SAIMM URANIUM CONFERENCE 2026

19-20 AUGUST 2026
SWAKOPMUND HOTEL AND ENTERTAINMENT CENTRE, SWAKOPMUND, NAMIBIA

Langer Heinrich Uranium

Harmony Gold mining company – South Uranium plant, ion-exchange plant

18 August 2026 – Workshop
19-20 August 2026 – Conference
21 August 2026 – Technical Visit

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FOREWORD

It is my great pleasure and privilege to introduce the proceedings of the Southern African Institute of Mining and Metallurgy (SAIMM) Uranium Conference 2026.

Uranium already forms part of a reliable and low-emission energy mix in many countries, contributing significantly to global decarbonisation efforts. With demand for clean and dependable energy expected to increase in the coming decades, nuclear energy is poised to assume an even more important role. This is the perfect time to bring together professionals from across the uranium value chain to exchange ideas, share experiences and discuss the future of the industry.

Namibia is one of the world's leading uranium-producing nations and it is thus only fitting to have this conference in the beautiful town of Swakopmund – the heart of Namibia's uranium mining industry. Speakers and delegates from all corners of the world contributed, emphasising the truly global nature of the industry. The papers and presentations in these proceedings cover a wide range of topics relevant to uranium exploration, mining, processing and environmental stewardship. Starting with a sound understanding of the geology of any deposit is critical to the success of the project. Equally important is the effective management of radioactivity, both during mining and processing, to ensure the safety of personnel and equipment.

Continuous improvement of existing processes is essential, and it is good to see that there is no shortage of innovation in this area.

Topics range from optimising the productivity of the haul-truck fleet, to minimising reagent consumption, increasing the understanding of each unit operation to allow tweaking of the flowsheet, and improving the purity of the final product. I would like to thank everyone who has contributed to the success of this event. My sincere appreciation goes to our sponsors, for their invaluable support. Thank you also to the SAIMM team, for their organisational skills and dedication. And a huge thank you to every speaker and delegate, without whom events like these would not be possible.

On behalf of the organising committee, I wish you a great conference.

Johanna van Deventer,
Chairperson: Organising Committee,
SAIMM Uranium Conference 2026

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Conference Chairperson

Johanna van Deventer

Industry Technical Consultant
Ecolab, Purolite Resins

Johanna has over 30 years of experience in the hydrometallurgical industry, starting her career in the Hydrometallurgy Division at Mintek. The focus was on both R&D as well as commercial projects, including laboratory and pilot plant work encompassing the entire hydrometallurgical flowsheet.

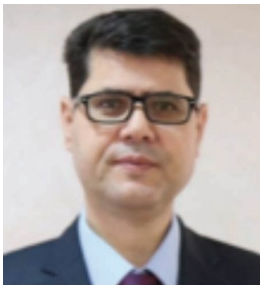
She joined Purolite in 2008 as technical sales manager for South Africa. The position involved sales and technical support to customers in all fields of ion exchange, including hydrometallurgy, industrial water treatment and environmental clean-up. More recently, she moved to the role of Industry Technical Consultant within the company, still focussing on metals and ion exchange.

Keynote Presenters

Petrus Johannes van Staden

Process Consultant
Freelance Hydrometallurgist

Petrus van Staden started his career with Mintek in 1986. Over the 35 years that followed, he served in the Hydrometallurgy and Biotechnology Divisions on the hydrometallurgical processing of gold, uranium, base metals and "technology metals" through the application of agitated chemical leaching, bioleaching and heap leaching. Since his retirement in May 2021, he has been self-employed as a Hydrometallurgist but since 2024 contracting mostly with Wood on projects related to uranium, rare earths, base metals and precious metals.



Mohammad Al-Shannag

General Manager
Jordan Uranium Mining Company (JUMCO)

Mohammad Al-Shannag is the General Manager of the Jordan Uranium Mining Company (JUMCO) and a Full Professor of Chemical Engineering at the University of Jordan. He earned his Ph.D. in Chemical Engineering from the University of Rovira i Virgili (Spain), in collaboration with the University of Virginia (USA), and his B.Sc. and M.Sc. degrees from Jordan University of Science and Technology.

