are exposed to the elements, there are atomised mist solutions that treat the cargo prior to the long journey. Other conveyors that drop material from high places may require another, more mobile and versatile mist solution, such as a misting ring or cannon that adjusts to changing weather conditions.

Disruption happens along the conveyor path. Between idlers, the belt slumps slightly, then the trough angle realigns with every new roller. This action causes the cargo to shift and bounce along the belt path, producing dust emissions. Mist treated with surfactants administered at the loading zone can aid in reducing dust. Mistracking resulting in spillage can cause excessive dust and might require a cannon to control emissions until the mistracking issue is resolved.

Figure 1. Coal operations need versatile and mobile dust control options that allow them to adjust for changing conditions.

Figure 2. Upwind wide-area dust control can help operators reduce emissions by introducing millions of droplets.

Figure 3. A dust ring suppresses dust from the discharge point to the top of the pile.

Transition dust happens after the cargo is discharged from the conveyor. When the material encounters the head pulley, it either falls or clings to the belt. As it falls, material not contained by a drop chute separates, exposing the entire stream to ambient air currents. If not adequately cleaned by a scraper, leftover dust and fines in the belt's cracks and divots ('carryback') drop along the return belt path, creating emissions that fill the air and pile under the stringer. To restrict dust within the chute, misting heads can be strategically placed around the transfer chute. Moreover, to control emissions from carryback, a small cannon pointed at the discharge area can suppress dust and improve workplace air quality.

Impact emits dust when the discharged material hits the side of the hopper or transfer chute, then happens again when it lands in a vessel, on a pile, or onto another moving conveyor. Depending on the drop height, weight, density, moisture content, and the conditions of the landing zone (the speed of the receiving conveyor, etc.), material impact causes turbulence and shifting that lead to airborne emissions. Mist technology can be added to the dust management plan in nearly every bulk handling operation.

Different conveyors, different dust solutions

Although there is a range of conveyor designs that can be used in any operation, the most common conveyors used in coal mining and handling are standard conveyors, stacker conveyors, and tripper conveyors.

Standard conveyors are static units that receive material, allow it to settle as it moves through an enclosure (settling zone), and then move at high speeds to another point where it is discharged. There are two good points to address dust: at the point of discharge or in the settling zone. At the point of discharge, misting heads can spray water or a water/surfactant formula onto the discharge stream. In the settling zone, misting heads offer surface suppression on cargo before it leaves the enclosure. The damp layer on the top of the cargo mitigates emissions while travelling along the conveyor path.

Stacker conveyors are tall, inclined belts that can be mobile or static, which receive cargo, move it to a height, then drop it into a vessel or onto a pile. The discharge of material is generally long and uncontrolled, so sock chutes and misting rings are often used to direct the material to the endpoint with minimal emissions. Stacker conveyors are rarely equipped with elaborate belt cleaning systems, so fugitive dust from carryback is common. Due to the height of the discharge, the emissions can travel long distances, so mobile cannons that can be

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adjusted for wind conditions are recommended for these conveyors.

Tripper conveyors are constantly moving horizontally on a track system, distributing material evenly across a designated area. Tripper conveyors are commonly found in massive enclosures, where indoor air quality can become a potential violation. An elaborate return belting system using several pulleys can contribute to dust from carryback. Strategically-placed mist cannons for wide-area suppression are recommended for these conveyors.

Conveyor air quality regulations

Testing and experience have shown that atomised mist is one of the best controls of airborne RCS in bulk handling settings. RCS is highly regulated across industries because of its association with chronic and deadly diseases like silicosis, pneumoconiosis, and COPD. This is due in part to the small size and crystalline particle shape, which damages lungs. Silicon dioxide is formed into a crystalline structure over millions of years. 30% of all minerals are silicates (minerals containing silica), and geologists estimate that they could comprise up to 90% of the Earth's crust.[1]

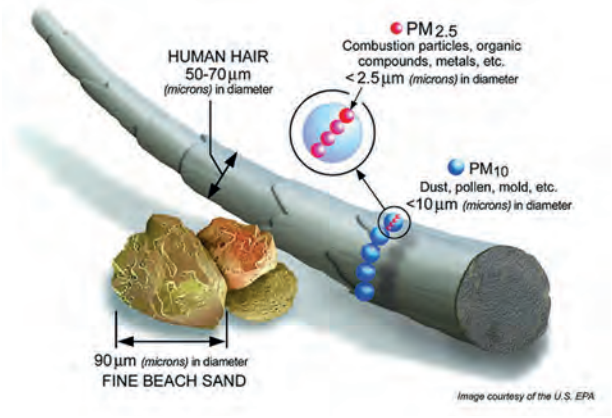

Figure 4. Although the air looks clean, invisible particulates <100 µm are the most hazardous.

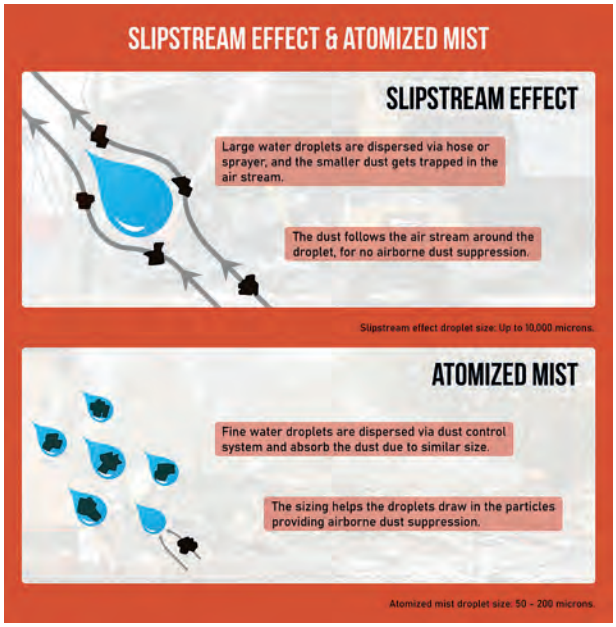

Figure 5. In some cases, the slipstream can lift small particulates, propelling them further.

Dust size is measured by diameter in microns (µm) and volume in micrograms (µg) using personal detection devices. Lightweight particulate matter (PM) as large as 200 µm can remain airborne on ambient air currents, and it is no longer visible to the naked eye under 100 µm. RCS can be the microscopic size of <PM_{10}, meaning the particles avoid the body's natural defences and penetrate deep into the lungs (Figure 4).

The Occupational Safety and Health Administration (OSHA) Final Rule for RCS dust emissions in the bulk handling industries sets a personal exposure limit (PEL) of 10 µg (stated as parts per million [ppm]) over a time weighted average (TWA) of 8 hours.[2] For perspective, a single grain of salt is approximately 58 ug. The TWA compensates for workers moving in and out of different concentrations of RCS throughout a shift, but exposure over that period should be limited.

The OSHA Final Rule suggests that dust control methods are generic, mostly involving surface suppression, ventilation, and the use of chemical surfactants. Regulators are testing for minuscule concentrations in the air, therefore 100% prevention is the goal, but in most high-volume industrial bulk handling environments this is not possible.

Why is atomised mist effective for conveyors?

Research has shown that droplet sizes need to be roughly the same size as the airborne particulates to be effective. Water remains the sole medium for control of airborne outdoor emissions. Hoses and sprinklers create droplets between 200 µm and 1000 µm compared to atomised mist, which is sized in the range of 15 – 200 µm. Droplet sizes greater than 200 µm are only adequate for wetting surfaces, but do not offer airborne dust suppression. This is due to the slipstream effect (Figure 5).

Atomised mist is effective because the fine engineered mist is distributed using a powerful fan-driven cannon design or strategically-placed misting bar or ring. Nucleating nozzles fracture pressurised water into millions of tiny droplets, preferably applied at the point of emission. As a large droplet moves through the air, the mass creates a strong current that moves around it called the slipstream effect. Particles get caught in the slipstream and remain unaffected. In some cases, the droplet can even lift the smallest particles, making the issue worse. Atomised droplets, on the other hand, travel with the particles, collide with them, and drag them to the ground.

The tiny droplets also raise the humidity of the target area, floating on atmospheric air currents with dust and capturing particles. Settling droplets provide surface suppression evenly across the material using less water

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than hoses and sprinklers, drastically lowering the volume of runoff and reducing the chance of pooling.

Dosing surfactants for conveyor dust control

Surfactants are a category of chemical additive that can be distributed by dust cannon or atomised misting system, particularly helpful for the suppression of dust emitted by naturally hydrophobic materials (shale, coal, etc.). Materials are hydrophobic when the interaction between the water molecule and the material is negative, causing the water molecules to bond to themselves rather than the material. This creates beaded droplets that roll off the surface rather than wetting it, similar to on a water-resistant fabric. Surfactants promote ionic bonds that spread the droplet across the material, allowing hydrophobic materials to cling and cake.

This is particularly beneficial during transport and transfer of dusty cargo. When surfactants are dosed into water prior to applying it to the material, the chemical is evenly distributed, so dust particles stay within the cargo stream rather than becoming airborne. Dosing pumps allow operators to control the concentration of additives.

Figure 6. Misting heads differ from spray bars, in that a large number of nozzles can be mounted at various angles for better coverage.

Figure 7. Smaller cannons can be mounted in loading and discharge zones to improve workplace air quality.

Misting equipment for conveyors

Mist cannons use a high-powered fan at the back of a cone-shaped barrel. Mounted on the front (exit side) of the barrel is a ring manifold with multiple nozzles that fracture pressurised water into atomised droplets. Air is forced through the barrel to propel millions of these minuscule droplets into the air. Misting heads use water pressure to fracture the water with similar nozzles and spray the fine mist with precision in a limited space.

- Misting heads: Discharged material at conveyor transfer points will separate, offering an excellent opportunity to introduce moisture from strategically-placed misting heads. This option can be accompanied by a dosing system to introduce dust-suppressing surfactants to mitigate downstream dust emissions.
- Misting rings: Material that is discharged from a conveyor and not contained in a transfer chute is exposed to ambient air currents. By using a stainless-steel ring, the material flow is surrounded by a curtain of light mist that falls with the material, preventing fugitive emissions from escaping.
- Compact mist cannons: These are mounted on two wheels with a tall handle, similar in size to a snow blower. They are light and easy to manoeuvre, while still offering industrial-sized dust control up to 30 ft (10 m) at a 20° throw angle.
- Mid-sized cannons: Often mounted in high points above material in coal barns, cement domes, and other large indoor facilities that utilise conveyors, these cannons have a reach of 100 ft (30 m) and a coverage area of up to 31 000 ft^2 (2880 m^2) when equipped with oscillation.
- Large misting cannons: Popular with storage facilities that need a mobile solution to move with wind and pile rotation, these oscillating cannons have a 200 ft (60 m) throw distance and cover up to 125 000 ft^2 (11 612 m^2).

