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ABB showcases exceptional achievers on International Women's Day

A global celebration that recognises the achievements, contributions, and challenges faced by women worldwide, this year's theme for International Women's Day on 8 March is #Inspire-Inclusion. It is based on the idea that when we inspire others to understand and value women's inclusion, we forge a better world.

ABB is committed to solving some of the biggest global challenges of our time. This is only possible through our exceptional people who work every day towards this endeavour. A culture of diversity, inclusion, and equal opportunity is critical to our business success and makes us stronger. At ABB, we strive for a culture where individual differences are not only welcomed but celebrated. Below we highlight two exceptional women making inroads at ABB Electrification in Longmeadow, Johannesburg:

Shernel Naidoo, Service Sales Engineer, ABB Electrification

Shernel has always had a passion for electrical engineering. "It was a career choice I made in high school, and I do not regret it. The fact I made the correct decision and enjoy what I do motivates me to excel daily."

Being a woman in this industry can be a bit daunting at times. However, Shernel takes pride in the fact that while it has not been an easy journey, she overcame all the challenges along the way and continues to persevere. "I love that my profession gives me the skillset to solve problems on the job as well as in my personal life."

Starting out as a graduate engineer, Shernel says the most fulfilling part of her role is to see the solutions she assisted in designing being deployed or delivered to a client. "That tangible outcome of what I do drives me

to grow and excel." Shernel has also garnered work experience in Sub-Saharan African that has stood her in good stead on her career path.

ABB has strived to inculcate an environment where every employee feels welcome, respected and included, irrespective of their gender identity, ethnicity, sexual orientation, race, culture, religion, ability. "Together we all continue to build an inclusive and respectful working culture."

For example, ABB acknowledges various holidays and celebrations of different cultures and religions. Making everyone aware of this diversity promotes multicultural respect. In addition, ABB offers mentorship programmes and invests in employee resource groups to encourage engagement at all levels.

Shernel says that the 2024 #Inspire-Inclusion theme means to celebrate

diversity and empowerment not only on International Women's Day, but beyond. "I see it as a global celebration of the social, economic, cultural, and political achievements of women. It is also a powerful reminder of the progress made towards gender equality.

"It encourages everyone to recognise the unique perspectives and contributions of women from all walks of life, including those from marginalised communities. As women, we need to be respected and be able to embrace our-selves and our identities and abilities," highlights Shernel.

Her advice to young women just starting out on their careers is to always be confident, as people who carry them-selves with confidence get noticed and stand out. Stay positive and trust your skills. Never be afraid to ask ques-tions and never stop learning. "Giving up is not an option," points out Shernel. "Always find a way to go through or around any obstacles or challengers you may face, and you will reach your destination."

Gaopalelwe Jabane, Service Specialist, ABB Electrification

Holding a National Diploma in Electrical Engineering (Heavy Current), Gaopalelwe is responsible for sales in the service business area in the Electrification Division in Southern Africa and selected Sub-Saharan countries. She assists clients with safe, smart and sustainable tailor-made solutions. She also ensures that quality information flows from sales to tendering teams and clients.

A career highlight to date was being a speaker at the ABB Johannesburg Summit in 2023. "I was really honoured to be part of such an important event. I am happy to be at a stage where I am trusted to represent my company at such a high level. I also had the opportunity to be a presenter in our client events, where I got to interact with important clients and showcase our solutions and offering."

Gaopalelwe says that what keeps her passionate and excited about her job is that the challenges she faces is a moti-vator for growth and achieving new milestones in her career path. "I always work harder to be better than I was yesterday. Knowing that other women have walked this journey and conquered their obstacles also encour-

ages me. I am fortunate enough to have access to women who encourage and guide me to develop myself in my ca-reer."

For Gaopalelwe, the International Women's Day 2024 theme of #InspireInclusion means being accepted and appreciated for what sets me apart from the rest, and for being recognised and acknowledged. Her advice to young women just starting out is to be an agile learner and to have confidence in yourself and your abilities.

"Set goals for yourself and always be accountable for your work. It is also important to have a mentor to guide you and equip you with the skills and knowledge you need to achieve your full potential. It is your responsibility to learn as much as possible and to have emotional intelligence," concludes Gaopalelwe.

ABB has policies in place to promote diversity and inclusion and educate employees to achieve an inclusive culture. More women are being appointed in management positions, which is an encouraging sign of the significant strides made to date.



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Mining Indaba shows mining players embracing future trends



The positive energy at this year's Investing in African Mining Indaba is an encouraging sign that stakeholders in mining are embracing the many challenges that the industry faces.

"The complexity of mining has been rising, driven by a range of factors from geopolitical tension and fast-changing battery technology to climate change and skills shortages," said Ralf Hennecke, Managing Director of Omnia group company BME. "Topics discussed at the Indaba, however, indicate that positive disruption is underway to build a path forward."

This direction was visible in presentations and discussions that emphasised environmental, social and governance (ESG) good practice, responsible mining, company-community engagement and the just energy transition. Hennecke noted that the mining ecosystem was gradually strengthening across Africa, as mining supply partners entrenched themselves in regions where their customers were active. This process introduces valuable

services, infrastructure and expertise into African countries where mining is initiated.

"The evolution of mining in Africa has seen closer partnerships between companies like BME and their customers – to tackle key priorities," he said. "Blue chip miners at the Indaba have reiterated their focus on critical areas like operational efficiency, business continuity and people development in the sector."

Highlighting the human factor, BME General Manager Technology and Marketing Nishen Hariparsad highlighted recent research showing that over 70% of mining leaders found that talent shortages held them back from delivering on production targets and strategic objectives. A panel contributor in the Indaba's Young Leaders session on 'New knowledge, new mining: the research and technology that drives innovation', Hariparsad argued that the mining sector needs repositioning to attract young talent.

"The Indaba's focus on positive

disruption applies to the question of attracting and retaining expertise," he explained. "As a sector, we need to showcase the great strides being made in developing and applying digital technology in the mining space."

This is creating career opportunities for young professionals in exciting fields like data science and software development. In the blasting field, for instance, BME is forging solutions for mines that help drive their mandate for safety, productivity and sustainability. He emphasised that mining companies were relying increasingly on their technology providers to forge the tools for achieving efficient and responsible mining.

"A key way that mines are positively disrupting traditional mining practice is to collaborate with partners to release value through the supply chain," he said. "This includes doing more with the data that we generate, and empowering personnel to drive efficiencies and safety on mines."



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DRC updates Mining Indaba on localisation policy



With the Democratic Republic of Congo (DRC) being a key focus of Africa's mining sector, the Investing in African Mining Indaba in Cape Town recently provided authorities with a good opportunity to update the mining fraternity on regulatory developments.

There was particular interest at the Mining Indaba in the presentations by the Regulatory Authority for Subcontracting in the Private Sector (ARSP), according to Dominique Sambwa, geological consultant and chairman of SRK Consulting (Congo). The ARSP is a government body set up in terms of the 2017 mining law to manage the rules relating to subcontracting by the private sector.

"The subcontracting regulations require that companies serving the mining sector must be locally based

and have at least 51% ownership by Congolese citizens," said Sambwa. "The Indaba allowed the ARSP to update many foreign stakeholders on how this plan is being rolled out, and what it means for foreign-based service companies working in the DRC."

Strengthening local economy

Vis Reddy, chairman of SRK Consulting (South Africa) and Africa lead for SRK Global, highlighted the importance of distributing the benefits of mining to local businesses and communities. This process strengthened the local economic ecosystem on which mining relies, while also building the local skills base and diversifying industrial activity – enhancing mining's contribution to long-term sustainability.

"It was useful for delegates to hear input directly from the ARSP Commission, including their insights into how

these localisation policies had been historically implemented in other parts of the world – including Europe and the US," said Reddy. "Mining's socio-economic contribution to host countries has been a prevailing theme at the Indaba, and it is encouraging to see the enabling strategies now being implemented."

Local presence

SRK Consulting has had an engineering consultancy practice in Lubumbashi for over a decade, managed and staffed by experienced local engineers and scientists. The practice has for some time been majority-owned by Congolese shareholders, providing valuable in-country support to mining companies. SRK Congo also operates a strategic initiative with partner practices SRK South Africa and SRK China to serve Chinese-owned mining companies.

Sambwa noted that there are new ARSP taxes provided for by legislation, which will be used partly to support the development of local companies in establishing ventures in collaboration with foreign partners. The regulations will lead to more foreign service companies looking for Congolese partners, but the lack of capital for local firms to buy into joint ventures is likely to be a factor that inhibits progress.

Promoting collaboration

"It is anticipated that the taxes levied by the ARSP will contribute to efforts to build the capacity of local companies to partner with outside companies," he said. "This assists foreign investors to enter this market by working with Congolese businesses and professionals who understand the local market, opportunities, processes and general corporate culture."

In addition to the new subcontracting regulations, he highlighted two other crucial outcomes of the 2018 DRC mining law. The one was to dedicate a portion of revenues generated by a mine to the development of local communities – by contributing to community plans for economic sustainability through initiatives in agriculture and other sectors.

Community engagement

"The other change that mining companies need to understand is the Cahier de Charge, which requires that mines engage formally and effectively with local communities when setting development priorities and implementing these initiatives," he said. "Through our experience in the sector and our expanding services, we have been able to pioneer successful projects in this regard with our clients operating in the DRC."

SRK Congo mining engineer and country manager Susa Maleba noted that there was also considerable scope to develop renewable energy sources in the DRC – which would help mines to reduce their carbon footprint. This potential included hydroelectric and solar power, which could be implemented on a localised basis close to mining sites. Infrastructure improvements were still required on road and rail networks to streamline supply chains and reduce the cost of doing business.

Comprehensive lubricant range for surface and underground mining

A trusted partner of the global mining industry for over 85 years, FUCHS LUBRICANTS SOUTH AFRICA offers a comprehensive range of lubricants to meet the arduous requirements of surface and underground applications, explains Dave Gons, National Sales Manager, Mining and Regional Mining Manager, Sub-Saharan Africa.

The range not only boosts equipment life but improves the health and safety for operators and other workers. This is especially important as failure to use the correct lubricants in mining equipment increases maintenance costs and leads to more downtime and production losses

The mining industry is an important growth area for FUCHS, not only in terms of products, but in servicing the centralised lubrication systems deployed by large mining operations.

"The aim is to provide our mining clients with complete solutions for their lubricant requirements," says Gons.

Depending on the specific mine, FUCHS has a field technician to respond to any maintenance or support issues, or it has an on-site technical team on a full-time basis. These technicians are responsible for looking after all equipment using FUCHS products, in addition to conducting any repairs necessary and compiling full reports.

Mines also have specific shutdown periods that provide a critical window for essential maintenance and repair of major equipment. In addition, FUCHS has the technical capability and resources to install any centralised lubrication systems on-site and provide the necessary technical and support backup.

Products for the mining industry include RENOLIT greases for permanent and long-term lubrication for high performance, reliability, and process compatibility, and RENOLIN industrial oils for diverse applications from hydraulic oils to turbine oils.

FUCHS mining lubricants can make a significant contribution to improved productivity in many other applications. They can increase efficiency and reduce energy consumption and associated CO2 emissions. "We develop technology-driven lubricants. As part of our commitment to technical excellence, we continually develop new products and optimise existing ones to better serve the requirements of our mining clients. Maintenance costs and breakdowns are reduced, productivity increases, and there is maximum value from the client's mining fleet," concludes Gons.

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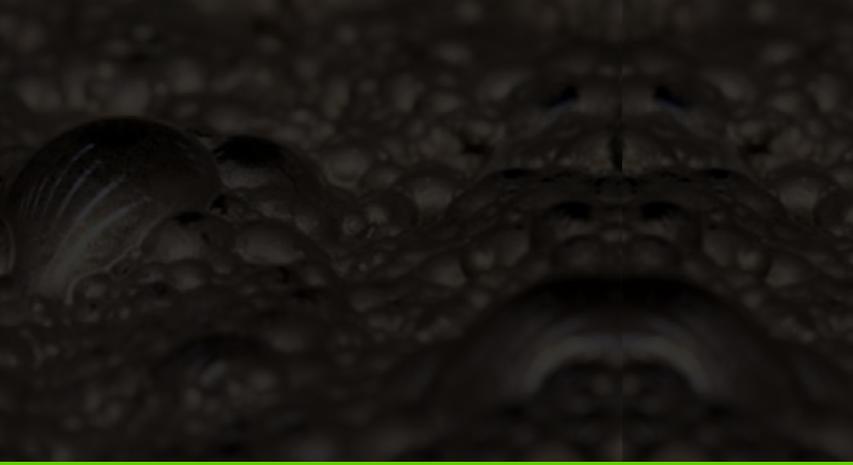
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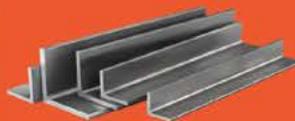


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Universal Mining and Chemical Industries Limited (UMCIL) Kafue Steel stands as the vanguard of innovation and quality in steel manufacturing. With a commitment to excellence spanning **15 years**, UMCIL has refined the standards of strength and durability, powering the nation's infrastructure from towering skyscrapers to vital flyovers, shopping malls, hotels, airports, and hospitals among others. This places UMCIL at the core of Zambia's most ambitious construction undertakings. The synergy between UMCIL's unwavering quality and the construction fraternity's vision is reshaping the skyline of the nation.