Since 2019, Professor Al-Shannag has led JUMCO, overseeing the design, commissioning, and successful operation of Jordan's first uranium extraction pilot plant, which produced yellowcake to international standards. He also established advanced hydrometallurgical and analytical laboratories and supervised the Preliminary Feasibility Study for the Central Jordan Uranium Project (CJUP). Under his leadership, JUMCO has advanced national uranium extraction capabilities and forged international partnerships, including with the IAEA and leading global uranium producers.

Dr. Al-Shannag is Jordan's official counterpart for multiple IAEA Technical Cooperation projects and its representative in the Joint OECD/NEA–IAEA Uranium Group, where he regularly contributes to the biennial Red Book on uranium resources and production. He has headed and participated in numerous scientific visits, technical meetings, and international conferences, including serving as Scientific Chairperson at URAM-2023 (IAEA, Vienna) and delivering keynote lectures at global uranium and water engineering forums.

In academia, Professor Al-Shannag has over two decades of teaching and research experience, serving as Chairman of the Chemical Engineering Department at the University of Jordan, Al-Balqa Applied University, and King Khalid University (Saudi Arabia). He has supervised numerous graduate theses and taught a wide range of undergraduate and postgraduate courses in transport phenomena, thermodynamics, and separation processes.

His research interests span uranium mining and extraction, computational fluid dynamics, transport phenomena, separation processes, and wastewater treatment. He has published extensively in internationally indexed journals. Professor Al-Shannag also contributes to the scientific community as a frequent peer reviewer for numerous high-impact journals.

Through his leadership in academia, industry, and international cooperation, Professor Al-Shannag continues to play a pivotal role in advancing uranium mining, sustainable energy, and chemical engineering research in Jordan and globally.

The invisible challenge – considering radioactivity and NORMs in underground mine planning for critical raw materials and REEs

L. Schaarschmidt[1], R. Ellmies[2], H. Mischo[1]
[1]TU Bergakademie Freiberg, Germany
[2]Gecko Group, Namibia

Beside uranium mining, the occurrence of NORM, both in host rock formations and in the de-posits themselves, poses a number of considerations and challenges for a wide range of min-ing operations. Especially in underground mining operations with their confined spaces and mine ventilation requirements, it is crucial that radiation aspects are addressed during explo-ration, mine planning and mining activities.

The paper provides an overview of NORM occurrences in planned underground mines and their respective mobility ways and explains with examples from Gecko's REE and fluorspar underground mining projects how radiation management is taken into account in planning of mining, haulage and ventilation.

Furthermore, the authors will dive into distinctive technical measures and personal manage-ment options that can be implemented in order to increase safety. This will also extend to per-sonal safety and PPE required in underground mining operations with NORM abundance.

One key aspect that will also be addressed will be the implementation of proper mine safety and rescue concepts for underground mining in a NORM environment. The authors have broad experience in the implementation of various safety concepts, which include PPE and also mine rescue aspects.

Additionally, remediation and environmental concerns will be addressed. These span from waste rock handling and tailings to dust erosion and remediation of former sites.

The overall goal of the paper is to share a broad planning experience and conduct knowledge transfer for interested stakeholders who possibly face the same challenges in their current or future mining endeavours.

The full paper will be published in the SAIMM Journal

Louis Schaarschmidt
Researcher
TU Bergakademie Freiberg

Louis Schaarschmidt obtained both his Master's Degree and PhD in Mining Engineering from TU Bergakademie Freiberg. In his research he is investigating backfill behaviour, underground waste storage and radioactivity aspects in underground mine planning.

Comparison of diluent characteristics on the solvent extraction of uranium with a tertiary amine extractant

K.C. Sole, K. Harkema
University of Pretoria, South Africa

Tertiary amines, such as Alamine 336, are widely used, usually in combination with a phase modifier, for the separation, purification, and upgrading of uranium in primary processing flowsheets. The extractant and modifier are dissolved in a hydrocarbon carrier, known as the diluent, to mitigate their high viscosity and to allow organic-phase uranium loadings that are compatible with practical operational requirements. In the last decade, the Southern African region has experienced considerable uncertainty and supply-chain disruptions in the local diluent market. This has led to discontinuation of well-known diluents and the appearance of new products in the market. Although not directly involved in the chemistry of uranium extraction, the diluent can play an important role in stabilising the uranium–amine complex in the organic phase and influence physical characteristics of the solvent-extraction system, including phase separation, crud formation, and stabilisation of silica species. This paper compares relevant chemical and physical behaviours of several diluents available in the Southern African region with respect to their application in primary uranium sulfate solvent-extraction circuits.