Preventing conveyor dust

When conveyor dust is emitted, it does not stay contained within the immediate area, but can spread across the operation and past the site line into neighbouring properties. Community complaints about dust emissions from normal conveyor operations can force inspections, violations, fines, and sometimes forced downtime until the problem is adequately addressed. WC

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DON'T SKIRT AROUND SAFETY

R. Todd Swinderman, Martin Engineering, USA, outlines the optimum belt conveyor skirtboard configurations for preventing dust and spillage.

Belt conveyors without an enclosure at the transfer point loading zone may still exist in some operations, but are becoming a thing of the past due to dust violations and excessive spillage. Whether the transfer chute is a dead drop, rock box design, or sloped design, dust and spillage from dry bulk material will still exist and must be controlled. Spillage can limit access to a system for maintenance, foul rolling components, add to labour costs for cleanup, and reduce workplace safety.

A skirtboard on either side of the conveyor belt that is sealed with a cover certainly helps, but operators have found that the air turbulence from loading still causes fugitive dust to escape if a wear liner and skirting is not applied. Moreover, there are nuanced details conveyor engineers should consider when designing a conveyor transfer point.

While controlling belt wear and the release of fugitive materials, all components of a skirtboard system must work together to contain the load as it forms a stable profile in the centre of the belt.

Figure 1. This an example of a fabricated curved skirtboard, which is hard to maintain when replacing wear liners and skirting.

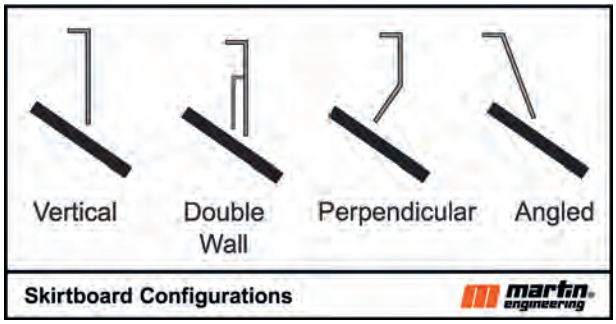


Figure 2. Unique skirtboard designs may limit wearliner and skirting options.

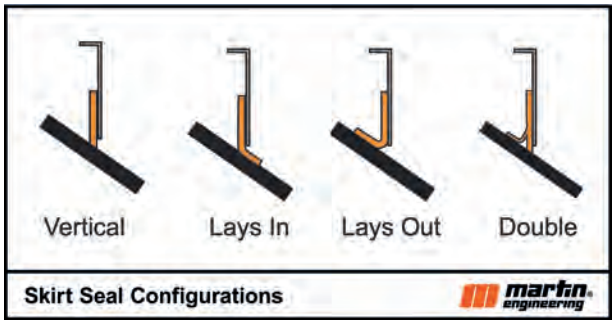


Figure 3. In some applications, skirting designs can entrap material, causing belt damage.

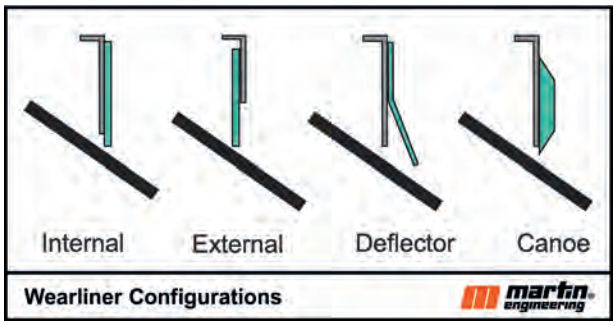


Figure 4. External wearliners allow maintenance from outside the system, improving safety.

Several skirtboard system design approaches can be used based on industry historical practice and the application. This article covers some of the common approaches bulk handlers use to mitigate dust and spillage and ensure a safe and compliant workplace with a lower cost of operation.

Configuring the skirtboard

By far the most common configuration is the vertical skirtboard. It is the easiest to fabricate and is a common detail for most engineering design firms (Figure 2). The height of the skirtboard is based on the sealing system components and is usually at least 300 mm high. The double wall skirtboard is sometimes used with dust extraction for very fine free flowing materials.

Perpendicular and angled configurations are used in some industries. Angled skirtboards are designed to allow the load to centre, while perpendicular skirtboards relieve side pressure on the skirtboard seal. In theory, the perpendicular arrangement should allow for light seal contact, but, in reality, the angle of attack of the seal is not nearly as important as having a running flat belt surface for the seal and liner system to function best.

Skirt sealing configurations

A vertical seal with a rubber or elastomeric material is the most common sealing system (Figure 3). The seal is held in place with a series of clamps which can be loosened to adjust the seal against the belt. The main drawback to the vertical seal is that an undulating or vibrating belt can break the sealing contact unless the belt is supported. The lay-in and lay-out seals are self-adjusting, depending on the elastic nature of the sealing material. The double skirting configuration is the most effective in retaining a belt seal. Even if the belt profile fluctuates, the secondary seal rides softly on the belt, retaining the seal. Any material that gets in between the double seal strips is non-abrasive, being carried by the belt, and rolls back to the centre once the skirtboard ends.

It is a common belief that the seal material must be softer than the belt, but the real property of concern is the abrasion resistance of the seal, which should be less than the belt top cover. The seal should be considered sacrificial and designed for easy adjustment and replacement without the need for excessive sealing pressure. Over adjustment can cause excessive friction heat of the seal, leading to heat damage on the belt, as well as premature wear of the skirting. In extreme cases, the heat generated can cause the seal to stick to the belt during shut down, which can prevent startup.

The sealing pressure should be light, with the skirtboard or the liners designed to reduce pressure on the seal. There is not much information published on seal pressure values. For the self-adjusting seals, a 15 kPa contact pressure should be used. CEMA proposes added belt tension of about 4 kN/m per side without considering the seal thickness.

Wearliner configurations

The wearliner has two functions. The first is to be a sacrificial wear material protecting the skirtboard wall, and the second is to reduce the side pressure on the sealing system. Not all systems require a liner. The most common liner is the internal liner made of abrasion resistant material, such as AR plate or ceramic blocks. The liner is often attached with bolts through the skirtboard, with some ability to adjust the space between the bottom and the belt for initial installation and to adjust for wear (Figure 4).

The deflector liner is a variation of the internal liner that is used to centre the load and reduce side pressure on the seal. The canoe liner performs a similar centring effect, with a substantial volume of wear material and is often used in heavy duty applications like hard rock mining. Canoe liners can be made from elastomeric materials or very hard cast metals.

The most important details for a liner are proper installation and ease of replacement. The external liner was developed to address these two issues. With the external liner, the skirtboard is raised above the expected depth of material rubbing against it and the liner is attached to the outer surface of the skirtboard. If there is concern over wear caused by full contact with the skirtboards, such as from constant overloading and plugging, the exposed upper portion of the skirtboard can be covered in wear-resistant material. The external design eliminates the gap between the liner and the seal, created by the skirtboard wall thickness, that can trap materials and damage the belt.

Skirtboard cover configurations

Covers protect the cargo from weather, but are used primarily for dust control. Covers enclose the loading zone and contain splashing material caused by significant drop distances from one belt to the other or process equipment such as rotary crushers. The most common cover is the rigid flat cover made from steel. When rain protection or buildup of fugitive materials is a concern, angled or semi-circular covers are often used (Figure 5).

Plastic covers are sometimes used to reduce weight. Regardless of the cover design, the most critical design feature is ease of access. When there is a lot of positive pressure in the enclosure, sealing the covers becomes an issue. Porous covers are sometimes used to reduce positive pressure, but the most common membrane applications are rubberised fabric with continuous grip edges that can connect between vibrating equipment – such as screens and the skirtboard enclosure.

Unfortunately, in the rush to get back into production, covers are removed during cleaning or maintenance and are often not replaced in those areas that require frequent access. Maintaining the integrity of the covers is critical to the control of fugitive material. If it is possible that covers will be walked upon,

load bearing work platforms should be incorporated into the design.

Skirtboard design and installation

Skirtboards are most often installed vertically and parallel to the centreline of the belt. Misalignment of the skirt board system will contribute to pushing the belt to one side and can cause mistracking. Skirtboards for multiple load points, when it is not desirable to have continuous skirting, are often staggered widths with inlet deflectors to consolidate the material at the edges. For continuously skirted loading with multiple loading points, the feeds can be managed to gradually increase until the full cross-sectional area is utilised. Reversing belts must use skirtboards parallel to the belt (Figure 6).

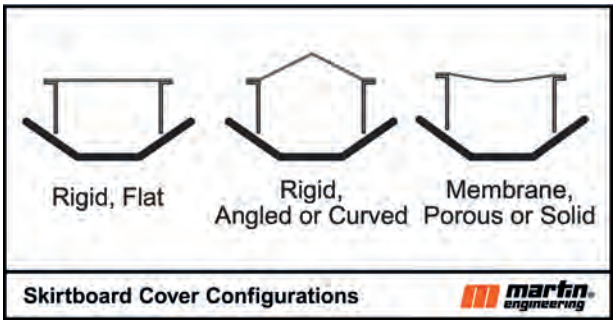


Figure 5. The skirtboard cover is specific to the needs of the application and operating environment.

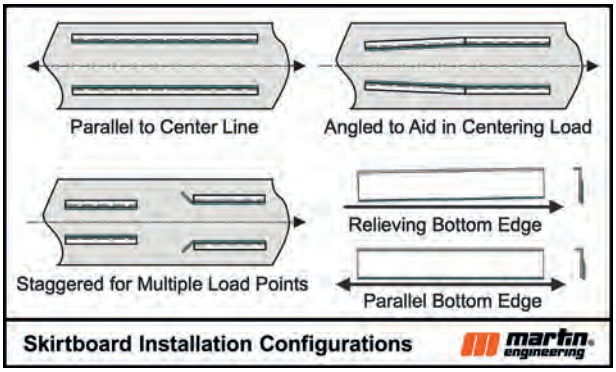


Figure 6. Skirtboard design should have maintenance safety as the priority.