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Droughts, Floods and Contamination: the triple threat to African mining investments

Water availability is a key investment risk to mining in many African countries, adding to the range of risks that will come under the spotlight at the Investing in African Mining Indaba in Cape Town in February 2024.

In a session on de-risking mining investment, to be held on 6 February, the focus will include infrastructure and regulations – both pertinent to the allocation and access to water for projects. According to Peter Shepherd, partner and principal hydrologist at SRK Consulting, water allocation demands early attention and a commitment to meeting stringent compliance and best practice requirements. Shepherd highlighted

that national regulations are often onerous, and any project's motivation for a water use licence needs to be both detailed and scientifically sustainable.

"Many parts of Africa are dry, and competition for water grows steadily with development and human migration, as well as climate change," he said. "In southern Africa, for instance, countries like South Africa, Namibia and Botswana are increasingly careful about how water supply is allocated."

Feasibility too late

Any new mine development therefore needs to establish at a very early

stage that there are in fact water resources available – and to investigate the terms for access to such resources. This is no longer an issue that can wait until the pre-feasibility or feasibility stages of a project, he emphasised.

"There was a time not too long ago when a mine would generally be able to find a reasonable water supply from somewhere," he said. "Today, there is a very real possibility that the water required to develop a mine is simply not available; even where a prospective ore body is defined, it is difficult to exploit it without the necessary volumes of water."

Desalination

A government decision in Namibia has meant that new mines will use desalinated water, for example, which is often piped many kilometres to the mine site where it is used. Steps like these are important for managing national water resources, but do have a cost impact on mine development projects. These costs must be budgeted for well in advance; as importantly, the necessary permitting, infrastructure and licencing processes to apply for access to water must also be initiated as early as possible.

“Even where there may be groundwater in the vicinity of a project in a low-rainfall region – such as 50-100 metres under a river bed – the developers may be instructed by water authorities to source water from other sources further away,” said Shepherd.

Settling times

The actual water demand for each project also needs to be carefully analysed, with due regard to the different types of mines. Processing of certain minerals is generally more water-intensive than others, but there may be high silt or clay levels that raise water ratios and settling times.

“Recycling of water is always important, and this process usually includes the settling out of suspended solids before water can be re-used,” he said. “Longer settling times need to be taken into account in designing the necessary infrastructure.”

He notes that many mines struggle with the silting up of water storage facilities over time; the lining of pollution control dams with geomembranes in recent decades makes it risky to dig out silt using mechanical equipment. This has resulted in greater efforts to restrict the inflow of silt at source, through features such as silt traps – from which the sediment can be more easily removed.

Resilience

While mines work to reduce their carbon footprint as part of their contribution to the planet’s future, there are also impacts which climate change is already having on operations. Rainfall patterns are changing; even where the annual rainfall remains similar, there are more exaggerated peaks and troughs – heavy downpours followed by long period of little rain, for instance. Mines have always needed to manage water levels through and between rainy seasons, but it is becoming more challenging.



Return water dams and settlement ponds need to retain as much water as possible for the dry periods, while still having capacity to absorb extra water during the rainy season. Variations to historical rainfall patterns means that extra capacity is needed to be designed into this infrastructure.

Water quality

“Mining with less water also requires better containment strategies for water of poor quality,” he said. “Recycling and re-use inevitably concentrates the level of salts and metals, and mines then need to isolate this water so that it can be either chemically treated or removed from site altogether as a hazardous liquid.”

Shepherd emphasised that a mine’s water management strategy is increasingly part of its social licence to mine, as any use of this scarce resource must be seen to be equitable. Engagement with local authorities and communities is crucial in this respect, allowing

new water infrastructure to be developed collaboratively. Especially where water is being transported long distances to the mine, additional distribution networks to local communities can be planned and implemented.



Emesent announces Hovermap integration with American made Freely Astro drone.



Emesent, the Australian makers of the award-winning Hovermap LiDAR mapping and autonomy payload, have responded to US regulations banning Chinese drones by announcing support for the American made Freely Astro drone.

Integration with the Astro drone offers Emesent clients – especially those in countries where government restrictions on Chinese drones reduce choice in technology platforms – with a new option for airborne survey missions.

“We’re extremely excited by the performance of the Astro platform, and keen to see how Emesent Hovermap users leverage the combination of Emesent technology and the Astro drone’s capabilities,” said Emesent co-founder and Chief Strategy Officer Dr Stefan Hrabar. “The latest release of our mission planning app Commander, and newly enhanced Hovermap Autonomy, will offer pilots an even easier and stress-free approach to 3D LiDAR mapping in challenging environments.”

“Professional customers have depend-

ed on Freely Systems for the most reliable technology products for over a decade. Our goal is to create the world’s most productive drone ecosystem. Tight integration of the Emesent Hovermap on Astro raises the bar again, providing unmatched autonomy and mapping capabilities even in the most challenging environments,” said Matt Isenbarger, CRO, Freely Systems.

Designed for physically challenging and GPS-denied environments, Emesent Hovermap captures survey-grade data, quickly and safely, providing surveyors with a high-definition 3D scan of the environment.

The insightful 3D visualizations generated from Hovermap scans enable critical decisions that impact the safety and continuity of business operations across high-risk industries such as mining, construction and public safety.

In addition to drone-based deployment, the platform-agnostic Emesent Hovermap is designed to be deployed on the Boston Dynamics Spot robot,

attached to vehicles, or operated as a handheld or backpack mounted scanner. This versatility allows 3D LiDAR mapping of almost any environment.

Emesent’s premium scanning model, the Hovermap ST-X, will be on display during the Geo Week exhibition at Booth #735, Colorado Convention Center, showcasing support for the Astro drone and other deployment options.

About Emesent: Emesent is a global leader in autonomous mapping technology, providing an innovative 3D data capture, processing and visualization solution for industries such as mining, public safety, oil and gas, construction, and engineering. Their flagship product Hovermap enables organizations to capture 3D LiDAR data quickly, efficiently, and safely in challenging and time-sensitive environments. Emesent’s products are used by clients worldwide to enhance productivity and decision-making. Established in 2018, Emesent was founded by Dr Stefan Hrabar and Dr Farid Kendoul, following a decade of robotics research at Australia’s CSIRO.



End-of-life planning for mines requires careful planning and assessment

Due to the nature of mining, the Minerals and Petroleum Resources Development Act (No. 28 of 2002) requires mines to have an environmental management programme in place, with the necessary funds allocated to it for closure before a mining permit is issued.

Mining and heavy industry are always evolving as new technology results in new methods and optimised operations. As such, consultation may occur in multiple stages during a facility's lifespan, most notably after major upgrades or changes to on-site infrastructure.

"Wherever there is industry, there is a need for end-of-life planning. Africa's rich and diverse mineral reserves are perfect for continuous improvement in systems and processes, in turn leading to more challenging and exciting planning opportunities," comments Kate Bester, Project and Contracts Manager at Jet Demolition.

The company provides professional on-site demolition assessments to large mining houses and industrial clients whereby experienced staff

conduct on-site investigations of existing infrastructure. The main aim is to determine the cost, resources, and schedule details relating to the demolition aspects of future closures.

More crucially, however, it is an opportunity for early involvement in final closure planning, which may ultimately result in an optimised closure approach. Such an assessment extends beyond measuring and quantifying what is present.

It affords the opportunity to identify, record and plan for heritage on-site conditions that may require special attention, allows for the identification of assets that may be transferred or sold prior to closure, and also considers options with regard to the timing, sequencing, and execution of closure.

The highly experienced members of the engineering and operations department at Jet Demolition who carry out these assessments possess various qualifications such as MSc degrees and engineering diplomas, combined with extensive practical experience.

The safety and environmental teams

also contribute to these studies, enabling full turnkey consultation with clients. This process ensures that all major items are carefully considered during pre-closure planning, aligning budgetary provisions with the final adopted approach.

While on-site assessments do not necessarily translate into additional scope of work, they do build on existing client relationships. "We have always focused on providing comprehensive, turnkey services to our clients. Demolition assessments are part and parcel of our turnkey demolition solutions," highlights Bester.

"There have been many projects throughout Africa where on-site assessments have been carried out successfully at large mining houses and heavy industrial plants. We provide practical, cost-effective and safety-centric solutions to technically demanding projects. Our reputation and experience in industry is well-suited to assist clients with preparatory works and detailed planning in order to best plan for end-of-life of large facilities," she concludes.



Embedding ESG in Mining

The mining industry's consistent focus on environmental, social, and governance (ESG) risks, once again a central theme at the Investing in African Mining Indaba, heightened the complexity in evaluating both mineral assets and the companies themselves.

Business models within the mining sector have indeed undergone transformation, shifting from a focus on ESG 'risk mitigation' to 'value creation,' as noted by Sabine Anderson, Principal Mining Engineer at SRK Consulting in Cardiff, United Kingdom. Anderson was a key member of the global SRK Consulting team at the Mining Indaba in Cape Town,

coinciding with the company's 50th year of service in the mining industry.

The conventional emphasis on shareholder returns has shifted to encompass all six capitals crucial for organisations to create value: financial, manufactured, intellectual, human, social and relationship, and natural," she



explained. “We have observed new mining projects actively incorporating ESG considerations, and as consultants, we play a vital role in supporting these efforts.”

The shift signifies that traditional indicators of value creation such as NPV, IRR, payback, and drawdown are evolving towards a focus on mutual prosperity for

all stakeholders. Companies are now integrating ESG into their core pillars and strategies, as explained by Anderson, with ESG commitments being made and publicly disclosed.

ESG credentials

“These trends accompany changes in stakeholders’ interest and behaviour, where there is growing concern about the ESG credentials of mineral products,” she said.

“The investor focus is now firstly on ESG – especially people, biodiversity and ecosystems – and then in parallel on technical due diligence.”

Shareholders are increasingly involved with company executives, and there’s a heightened focus on ESG in assessing mineral resources and reserves. Worries about the carbon footprint and energy intensity of processes and products extend beyond the mine site to downstream manufacturers and upstream suppliers.

Explosion of standards

“Backing these trends is the surge in new disclosure and performance standards. This places significant pressure on companies to substantiate their performance in alignment with their commitments,” said Anderson.

She emphasised the need for ESG integration in projects starting from the early stages of mineral project development. Risks and opportunities should be integrated across all disciplines, with a specific focus on aligning with relevant standards and transparently disclosing carbon reduction plans.

Optimisation

There were various examples of how mining companies are innovating to more deeply incorporate ESG into their projects and thereby enhance value. For instance, mine plans can be optimised to reduce carbon emissions over the life of the mine through optimising project equipment, designs, and scheduling.

The primary sources of carbon emissions (Scope 1 and 2) on a mine site are diesel consumption, particularly from the mining fleet, and energy consumption, notably from comminution, processing, and hoisting. There are also less significant impacts from consumables such as explosives and reagents. While Scope 3 is relevant, data is currently lacking as the industry is working to improve reporting in this area.

“Pit selection can be fine-tuned during the optimisation stage to minimise mining waste,” she explained. “In the EU, we collaborate with clients to design projects with minimal footprints. Strategies include underground storage of waste rock and tailings, along with selling waste rock as aggregate to avoid on-surface storage. The adoption of electric mining equipment underground is also becoming more widespread.”

SRK Consulting remains committed to innovating various engineering and scientific solutions to meet the evolving demands of the mining industry. The company took a significant step almost 30 years ago by hiring its first social and development specialist, recognising the growing importance of issues that are now collectively grouped under ESG practices.

SRK is integrating the latest research into our mining studies and consulting, to target not only economic optimisation but also align with decarbonisation goals through mining strategy, design, and equipment selection. Underground projects have an advantage due to generally lower production rates and the utilisation of electric and battery-electric equipment. Open-pit projects are advancing with diverse options to reduce carbon emissions, adapting to the rapidly changing landscape of battery-electric equipment, as well as incorporating combinations of trolley assist and in-pit crushing and conveying. SRK’s studies also include considerations for renewable energy supply options, alongside factors such as zero groundwater withdrawal.



The Gold Standard in Process Instrumentation- VEGA crushing challenges in the Sub-Saharan Mining Sector

Most engineers would agree that the mining environment in Africa is undeniably one of the most demanding and challenging workspaces, taking into consideration the considerable distances equipment must be situated to ensure its uninterrupted and damage-free operation, making it a highly complex setting.

The majority of the focus in the processing sphere is on maintaining everything in perfect working order as inaccuracies in measurements can have dire consequences, endangering both equipment and human lives.

As the rake arms rotate or move through the settled solids, they help in the separation of solid particles from

the liquid in the slurry. The motion of the rake arms assists in pushing the settled solids towards the centre of the tank, where they are collected and removed. The position and movement of the rake drive can be adjusted to optimize the thickening process. The rake drive's speed and angle can be controlled to achieve the desired level of solid-liquid separation. This is



crucial in gold mining, where the concentration of valuable minerals in the slurry needs to be maximized.

The rake drive's position and operation are often monitored and controlled using sensors and control systems. This allows for real-time adjustments to ensure that the thickening process operates efficiently. Regular mainte-

nance of the rake drive mechanism is essential to ensure it continues to function correctly. Any issues with the rake drive, such as mechanical wear or malfunction, can impact the thickening process. This can result in costly breakdowns and massive revenue loss, which all mines try to avoid at all costs.