The full paper will be published in the SAIMM Journal

Kathryn C. Sole

Adjunct Professor: Hydrometallurgy
University of Pretoria

Kathy holds a PhD from the University of Arizona. She has been providing independent hydrometallurgical consulting services since 2011, with clients on six continents and has worked across a wide range of commodities, including base metals, uranium, titanium, vanadium, and precious metals. Her main areas of expertise are in solvent extraction, ion exchange, and electrowinning. She also holds an adjunct professor position at the University of Pretoria. She received the 2019 Milton E. Wadsworth award from SME (USA) and has received two Silver Medals of the SAIMM. Kathy is a Fellow of SAIMM and the South African Academy of Engineers.

Management of iron level in yellow cake during uranium processing

M. Ramabulana, O. Bazhko
Mintek, South Africa

Mintek has conducted comprehensive research on uranium extraction to develop advanced processes and identify potential future developments. The primary aim of this research is to meet the increasing demand for uranium processing, which is driven by both current and future energy requirements. This initiative places a significant emphasis on evaluating existing methodologies for the extraction of uranium ores. Furthermore, an in-depth understanding of contaminant behaviour is critical for nuclear reactor performance and for ensuring the purity of final products, given the inherent challenges associated with uranium processing.

Iron is one of the most common impurities encountered in the uranium circuit. It can be separated through a range of processing techniques, including solvent extraction, ion exchange, nanofiltration, and precipitation. This impurity may originate from the ore itself or be introduced during various stages of processing. This paper aims to examine the behaviour of iron at each stage of uranium processing, as well as the operational techniques designed to reduce its concentration to acceptable levels in the final concentrate.

Keywords: Ion exchange, Iron impurity, Membrane technology, Precipitation, Solvent extraction, Yellow cake

Mpho Ramabulana
Senior scientist
Mintek

Mpho is a Senior Scientist at Mintek. She works on commercial and research projects in Hydrometallurgy. Her primary focus entails the recovery, purification, and separation of diverse commodities, including gold, uranium, copper, cobalt, nickel, and zinc.

Mpho started her journey at Mintek as an intern in 2011. She obtained her BSc, Honours, and MSc degrees in Chemistry from the University of Venda and is pursuing her PhD at Wits.

Heap leaching as a low-cost process route for uranium ores

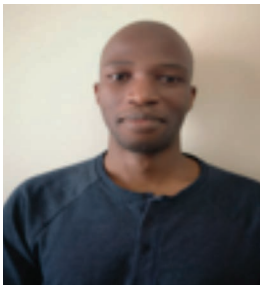
S. Mxinwa[1,2], S.W. Robertson[1], M. Ramabulana[1], V. Govender[1], A. Kotsiopoulos[1,2], J. Petersen[2]
[1]Mintek, South Africa,
[2]University of Cape Town, South Africa

Nuclear energy is a reliable, low-carbon energy source. As data centres and governments seek to improve energy security and target reduced carbon emissions, demand for uranium is increasing. However, the exploitation of uranium resources is constrained by declining grades, complex mineralogy, and environmental and regulatory requirements. Uranium is primarily processed via hydrometallurgical routes, with the ore grade being the most important factor influencing the choice of process. Traditionally, uranium has been processed by milling and stirred tank leaching, which offers high recoveries. However, due to high capital and operating costs, these processing options are now limited to high-grade ores. In-situ leaching has become one of the most common processing routes, with low capital and operating costs, but is limited to permeable sandstone and calcrete deposits confined within impermeable layers.