Figure 7. The raised skirtboard allows room for the external wearliner to perform its function and be changed easily from outside the system.

In some cases, such as flat belt feeders, it is desirable to create a relief of the skirtboards in the direction of travel to help more uniformly feed the material from a bin. A wider notch opening in the direction of belt travel can be designed using mass flow techniques. If the notch (or 'V' design) is absent, the material will tend to feed only from the rear, which can result in segregation or bin plugging. Using this technique on troughed belts adds to the fabrication complexity, so there is often a transition section from the bin to the skirtboards that accomplishes the same end result, but simplifies the design and installation of the skirtboards.

The distance between the bottom edge of the skirtboard or wearliner and the belt surface often varies by industry. Some designers keep the skirtboard high off the belt to facilitate idler changes, but a better solution is to use retractable idlers. Installing the liner parallel to the belt is required for reversing belts. The primary issue is the flatness of the belt in the loading area. To achieve a good seal without damaging the belt's surface, the belt must be supported.

Industries that use winged tail pulleys, load on the transition from flat to fully troughed, or use widely spaced idlers in the load zone will have a difficult time sealing the belt and preventing grooves made under the seal. If the transition is incorrectly designed, the belt can lift off the idler when unloaded, requiring the liner to be too far above the belt and resulting in spillage and/or trapped material. Winged pulleys should be in a spiral design or wrapped to reduce dust pumping vibration. Common practice is to place the wearliner bottom edge parallel, but close to the belt, with approximately 25 mm of clearance for the skirtboard upright from the belt. The liner is then adjusted to be closer to the belt in the range of 10 – 20 mm and self-relieving in the direction of travel. Adjustment of the liner so that there is a smooth surface presented to the belt without steps or gaps between liner sections is a must, in order to prevent particles from being trapped and abrading the belt.

Conclusion

Each approach is unique to the application and the bulk handling environment, but preventing dust and spillage makes the cost of the modifications easy to justify over the long run. Consider installing an enclosed modular loading chute with an external wear liner and double skirting, and make sure that the skirtboard and cover are long enough that turbulent air can slow and dust can settle back into the cargo stream.

The modular design makes the chute able to be easily adjusted to changes in production, belt speed, or material, and the seal and wear liner are adaptable to those changes. This lowers the cost of future modifications and improves the overall safety of the transfer point through the life of the conveyor. WC

OPTIMUM MONITORING

Bernd Küsel, CBG, Germany, considers the reasons for conveyor belt defects and the best monitoring method to avoid damage.

Economical extraction of coal and other minerals such as copper, iron ore, bauxite, or limestone, which are mined on a large scale in opencast mines, is unimaginable without steel cord conveyor belts. Other methods, such as discontinuous transport by truck, are more expensive, less reliable, and more detrimental to the environment.

A rough estimate puts the number of steel cord conveyor belts installed worldwide at around 100 000 km. Large lignite mines, such as RWE's in Germany, have 500 km of conveyor belts in use, which are up to 3200 mm wide. The longest conveyor belt system has a length of 100 km and is used in North Africa for phosphate rock transportation.

The strongest belt is an ST10000, which has a minimum breaking strength of 10 000 newtons per millimetre of belt width and is used to convey copper ore in Chile. Steel cable conveyor belts are being used in more and more areas, for example to overcome even the most difficult terrain by increasing their ability to negotiate curves.

Depending on operational stress, product quality, and extent of maintenance, steel cord belts last between a few months and several decades.

Possible defects and their origin

Conveyor belts are the most expensive system component. Nevertheless, they are often neglected.

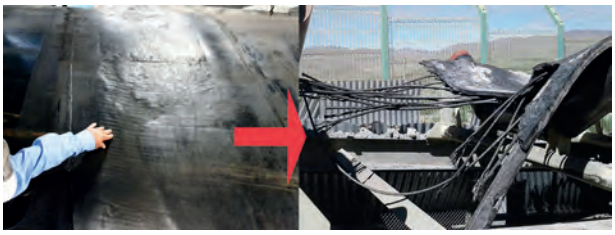


Figure 1. Steel cables are pulled out of the splice and result in belt breakage.

Figure 2. Visually undetectable rope corrosion in the conveyor belt.

Figure 3. Cover damage that allows moisture to reach the cables.

Figure 4. CBGuard all-in-one scanner.

In contrast to motors, gearboxes, and idlers, the opinion often seems to prevail that conveyor belts can withstand all influences in the long term, but this is a fallacy.

It must be remembered that a single critical fault within the conveyor belt that occurs anywhere along the kilometre-long route will result in the failure of the entire conveyor belt. Anyone can imagine what happens if a fully loaded belt breaks at a speed of 25 km/h. The result is not only smashed and damaged system components (including the belt itself), but also loss of production. Such disasters can easily cost tens of millions of US dollars.

How is it possible for conveyor belts that have 'looked good' for years to suddenly end up in total failure?

One of the most difficult tasks in the manufacture of conveyor belts is to achieve permanent adhesion between the steel ropes and the rubber. The correct compound composition, vulcanising pressure, heating time, steel cord construction, bonding system, and other factors are very important.

However, the ropes themselves are also subject to increasing embrittlement due to multi-axial tension conditions and temperature influences, which lead to a gradual loss of breaking strength. Conveyor belt ropes consist of dozens of wires. Often, wires or strands are initially severed, before entire cables. Due to numerous dynamic influences (e.g. flexing, friction, pressure, etc.), this damage continues and eventually leads to rope breakage. Broken cables can work their way out of the belt due to flexing, jam on a part of the system, and lead to conveyor belt ripping.

The cables are more or less well rubberised depending on the quality and construction of the belt. If cables are not fully rubberised – i.e. if the core rubber has not reached the inside of the cable or has crumbled there – capillary effects can occur. If the belt is damaged, moisture will enter and propagate in the cables, like in a straw. This can lead to corrosion of the cables at points that are far away from the damaged area.

Another example are poorly adjusted chute transitions in the feed area, which can lead to grooves along the entire length of the conveyor belt. These grooves, which are just a few millimetres or centimetres wide, can ruin the entire belt.

Inevitable ageing changes the mechanical properties of the rubber and the suitability of the conveyor belts is continually reduced. Molecularly irreversible physical and chemical processes eventually lead to small cracks and/or other types of progression.

Furthermore, the operating conditions may have changed over time. Idlers may no longer run as smoothly or are even blocked. There may also be overloads, faults in the gears or brakes, or wear in the drum lagging. Foreign objects – such as

structural parts, tools, or oversized material – can damage the belt.

Undetected defects will continue to worsen, and, along with the risk of belt failure, repairs become increasingly expensive. It is essential to endeavour to carry out repairs promptly.

Safety factors have been and continue to be minimised in the industry, in order to reduce the minimum breaking strength of the belts and thus decrease manufacturing and operating costs. This is perfectly acceptable if the conveyor belts are constantly monitored at the same time.

Belt splices – the weakest link

A belt is only as durable as its weakest link. Naturally, these are the splices, especially in terms of their dynamic performance.

In contrast to belt production, which takes place under optimum conditions, there are numerous risks involved in splice production, such as: incorrect vulcanising pressure, temperature or heating time, processing of rubber that is no longer fresh, incorrect dimensions, cable laying errors, dirt, and moisture.

Faults made during splicing are rarely recognisable from the outside. They usually only become apparent after a long period of operation. The cables in the splice slowly pull out due to the loss of adhesion. In the splice, all cables are subjected to different loads, whether due to the splicing scheme itself, or troughing movements, pulley rotation, and load impact. The ropes neighbouring the weakest, dislocated rope group have to take on more tensile forces, which leads to an acceleration of the loss of adhesion of these ropes. At some point, a zipper effect occurs and the splice fails completely and breaks.

Maintenance is necessary

A common inspection method is a plant walk-through. This involves one or more people walking the conveyor and trying to detect faults. In the best-case scenario, this inspection method will detect gross external damage. However, it is impossible to detect internal defects such as corroded, dislocated, or damaged ropes. Broken cables in particular – which often occur when a stone or something similar has been trapped between the conveyor belt and a pulley – cannot be detected because the very different stretching behaviour of the cover rubber and the ropes damages the ropes, but not the rubber, which returns to its original shape after overstretching. After all, there are surface pressures of several newtons per square millimetre that are required to drive the belt by means of frictional locking.

Similarly unreliable are surface scanners (e.g. line lasers), which hardly detect any more damage. This is also a cost-intensive method because no material can be conveyed during the inspection.

Monitoring systems based on magnetic resonance are too coarse and require complex analysis. They are unsuitable for the early detection of defects.

The solution

It is obvious that long and important conveyor belts need to be permanently monitored in real time.

Serious monitoring of steel cord conveyor belts is only possible with radiological systems. Only X-ray images provide clear details for recognising damage, even in its early stages. Only on the basis of precise data can remedial action be taken in good time.

The CBGuard Life Extender, an all-in-one monitoring system, provides this analysis. It detects all types of belt defects in real time and flags them automatically. The AI-supported software uses the latest face and palm algorithms and utilises experience from hundreds of mining applications.

If there are serious defects, the operator's personnel are automatically informed by text message. This is in addition to the warning messages on the scanner and the monitor in the operator's control room. In the event of threatening faults, e.g. if a splice is about to break or a belt is being slit, the conveyor system's motor is automatically switched off. Furthermore, it is possible to estimate the remaining service life of the conveyor belts and thus ensure that new belts are procured in good time. The belt operator can call up a complete inspection report or a video of the entire belt or selected areas at any time. All defects with their exact position and the exact damage pattern, as well as the recommended remedy, are shown.

The CBGuard scanner can be retrofitted to any conveyor system. It is very compact and virtually maintenance-free. Manipulation of the belt, such as the installation of magnets or transponders, is not necessary. The system does not contain any radioactive material; its function is similar to such devices at airports and hospitals, and it complies with international regulations.

In many coal-producing countries – such as India, Germany, Greece, Poland, Turkey, Australia, and Thailand – used conveyor belts with worn rubber covers are often reconditioned. This means that the worn covers are milled off, covered with unvulcanised cover and then vulcanised in a press. This is only economical if the belt carcass is completely intact. The CBGuard scanner recognises such belt segments and enables fast and reliable selection.