Thickening tanks in mining pose several challenges for measuring equipment due to the nature of the materials and processes involved. The materials processed in thickening tanks often contain abrasive or corrosive elements that can damage sensors and equipment over time. The slurry inside these tanks can be very thick and dense, making it challenging to obtain accurate level and density measurements. The density of the slurry can change often as more material is added or as water content fluctuates. Accurate monitoring of these variations is essential.

Thickening tanks can be difficult to access for maintenance, which can complicate the installation and replacement of measuring equipment. The mining environment itself can be harsh, with factors like vibrations, temperature extremes, and high-pressure conditions that measuring equipment must withstand.

To address these challenges, one gold mine in particular had to find a reliable and robust solution where measurement is concerned. And VEGA had the perfect solution. The technicians at VEGA INSTRUMENTS suggested the use of VEGAPULS RADAR SENSORS after establishing the exact needs of the mine and the solution that was required.

The VEGAPULS instrumentation faces specific challenges due to its installation in an open slurry tank, leaving it exposed to environmental elements. Its primary role is the monitoring of the rake drive, a task of the utmost importance. The rake drive stands as a crucial component, directly influencing the efficiency of the thickening process. Any malfunction in these rake drives can have a detrimental effect on the thickening process, ultimately impacting the quality of the final product.

In an open slurry tank, the VEGAPULS is a reliable, versatile, non-contact tool for process control and automation, providing valuable data that contributes to efficient and safe industrial operations. It can be used to accurately measure the level of the slurry within the open tank. It emits radar pulses that travel to the surface of the slurry and back to the sensor, providing real-time data on the slurry's level.

This is essential for monitoring and controlling the amount of slurry in the tank. The data collected by the VEGAPULS can then be integrated into the control system of the slurry tank. This allows for real-time monitoring and control of the slurry level, which can be critical in maintaining the efficiency of various industrial processes.

By installing the sensor near the rake drive, it continuously measures and reports the level of the slurry. The level data collected by the VEGAPULS radar sensors can be integrated into the control system of the thickening process. This allows for real-time monitoring and control of the rake drive's position and, by extension, the thickening process. Operators can adjust the rake drive based on the sensor's feedback, optimizing the separation of solids and liquids.

Maintaining the correct slurry level is crucial for safety and the VEGAPULS help to ensure that process conditions remain within safe operating ranges. The VEGAPULS sensors can be used to automate processes based on the slurry level. If the slurry level reaches a certain point, the sensor can trigger actions such as starting or stopping pumps, valves, or mixing equipment. The sensor data can be logged and analysed to identify trends and patterns in the thickening process. Historical data can be used to improve process efficiency and optimize the use of resources.

VEGA's measuring instruments are an invaluable tool for continuously monitoring the level of settled solids in a thickener tank, which indirectly provides information about the rake drive position and its impact on the thickening process. The VEGAPULS assist in better process control, automation, and optimization, leading to improved efficiency and productivity in mining and mineral processing operations at the gold mine in Tanzania. VEGA sensors are typically straightforward to install and configure, making them user-friendly for operators. The seamless installation process empowers instrumentation technicians to handle the setup themselves, and in times of need, VEGA's dedicated technicians are just a phone call away. The VEGA technicians offer valuable guidance, readily addressing installation inquiries, and providing troubleshooting support when necessary.

This combination of reliable technology and accessible expertise makes VEGA a trusted partner in the pursuit of operational efficiency and accuracy in liquid-level management for industrial applications.

Hitachi Energy invests over 30 million euros to expand transformer operations in Germany



- The expansion and modernization of the power transformer manufacturing facility in Bad Honnef will generate up to 100 new jobs in the region.
- Set for completion in 2026, the investment expands the company's global footprint and capacity at speed, addressing the accelerating demand for transformers to meet Europe's energy transition.

Hitachi Energy today announced an investment of more than 30 million euros (approx. \$32 million) in the expansion and modernization of its power transformer manufacturing facility in Bad Honnef, Germany. Expected to be completed in 2026, the project will generate up to 100 new jobs in the region and address the rising demand for transformers to support Europe's clean energy

transition.

Operational since 1906, the facility in Bad Honnef is one of Hitachi Energy's key manufacturing locations in Europe. The factory produces large power transformers, forming critical components of the electrical grid used to step up or down the voltage level for efficient transmission and distribution.

"Electricity will be the backbone of our entire energy system. In the global power system of 2050, we need around four times the power generation capacity and transfer of up to three times as much electrical energy compared to 2020", said Bruno Melles, Business Unit Transformers Managing Director at Hitachi Energy. "The Bad Honnef facility is one example of our commitment to expand our global footprint and capacity at speed to meet accelerating demand driven by the energy transition."

The investment signifies an expansion of the facility to over 15,000 square meters. Combined with process enhancements, the upgraded facility is geared towards optimizing operational performance and boosting the overall manufacturing capacity to address the growing demand. Over the years, the factory in Bad Honnef has delivered transformers to many of the leading transmission system operators, utilities and industries in Europe, such as those included in the strategic partnership with TenneT.

The expansion of this factory reflects a wider scaling up of Hitachi Energy's capacity in Europe. Last year, the company expanded production in Sweden with an additional 2,000 new jobs over the next two years, in addition to the acquisition of power electronics companies eks Energy and COET.

Multi-dimensional tailings standard demands varied disciplines



Vis Reddy, Chairman of SRK Consulting (SA) and Regional Coordinator (Africa) for SRK Global

John Stiff, Partner and Principal Engineering Geologist at SRK Consulting

With the passing of the first deadline for mining companies to bring their tailings storage facilities (TSFs) into compliance with new standards, a fundamental shift has taken place toward a more multi-dimensional approach.

In August 2023, the Global Industry Standard on Tailings Management (GISTM) required compliance from tailings storage facilities (TSFs) with the highest potential consequences in the event of a failure. A key element of the GISTM's impact is that tailings management is no longer one-dimensional. Significantly, it systematically considers the environment in which the TSF is located – beyond the technical requirements from an engineering perspective. This clearly demands

that a wider range of disciplines are brought to bear on analysing and mitigating the risks.

Closure and climate change

Nowhere in the standard is this clearer than in the closure requirements that it stipulates. The background to the renewed focus on closure is important, as some of the TSF failures that prompted the GISTM took place in facilities that were no longer operational. They were under care and maintenance, having entered the closure phase of their life cycle. Certainly, there has been more attention paid to mine closure generally in past decades, and TSFs were considered part of this process – but the GISTM has been specific and pointed in its approach.

Traditional tailings-related disciplines include civil engineering – in particular the geotechnical element – and hydraulic engineering, as well as engineering geology, geohydrology and geochemistry. To these have now been added the environmental and social disciplines, including

speciality areas such as climate change adaptation and stakeholder engagement.

Climate change has precipitated shifts in rainfall patterns, making it more difficult to rely on historical rainfall statistics when planning for closure. More rainfall could lead to a TSF capturing greater volumes of water than its initial design capacity. Less rainfall could mean that vegetation cover does not survive, resulting in high levels of erosion and consequent instability. SRK has been expanding its environmental engineering capability over recent decades that feeds well into these requirements.

Dam breach and disaster management

The GISTM also highlights the social impacts related to TSF design and operation, and guides mining companies on how and what they need to communicate to adjacent communities. An important aspect of the new standard is the need for dam breach analysis, to assess scientifically where tailings could flow



in the event of a breach. Once again, SRK's environmental engineering team has developed specific capacity in this regard over the past five years.

Results of dam breach analysis are vital to inform the emergency response and disaster management plan required by the GISTM – a plan which looks to the involvement of various stakeholders. With SRK's multi-disciplinary teams serving mining and non-mining markets, disaster management planning is already a focus of our work for municipalities and other sectors.

The journey to date in applying the GISTM requirements has involved many additional studies to understand inherent geotechnical risks. The failures leading to the GISTM were clearly unforeseen by industry stakeholders that considered these structures as stable and safe. It is worth remembering that, in some cases, monitoring showed no signs

that failures could occur, so this pointed to elements of the mining sector's understanding of either the TSFs or the monitoring required that were incomplete.

Record-keeping and monitoring

The sector has been working hard to close that gap, and a significant level of new investigation is developing our general understanding of TSF behaviour. At operational level, there have been improvements on administrative aspects such as the record-keeping of reports and studies to track the design intent of each tailings dam.

Such attention to detail allows for cycles of continual re-assessment, following any changes that take place after the original design report – which could affect the stability of the TSF. The facilities are generally designed well, but there are often deviations during the construction and operation – which could lead to future

instability. Keeping better records of each site's development is therefore critical, as it improves the likelihood of them being well maintained and operated in accordance with the designs.

Technology is improving the way that TSF performance can be monitored in real-time, and is playing an important role in continuously tracking vital signs within the structure. Operators no longer need to wait for monthly or quarterly inspections; monitoring can now be conducted in real-time, delivering critical information through a dashboard to inform the responsible engineers, operators and accountable executives.

Progress and skills

The sector will need to keep up the momentum of advancements being made; many companies are making good progress while others are still lagging. Members of the International Council on Mining and Metals (ICMM) – a body that has strongly supported the implementation of the GISTM – are the custodians of around 1,100 TSFs globally. However, it is estimated that this is probably less than half of the TSFs to be found around the world.

While more TSF owners need to be brought into the fold of GISTM compliance, there also needs to be a concerted effort to generate and nurture the range of specialised skills that this work demands. Implementing the new standard lends itself more readily to the larger mining companies that have more resources, and for consulting engineers with the requisite multi-disciplinary skills base. However, as the foundation of expertise is stretched, it needs bolstering to make it more readily available to all who need it.



SRK MAKES KEY APPOINTMENTS

Armstrong promoted to director at SRK

SRK Consulting has appointed partner and principal geologist (geotechnical) Robert Armstrong as a director in its South African Consulting Practice.

Armstrong has been with the company since 2001, when he joined as a student geologist. He has been involved in geotechnical projects throughout Africa, as well as in countries including Argentina, Peru, Russia, Serbia, Iran, and Australia. His expertise covers slope design, the collection and reviewing of geotechnical data, geotechnical slope management programmes and geotechnical risk management. He was made a partner of the practice in 2016 and is the managing partner of the Mining Business Unit since 2021.

He has written and contributed to over a dozen technical papers, and has served as chairman of the International Symposium on Slope Stability, and as vice-president of the South African National Institute of Rock Engineering. He has also been the recipient of the Silver Certificate of Merit from the Southern African Institute of Mining and Metallurgy. Armstrong earned his qualifications at the University of Witwatersrand's School of Geosciences in Johannesburg, where he completed a BSc (Hons) in Mining and Exploration Geology.



SRK appoints O'Brien as partner

Leading global firm of consulting engineers and scientists SRK Consulting has appointed principal scientist Richard O'Brien as a partner in its South African practice.

Based in SRK's Cape Town office, O'Brien has been involved in environmental geochemistry for over 22 years, and specialises in the management, assessment and remediation of contaminated land and industrial waste characterisation. He works in mine residue characterisation and environmental due diligence investigations, as well as the design and implementation of groundwater monitoring programmes. His areas of expertise include environmental site assessments, conceptual site model development, vapour intrusion assessments and water quality.

He holds a Masters degree in Environmental Geochemistry, a BSc (Hons) in Geochemistry, and a BSc in Geology.

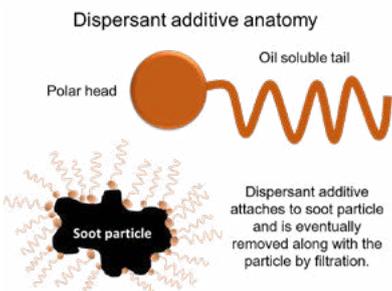


WearCheck LUBE TIPS: Volume 3



11. Lube tip: introducing additives to improve oil quality

Oil quality is established by the refining processes, and additives are most effective if the oil is well refined. Although the overall performance of an oil can be improved by introducing additives, a poor quality oil cannot be converted into a premium quality oil by introducing additives. Visit www.wearcheck.co.za for more condition monitoring information.



12. Lube tip: how contaminants affect additives

Particle contamination in a lubricating or hydraulic system is widely known as one of the most devastating contaminants. One effect of particle contamination that is rarely discussed is additive leaching. Many additives attach to particles and are removed along with the particle by filtration. Visit www.wearcheck.co.za for more condition monitoring information.

13. Lube tip: nitration - why it's bad

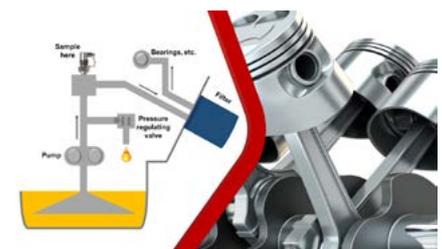
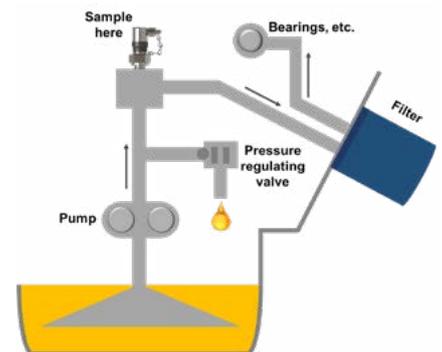
Nitration is the degradation of oil in the presence of nitrogen compounds. Nitration is a common mode of gas-engine lubricant degradation. It is a particular problem with higher temperature 4-cycle engines. Nitrogen oxides are typically formed during fuel combustion. These nitric oxides react with water to form nitric acid. The formation of nitric acids can lead to a corrosive environment to exposed engine surfaces. Nitration also leads to the formation of deposits and sludge. Visit www.wearcheck.co.za for more condition monitoring information.