Heap leaching is commonly applied to gold and copper ores and is being considered for large, low-grade standalone uranium projects, due to its low capital and operating costs. Heap leaching may be applied as a satellite to existing operations or combined with ion exchange recovery to make it suitable for remote locations with limited infrastructure. This paper describes the various stages involved in metallurgical testing of ores for heap leaching. The need for physical and hydrology testing is discussed. Parameters that require optimisation include crush size and reagent addition, for example in an agglomeration stage. Although the ore may be upgraded by radiometric sorting, the influence of the gangue minerals on the reagent consumption is important.

Keywords: uranium, heap leaching

The full paper will be published in the SAIMM Journal



Sibabalwe Mxinwa

Engineer
Mintek

Sibabalwe Mxinwa is an Engineer at Mintek with over a decade of experience in hydrometallurgy, serving as both a Researcher and Chief Investigator on mineral processing and leaching projects. He specializes in the development and optimisation of innovative extraction technologies for complex ores and tailings.

He leads multidisciplinary projects from concept through laboratory- and pilot-scale validation to on-site implementation. His work focuses on designing efficient, sustainable metallurgical processes tailored to ore characteristics and operational constraints. He collaborates closely with mining clients and stakeholders to develop practical technical solutions that improve metal recovery, operational efficiency, and cost performance.

Sibabalwe is currently a PhD candidate in Chemical Engineering at the University of Cape Town. Passionate about innovation and resource efficiency, he is committed to translating research into practical solutions that support the sustainable development of the mining industry.

He has presented his work at international conferences and symposia and has published conference proceedings and peer-reviewed journal articles. He remains dedicated to advancing hydrometallurgical technologies that enhance resource efficiency, reduce environmental impact, and deliver measurable value to the mining industry.

Application of RIP in alkaline uranium leaching process of carnotite ores

C. Bornheim
Wood Group, South Africa

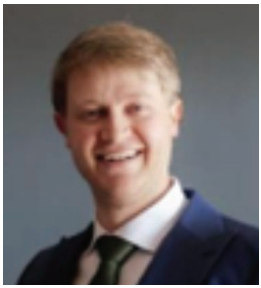
Uranium is critical for the future of nuclear energy with the metallurgical extraction of uranium from ore playing a large role in the value chain. The process selection is strongly influenced by ore mineralogy, grade, impurities, byproducts, and reagent costs. Carnotite-bearing ores, typically associated with significant carbonates and high clay content, present unique challenges for acid leaching as well as for solid-liquid separation circuits.

Alkaline leaching is generally preferred for ores containing significant carbonate content to reduce reagent consumption as the acid will be neutralised by these carbonates. The complications created in the solid-liquid separation steps after alkaline leaching, due to the high clay content, increase capital and operating costs. This influences the viability and profitability of these projects.

This paper evaluates solid-liquid separation technologies and compares the approximate percentage of the total equipment capital cost of a project for the various solid-liquid separation technologies evaluated. Resin-in-pulp (RIP) technology, which directly contacts resin with slurry, is reconsidered. Historically, there have been concerns outside of the capital cost of RIP systems such as:

- Reagent recycling
- Effective separation of resin and ore
- Impurity control
- Attrition rate of resin
- Silica fouling of resin
- Leaching temperature.

Preliminary findings from research highlights RIP as a promising option for carnotite ores. RIP offers potential advantages in reducing capital expenditure, simplifying flowsheets, and improving uranium recovery under challenging ore conditions. Although the inclusion of RIP would still require a solid-liquid separation step to recover reagent and water, the uranium has already been extracted from the solid-liquid separation stage feed stream. Therefore, a much simpler and less intensive solid-liquid separation step can be implemented. Newer developments in ion exchange resins assist in relieving some of the historical concerns of implementing RIP systems in alkaline leach uranium projects.



Craig Bornheim

Senior Process Engineer
Wood PLC

Craig Bornheim graduated from the University of Pretoria with a degree in chemical engineering (B.Eng. Chemical). Over the past decade, he has built extensive experience in the chemical and mineral processing industry, contributing to projects across a wide range of commodities which include gold, copper, cobalt, diamonds, mineral sands, PGMs, chrome, vanadium and uranium. His career spans the full project lifecycle, from concept design through to commissioning and operational support.