Conclusion

The dangers for steel cord conveyor belts are manifold. Normal ageing, manufacturing defects, overloading, or damage, can lead to a catastrophic situation for the mine at any time. This must be avoided at all costs. The only reliable inspection method with accurate results is stationary radiological monitoring. WC

MAKING SECONDARY CLEANING A PRIMARY OBJECTIVE

Brian David, Flexco, USA, analyses the underrated power of secondary belt cleaning in boosting operational safety and cutting costs.

It only makes sense that the precleaner, or primary belt cleaner, receives most of the attention in the world of conveyor belt cleaners.

After all, they keep the most visible area of the belt conveying process clean and allow for the bulk of material flow to make it to the next section of the belt conveying process, often eliminating up to 70% of carryback directly at the source.

However, this begs the question: what about the rest of the carryback that is stuck to the belt?

Yes, there is no denying that a primary belt cleaner is a great first step. In fact, installing a primary cleaner to a conveyor system that currently has no belt cleaning process probably provides more value than any other solution could. However, this should not be the only belt cleaning measure taken by heavy-duty material conveying facilities. Of course, there are excellent solutions available outside of primary cleaners, with products such as wash boxes and brush cleaners, but those are often application-specific.

For another major value-added solution, coal facilities, among other heavy-duty industries, should consider utilising an additional useful tool: the secondary belt cleaner.

What is a secondary belt cleaner?

After material is dispensed at the head pulley, there is often excess build-up that sticks to the belt and continues to flow through the belt conveying system. Generally speaking, this unwanted residue is referred to as 'carryback'.

On the surface, carryback does not seem to be such a big problem, but there are huge long-term consequences, especially if steps are not taken to eliminate it from continually being conveyed through the underside of the system. From production loss, belt damage, safety concerns, and even major financial implications, carryback wreaks major havoc.

Figure 1. Secondary belt cleaners help to eliminate carryback.

Figure 2. Over time, a belt that has been maintained with a secondary cleaner will last longer.

The best way to combat the negative effects of carryback for a heavy-duty belt conveying system is to implement secondary belt cleaners.

Located either at six o'clock of or just beyond the head pulley and potentially at other areas down the return side of the belt, the secondary belt cleaner removes excess material on the belt that was missed by the primary cleaner.

When site managers combine both primary and secondary cleaners, they can see an immediate impact. Most cleaning systems estimate that this combination removes over 90% of carryback, vastly improving cleaning efficiency.

Major benefits of secondary belt cleaners

There is no doubt that installing secondary belt cleaners provides an overwhelming amount of benefit to heavy-duty material conveying facilities. Whether a site is looking to cut costs on production, limit the likelihood of receiving fines, or create a safer overall environment, a great first (rather, secondary) step would be to consider a secondary belt cleaner.

Negating product loss

Material that is not properly conveyed at the head pulley is material that a site cannot use, and therefore cannot make money off of. A secondary cleaner helps to ensure that material is being disposed of at the right point and time of the belt conveying process, allowing users to get a real hold of their production.

As mentioned previously, the combination of primary and secondary cleaners can reduce over 90% of carryback for belt conveyors. This is a product that would once be rendered useless or become a general nuisance, but is now able to perform its intended function.

Extending belt life

Over time, the buildup of carryback material on conveyor belts takes a real toll on the long-term performance of both the belt conveyor system and the belt itself.

The abrasive nature of coal and other heavy-duty materials creates an imprint on the belt, rubbing away at the surface layer. If material is constantly stuck to the belt, ends up as carryback underneath, and is left untreated, sites often see a rapid deterioration of the belt itself.

A belt that is worn down due to dragging through untreated carryback will eventually lead to real downtime. Sites will find themselves having to make new investments in belts that they did not anticipate having to make for much longer down the line.

Furthermore, the belt conveyor system itself is at risk of damage. Often, a damaged belt can mistrack, leading to a disproportionate workload on one side of the system. If mistracking is severe enough that the belt contacts the structure, the structure itself can become impaired, leading to serious downtime and catastrophic failure.

Increasing site safety

By keeping a clean belt, sites are less likely to have to perform unnecessary and repetitive repairs. A properly installed system of secondary belt cleaners keeps maintenance teams from having to be deployed, minimising the risk of putting a worker in a potentially harmful and often challenging work environment.

As an added bonus, the time saved from having a well-run and maintained secondary belt cleaning system can be used to perform other pressing tasks for preventative maintenance around the facility, further staving off downtime.

Additionally, secondary belt cleaners keep carryback from being unintentionally disposed of later in the conveying process. Often, this carryback material can fall from an elevated position that is over a worker's walkway and could strike them as they are underneath the platform. This can even pose a a tripping hazard. A secondary belt cleaner can help prevent this from happening, limiting the probability of a potential workplace safety incident.

Figure 3. Secondary belt cleaners keep workers safe from the spread of harmful carryback.

Reducing potential MSHA fines

The main concern of the Mining Safety & Health Administration (MSHA) has always been protecting the people that are working in one of the most physically demanding industries in the world. Every year, there is grumbling from insiders of the mining industry on rumours of what new regulations mining facilities can expect to be imposed on their processes. 2024 is no exception. This year, there is an anticipated massive shift in how MSHA will be handling silica dust containment.

Why silica dust?

From the residue that is visible on the sides of the common house fan to what is breathed in during a walk down the street, dust is everywhere, and is simply part of everyday life. The hazardous particles around the heavy-duty job site are what make it truly dangerous.

The material that is often conveyed at heavy-duty facilities, especially those working in coal, is susceptible to creating silica dust. Over time, exposure to silica dust can have a resounding impact on lung and respiratory health. In extreme cases, this can lead to cancer. Because of this harsh reality and that workers have to operate in such conditions every day, MSHA has made it a goal to limit the amount of dust that is allowed to be present.

Figure 4. Clean conveyor belts free up maintenance teams to work on other pressing site tasks.

Figure 5. Secondary belt cleaners help to stop the spread of dust, limiting MSHA fine possibilities.

Anticipated MSHA measures and fines

Although not official at the time of writing, there is a growing expectation that MSHA intends to implement new measures to limit the amount of silica dust that is present in heavy-duty facilities.

There are four key amendments set to be implemented in 2024 that will impact those in coal. Those amendments are focused on the following: Permissible Exposure Limit (PEL) and Action Level (AL), Methods of Compliance, Exposure Monitoring, and Corrective Actions.

In total, MSHA is trying to ensure that site managers know the acceptable amount of dust, and what steps must be taken to keep them in check. If correct measures are not taken to monitor and limit silica dust exposure, then MSHA will be issuing major fines.

The aforementioned amendments are only proposed and have not been finalised. Specific amendments should be announced later in 2024, so specifics should be confirmed as they become available.

How secondary cleaners can help

Dust is often created from a buildup of material that has not been properly cleaned or disposed of. As previously mentioned, adding a secondary cleaning method further limits the amount of carryback that is present on the belt as it rotates.

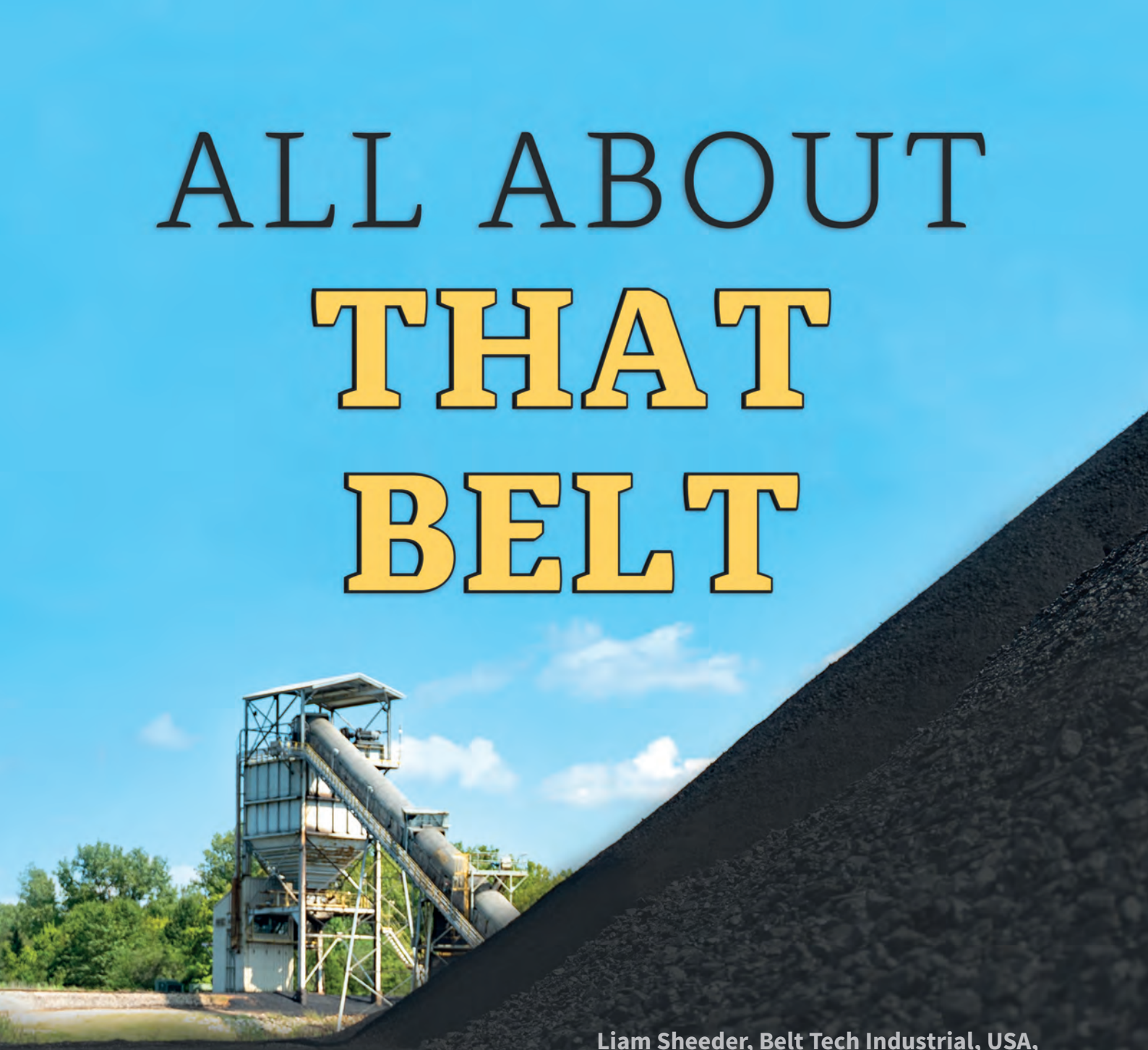
Not only do secondary cleaners cut back on the volume of dust that is created, but they help to keep the material in a designated section of the belt conveying process, containing the amount of loose sediment and dust that is otherwise spread to other areas.