14. Lube tip: understanding the difference in synthetics

There is no minimum quantity of synthetic base oil required in order to call a blend a semi-synthetic lubricant. Because Group III and Group IV base oils are both considered synthetics, any oil labelled as a full

synthetic would contain either Group III or polyalphaolefin (PAO) or both. Any oil that is labelled as a partial synthetic, semi-synthetic or synthetic blend would contain Group I or Group II (mineral oil) plus some amount of Group III oil or PAO (synthetic). Visit www.wearcheck.co.za for more condition monitoring information.



15. Lube tip: engine crankcase oil sampling techniques

When taking a sample of engine crankcase oil, it is important to avoid contaminating the sample, as with any sample. A good place from which to take the sample is just before the filter. The sampling valve can be inserted between the filter and the pump. It is recommended to use this place as a source for the sample, rather than taking the sample using a vacuum pump with a tube inserted down the dipstick port, or from a drain port. Visit www.wearcheck.co.za for more condition monitoring information.

Vertical Roller mill operating made simple with AI

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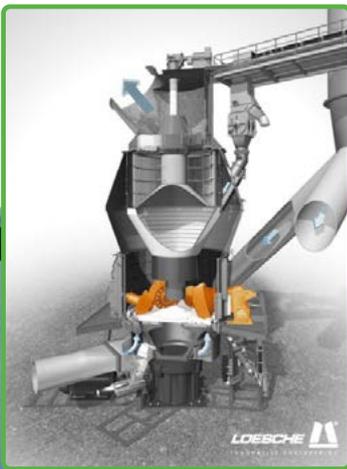
Digitalisation and Artificial intelligence has become a part of our day- to day lives both personally and in our work environment. The Economic pressures and dwindling of resources globally has added to financial strain across all industries. The resource shortage and costs cutting actions is putting severe strain on employees and with a dwindling resource pool it might seem like an endless battle to increase

production. The answer is simple, turn to Technology.

Artificial Intelligence in Process control and optimisation is not a new technology and has proven itself in numerous industries and applications. The optimisation and control solutions developed by OEM`s such as Loesche has been a game changer. You can trust the technology developed by the product owner that engineered and perfected their equipment for over a 100 years. Loesche has mastered the vertical roller mill and related equipment and has been supporting clients in all industries by engineering solutions to overcome any and all obstacles as they arrive. The digital software developed for automation and control was no different.

Loesche developed their Digital solution packages to address specifically skill shortage, energy savings and increase production, all whilst utilizing the clients current equipment irrespective of the vendor.

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Miners tackle hard conversations at Indaba – SRK



Mining continues to engage with the many difficult issues that affect the future of the industry and broader society, judging by the topics and turn-out at this year's Investing in African Mining Indaba in Cape Town.

"The event remains a forum for productive, if challenging, conversations," said SRK Consulting (South Africa) managing director Andrew van Zyl. "Many of these issues – from climate change and decarbonisation to the just energy transition – can be controversial; what is important, though, is that all stakeholders feel that they can participate in robust dialogue to find sustainable solutions."

Van Zyl acknowledged that many of the sector's responses to the challenges of today and tomorrow were "works in progress" but emphasised how constructively it had adapted in recent decades. SRK Consulting, celebrating its 50th year in 2024, was proud to have contributed to this progress, he said.

"Part of the value of the Mining Indaba is that it brings together leaders and role players at both a strategic and technical level," he said. "This allows not only for ideas to be shared and developed, but for experts to find practical strategies for implementing solutions."

The rapid pace of global changes was making these forums for knowledge sharing even more important, he noted, as decision makers in mining needed to factor in fast moving variables. This related as much to the political evolution of African countries as it did to technological advancements in the energy sector.

"It is more vital than ever that, as players in mining, we regularly and frequently update our world views with quality information – so that we retain a relevant opinion on future demands and opportunities," said Van Zyl. An example is the steady improvement being made in renewable power generation and storage. Whereas certain orebodies were in the past uneconomic due to their remoteness from a centralised power grid, the renewable energy technologies of today could now remove that hurdle.

He pointed out that trends related to the energy transition continued to make commodity prices volatile – complicating the task of valuing mineral resources and planning mining operations. Various early-stage technologies in electric battery manufacture, for instance, still competed for market acceptance, affecting demand for the minerals each technology embodied.

"As in so many spheres that affect the demand for mineral commodities, the

mining sector does not get to decide the final value of what it mines," he said. "Neither does it decide on what the global economy wants to make with its mineral production; these external trends introduce ongoing disruption to which the sector must constantly adapt."

As an industry, he argued, mining will continue to drive improvements in fields such as safety, operating costs, employee diversity, social value and environmental impact – while navigating the broader socio-economic trends. Its resilience was well tested by the Covid-19 pandemic, when mining came to the rescue of many economies and communities.

In South Africa, for instance, the mines' experience and infrastructure in respiratory illness helped protect employees and their communities – while its stand-out economic performance supported the national fiscus at a time when much of the private sector was in crisis.

"We need to appreciate the value of having honest discussions on what mining has to offer, what its considerable contribution has been, and what kind of future we are working towards," said Van Zyl. "As a regular participant in the Mining Indaba, we see this forum as helping promote such conversations."

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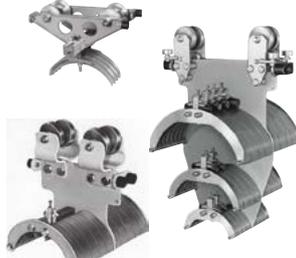
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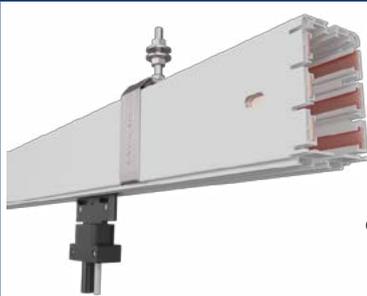


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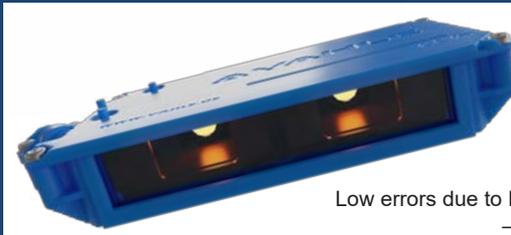
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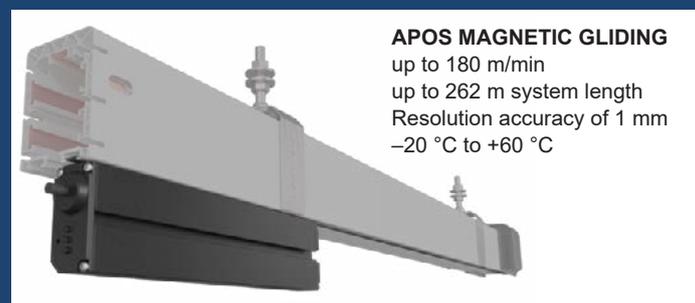
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SMGM
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 into all common
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Positive under-the-radar trends for mining in 2024



By Andrew van Zyl, Managing Director, SRK Consulting

While mineral exploration investments and discoveries grab the headlines on Africa's mining prospects for 2024, there is less visible progress being made that promises to strengthen the sector's future.

Africa's substantial and varied mineral endowment is undisputed, and the year ahead will likely see ongoing progress in exploration and mine development. This will be in both 'traditional' metals and in those minerals associated with the global energy transition. According to S&P Global, the continent is home to the world's most highest grade of mid-sized gold reserves. At the same time, it also hosts more than half the planet's platinum group metal, manganese and cobalt reserves – which are vital for

certain battery storage technologies.

By the end of 2022, there was a healthy project pipeline of almost 600 projects led by gold and copper-cobalt, but also including coal, diamonds, PGMs and base metals. The exploration spend at that time was rising at about 12% year-on-year, driven mainly by funding out of Canada followed by Australia, the United Kingdom and South Africa.

Islands of prosperity

So there is every reason to feel confident that mining is an industry with a great deal still to contribute to Africa's economic development – even if the progress is uneven between countries and regions. Perhaps the more important questions about mining's prospects for the coming year relate to the foundation that we are creating for the longer term.

As mining has grown across the continent, it often creates islands of prosperity that stand out starkly from the existing socio-economic landscape. Mines attract not only job-seekers and prospective suppliers and beneficiaries, but also informal artisanal miners; the result is a range of environmental, social and other impacts that are complex to manage.

Neither do these impacts remain only locally significant. As mineral-consuming corporates and end-users become more concerned to ensure ethical standards in procurement, so these in-country conditions attract international attention. These issues are just one aspect of the environmental, social and governance (ESG) priorities that are now considered by mining operations – including human rights, decarbonisation and supply chain localisation.

Mining and society

As we look ahead to 2024, it is important to reflect on the progress that the sector is making in addressing these challenges. From our experience in SRK Consulting, there is certainly much to commend mining's advances to date – notwithstanding the difficulties yet to be resolved.

Consider, for example, how the purely technical focus in areas such as engineering, mining and processing has evolved. The business of mining has today generally embraced a much broader understanding of how mining can support broader societal goals and better engage with the community. This has led to the integration of disciplines relating to water, environmental and social science, which now make an essential contribution to the way that mines are planned and operated.

In this sense, mining is always being positively disrupted by advances in expertise, approach and technology – albeit usually at a gradual pace. Importantly, there have been many changes across an ever-wider spectrum of professional fields, as we bring more disciplines to bear on our central goal of responsible and efficient mining. This ongoing development of expertise in a broader range of disciplines is also contributing to progress in solving previously intractable challenges like artisanal mining.

Pioneering standards

Mining institutions have played an

important role in continuously raising the ESG bar alongside the industry's technological advances. Standards of business practice are always being developed and reviewed in the light of global trends, and the sector's leading companies commit to these and devote considerable resources to applying them.

In Africa's mining sector, this is particularly important – as there are still many countries where regulatory frameworks to govern in-country mineral exploration and extraction are not yet well developed. The importance of industry codes is that they can raise performance levels, irrespective of the capacity of the host country to legislate and police these requirements.

We have seen an example of this recently with the Global Industry Standard on Tailings Management (GISTM), where the sector worked with stakeholders to develop more stringent and far-reaching requirements. Members of the International Council on Mining and Metals (ICMM) committed themselves to comply, and these standards will in time become the new benchmark for the whole sector. There are few countries whose national or industry regulations are as demanding as the GISTM, which has galvanised important progress in a very short time.

Shifting priorities

Over our five decades in business, SRK has seen how our mining clients' needs and priorities have shifted, and

we have responded by expanding our mining-related expertise by drawing on additional disciplines.

An example of the company's early foresight was the embracing of social science in mining. As early as 1995, it was employing its first social and developmental specialist, who went on to become a partner of the firm and help guide strategy and focus. This appointment was fully supported by SRK's founder members, who encouraged this direction long before it found its way into legal conformance requirements.

High standards are also vital for mining as our impact is so concentrated – unlike sectors like the construction industry where negative externalities tend to be more diffuse. Mines are large operations and many have long life-spans; their impacts are deep and varied, and are highly visible to all.

In the year to come, industry will continue to work – often under the radar – to find integrated solutions that contribute to resilience in the sector. As outlined here, such true resilience will be based upon cost competitiveness that is achieved in the context of an external environment that requires sustainable environmental and social practices.

Importantly, mining will continue to progress in supplying minerals critical to society and in its transition to more responsible and sustainable practices.



Women leaders in BME ignite change in blasting industry



Celebrating International Women's Day, BME reflects on its efforts to champion gender diversity and empowerment in the mining sector.

Shaping this narrative at BME, part of the JSE-listed Omnia Group, are four women who exemplify leadership and innovation in the mining industry. According to Kasturi Adari, BME's GM for Human Resources, BME embraces a commitment to actively support and elevate women in the blasting industry.

"We offer equal opportunities for women in all aspects of the blasting value chain," says Adari. "This includes recruitment, training, career advancement and leadership roles. We also ensure safe workplaces that are respectful and free from harassment, creating a supportive environment for women to thrive."

She notes that BME conducts awareness campaigns to highlight

successful women within the business – sharing their stories, achievements and contributions to inspire others. There are several initiatives to recruit, retain and develop female talent, recognising the challenges in the niche explosives industry.

"We constantly review our hiring practices, using dedicated recruitment processing outsourcing (RPO) for market research to attract the best talent," she points out.

She highlights that all employees at BME have access to study assistance, noting that specialised training programmes for women, such as a rock-breaking qualification, aim to improve female representation in the field.

"Where we offered entry blasting assistant programmes to our community members in the Northern Cape, 60% of the intake were females," she adds. "We intend to expand our offerings in the various

regions where we operate."