Since joining Wood PLC in 2024, Craig has focused on uranium processing and has been involved in the design of two green-fields uranium projects. He has collaborated with leading experts in the uranium processing field during these projects while also drawing on his diverse background in other commodities to bring fresh perspectives to conventional approaches in uranium extraction. His ability to integrate cross-commodity insights with specialized uranium knowledge positions him as a valuable contributor to advancing innovative and practical solutions for the improvement of uranium processing.

Operational optimisation of uranium milling using process modelling

J. Adams, L. Lei, J. Shannon
Hatch, Canada

The demand for uranium is increasing due to demand for clean energy from nuclear power. Years of low uranium prices have led to under-investment in existing mills and relatively little new supply. In addition, regulatory barriers and the high cost of new mines and processing plants further strengthens the case for existing operations to maximise their production with minimal investment. The challenge in both of these goals is knowing where to invest, how much to invest and what the risks are. Fortunately, there are tools that can be used to help in this type of decision-making. This paper will present three example studies of modelling tools that can be used by producers to get the most out of existing mills.

The first example study involves a mill that is not meeting design availability and utilisation targets. The use of a reliable, available and maintainable model can identify problem areas in the plant, down to the equipment level if desired. Depending on the issue identified, a mitigation plan can be implemented which can involve equipment upgrades, increased maintenance of key equipment, or the addition of surge capacity between process plant areas to smooth operational interruptions.

The second example study involves a mill that is running well at nameplate capacity but becomes bottlenecked when production is increased beyond the design throughput. The aim would be to determine the mill's ultimate capacity at different levels of investment. In this case, the operator has years of historical operating data available for analysis. Evaluating the data by process plant area, the operator can determine the maximum sustained operating rate while still achieving key performance indicators. This should coincide with the equipment design operating rate. Where it does not, bottlenecks are identified and the cost of eliminating them is estimated.

The final example involves a mill bottlenecked by water supply and water treatment limitations. The operator needs to investigate new water sources and the level of treatment required to use them. These include a high-cost fresh water source, a lower-cost brackish water source, as well as recycled process water and/or mill effluent. The use of mass and energy balance modelling software predicts impurity deportments and identifies the process and environmental impacts of changing the water sources within the process.

Together these three examples show the benefits of modelling tools for process plant optimisation. Getting the most out of existing assets while minimising costs will be an important contributor to future uranium supply and these tools can play a key role.

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Global Commodity Director – Uranium
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Jeff is Hatch's Global Director for Uranium. He has over 25 years experience in hydrometallurgical research, process design, process engineering and study management. This includes 21 years as a process engineer at Hatch Ltd. Engineering experience includes process analysis and optimization, hazard analysis, technology and due diligence evaluations, test work review, and capital and operating cost estimation. He has expertise in design and operation of uranium leaching, solid/liquid separation, neutralization, ion exchange/solvent extraction, and precipitation. He has designed and led testwork programs in uranium hydrometallurgy as well as other base metals.

Technical and economic evaluation of hydrogen peroxide as an alternative to pyrolusite in uranium oxidative leaching

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Uranium ore predominantly occurs in insoluble tetravalent and soluble hexavalent oxidation states. Invariably, tetravalent uranium must be oxidised to the hexavalent state for effective extraction. Thus, maintaining a leachable oxidation state is crucial for efficient extraction. The common oxidant used for this is pyrolusite, although its commercial purity ranges from 30 to 50% MnO_2. However, using pyrolusite poses operational and safety challenges, including the generation of solid residue and manganese dust, handling challenges, and high reagent consumption. Consequently, the mine is seeking alternatives to eliminate these challenges. Hydrogen peroxide offers advantages such as no solid residue or dust generation, ease of handling and low reagent consumption. This paper investigated the techno-economic feasibility of replacing pyrolusite with hydrogen peroxide in the oxidative leaching of tetravalent uranium ore at a Namibian operation. Laboratory tests compared hydrogen peroxide and pyrolusite in terms of uranium extraction efficiency, oxidant and acid consumption, redox control, and iron speciation. Results showed that both oxidants achieved similar uranium extraction efficiencies (>89%). However, only 0.0354 kg/t of hydrogen peroxide was required, compared with 0.7118 kg/t of MnO_2, and acid consumption was slightly reduced by 0.9 kg/t. An economic evaluation based on these findings indicated total annual savings of US$ 3.5 million. The savings were primarily attributable to the lower oxidant requirement, as uranium extraction performance was similar for both oxidants, and acid consumption differed only marginally. Based on the techno-economic benefits shown above, a plant trial to validate performance under operational conditions was recommended.