Finding the right belt cleaner

A great next step to determine the need for secondary belt cleaners is to do a site walkthrough. By seeing how a belt is performing in real-time, users can identify key problem areas that are negatively impacting production and potentially putting workers in danger.

From that point, a site manager might consider having a conversation with their site maintenance team to see what processes they already have in place to keep their belts clean and performing up to standard. If the general consensus is that not enough is being done and that there is real product loss throughout the process, it might be a good idea to connect with a conveyor belt solutions company, or the site's conveyor components distribution network, to hear what options are available for their application. WC

ALL ABOUT THAT BELT



Liam Sheeder, Belt Tech Industrial, USA, discusses optimising conveyor belt selection by balancing durability, efficiency, and cost-effectiveness.

Conveyor belt technology has come a long way. This article looks at some key differences between straight warp and ply belts, how end users can make a choice that optimises production and profit, the power of keeping good records, and how making even small improvements can have big payoffs.

In every conveyor installation, there are certain applications where the normal expected belt life significantly deteriorates due to continuous abuse. This results in premature failure caused by a rip, tear, and carcass fracture. The ripple effect of a single belt failing could compound into a tsunami of lost production and financial implications that are not easy to recover from.

When this happens, managers may be tempted to either go with a heavier, thicker belt or to buy used belts and change them out more frequently, sacrificing them on the altar of 'the cost of doing business'. Unfortunately, if there are no records to indicate what has been tried in the past, mistakes will tend to be repeated, especially when management changes hands.

There is a time and a place for all kinds of solutions, but this article will examine the benefits of making an informed decision. In particular, it will consider the differences between straight warp or plain-weave ply belts, the pros and cons, and how operators can arm themselves with data.

Understanding the difference

What is the difference between a straight warp and ply belt? A ply belt, also known as a multi-ply belt, comprises multiple layers of synthetic fabric or polyester and nylon woven materials. These layers are bonded together with rubber to form a durable and flexible belt (see Figure 1). They offer good strength and are commonly used for general conveying applications in various industries.

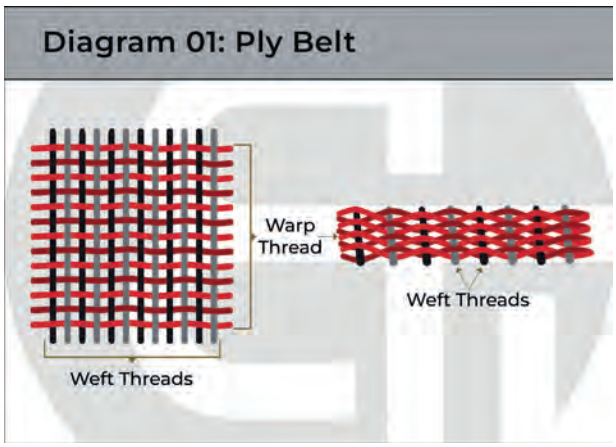


Figure 1. A ply belt carcass utilises a familiar woven pattern.

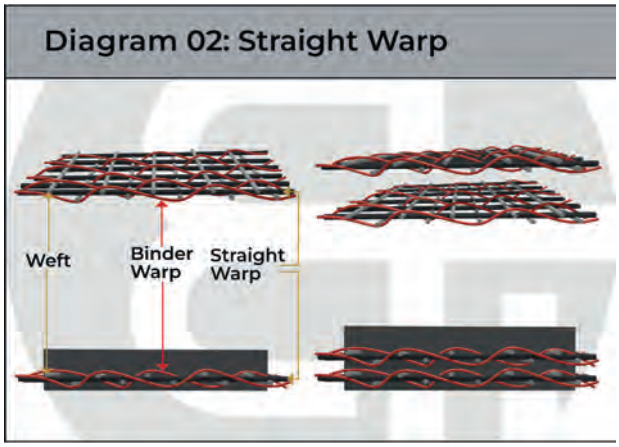


Figure 2. This unusual configuration is the key to a straight warp carcass strength, rip, and tear resistance.

Figure 3. Just like different articles of clothing are better suited to certain tasks, different kinds of belt are better suited to certain applications.

Straight warp belts typically consist of a single layer of longitudinal cords. The warp and the weft do not intertwine, instead they are joined with a binder warp (see Figure 2).

Straight warp can be imagined as a sort of rip-stop fabric. This kind of fabric incorporates reinforcement threads that are placed in a crosshatch pattern. Should a puncture occur, the reinforcement threads surrounding the damaged spot help to contain the tear, preventing it from going further. The same principle that makes rip-stop fabric effective, is at work with a straight warp belt.

A plain-weave ply belt has warp and weft yarns that are interwoven. This weaving crimps the yarn, weakening and stretching it to some extent. This does not mean it is weak, only that it loses some strength.

Therefore, does this mean that straight warp is always the best choice? Not necessarily. To take an example, boots and gloves have different strengths, but, ultimately, we need both. Coats and hardhats are constructed completely differently, but one is not better than the other, they both have their place. Further, if you try to wear boots on your hands or gloves on your feet it will make for a very interesting day's work (see Figure 3).

Similarly, it is always advantageous to choose the best belt for the need.

Ply belt and straight warp: Pros and cons

Complicated decisions can be simplified by looking at the pros and cons. Figures 4 and 5 present some for both ply belt and straight warp.

When adding up the differences, it becomes clear that there are uses for both kinds of belt. Furthermore, within this broad category of ply and straight warp there is a lot of variety. Therefore, beyond pros and cons, making the right choice involves three things: 1) Understanding the needs of each section of the conveyor system, 2) Keeping and consulting records to identify problem areas and what has worked or did not work in the past, and 3) Considering which conveyor belt will actually reduce the cost per tonne of operations, not which belt costs less up front.

Making an informed decision

Each section of a conveyor system experiences its own set of challenges. An underground section is going to experience higher humidity, dust, and potentially corrosive substances. Run-of-mine (ROM) belts might experience greater impacts, heavier loads, high volumes of coal, or longer runs. Feeder belts require frequent cleaning. Operators are in the best position to know what is working or not.

There are several factors to be considered when selecting a belt for any given section. Some that readily come to mind are considering the makeup of the material, the height of a drop zone, the trajectory of the material being loaded in relation to the direction of the conveyor, and so on. How long is the belt? The longer the belt, the less impacts per minute. In contrast, a shorter

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belt will experience far more impacts every minute and ultimately tends to wear out faster in the same way that certain parts of boots tend to wear out before others.

Further considerations include: the belt width, the maximum operating tension (both steady state condition and peak), the minimum number of plies required to support the load, and the maximum number of plies beyond which transverse flexibility is reduced and troughing efficiency is affected. What kind of splice will be used? A vulcanised splice will allow a belt to be operated closer to the belt rating than a mechanical splice.

If the details are recorded, a manager can make an informed decision. These are also questions that a belt supplier will be asking. Knowing the answers can help them provide the best guidance.

PLY BELTS	
PROS	**CONS**
Suitable for various industries and applications.	May have a lower tensile strength than a straight warp belt of similar weight.
They handle different materials and products well.	They tend to exhibit more stretch or elongation under load.
Generally, ply belts are more affordable compared to some specialized belt types.	In abrasive environments, they might wear out faster leading to a shorter lifespan in certain conditions.
If damaged, ply belts can be easier to repair or splice compared to some other belt types, reducing downtime during maintenance.	They may not provide the same level of impact resistance as specialized belts, potentially resulting in higher susceptibility to damage from impacts or sharp materials.
Widely available, come in various configurations and readily accessible for different conveyor setups.	While repairs are easier, ply belts might require more frequent maintenance compared to some specialized belts to maintain optimal performance.

Figure 4. Pros and cons for ply belt.

STRAIGHT WARP BELTS	
PROS	**CONS**
Excels at withstanding heavy impacts, making them suitable for applications involving sharp or abrasive materials.	Tends to be more expensive per foot, compared to ply belts.
Generally higher tensile strength than a ply belt of similar weight.	They might be less adaptable to handling a wide range of materials or products compared to more flexible belt types like ply belts.
Known for durability and longer lifespan, reducing the frequency of replacements and downtime for maintenance.	Optimized for specific heavy-duty applications, which may be overkill for general use.
Exhibits lower stretch or elongation under load.	Installation and maintenance might require specialized expertise and therefore a higher cost up front.
A thinner carcass, thinner belt, smaller drum size and less weight (5-20% less in some cases) can mean energy savings and improved efficiency.	

Figure 5. Pros and cons for straight warp.

Finally, performing a cost/benefit analysis can remove the haze of indecision by providing cold hard facts. It may reveal that a higher up-front investment will be worth it or it may show where funds could be better spent.

The power of small improvements

The real issue is not so much which kind of carcass or belt is good and which is bad; it is which is best for the situation. The only way to know this is to keep a record and really understand the system. It is important to standardise before being able to optimise.

For example, when reviewing records, an operator may notice that one conveyor is consistently having issues with rips or tears, and records indicate that a used belt has been installed in the past. The operator has looked at the impact zone and a complete redesign is not practical or economically feasible. It is also evident that it is a shorter conveyor and is receiving consistent and continuous impacts.

Bearing this in mind, the operator runs the numbers, considering more than just the 'cost per foot' of the belt. Instead, they consider which option is going to actually reduce their operating 'cost per tonne'. The numbers indicate that one slightly more expensive belt is more cost-effective than multiple belt changes.

Even the simple act of recording observations is powerful. If there is a change in management, those records can ensure that an operation continues to make consistent improvements, no matter how small they are.

Conclusion

There is not one kind of belt or belt carcass that is best in every situation. It is important to understand some of the key differences and to consult with a belt supplier to discuss specific needs.

Choosing the most expensive option is not always necessary. A small, well-planned, specific improvement may provide a bigger payoff than major changes or repairs that spring from emergency situations.

Optimising conveyor systems does not result from one grand effort. Like the single grains making up a stock pile, small consistent improvements turn into huge payoffs. WC

THE XRF FACTOR

Dr Uwe König, Malvern Panalytical, the Netherlands, examines the benefits of X-ray fluorescence tools to harness the potential of coal fly ash.