Adari concludes that holding company Omnia furthers this ideal, having recently launched science, technology, engineering and mathematics (STEM) bursaries with a focus on females, addressing the challenge of getting youth interested in maths and science.

"We partner with youth development organisations like Prime Stars to assist learners with additional classes," she says. Omnia has also launched a Leadership Excellence in Action Programme (LEAP) in collaboration with Duke and Rhodes University – where 35% of BME attendees were women.

"There is a huge focus on soft skills training, conflict resolution and courageous leadership, as this enhances team effectiveness," she adds. "We recognise that by investing in education, we empower women to excel in their roles and to have a meaningful career path."

Queeneth Vikisi, Business Development Manager at Mining Chemicals, BME's sister company in the Omnia Group's mining division, shares her perspective on the influential role women play in mining.

"Mining includes several disciplines that are attractive to young women," says Vikisi. "Mining-related fields including geology, environmental science, surveying and other engineering disciplines are attracting new talent today. What inspires young women is seeing other women succeed and excel in their fields, as it encourages them to pursue their own goals and passions. These role models become living examples of what's possible despite circumstances and backgrounds."

Reflecting on her role in the chemical sector, Vikisi acknowledges industry challenges but sees these as an opportunity to learn, through a continuous process of solving problems.

Among the ways Vikisi has contributed to the growth of BME has been by creating project pipelines and advising on new technologies. "The mining industry is tough and very reluctant to change; it is also quite process-sensitive," she notes.

Nelisile Thanjekwayo, Head of Legal at BME, stands as a beacon for others, embodying the spirit of International Women's Day and reinforcing BME's dedication to a diverse and empowering workplace.

"Landing a scholarship with one of South Africa's top law firms was the foundation of my legal career, setting the tone for milestones to come," Says Thanjekwayo.

Her leadership journey is marked by dedication, earning her recognition as one of South Africa's Mail and Guardian Top 200 Young South Africans. Thanjekwayo attributes her department's success to a collaborative and inclusive leadership style, emphasising teamwork and communication.

"I believe in advocating for the growth of each team member, understanding their personal career goals, and ensuring their overall well-being through one-on-one catch-up sessions," she states.

She spearheaded initiatives for a more inclusive work environment, notably contract management projects, facilitating collaboration and contributing to an increasingly



inclusive workplace.

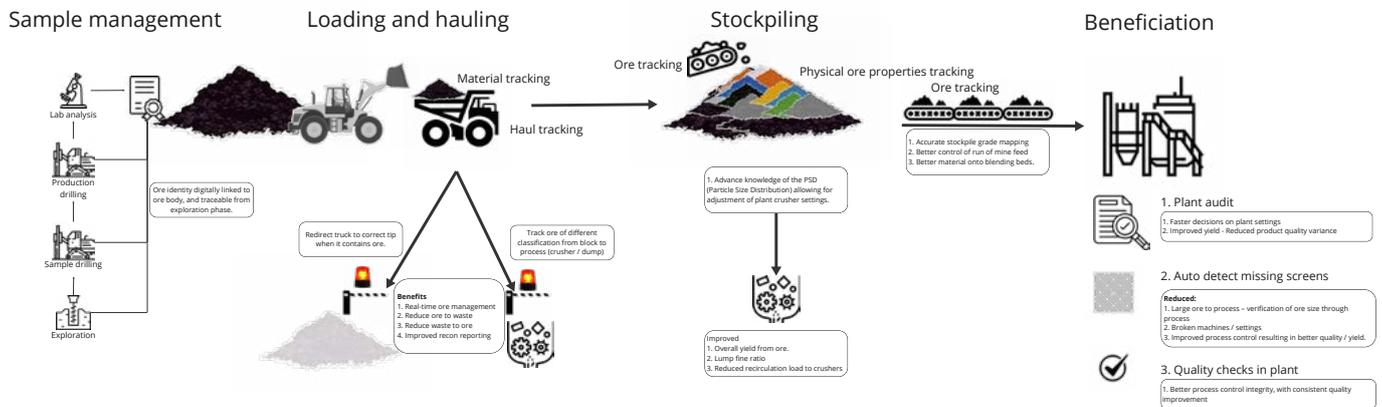
Reiterating the importance of women leadership in an organisation, BME credit manager Maria Sequeira highlights that it fosters a culture of trust, collaboration and accountability. "I've empowered team members to take ownership of their responsibilities and strive for excellence, ensuring they are equipped with the skills and knowledge needed to adapt to evolving industry trends and challenges," she adds.

According to BME Managing Director Ralf Hennecke, fostering diversity,

equality and sustainable development in the blasting industry requires a concerted effort to support and elevate the participation of women.

"At BME, we are committed to creating an inclusive environment where women can thrive and contribute to the industry's success," he emphasises. "We proudly support the global movement for gender equality, recognising crucial issues that women face every day. We continue working together towards a more inclusive and diverse mining sector."

Headline: Digital ore grade control



Introduction

The future of mining will be shaped by automation, robotics, AI and data analytics. Core to this is the unique and defined economic signature of the ore deposit. Knowledge of the ore body and the ability to detect, identify, blend and trace it, will enable the optimization of ore grade control and the processing plant. This will be the difference between success and failure for many mines.

Question is, can it be done? And the answer is a resounding YES, the technology is mature, proven and available.

Back ground

Radio Frequency Identification (RFID) is a system which involves electronic tags containing identification numbers of other data encoded onto the tag. A device called a reader sends an electromagnetic signal to the tag. By monitoring the tag's identification, the RFID system can track the presence and location of an object as it moves through the mine or the plant. We are all too familiar with this technology and use it daily to access the office building or gym. In retail it is used to prevent people from exiting a store without paying for items such as clothing – yes, those funny clips they remove from clothes when you pay for them contains RFID chips.

RFID technology has proven

benefits in a number of industries, including manufacturing, retail and mining. Within the mining environment, the ability to closely control the underground environment is difficult due to the nature of the mine. Implementing technology that enables a greater control environment, would be of great value. RFID technology compliments this move to greater control as it enables the miner to know in real time where the people, machinery and materials are located, their historical and current movement. Being able to control the movement of machinery and material in the mine will also benefit the underground mining logistics process.

Three main application areas have proven to be of greatest value:

1. Personnel Logistics: The safe and efficient movement of people into and through the underground mining environment. RFID enables the mine to validate that every worker has all their safety gear with them when entering the mine. By implementing a personnel logistics system, the mine will know in real time where every worker is at any time inside the mine. In the instance of slope failure, mine management would immediately know which workers are affected and where they are located. This will speed up and focus rescue efforts. Latest RFID technology also provides an Emergency Activation button when a worker is in danger and in need of support.

2. Inbound Logistics:

The effective and efficient movement of people, material cars, locomotives, equipment and material through the mine to where they are required, and when they are required. This includes the return of material cars to the surface within a specified turnaround time. Knowing where all the equipment and people are, leads to reduced lost blasts which costs mines millions of dollars each year. It also enables better inventory control, and automatic notifications of items reaching their expiry or service dates.

3. Outbound Logistics:

Blast resistant ore tracers are placed inside the blast hole. These ore tracers are linked to the ore grade certificates and positioned in the same blast hole and depth where the specific sample was taken from. When blasting occurs, the tracers shift along with the ore body. This provides the ability to digitally detect the specific ore identity at any point in the life cycle of the ore until it reaches the processing plant. The ore tracers are small enough to survive the crusher but gets destroyed by the grinder.

Benefits of digital ore tracking

1. Tracking ore samples from sample holes, whether the pit or underground, to the sample analysis lab. On average up to 35% of samples are lost before it reaches the lab. This is due to several factors including bar codes that get smudged, wet,

or samples that gets mixed with other batches. The geologic value of such lost samples could easily add up to \$4 million per mine per year. Being able to track these samples with RFID enabled sample bags, generally leads to 100% recovery rates.

2. Sample analysis is still often done by hand, and short cuts are taken which leads to inaccurate ore data. For every sample that gets rejected, the whole batch must be rejected. This easily adds up to \$250,000 direct losses as result of rejected samples each year. An RFID enabled sample tracking management system enables 100% compliance to lab protocols before sample certification is issued automatically. These lab certificates are then linked to the digital ore tracers that gets fitted in the blast holes.

3. During blasting ore always shifts, often up to 15m. Reclaiming blast ore from the muck pile at demarcated areas prior to blasting, means that ore is often not recovered. Trials during four blast events, showed that in three of the four blast events, ore was not recovered. The direct ore losses incurred due to this amounted to \$650,000 for three blast events. Being able to track and identify the ore in the muck pile will prevent this.

4. Ore-to-waste and waste-to-plant. The greatest financial benefit of ore tracking, is in preventing ore from being taken to the waste dump, and from waste taken to the plant. A three-month validation study at two large open pit iron ore mines, showed that 13% of the ore was incorrectly dumped as waste. The revenue potential of this incorrectly dumped ore amounted to \$230 million or net value of \$93 million. It turned out that hauler drivers are incentivized per trip, and during the night they took the shortest route to the waste dump to increase their trips

tally. Not being able to validate what they are hauling during the night, would have made it almost impossible to detect. An ore tracking system will read the material identity on the hauler truck, and prevent ore from being dumped as waste.

5. Stockpile mapping is more accurate when it's possible to detect what ore grade and identity is in the stockpile. It provides accurate retention times and enables accurate ore blending to optimize processing plant configuration.

6. Ore security. Finally, digital ore tracking makes it possible to validate that ore loaded at point A, is the same ore that arrives at point B. Such digital auditing of ore will help avoid penalties imposed on mine companies for subgrade ore deliveries to buyers. It also provides increased ore security, transparency and accountability during transport.

Other applications that might soon be legislated, is the real-time ability to account for explosives used by mines. Also here, RFID provides a safe and viable solution when the right technology is used.

RFID in mining around the world

Several companies like ABB, Metso and Canadian company TopVU offers RFID solutions for mines, and to a lesser extent for ore tracking. This forms part of their larger service offering to mines. Local South African company, Simera Trace (www.simera-trace.com) commercializes the technology developed by RFID trail blazer Kevin O'Neill. O'Neill worked for twenty years with South African mining companies to develop a system suitable for mining demands. This resulted in the world's only blast resistant

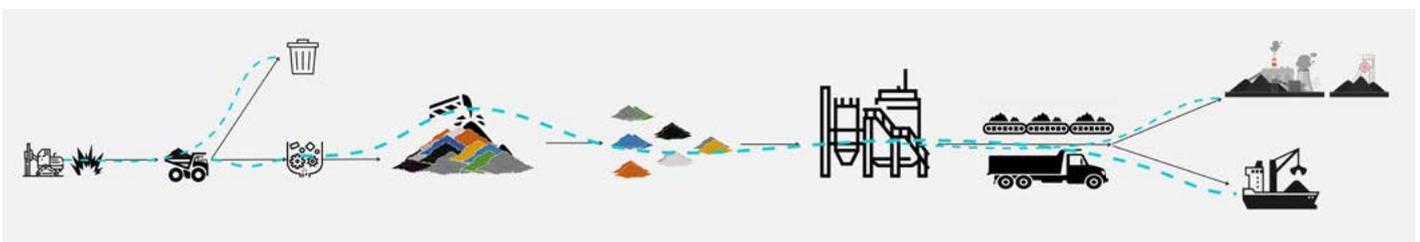
ore tracers that simulates the properties of ore. The comprehensive software platform, MINEX, integrates data from all mining verticals i.e. Planning, Geology, Mining, Plant, Processing and Transfer. This provides each function real-time insight into the ore and eliminates finger pointing when problems occur.

Summary

The ability to track ore digitally creates tremendous advantages. It prevents ore from being dumped as waste, and waste being crushed and processed. Identified and tracked ore also enable accurate management of stockpile grades and retention time. Prior to processing, digitally tracked ore can be blended for optimal results. Finally, it enables the validation of ore identity during and after haulage to point of consumption or sale. Creating a digital ore trail enables the digital simulation and optimization of processing plants. It also provides a digital and auditable trail of events from which intelligence can be derived, and to validate ore origin, grade and quality.

In a time where focus is on insight driven organisations, real-time management systems and digital twins, digital ore tracking completes the digital loop, by adding digital ore tracking to the mix. The ability to identify and trace ore at any point of its life cycle, will provide accurate metal accounting and optimized ore grade control. Can we afford not to have it?

For more information visit www.simera-trace.com or contact info@simera-trace.com



Interdisciplinary knowledge base is key to tailings compliance



To improve safety, mitigate risks and create a state of readiness for any eventuality among internal and external stakeholders related to tailings facilities, mines are developing comprehensive knowledge bases that integrate insights from multiple disciplines.

This interdisciplinary approach is key to complying with the Global Industry Standard on Tailings Management (GISTM) and to developing and using a knowledge base to guide decisions, according to SRK Consulting senior environmental scientist Kavandren Moodley.

"Principle 2 of the GISTM specifically requires mines to develop an interdisciplinary knowledge base, while Principle 3 specifies that all elements of that knowledge base – social, environmental, local economic and technical – must be considered in decision-making throughout the tailings facility's life cycle," said Moodley. He emphasised

that risk mitigation decisions must respect the rights of project-affected people – which involves meaningful engagement on an ongoing basis through to closure.