Keywords: Uranium, oxidative leaching, hydrogen peroxide, pyrolusite, sulfuric acid, hydrometallurgy.

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Dr Walter Amos Ngobeni is a metallurgical engineer and extractive metallurgy expert with over 16 years of experience spanning mineral processing, hydrometallurgy, product development, research and development. He holds a PhD in Metallurgical Engineering from the University of Johannesburg, where he was also honoured with the prestigious Golden Key Award for academic excellence.

Dr Ngobeni currently serves as Technical Manager – Mining & Metallurgy at BME Metallurgy, a division of the Omnia Group. His technical expertise covers a broad spectrum of commodities, including Aluminium, Coal, Cobalt, Copper, Gold, Iron, Lead, Lithium, Mineral Sands, Nickel, Platinum Group Metals, Phosphate, Rare Earth Elements, Uranium, and Zinc.

Dr Walter Amos Ngobeni is committed to advancing academic excellence and promoting professional development within the field of mineral science. He is a regular contributor to both local and international conferences. His work is published in peer-reviewed journals. Beyond his technical contributions, he serves on the Advisory Board of the Vaal University of Technology, where he actively shapes curriculum standards, promotes industry-academic collaboration, and mentors emerging talent in metallurgical engineering. Additionally, he serves as a peer reviewer for the Minerals Engineering journal, lending his technical expertise to uphold the integrity and quality of scholarly research in mineral processing and extractive metallurgy.

Purification of the nanofiltration product using magnesium oxide to remove iron and other impurities from uranium

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Solvent extraction is a process that uses solvents to remove impurities and purify uranium before the final product is precipitated. These solvents are hazardous, flammable and costly. Despite its effectiveness, the process is associated with high operating costs, emulsion formation, and environmental and health hazards. To address these challenges, reduce costs, eliminate safety hazards, and improve the Environmental, Social and Governance score, a Namibian operation investigated the feasibility of replacing solvent extraction with nanofiltration. The investigation showed that nanofiltration successfully upgraded uranium, reduced product stream volume by 75%, and produced clean, recyclable acid. However, nanofiltration was less selective than solvent extraction and yielded a product with higher impurities, requiring further purification to meet the target product specification. The objective of this study was to precipitate nanofiltration product impurities without co-precipitating uranium. Precipitation was performed using high and low-purity magnesium oxide (MgO). Furthermore, to assess the effect of iron oxidation state, precipitation was conducted on the sample with and without a ferric–ferrous redox buffer wire. The results with wire showed that ferric precipitation above 90% was achievable, but ferrous precipitation was low under all conditions tested. Tests without wire showed improved performance, including partial ferrous precipitation (70%). Low-purity MgO achieved higher iron precipitation but also increased uranium co-precipitation. Based on these results, it was concluded that selective precipitation with MgO is technically feasible, provided ferrous is oxidised to ferric before precipitation. Further optimisation of MgO dosing and redox control is recommended to minimise uranium co-precipitation and achieve the target product specification.

Keywords: Uranium, precipitation, hydrogen peroxide, magnesium oxide, Pourbaix diagram, hydrometallurgy, solvent extraction

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Dr Walter Amos Ngobeni is a metallurgical engineer and extractive metallurgy expert with over 16 years of experience spanning mineral processing, hydrometallurgy, product development, research and development. He holds a PhD in Metallurgical Engineering from the University of Johannesburg, where he was also honoured with the prestigious Golden Key Award for academic excellence.