Once considered little more than a waste product from the coal-firing industry, fly ash has firmly established itself as an important ingredient in a wide range of applications, from ceramics to construction. The transformation of its fortunes, from atmospheric polluter to valuable material, is welcome news: not only for the ongoing operations of the power plants where it is generated, but also for the health of the environment and people around the world.

After all, the coal industry is under immense pressure as the sustainability transition takes hold. For one thing, the value chain is facing the challenge of reducing its environmental footprint, particularly when it comes to pollution and greenhouse gas emissions. At the same time, the demand for renewable energy in place of coal is on the rise, especially in the West.

The future of the coal industry rests heavily on it being able to make power plants as efficient as possible, with minimal emissions and increased circularity. Capturing waste fly ash and giving it a useful new life helps to hit both those targets – but only if the composition, characteristics, and quality of the fly ash can be relied on to meet increasingly stringent standards.

Old meets new

These standards are particularly relevant in the cement and construction industries, where the properties of fly ash give it an important role. This is not a new discovery: as a siliceous or alumino-siliceous material, coal fly ash has plenty in common with the pozzolanic volcanic ash used by the Romans in their

hydraulic cement, with famously impressive results (considering the number and scale of ancient aqueducts and monuments that are still standing after 2000 years). Even in more recent history, fly ash from the burning of pulverised coal was used in concrete as far back as the 1930s.

This is because, in the presence of water, fly ash combines with calcium hydroxide to form cementitious compounds. Consequently, it can replace clay, sand, limestone, and gravel – thereby reducing not only the direct environmental impact associated with mining these other materials, but also its energy consumption. Despite the threats facing the global coal industry, fly ash has a projected compound annual growth rate of over 6% between 2020 – 2030. This increase is thanks to the greater demand expected from the construction industry, where the biggest single use of fly ash is as a mineral admixture in Portland cement.

Figure 1. Coal fired power station silhouette at sunset.

Figure 2. Blocks of fly ash bricks drying at manufacturing site.

Figure 3. XRF instrument sample changer.

Making the grade

Of course, unlike the building carried out by the Romans and more recent civilisations, modern-day construction is governed by strict regulatory frameworks. Fly ash used as a replacement for clinker in Portland cement, for instance, must meet the requirements for one of two categories within the ASTM C618 standard: either Class C, which has a higher calcium content and is better suited to strengthening concrete, or Class F, which offers higher resistance to water permeation and chemicals, such as sulfates and alkali-aggregate reactions. Not all coal fly ash lives up to the standards needed for construction applications. The most important characteristics that affect its suitability are fineness, loss on ignition, and chemical composition, which can impact fly ash processing, handling, and use.

Nevertheless, while modern building standards pose new challenges for producers of fly ash, cement, and concrete, the value chain also has other aspects of modernisation on its side, such as advanced materials analysis technology. Only by measuring and monitoring the mineralogical properties and elemental composition of fly ash can the coal and construction industries get the most out of this by-product – and meet their obligations to safety-focused regulators, as well as today's increasingly environmentally conscious society.

Accurate, precise, reliable, efficient

Enter X-ray fluorescence (XRF) spectrometry: an ideal technology for accurately determining – both qualitatively and quantitatively – the elemental composition of fly ash. Suitable for analysing a wide range of elements (such as Na_2O, MgO, Al_2O_3, SiO_2, P_2O_5, SO_3, K_2O, CaO, and Fe_2O_3) over a wide range of concentrations (from 100 wt% to sub-ppm levels), this technique applies an X-ray beam to a sample of material, to energise the atoms into emitting fluorescent X-rays. The spectrometer then measures the unique wavelengths and intensities of these X-rays to characterise the elements present in the material. Simple to use, easy to automate, and non-destructive, this method is highly prized in many industrial settings today – coal and cement among them.

Indeed, when it comes to fly ash, XRF is a trusted technique for closely monitoring the chemical composition of samples. The results are extremely valuable in informing everything, from product development and quality control to performance classification in line with ASTM C618. In this way, XRF helps producers ensure their product consistently demonstrates the optimal characteristics for the cement, concrete, and building materials industry.

What is more, using powerful XRF tools can maximise at-line or in-lab efficiency and productivity – in the power plant and beyond. Not only is XRF a high-capacity

method that requires minimal sample preparation, but it also has a low level of operator dependence, making it a valuable tool in today's high-pressure industrial environment. Crucially, XRF can provide frequent, highly precise, and highly accurate measurements, even in the challenging conditions associated with coal production. Of course, when it comes to ensuring high levels of quality and consistency in fly ash, the reliable repeatability and reproducibility of measurements – over the short and long term – is essential. XRF spectrometry is more than up to the challenge, making this technique well-placed to support the multi-elemental analysis required by the entire coal value chain.

Giving coal a lighter footprint

With the pressure on to reduce pollution from coal burning and capitalise on otherwise wasted resources, the coal industry is increasingly recognising the potential of fly ash as a raw material further down the value chain. Crucially, so is the value chain itself.

In the face of growing demand for safe and high-quality construction materials, ensuring the optimal elemental composition and characteristics in fly ash is key. Including XRF materials analysis in the production process is a proven means of gathering important insights, making informed decisions, complying with industry standards, and maximising profitability – all while enabling the sustainability and circularity transition of the coal value chain.

Figure 4. Malvern Panalytical XRF instrument, Zetium.

Figure 5. Hands of a miner planting a green plant on a coal heap.

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FILLING THE GAPS

Anthony Ferrenbach, Weber Mining and Tunnelling, Mexico, evaluates how the use of phenolic foams can help address the problem of roof cavities in longwall mining.

The longwall mining method, a cornerstone in the coal mining industry, has great challenges. Among the most daunting of these is the occurrence of major roof cavities, which can significantly disrupt operations and endanger the safety of miners. The advent of innovative cavity filling techniques, particularly the use of phenolic foams, has revolutionised the way these challenges are addressed, offering a new era of safety and efficiency in longwall mining.

The emergence of major roof cavities in longwall mining primarily stems from the dynamic nature of geological conditions. As mining operations delve deeper, often exceeding depths of 250 m, the likelihood of encountering fault zones and poor immediate roof conditions increases. These precarious scenarios not only halt operations, but also pose significant risks to the structural integrity of the mining site and the safety of the workforce.

Historically, the response to roof collapses in longwall mining was limited and often fraught with difficulties. Traditional methods struggled to provide immediate and effective support, particularly in the case of large cavities. The breakthrough came with the development of cavity filling materials, which offered a rapid, efficient, and safe solution to this long-standing problem.

Phenolic foam, specifically products like Rocsil, has significantly impacted longwall mining operations, particularly in managing major roof cavities. These innovative materials have brought about a paradigm shift in addressing the complex challenges of underground mining.

Enhanced stability and safety

Phenolic foam provides exceptional stability to fractured roof materials. This characteristic is crucial in longwall mining, where the stability of the roof ahead of the face is paramount. The application of cavity filling materials in longwall mining involves a series of well-defined steps. Initially, the extent of the cavity is assessed and strategic injection points are identified. The foam is then injected from a safe distance, filling the cavity from the lowest point upwards. Continuous monitoring of the process ensures that the foam effectively stabilises the area, adapting to the unique contours of each cavity.

When applied, phenolic foam confines fractured materials. The in-situ expansion provides a positive pressure to the roof, reducing the likelihood of further collapse onto the armoured face conveyor (AFC) and the coal face. This confinement enhances operational safety and mitigates the risk of equipment damage. Additionally, its fire-resistant properties add an essential layer of safety in coal-rich environments, a crucial factor given the inherent fire risks in mining.

Another significant benefit is the stabilisation of large rock lumps situated on powered supports. The foam ensures that these lumps are pushed backwards towards the goaf instead of moving forward with the powered support. This aspect is critical in preventing these lumps from falling onto the AFC during recovery operations, thereby reducing the risk of accidents and equipment breakdowns.

Rapid application and reduced shuttering requirements

The quick application of phenolic foam is a key advantage in longwall mining. It allows for rapid response in stabilising cavities, which is particularly beneficial in the early stages of a cavity developing. The faster curing time and thixotropic nature of phenolic foam mean that less time is needed for shuttering, a process that can be time-consuming and labour-intensive. This reduced need for shuttering not only accelerates the recovery process, but also minimises the need for mine operators to work in hazardous conditions on the AFC.

Despite the efficacy of phenolic foams, their application does not

Figure 1. Cavity in longwall mining.

Figure 2. Cavity filling with expansive resin Rocsil Foam.

come without challenges. The variability in cavity sizes and shapes necessitates a flexible and adaptive approach. The skillful manipulation of injection points and monitoring of foam expansion are crucial to ensure comprehensive filling and stabilisation.

Cost-effectiveness and operational efficiency

The faster application rate of phenolic foam significantly reduces the downtime associated with roof cavity recoveries. For instance, filling a large roof cavity with phenolic foam can be completed at a rate of 60 m^3/h, a substantial reduction in time compared to other methods. This rapid application has both geotechnical benefits and cost implications, as prolonged recovery processes can lead to further deterioration of face conditions and increased operational costs. This also implies a shorter longwall face downtime. In scenarios where production losses can be significant, the quicker application and setting times of phenolic foam translate into considerable financial savings. This cost-benefit analysis is crucial in environments where time is often synonymous with revenue.

Conclusion

In summary, phenolic foam has proven to be an invaluable asset in the field of longwall mining,

Figure 3. Longwall recovery after foam filling.

especially in the context of roof cavity recoveries. Its ability to rapidly stabilise fractured roof materials, combined with its reduced shuttering requirements and cost-effectiveness, makes it an ideal choice for ensuring safety and operational efficiency in mining operations. The adoption of phenolic foam represents a significant advancement in mining technology, offering a safer and more efficient approach to managing the inherent challenges of underground coal mining.

More in '24

The Coal Preparation Society of America (CPSA) is bringing back the Coal Processing Technology Conference and Exhibition to the Central Bank Center. It will again be a joint conference with the Society of Mining Engineers, Central Appalachian Section with parallel technical sessions.

The majority of our exhibitors along with some new ones will be back on the floor. Lunches will be served on the exhibit floor thanks to our sponsors: Elgin and FLS.

Monday, April 29 features two workshops as part of our technical program (total of up to 13 Professional Development Hours for the conference):

- Efficient Magnetite Utilization and Recovery - Topics include the fundamentals, what affects heavy medium circuit performance, control systems, and the best maintenance practices.
- Screen Application, Operation and Maintenance - Topics include a review of the many types of screens available for coal sizing and dewatering operations along with screen monitoring and optimization.