Engagement is priority

"This aspect is highlighted in the very first principle of the GISTM, where human rights, specifically the right to access to information is the focus," he noted. "Gathering indigenous knowledge about the area from the community and providing capacity building and information about tailings management are therefore important parts of the knowledge base that a mine develops."

The approach is leading to a closer integration of elements such as engineering considerations with environmental, social and governance (ESG) factors such as climate change, as well as the emergency preparedness and response plans (EPRPs) that are put in place by mines. While a 'multidisciplinary'

approach draws on knowledge from different disciplines, its value is still limited by those disciplines keeping to their own lanes. An interdisciplinary approach, by contrast, goes further by analysing and synthesising the links between disciplines into a coherent whole.

"For instance, the GISTM calls for a breach analysis that models where tailings will flow in the case of a tailings facility breach – so that the inundation zone can be predicted," he said. "This in turn informs decisions about the technical design of the tailings facility and where it is located, decisions about environmental and socio-economic risks associated with the inundation zone, as well as the mine's engagements with nearby affected people."

Lisl Pullinger, who collaborated with SRK on GISTM projects, noted that an important part of developing the socio-economic part of the knowledge-base is determining the presence of vulnerable people in the inundation



zone and working with the community relations and emergency response teams. "This ensures that specific plans are developed to support vulnerable groups in case of an emergency," she added.

In addition, it is paramount to understand both the number of people potentially affected by a breach as well as the value of private, public and community assets in the inundation zone. "This information provides a scientific baseline, included in the knowledge base from which mining companies can make informed decisions about tailings design and management," Pullinger said.

Bruce Engelsman, partner and principal engineer at SRK Consulting further highlighted that the knowledge base impacts dramatically on the assumptions taken when a breach analysis is undertaken. "A poor technical knowledge base and uncertainty leads to conservative assumptions which, in turn, leads to larger inundation areas from a

hypothetical breach. This means a larger community to consult with and the need for more comprehensive emergency preparedness and response planning."

Buy-in and disclosure

This implies that the consultation process with affected people must generate sufficient buy-in from stakeholders such as local communities regarding the technical solutions proposed by engineers and scientists, said SRK Consulting associate partner and principal civil engineer Justin Walls.

"For example, the most commercially feasible option for siting, or even closing, a tailings facility may in fact not align with the community's expectations or preferences for a specific land use – and this needs to be ascertained as early as possible in the design process," said Walls.

Pullinger added that transparency is another key focus of the GISTM, not only to investors through publishing specific information, but also to local affected communities. "Sharing an integrated knowledge base and being able to solicit interdisciplinary input into key messages about tailings design, management and risk ensure that messaging remains consistent between stakeholder groups. This is a key component in building trust with local stakeholders and increasing investor confidence."

Planning for emergency

The knowledge base also guides the emergency planning, and the short-term, medium-term and long-term aspects of an emergency response – each of which demands the involvement of other stakeholders such as municipal emergency services, national government departments or specialised rescue agencies. Andries Fourie, senior technologist at SRK Consulting, pointed out that working with district or metropolitan municipalities is part of GISTM compliance, even though many of these bodies may not be sufficiently resourced to play their role in a long-term EPRP.

"In these cases, some mines have even stepped in with assistance programmes to identify the gaps in municipal capacity – and to actively help to address those shortcomings," said Fourie. "The GISTM requires this level of collaboration as an essential aspect of preparing adequately for the prospect of a tailings dam failure."

He also noted the proactive approach

to GISTM taken by organisations like Mine Rescue Services (MRS). Supported by South African mining companies, MRS has put itself forward in a primary responder role in the event of tailings dam failure, he said, and is prepared to provide support for these possible events.

Years of ESG experience

SRK Consulting partner and principal environmental scientist Franciska Lake emphasised that the GISTM builds on what has been learned through years of ESG practice. While the fieldwork and analysis required to assess the environmental and socio-economic impacts is standard practice in the sector, the GISTM now sharpens the focus on the impacts of possible dam failure.

"This means being very thorough with assessing the baseline situation to inform the knowledge base within the inundation zone – such as affected people at risk, or which biodiversity-sensitive areas exist could be impacted by a tailings dam failure," said Lake. "The industry has considerable experience in these fields which can contribute to GISTM compliance, however the standards require an effective integration of the different disciplines."

She pointed out that a well compiled knowledge base can facilitate improvements to the safety and management of both existing and new tailings dams – with the siting of new facilities being particularly important.

Engelsman noted that tailings storage facilities are ever evolving. "A thorough knowledge base requires compilation of knowledge at hand, as well as meticulous planning and development to improve the knowledge base, as technical knowledge base improvement is time consuming and costly," he added.

Living asset

"The knowledge base should not be static, but is rather a living asset that mines can expand and adapt in line with the developments on and around the mine site," she said.

Lake also highlighted the importance of designing a tailings facility with closure in mind, and how the GISTM provides valuable additional guidance for this priority. For new operations, therefore, the standards should be applied from the concept stage to gain the best advantage. Moodley concurred, emphasising that interdisciplinary collaboration in these early stages were the most effective

way of balancing engineering, financial, socio-economic and environmental imperatives.

“In choosing an optimal site for a tailings dam, for example, a fatal flaw in any one of these factors will rule out that option,” he argued. “It is essential to find out very early which sites are unacceptable, and whether the risks can be mitigated to an acceptable level.”

Risk and uncertainty

From a technical perspective, the GISTM is attempting to reduce risk by managing uncertainty, according to Engelsman. Much of this uncertainty, he argued, resides at the boundaries of disciplines – highlighting the need for better integration within the knowledge base.

“On the ground, mining operations

are often quite compartmentalised, which make integration of knowledge difficult in practice,” he explained. “Consultants in fact play a very important role in helping clients to bridge these disciplinary boundaries on their mines; certainly SRK’s range of in-house disciplines and our interdisciplinary approach is a significant benefit in this respect.”

Design philosophy

Given the lengthy operating lives of tailings facilities, the knowledge base also represents a vital tool as a paper trail for the approaches, plans and actions of the owner and operator over time, argued Roanne Sutcliffe, principal environmental engineer at SRK Consulting.

“It allows for the design philosophy of the facility to be followed in detail – right up to the point where

mine closure is being considered,” said Sutcliffe. “During the tailings facility’s life, there may be changes in legislation and standards, for instance, which have guided decisions in the past. A knowledge base helps practitioners to understand the strategies and the thinking behind decisions at any given time.”

To comply with the closure aspects of the GISTM, considerable work is now being undertaken retrospectively, she added, whereas closure work should ideally be initiated from the tailings facility’s inception and carefully documented. The knowledge base needs to capture this information on an ongoing basis, providing the necessary information for those accredited agencies and individuals who will in future conduct GISTM audits.



No lubrication plastic bearings for earthmoving machines



Injection-moulded plain bearings have been developed for earthmoving machines for lubrication-free operation even while working at maximum load capacity performance.

Produced by global polymer specialist, iglus, the new bearings are a stronger and more cost-effective alternative to steel bearings for the agricultural and construction machinery industry. Using its patented iglidur materials, the Q3E plain bearing, the company has for the first time managed to manufacture heavy-duty bearings made of two layers of high-performance plastic using a cost-effective injection-moulding process.

If an excavator moves hundreds of kilograms of sand, enormous loads act on the bucket's bearing points. So far, iglus has primarily used igutex-series plain bearings to handle this. The bearings are made of different materials and manufactured in a winding process. Integrated solid lubricants ensure low-friction dry

operation. The outer layer provides enormous strength.

"We have now succeeded in implementing a multi-layer structure using the injection-moulding process, that is both stronger and more cost effective than alternatives," says iglus South Africa managing director, Ian Hewat. The result was the iglidur Q3E series. "The new technology enables us to mass-produce multi-component heavy-duty bearings using very cost-effective injection moulding."

Igus bearing specialist, Juan-Eric Davidtz says The new iglidur Q3E series is the result of intensive cooperation between iglus material development and the specialists from iglus' in-house tool making. While developing iglidur Q3E, our goal was to implement a multi-part structure similar to the igutex series with iglidur Q3 high-performance plastic for a tribologically optimised core and a strongly reinforced polymer for a mechanically high-strength shell."

Heavy-duty applications normally require bearings made of metal or fibre composite bushings, for example in construction and agricultural machinery. To reduce costs, the plain bearings made of iglidur Q3E are used as their maximum dynamic surface pressure is 75MPa. This means that it can cover many heavy-duty applications. The decisive advantage is that the plain bearings require no lubricating grease. Microscopic solid lubricants are integrated into the polymer of the inner layer and released gradually over the bearing's service life.

"Construction and agricultural machinery maintenance are two areas where lubricating the bearing points is one of the most time-consuming tasks," says Juan-Eric. "By switching to iglidur Q3E or igutex, users can reduce maintenance costs and extend machine service life. Neglecting lubrication for classic metal bearings is a frequent cause of expensive damage to shafts and plain bearings."



Wacker Neuson Group: *strong revenue and earnings growth in fiscal 2023 – focus on Strategy 2030*

- Despite a difficult second half of the year, Group revenue rose again by 17.9 percent to EUR 2,654.9 million
- EBIT increased by 35.4 percent to EUR 273.2 million with EBIT margin at 10.3 percent
- Dividend proposal: EUR 1.15 per eligible share – this represents an attractive dividend yield of 6.3 percent based on the closing price in 2023
- Fiscal 2024 is forecast to be a year of consolidation with lower revenue expected in the EUR 2,400 to 2,600 million range with an EBIT margin between 8.0 and 9.0 percent

Although the economy weakened progressively, with challenges ramping up as the year progressed, the Wacker Neuson Group was still able to achieve profitable growth and reached the targets announced most recently. Revenue rose sharply by 17.9 percent to EUR 2,654.9 million (2022: EUR 2,252.4 million). Earnings before interest and taxes (EBIT) increased even faster at 35.4 percent and reached EUR 273.2 million (2022: EUR 201.8 million). At 10.3 percent, the EBIT margin was higher than the previous year's level (2022: 9.0 percent). This performance puts the Wacker Neuson Group firmly on track to achieve its Strategy 2030. Aligned with ten strategic levers, execution of this strategy is expected to deliver a revenue of EUR 4 billion and an EBIT margin of more than 11 percent in the long term.

"Fiscal 2023 began with dynamic

growth, which increasingly gave way to downward trends across many sectors of the economy in the second half of the year. Once more, our global teams demonstrated that our experienced and motivated employees are able to achieve extraordinary results for Wacker Neuson Group in challenging times. And all of this against the backdrop of celebrations for our 175th anniversary. This solid foundation will also keep us on course with our Strategy 2030 in the long term. Even though the underlying economic conditions are very uncertain at the start of 2024, we feel well positioned. We will use this year to further improve structures and flexibility, increase efficiency and actively prepare the next stage of growth," explains Dr. Karl Tragl, Chairman of the Executive Board and CEO of the Wacker Neuson Group.

Dividend proposal to the AGM

The Wacker Neuson Group again enjoyed strong growth in fiscal 2023, managing to increase profitability simultaneously.

The Wacker Neuson Group has adopted an attractive shareholder remuneration policy to ensure that shareholders enjoy a steady and appropriate share of the company's profit. The dividend policy provides for a payout per share amounting to between 40 and 60 percent of earnings per share. At the Annual General Meeting on May 15, 2024, the Executive Board and the Supervisory Board will propose a dividend payout of EUR 1.15 (2022: EUR 1.00) per eligible share. This corresponds to around 42.1 percent (2022: 47.6 percent) of the earnings per share and represents an attractive dividend yield of 6.3 percent based on the closing price in 2023 (2022: 6.1 percent).

Fiscal 2023 results in detail

- Double-digit growth – breakdown of revenue by region: Revenue in Europe (EMEA) increased by 18.3 percent to EUR 2,022.4 million (2022: EUR 1,709.9 million). Growth in the region was mainly driven by the Group's home market of Germany as well as the sizeable construction equipment markets in France and Switzerland. On the product side, large stretches of the year saw strong demand for Kramer- and Weidemann-branded compact equipment for the agricultural sector – a market that is less sensitive to economic cycles by comparison. The EMEA region's share of total revenue increased slightly to 76.2 percent (2022: 75.9 percent), thus solidifying its position as the Group's biggest sales market. Once again, double-digit growth was recorded in the Americas region in the fiscal year under review with a 21.2 percent increase to EUR 556.5 million (2022: EUR 459.1 million). In particular, the individual markets of the USA and Canada were the major growth drivers in the region, with strong demand recorded across all sales channels. The region's share of total revenue increased once more to 21.0 percent (2022: 20.4 percent). At EUR 76.0 million, revenue in Asia-Pacific fell by 8.9 percent in fiscal 2023 (2022: EUR 83.4 million). While Australia again powered growth in the region, this was not sufficient to offset the decline in revenue in other markets, particularly China. Overall, the region thus accounted for 2.9 percent of the Group's total revenue (2022: 3.7 percent).

- Increase in profitability – EBIT rises again: Following the very strong business development recorded by the Wacker Neuson Group in fiscal 2022, the dynamic pace of growth initially continued into the first half of 2023. Demand for the Group's

products remained at a high level in both the construction and agricultural sectors. Against the background of higher material costs, which are mainly the result of rising raw material, energy and logistics costs, the Wacker Neuson Group adjusted its selling prices and introduced flexible pricing models. With an increase of 35.4 percent, EBIT grew at a faster rate than Group revenue to reach EUR 273.2 million (2022: EUR 201.8 million). Therein included are two one-off effects due to the sale of an asset no longer required for future operations in the amount of EUR 15.5 million and the sale of design and technical know-how in the amount of EUR 11.0 million. At 10.3 percent, the EBIT margin in the fiscal year 2023 was also higher than in the previous year (2022: 9.0 percent).

- Net working capital impacted by weak sales in the second half of the year: At 32.8 percent, the net working capital ratio was higher than the target of 30.0 percent at the year-end of 2023, but was, however, within the range as most recently forecast. The absolute value for net working capital was EUR 869.5 million, an increase of 20.9 percent relative to the previous year (December 31, 2022: EUR 718.9 million). This was primarily attributable to the increase in inventory levels of machines, raw materials and supplies, which rose by 14.1 percent in the fiscal year under review to EUR 774.4 million (December 31, 2022: EUR 678.9 million). Whereas levels of unfinished machines were still elevated at the close of 2022 due to a strained supply chain situation, the company managed to reduce this elevated inventory over the course of 2023. Against the backdrop of the more subdued economic climate in the second half of the year, however, this resulted in a higher inventory level of finished machines.

- Cash flow development still impacted by investments and higher net working capital: Gross cash flow was 14.8 percent higher than in the previous year at EUR 317.3 million (2022: EUR 276.4 million). This increase was primarily attributable to the overall

improvement in the Group's operating activities. Following changes to net working capital and taxes paid on income, cash flow from operating activities was higher than in the previous year at EUR 113.2 million (2022: EUR -6.4 million). After deduction of cash flow from investment activities amounting to EUR -138.1 million (2022: EUR 5.6 million), free cash flow amounted to EUR -24.9 million (2022: EUR -0.8 million, including the effect from the discontinuation of a fixed-term investment in the amount of EUR 130.0 million). At December 31, 2023, free cash and cash equivalents amounted to EUR 27.8 million (December 31, 2022: EUR 53.7 million).

Outlook for 2024: a year of consolidation

Based on the volatile political and economic developments at the beginning of 2024, the Group is facing high levels of uncertainty for the current fiscal year. The Executive Board therefore expects to see growth remain flat or fall slightly in fiscal 2024 – not just in its three reporting regions but also across the three business segments (light equipment, compact equipment and services). For fiscal 2024, the Executive Board expects revenue to lie between EUR 2,400 and 2,600 million, with an EBIT margin between 8.0 and 9.0 percent. Group revenue is expected to recover and profitability is forecast to grow slightly in fiscal 2025. Over the longer term, the Wacker Neuson Group believes that global megatrends will continue to provide opportunities for its business model. The Group plans to capitalize on these trends in the future in a number of ways, including by focusing on developing its core markets and offering a portfolio of innovative products and services.

Key indicators for the Wacker Neuson Group

| Key figures in € m | 2023 | 2022 | Δ |
|-----------------------------|---------|---------|--------|
| Revenue | 2,654.9 | 2,252.4 | 18% |
| EBIT | 273.2 | 201.8 | 35% |
| EBIT margin (as a %) | 10.3 | 9.0 | 1.3 PP |
| Profit for the period | 185.9 | 142.6 | 30% |
| Earnings per share in € | 2.73 | 2.10 | 30% |
| Free cash flow ¹ | -24.9 | -130.8 | 81% |

¹ Before cash inflow in the amount of EUR 130.0 million in fiscal 2022.

SLIDING THROUGH TIME: Lubrication from stone age to modern age

Part 1 of 3

by Steven Lumley – technical manager, WearCheck

Lubrication from Stone Age to Modern Age



From stone age to modern age, pharaohs to phenols, the history of lubrication is a story that demonstrates how a seemingly simple substance - oil - has propelled human progress, shaped industries, and ushered in a world of smoother operations and optimised performance.

Now, while the field of tribology - which is the science of friction, wear and lubrication - has advanced significantly over the last 100 years, the roots of lubrication extend back further than one might imagine. Lubrication, in its simple form, has been in existence at least since the beginning of documented times.



Early humans recognised the importance of reducing friction, and intuitively understood that applying a lubricant between two surfaces would ease their movement. Before the Common Era, tallow (animal fat) and naturally occurring elements were used for lubrication for chariots and in transporting construction materials. In fact, one of the earliest examples of tribological practices can be found in the ancient Egyptians' use of lubricants to reduce friction in the movement of large stones during the building of the pyramids. Other ancient civilisations like the Greeks and Romans used olive oil and other plant-based oils as lubricants.

Fast forward past the dark ages, (trust me, nothing much happened with lubricant development then) and twelve centuries later, tribology as a scientific discipline begins to take shape during the Renaissance with our favourite Italian polymath - Leonardo da Vinci - whose observations about friction and lubrication laid the foundation for further exploration.

WearCheck is a registered ISO 9001, ISO 14001 and ISO 17025 company

Before the dawn of the industrial revolution, whale oil was commonly used as a lubricant, but with the worldwide decline in whale populations and the widespread use of machines, other sources of lubricants had to be found.

The discovery of crude oil in Pennsylvania in 1859 set the stage for the new oil economy, and led to the development of petroleum-based lubricants, which quickly replaced animal- and vegetable-based lubricants due to their superior performance and availability.

Today, lubricants are highly developed, using complex chemical methods designed to push their potential to the absolute limit. There are specific oils formulated for specific purposes, and our machines - from shipping, to transportation, to industrial factories - work faster and more efficiently than ever before. Our world could not function as it does today without modern lubrication advancements.

But how did we get here? Who first decided that mechanical lubrication was a good idea? And who helped develop these processes over thousands of years to get us to where we are today?

In this trip down memory lane, we will chronicle the significant milestones of lubrication through the ages - but don't be fooled, this isn't your run-of-the-mill timeline of notable inventions and courtly characters. Au contraire, like all good sagas, this tale is filled with intrigue and subterfuge, heroes and villains, great victories and heartbreaking defeats, all played out against the backdrop of human progress. So, join us as we pay tribute to the true significance of these early achievements and the remarkable people through history who pioneered an industry.

ANCIENT HISTORY (AKA A REALLY, REALLY LONG TIME AGO)

3500 BCE (Before Common Era) – 476 BCE

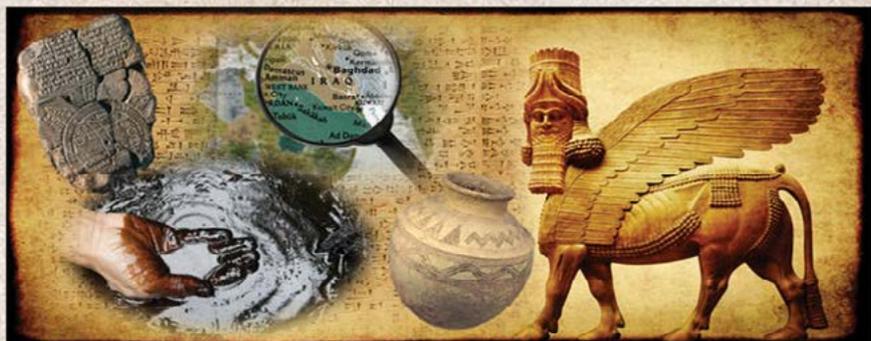
Historical context

Ancient history is the historical time period between the origins of human civilisation and the fall of the Western Roman Empire. Honourable mentions – this epoch includes the birth of civilisation in Mesopotamia, the emergence of written records in cuneiform and hieroglyphs, the rise and fall of fourteen different empires and kingdoms, with guest appearances by the bronze and iron age and one great flood.

3500-ish BCE

The oldest historical evidence of ancient oil use was discovered in archaeological records near the city of Hit in Mesopotamia, modern day Iraq. Hit, which straddles the Euphrates River, is the site of an oil seep known locally as The Fountains of Pitch.

This petroleum-derived pitch (bitumen) had the advantage of being both adhesive and slippery, making it suitable for a variety of applications, and so began our love affair with one of the world's most powerful substances.

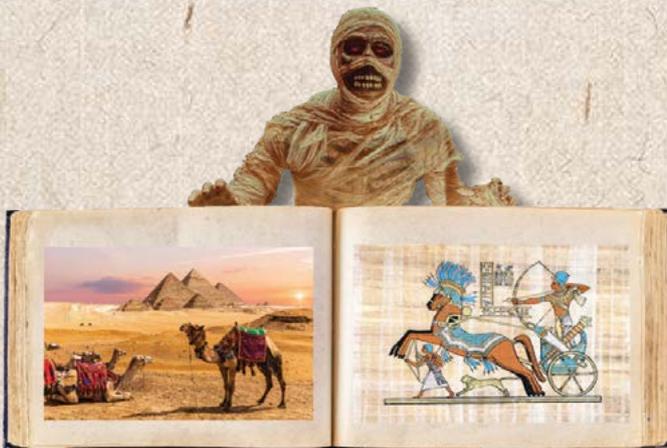


Our Sumerian friends used the black goo as a caulk agent for waterproofing ships, as a lubricant on wheeled carts and as an adhesive to secure the handles of various tools, and even as a setting agent for jewels and mosaics, which no doubt made it a firm favourite with the arts and crafts crowd.

3000-ish BCE

Some of the most widely known uses of petroleum in ancient history were undertaken by the Egyptians. There are Egyptian hieroglyphs that depict the use of bitumen as an embalming fluid, to grease chariot wheels and in the construction of monumental structures like the pyramids. Egypt's primary source of bitumen was the Dead Sea, which the Romans later named Palus Asphaltites (Asphalt Lake).

2600-ish BCE



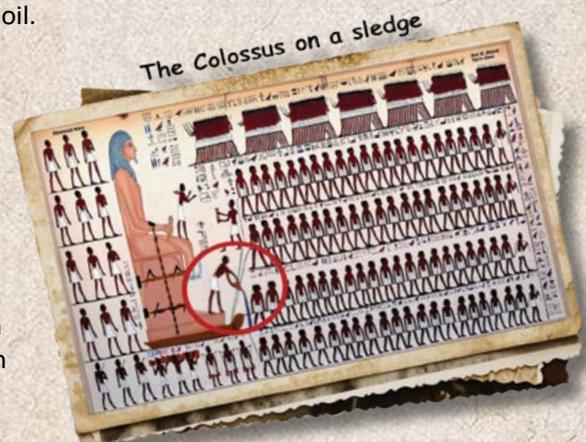
Archaeologists discover a greasy substance on a sled wheel dating back to 2600 BCE that belonged to an Egyptian pharaoh. Analysis later showed that this substance was a mixture of beef and sheep tallow (a rendered form of animal fat made up of triglycerides) mixed with lime powder. This discovery led to the conclusion that our ancient Egyptian friends also used tallow as a lubricant for their sleds to transport materials such as wood and rocks.

1900-ish BCE

Paintings and hieroglyphics found in the tomb of Tehuti-Hetap (a fourth-dynasty nomarch) in Deir El-Bersha in Egypt showed a giant statue of the man himself, being moved with the aid of a liquid that controversially is believed to be either water or oil.

The painting, aptly known as "Colossus on a sledge", depicts many labourers dragging the statue along the ground, with one man standing on a sledge pouring a mystery liquid on the ground, presumably to reduce friction between the two surfaces.

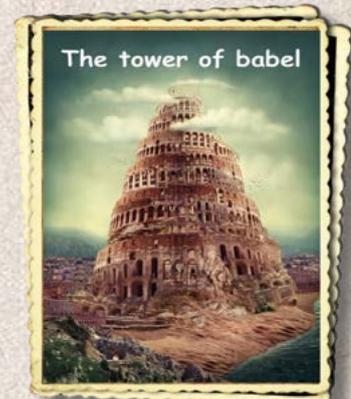
Unfortunately, no traces of this colossus have ever been found, but this has not stopped archeo-tribologists from arguing over whether this depiction was ceremonial in nature or proof of ancient tribological prowess.



1800-ish BCE

Back to Mesopotamia and following hot on the heels of their Akkadian predecessors (the people who conquered the Sumerians), we find the Babylonian civilisation using bitumen to construct roads and bridges. Bitumen was applied to road surfaces to help bind gravel and create smoother, more durable roadways. (Which is not a million miles away from how we make roads today.)

More than a millennium later, the Greek historian Herodotus, often referred to as the father of history, told how bitumen was used as mortar to construct the famous walls of Babylon, and the world's first skyscraper – "Etemenanki", also known as the Tower of Babel.



780-ish BCE

Meanwhile in East Asia, during the reign of the Western Zhou Dynasty, the Chinese discover the friction-reducing properties of a concoction made with vegetable oil and lead, making this momentous event the first historical record of what would later become known as a compound lubricant.

680-ish BCE

The inaugural Olympic Games were held in Olympia, Greece, in 776 BCE, but by 680 BC our Zeus-loving Hellenes had added four-horse chariot racing to the momentous event, and with that, the requirement for high-speed wheel-axle lubrication in the form of animal fat, making this milestone the first historical record of racing lubricants.

200-ish CE (Common Era)



Still in the Mediterranean, but 879 years later and during the Roman Empire heyday - also known as Pax Romana (Roman peace) - we find a multitude of olive oil-based lubricants in everyday use.