Tuesday, April 30, the conference begins with a keynote address by Randall Atkins, Founder and CEO of Ramaco Resources, a leading operator and developer of high-quality, low-cost metallurgical coal. As recently featured in the Wall Street Journal, they have commenced development of the Brook Mine in Wyoming, the first new rare earth elements mine in the U.S. since 1952. Ramaco is also working on commerical development of patented coal-to-products technology to help create vehicle batteries, infrastructure materials and a wide range of consumer products. This is in line with the technologies that will be discussed in the CoalProTec, Critical Materials Derived from Coal-Based Materials technical session on Wednesday morning.


Photo - Wall Street Journal

The exhibit hall opens after the keynote and following a quick tour of the exhibit hall, join us for our Kentucky BBQ lunch and our annual membership meeting where you will learn what new programs and training opportunities the CPSA will be offering to *further the knowledge of coal preparation*. The technical sessions begin Tuesday afternoon with both the SME/CAS and the CPSA having paper presentations on timely topics such as: Plant Operations and Modifications and the search for Rare Earths and Critical Minerals.

Our Members Night Out is Tuesday evening at Club C at the Center. With help from our sponsors, Conn-Weld and Polydeck, it has been expanded to feature bourbon tasting, hors d'oeuvres, dinner and Josh Fletcher, an entertaining mentalist. A warning about the show - be careful what you think! The evening will close with a DJ and for the adventureous, karaoke. It is a great networking opportunity so reserve a seat or an entire table, but do so soon because this event usually sells out.

Wednesday, May 1 there are morning and afternoon technical sessions with a lunch that includes a raffle of some very nice items provided by many of our exhibitors and the CPSA will also be giving away a couple of expanded 2nd editions of "Ask Mr. Prep". It will also be on sale at the registration desk. The conference wraps up Wednesday afternoon with Innovative Coal Cleaning Methods and Technologies.

You can register for the conference and exhibition, book your seat(s) at Members Night Out, sign up to exhibit, and buy "Ask Mr. Prep" at www.coalprepsociety.org. Early registration continues until March 25th. After that conference registration increases $100 and exhibit passes by $50.

A SOLUTION FROM THE SKIES

Emily Loosli, Wingtra, Switzerland, details how drone technology can be implemented to streamline mining operations and improve efficiency.

Located in Bismark, North Dakota, BNI Coal Ltd. plays a significant role in regional energy supply, providing about 4.5 million t of lignite coal annually to a nearby steam electricity generating station. This coal originates from the Center Mine, situated northwest of Bismark. A surface mine, Center hosts an annual coal excavation area of roughly 210 acres.

Once mining operations conclude in a particular area, the land is restored in the mine's wake as pasture or farmland. This all happens at the same time when the next section becomes active. With the demands for energy production and government regulations shaping restoration deadlines across large areas, BNI has embraced drone technology to streamline their operations and enhance efficiency.

How BNI started with fixed-wing tech

BNI uses an 8200 dragline, which excavates approximately 40 000 – 60 000 yd^3 of earth every day. It digs into untouched terrain, unearthing materials into huge mounds for coal extraction. The challenge comes from the fact that these mounds are too high for surveyors to safely access and conduct precise surveys.

In the past, due to the accuracy limits of volume measurements via terrestrial surveys, BNI used to contract manned aircraft for surveys to satisfy quarterly US Federal Government reporting requirements.

Figure 1. The high accuracy and high coverage provided by Wingtra allow for detailed analysis of progress and clear reporting.

Given the government's mineral rights, these surveys were mandatory. However, due to their significant costs, they could not be conducted frequently enough to aid BNI in site management.

Since manned aircraft mining surveys were cost prohibitive, site managers needed another approach to conduct them more frequently and receive regular, high-accuracy views and volumetrics. Drone tech emerged as a practical solution, offering increased survey frequency and accuracy for more effective tracking and planning.

At the Center Mine, accurately tracking coal extraction, measuring precise volumes and land usage, and logging the right topsoil volumes for reclamation are critically important. Drones were a logical value-add, but given the vast size of Center Mine, short-range multirotors were not an option. BNI Coal therefore started out in 2014 with a traditional fixed-wing drone, which at the time offered breakthrough survey drone coverage potential.

Figure 2. BNI's 8200 dragline strips 40 000 – 60 000 yds of earth (3 – 5 ha.) a day, so regular drone surveys are a boon for tracking progress and keeping records.

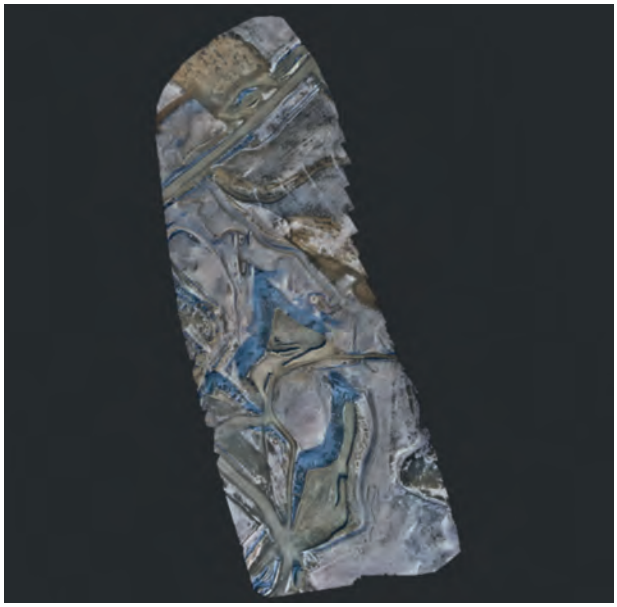


Figure 3. BNI Coal maps gravel stockpiles with WingtraOne and its Sony RX1R II payload covering 81.4 ha. (201 acres) in 42 min., at a GSD of 1.61 cm/0.63 in. This pushes analytics and site planning to a new level of functionality.

Evolving from fixed-wing to VTOL

Fixed-wing drone technology served its purpose in its time. However, users reported that its coverage per battery charge fell short of requirements over the long run. Additionally, it faltered in windy conditions, which are standard in North Dakota.

Fixed-wings pose other challenges as well, which are now solvable. Most obviously, they always require a large and low-impact take-off and landing space for hand-launch and belly landing without damaging the system, surroundings, payload, and possibly even the data captured.

Keeping tabs on evolving technology, BNI began to explore vertical take-off and landing (VTOL) drones, which led them to invest in the WingtraOne. The VTOL fixed-wing system immediately enabled them to cover more ground and featured a bonus increased resistance to windy conditions. Pilots report flying it successfully in 20 mph winds, without any disruption to data quality or accuracy. The field time with the VTOL system BNI chose was also reduced to two or three flights a month at most, whereas the previous system required at least four flights.

How did this happen? Technology evolved. Specifically, BNI's previous fixed-wing covered 160 acres per flight, while WingtraOne significantly expanded this range to 640 acres. Part of this is due to the robustness of the system, including the quality of the glass fibre airframe. The other reason is that more area per image is captured with VTOL, because the tech enables a drone to carry higher-quality, full-frame payloads without the risk of damaging expensive optics during belly landing.

Safer, high-precision operations

Drones contribute significantly to better safety measures at mine sites. Clear site perspectives facilitate safer planning and better markers for hazards to avoid. With a VTOL equipped with high-precision PPK, surveyors no longer need to venture into active mining zones as frequently, which already cuts safety concerns to a fraction of what they were before. They do not even need to set ground control points in this case, because several well-placed checkpoints can validate high accuracy.

BNI surveyors used to navigate steep stockpile edges during winter, which posed risks due to snow and ice. Drones have reduced this risk and, at the same time, have raised the quality of the results. Wingtra helped BNI to implement further improvements, as their drones allow for data capture in the tightest of time windows all year round. Windy, cold, and rough worksites no longer pose a limit.

The same applies for disputes with contractors or government officials, as proving actual earth moved or progress according to regulations, respectively, is only a few clicks away.

This story of graduation into different drone systems is not isolated to BNI; it sheds light on the different levels of added value this technology provides. Efficiency, accuracy, ease of use, reliability, wind tolerance, and precision take-off and landing have all emerged as important considerations, along with adaptability in complex airspace conditions.

In the vicinity of Center Mine, for example, low-flying crop-dusting aircraft pose potential risks for drones. However, the introduction of VTOL technology has bolstered trust and predictability around operations. Pause and resume, as well as loiter and reposition options offered through a tablet interface, enhance control and bring another level of safety on a busy mine site. This is all not to mention the savings in paid field time.

Since bringing the VTOL system onboard, BNI only needs one surveyor in the field, a couple times a month, to get a complete and regular picture of operations. A leaner, safer workflow saves time, boosts productivity, and improves margins enough to easily warrant the cost of the system. Moreover, surveyors who once spent time on the site are freed up to analyse data collected and contribute to strategies for optimal operations.

Conclusion

What all sites must consider about any system is ease of integration. An almost totally autonomous aerial robot like WingtraOne avails ease of use in the field. When this is coupled with easy geotagging workflows and software agnostic data, the value-add is clear. Drones are only going to become more integral to mining operations. WC

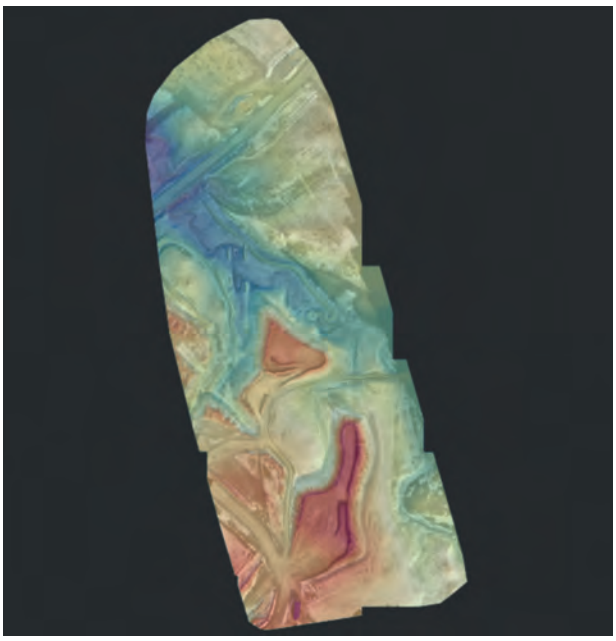


Figure 4. Drone data can easily be toggled to reveal different views based on outputs, like this stockpile digital surface model from Wingtra data, providing helpful surface analytics.