Experimentation at the time led to the use of more sophisticated lubricants, including those from olive oil and other vegetable derivatives. The Romans discovered that some of these more viscous liquids not only dissipated heat better than tallow, but also allowed mechanisms to move more freely. Writings by Cato the Elder (famous Roman senator, and historian) recommend that wagon axles should be lubricated with the boiled, viscous by-products of olive oil production.

Greases made from calcium salts and olive oil (basically calcium grease) were used to lubricate axles in horse-drawn chariots used for travel and warfare, and different oils were used in various metalworking processes, to lubricate moving parts in water clocks and to keep door hinges from squeaking in temples.

It was even rumoured that Caligula (3rd Roman emperor and all-round whack job) had his engineers make up a concoction of beeswax and olive oil to lubricate the bronze bearings on the rotating platform of his palatial pleasure barge on Lake Nemi.

These early experimentations marked the dawn of machinery lubrication and the world's love of olive oil as a salad dressing.

THE MEDIEVAL PERIOD (AKA THE DARK AGES)

475 CE - 1400 CE:

Historical context

The medieval timeperiod falls between the fall of the Western Roman Empire and the beginning of the Renaissance, and was mainly characterised by economic, intellectual, and cultural stagnation with feudalism, Viking raids and the bubonic plague also thrown in for good measure.

Long story short, people became superstitious, were mostly illiterate, and there was plenty of violence to go around. Honourable mentions for this period include advancements in armour technology, gothic architecture, the Wells Cathedral Clock and guest appearances by Attila the Hun, Charlemagne, King Arthur and Beowulf.

500-ish CE

During the medieval period, lubrication techniques were less advanced compared to later periods, and likewise the availability of specific lubricants and their use varied by region and technological development. During this dark time, tallow was predominantly used as a lubricant in Northern Europe to lubricate items like pivots and bearings. The stuff was often thickened with agents like clay or lime to form grease that was mainly used to lubricate gearing mechanisms in vertical watermills and post mills, for opening the gates of castles and on carriage wheel axles.

600-ish CE

During the late 7th century, warfare took a nasty turn with the invention of a devastating incendiary weapon called Greek fire – this stuff was nothing less than the medieval equivalent of a napalm bomb. This formidable weapon was invented by a Jewish refugee from Syria called Callinicus of Heliopolis during the reign of Byzantine Emperor Constantine IV.



Greek fire, or liquid fire as it was also known, was used by the Byzantine Empire during naval warfare and sieges. It was a highly flammable and adhesive substance that could stick to targets and continue to burn – not even water could extinguish it. The stuff would be fired at enemy ships from siphons, or hurled in pots, or sprayed using a basic handheld flamethrower-like device, or even used to create fire arrows.

The recipe for Greek fire was a closely guarded secret that was lost to history, so its exact composition is still a matter of speculation and debate, but many historians believe that it was composed of liquid petroleum, bitumen, and quicklime.

In spite of its name, Greek fire was not a Greek invention. The etymology of the term, just like the recipe for the stuff, is also shrouded in mystery, but historical records dating back to this time period claim that the term was coined by western crusaders 100 years after the stuff had disappeared from historical records.



700-ish CE

While Vikings are often associated with raiding and warfare, they were also skilled traders and boat builders. In fact, Viking warriors were considered the quintessential shipwrights of the 8th century and built longships called Drakkars - a term believed to derive from the Old Norse words “dreki” and “kar,” meaning “dragon” and “ship,” respectively.

These ancient mariners are believed to have used whale oil to lubricate the sails’ hinge supports, rowlocks and the rudder axes. This ‘new’ type of oil was obtained from the blubber of whale stomachs.

With their Drakkars well lubricated, these seafaring Northmen could go about their business of exploring new territories and raiding coastal regions.

THE RENAISSANCE (AKA THE AGE OF REBIRTH)

1400 CE – 1600CE

Historical context

Whatever we lacked in the dark ages we made up for in the Renaissance – this incredible period in human history was a cultural, artistic, and intellectual movement that marked a profound transition from the medieval to the modern world and, just like Ferraris, good espresso and Luciano Pavarotti, this movement traces its origins to Bel Paese - otherwise known as Italy

As civilisation continued to develop in Italy through the 15th and 16th centuries, some of the greatest revolutionary minds developed inventions and mechanical tools.



Honourable mentions of this era include astronomical discoveries, the development of artistic and scientific methods, and the invention of the printing press, microscope and barometer, to name a few.

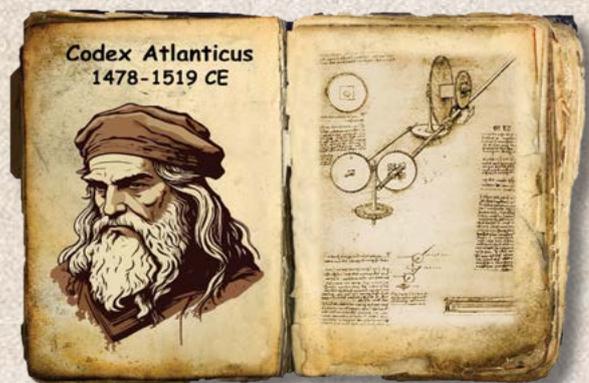
As for guest appearances, the Renaissance was littered with the world's biggest ensemble of overachievers - Nicolaus Copernicus, Galileo Galilei, Johannes Gutenberg, Christopher Columbus, Dante, Andreas Vesalius, Michelangelo and, of course, Leonardo da Vinci.

1500-ish CE

With animal fats and primitive oily compounds in use throughout the world, the next true evolution in lubrication came from the father of invention, Leonardo da Vinci.

Signore da Vinci introduced the idea that the coefficient of friction is the ratio of its force to the weight or load applied. He made significant observations about friction and lubrication, including the concept of reducing friction by using a layer of lubricant between moving surfaces. To this end, he created a self-oiling lubrication system for wheel axles, using bearings, which he lubricated with animal fat and opium oil.

Da Vinci's mechanical inventions and designs, including those related to lubrication, reflected his deep understanding of engineering principles and his desire to improve various aspects of technology during his time. His creations laid the groundwork for many advancements in mechanical engineering and lubrication techniques that followed in the centuries to come.



'The noblest pleasure is the joy of understanding.' — Leonardo da Vinci

1600-ish CE



As iron and brass replaced wooden machine parts, animal fat fell short of our lubrication requirements. As a result, people in Europe began experimenting with mixtures of vegetable oil, including castor, peanut, rapeseed and canola oil. Whale oil, however, saw continued use throughout this century - not only as a lubricant, but also as a fuel in lamps, and for the manufacturing of candles.

Meanwhile on the other side of the pond in the new world, we find Seneca Indians in North America – upstate New York and Pennsylvania - using crude oil to waterproof baskets and wigwams, as a glue to make arrowheads, but mainly for medicinal purposes to cure a variety of ills.

Seneca Oil, as it became known, was traded by the Seneca tribe to European settlers as a tonic, insect repellent and salve that could treat anything from rheumatism to toothache.

THE AGE OF ENLIGHTENMENT (AKA THE AGE OF REASON)

Late 1600 - late 1700 CE

Historical context

The Age of Enlightenment was an intellectual and philosophical movement between the late 17th century and the 18th century, that emphasised reason, individualism, and the pursuit of knowledge and human rights. It played a crucial role in shaping modern thought, including political and scientific developments.

Honourable mentions for this period include René Descarte's first principle of "I think therefore I am", the invention of the steam engine, telegraph, lightning rod, the mechanical calculator and the hot air balloon.

Apart from a think tank of philosophers and engineers, this movement gave us some heavyweights in the natural science fields of zoology, physics and chemistry, with guest appearances by Carl Linnaeus, Daniel Bernoulli, Benjamin Franklin, Anders Celsius and Alessandro Volta, Charles-Augustin de Coulomb and the father of modern chemistry, Antoine Lavoisier.

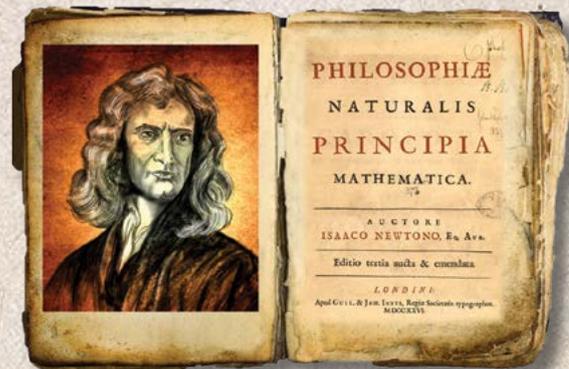
1687 CE

Sir Isaac Newton was an intellectual giant of his time and one of the most influential scientists and mathematicians in history. He made groundbreaking contributions to physics, mathematics and astronomy, laying the foundation for many scientific principles that are still in use today.

Newton's most famous work, *Philosophiæ Naturalis Principia Mathematica*, commonly referred to as the *Principia*, was published in 1687. In this monumental book, he outlined his laws of motion and universal gravitation, providing a mathematical structure for understanding the physical world around us. He also formulated the mathematical framework for understanding viscosity and its relationship to the flow of fluids.

Newton's work in the *Principia* laid the groundwork for the study of viscosity and a fluid's resistance to flow. While he did not provide a comprehensive theory of viscosity or use the term itself, his contributions to the mathematical description of fluid motion and forces within fluids were foundational for later developments in fluid mechanics and our understanding of viscosity in the modern sense.

Isaac Newton's work had a profound and enduring impact on science and mathematics, ushering in a new era of scientific understanding. His work provided the framework for classical physics, and paved the way for subsequent scientific discoveries by geniuses like Albert Einstein, Niels Bohr, Werner Heisenberg and Erwin Schrödinger – the famous theoretical physicist who lost his cat in a box.



1699 CE

Guillaume Amontons was a self-taught French physicist and engineer known for his pioneering work in the field of friction and thermodynamics.

In 1699, Guillaume presented a paper to the Royal Academy of Sciences in Paris, France titled "De la résistance causée dans les machines" (On the Resistance Encountered in Machines), which discussed various aspects of friction and the resistance generated in machines.

Expanding upon the earlier works of Leonardo da Vinci, Amontons' paper explored the frictional forces that occur when surfaces come into contact with each other. This groundbreaking research laid the foundation for subsequent developments in the study of friction and the laws governing it, namely Amontons' first and second laws of friction.

But that's not all! In addition to his work on friction, he also made contributions to the field of thermodynamics. He discovered a relationship between the pressure and temperature of gases, that became known as "Amontons' first law of gas." Not bad for a deaf guy who never went to university.

Illustration of Guillaume Amontons showing off one of his inventions in 1690



The story so far...

| | | | | | | |
|---|---|---|---|--|---|--|
| <p>Egyptians using bitumen for construction and embalming.</p> <p>3500 BCE</p> | <p>The tomb of Tehuti-Hetap in Egypt shows giant statue been moved with the aid of a lubricant.</p> <p>3000 BCE</p> | <p>Ancient Greeks using tallow to lubricate chariot wheel axles during the Olympic games.</p> <p>2600 BCE</p> | <p>The tomb of Tehuti-Hetap in Egypt shows giant statue been moved with the aid of a lubricant.</p> <p>1900 BCE</p> | <p>Chinese using vegetable oil and lead as a lubricant during the Zhou dynasty.</p> <p>780 BCE</p> | <p>Ancient romans using olive oil and calcium salt as a lubricant.</p> <p>680 BCE</p> | <p>Evidence of oil use from the Fountain of Pitch by Sumerians in Mesopotamia.</p> <p>200 CE</p> |
| <p>Tallow mixed with clay used as a lubricant in Northern Europe during medieval times.</p> <p>500 CE</p> | <p>Byzantine empire use Greek fire made with petroleum.</p> <p>600 CE</p> | <p>Vikings using whale oil to lubricate their Drakkars.</p> <p>700 CE</p> | <p>Leonardo da Vinci creates self oiling lubrication system using opium oil.</p> <p>1500 CE</p> | <p>Seneca Indians using and trading crude oil for medicinal purposes.</p> <p>1600 CE</p> | <p>Isaac Newton publishes his research on the flow of fluids in the Principia.</p> <p>1687 CE</p> | <p>Guillaume Amontons presents his work on friction.</p> <p>1699 CE</p> |



Be sure to catch the next instalment of our timeline in *Technical Bulletin 89*, where we will brave the age of revolution and take you on a journey through the events that defined one of the most incredible periods of human progress and spawned the modern petroleum industry.

We will recount how the invention of kerosene saved a species of majestic sea titans from extinction and how a small antique shop in London evolved into one of the most prominent multinational energy companies in the world. We will live vicariously through a retired train conductor as he goes wildcatting for oil in Pennsylvania, learn how Rockefeller rose to prominence and discover who the real McCoy was.

About the author...



Steven Lara-Lee Lumley is in charge of technical development and training for WearCheck. She holds an N6 mechanical engineering diploma (HND N6) as well as Honeywell aerospace and ICML III accreditations.

Steven joined WearCheck in 2008 as a diagnostician and worked her way up to the position of senior diagnostician, during which time she diagnosed her millionth used oil sample, in addition to running oil analysis training courses for customers in several countries. In 2015, Steven was promoted to the position of technical manager.

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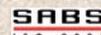
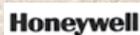


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