ASSESSING SCREEN MEDIA OPTIONS

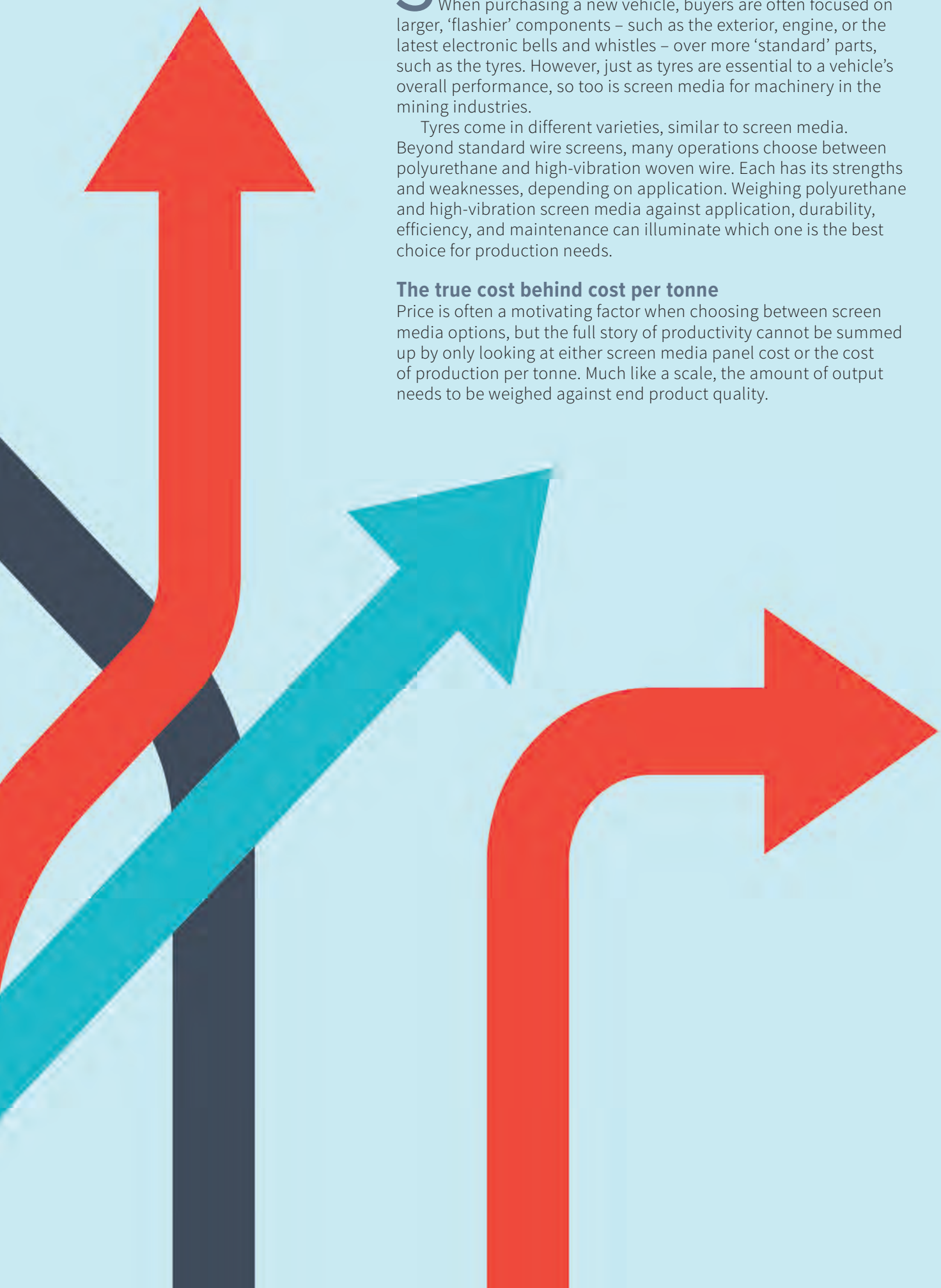
Serge Raymond, MAJOR Wire, Canada, evaluates the pros and cons of polyurethane and high-vibration screen media for coal operation needs.

Screen media is often an afterthought for coal screening operations. In the car world, an equivalent would be tyres. When purchasing a new vehicle, buyers are often focused on larger, 'flashier' components – such as the exterior, engine, or the latest electronic bells and whistles – over more 'standard' parts, such as the tyres. However, just as tyres are essential to a vehicle's overall performance, so too is screen media for machinery in the mining industries.

Tyres come in different varieties, similar to screen media. Beyond standard wire screens, many operations choose between polyurethane and high-vibration woven wire. Each has its strengths and weaknesses, depending on application. Weighing polyurethane and high-vibration screen media against application, durability, efficiency, and maintenance can illuminate which one is the best choice for production needs.

The true cost behind cost per tonne

Price is often a motivating factor when choosing between screen media options, but the full story of productivity cannot be summed up by only looking at either screen media panel cost or the cost of production per tonne. Much like a scale, the amount of output needs to be weighed against end product quality.



Because of its durability and longer wear life, synthetic media, such as polyurethane, is often selected as a lower-cost option, since it requires fewer replacements than high-vibration screens. Its durability is also effective when used to handle high-impact material screening – such as dewatering or when processing large amounts of minerals with little risk of pegging or blinding.

However, polyurethane panels trade durability for less open area and are much more rigid, therefore relying on the vibrating screen to do most of the work. The static movement of the screens limits vibration to 800 – 900 cycles per minute, which can decrease throughput and invite blinding and pegging with finer minerals. In comparison, high-vibration screen media has as much as 50% more open area than polyurethane, which allows more material to be sized accurately in less time. This result is achieved through the high frequency of its wires – 8000 – 10 000 cycles per minute – that adds to the vibration of the screen box to speed up material separation and passing. This performance requires more changeouts of screens because unprotected woven wire breaks more easily than polyurethane. The trade-off to more frequent replacements is that the increased screening action improves material throughput, virtually eliminates pegging and clogging across the top and bottom decks, and yields a better-quality product. With high-vibration screen media, a higher investment upfront can lead to greater production gains down the road.

Figure 1. Of the many varieties of screen media, polyurethane and high-vibration woven wire are two popular choices.

Figure 2. Polyurethane screens trade durability and a longer wear life for less open area and static movement, which can decrease throughput. In comparison, high-vibration screen media has more open area than polyurethane, which allows more material to be sized accurately in less time.

Figure 3. The inclusion of polyurethane strips within the design of high-vibration wire screen media boosts its durability, without sacrificing open area.

It should also be noted that while polyurethane screens currently outlast a wire product, this gap has been closing. The inclusion of polyurethane strips within the design of high-vibration wire boosts its durability, without sacrificing open area. This addition means that high-vibration panels can withstand harsher screening conditions with the most abrasive materials, such as granite and basalt.

In some applications, the strengths of polyurethane and high-vibration screens can complement one another. In cases where the top deck receives heavy material with a high impact and requires a longer wear life, using a synthetic screen would be best. Once the polyurethane has taken the impact and the material is spread out more easily on the lower deck, a high-vibration screen can be used to overcome the limitations of the open area of the synthetic screen and produce more throughput. One industry case study reveals the benefits of such a pairing. An operation running polyurethane panels on the top deck and woven wire screens on the bottom decks experienced diminished throughput due to low open area, as well as poor material stratification and pegging and blinding issues. Replacing the middle deck with a high-vibration panel tripled its operational life, eliminated pegging and blinding, and resulted in a 200% increase in production volume.

Is silence always golden?

Many synthetic panels are made up of relatively soft polyurethane, which means that they can be up to 10 db quieter than wire screens. Lower noise levels reduce occupational noise exposure for plant personnel and the associated potential for hearing damage.

One downside, however, is that less noise can mask underlying performance and maintenance issues. Tears in the panel are not visible, which means performing quick visual checks for them is not feasible. Moreover, these tears can lead to larger, less precise openings over time and therefore out-of-spec, potentially contaminated material coming through. Operators are only alerted to an issue when performing an assessment of the panels or when the opening is large enough that the material starts to flap when in motion. At this point, the quality of material may have already been significantly impacted. In contrast, while it is noisier, high-vibration screen media only requires a visual check each shift to assess any issues.

In one industry case study, an operation screening salt materials was only changing out its polyurethane screen media every eight months, but they noticed the panels passing out-of-spec minerals. Switching to high-vibration panels not only solved the issue, but also eliminated pegging and extended the changeout time to two years.

A tailor-made approach

There is no one-size-fits-all when it comes to screen panels and fit. Sizing that is even a fraction of an inch off can have a lot of impact in terms of quality screening. While polyurethane panels come in a variety of options for different screening needs, custom-designed high-vibration screen media can often ensure a perfect fit and more precise screening.

Whereas some custom high-vibration options are suitable for high-impact, heavy-material applications that still need a good amount of open area, others are ideal for low-impact, finer, or more sticky material. Despite their different uses, each custom-fit option is designed to strike the right balance of wear resistance, throughput, and blinding and pegging resistance to meet processing demands.

When ordering screen media, operations should look for a reputable manufacturer that uses first-class materials and a thorough manufacturing process to ensure that they are receiving the best possible product to achieve the strongest possible results. Whereas global supply chain issues may lead to some manufacturers cutting corners and using less than stellar materials in their wire, others are uncompromising in the composition of the final product they deliver to their customers.

Figure 4. High-vibration panels can withstand harsher screening conditions with the most abrasive materials, such as granite and basalt.

The bottom line

Just as drivers need high-quality tyres that offer excellent tread for enhanced traction and safety, so too do coal mining operations need high-performing screen media that provides higher throughput alongside reduced downtime, maintenance, and replacement costs.

When it comes to making the best purchasing decision for operations, added value should take the place of cost per tonne. At the outset, polyurethane may seem like a cheaper alternative to many premium high-vibration wire products. In the longer term, customised high-vibration screens offer a more cost-effective and high-yield solution.

It may also be that a combination of both options can help companies maximise production, while retaining quality. Partnering with an OEM-certified technician is a cost-effective first step towards identifying problems and solutions, as well as selecting the screen media that fits the application and the different phases of screening in operations. WC

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