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Transforming uranium hydrometallurgy: Reagent recovery and operational expenditure optimization through nanofiltration

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Acid and alkaline leaching are the two traditional hydrometallurgical routes for uranium processing. These traditional routes are associated with high reagent consumption, large waste generation, increased operating costs and environmental impacts. This has prompted the uranium industry to look for alternative separation technologies that enable reagent recycling and process simplification. This study presents pilot-scale results from two case studies that integrated membrane technology into uranium hydrometallurgy: one based on an alkaline route and the other on an acidic route. In both cases, ultrafiltration (UF) was used to remove suspended solids, followed by nanofiltration (NF) for selective uranium concentration and reagent recovery. The NF stage used multiple 4040 spiral-wound modules to evaluate commercially available membranes under representative process conditions. The acidic pilot campaign was conducted at a uranium processing plant in Namibia, while the alkaline trials were completed at a research facility in France. Results showed that UF achieved effective removal of solids and colloids. NF selectively concentrated uranium while allowing reagents to permeate, enabling recycling of sulphuric acid in the acidic circuit and sodium bicarbonate and sodium carbonate in the alkaline circuit. Uranium concentrations increased from 375 mg/L in the feed to 2,470 mg/L in the NF concentrate. Reagent recoveries of up to 97% sulphuric acid and 89–94% carbonate were achieved. Overall mass balances demonstrated good accountability. The pilot results confirm that integrated UF–NF circuits offer a technically viable option for reducing reagent consumption, simplifying flowsheets, and lowering environmental impact in commercial uranium hydrometallurgical operations.

Keywords: Uranium; nanofiltration; ultrafiltration; reagent recycle; sulphuric acid; hydrometallurgy; sodium carbonate; sodium bicarbonate.

Leon Bartel
Process Engineer
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Leon has worked in industry for 3 years. Starting his professional career with Memcon and has been focused on membrane technology. He has done pilot plant test work in South Africa, Namibia and France to apply membrane technology to the mining industry. Leon is currently a Process Engineer at Memcon based in JHB, South Africa. He aims to build solutions in the mining and hydrometallurgy industry on the massive benefits that membrane technology offers to these industries.

Trade-offs between settling rate and turbidity in uranium processing: A case for circuit-specific flocculant design

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Flocculant selection in uranium processing circuits is governed by competing performance requirements, particularly in operations employing both pre-leach thickening and Counter Current Decantation (CCD) systems. While pre-leach performance is primarily driven by settling rate and underflow density, CCD circuits impose an additional and critical constraint in the form of overflow turbidity, which directly impacts downstream ion exchange (IX) efficiency.

This paper investigates the trade-off between settling performance and overflow clarity through a structured evaluation of a baseline (standard) flocculant and a series of developmental polymer formulations (DevProd variants) derived from a common base polymer platform. Testing was conducted on slurry samples from a Namibian uranium processing operation under conditions representative of both pre-leach and CCD circuits. Performance was assessed in terms of settling rate, underflow density, and overflow turbidity.

The results show that multiple developmental formulations significantly outperform the baseline (standard) product in the pre-leach circuit, confirming that throughput-related performance is readily achievable. In contrast, CCD performance is strongly constrained by turbidity, with most high-settling formulations producing elevated overflow turbidity due to the formation of open, permeable floc structures. A subset of formulations demonstrated improved turbidity performance at moderate settling rates, indicating that fines capture and floc structure can be influenced through targeted modification of polymer characteristics.

The results define a bounded performance envelope, as demonstrated by the absence of achievable conditions combining high settling rate and low turbidity. No single formulation was found to simultaneously optimise both parameters. These findings demonstrate that the concept of a universal flocculant is not supported for systems with fundamentally different separation requirements.

The paper therefore establishes a case for circuit-specific flocculant design, where formulations are tailored to the dominant performance constraints of each unit operation. This approach provides a more robust framework for optimising solid–liquid separation in uranium processing and supports the development of next-generation flocculants designed to operate within defined performance windows rather than attempting to maximise individual parameters.

Keywords: Flocculants, Pre-Leach, CCD, Uranium

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Natalie Shackleton is the R&D Manager: Mining Metallurgy at AECI Mining Chemicals, with over 40 years of experience in analytical chemistry, hydrometallurgy, mineral processing, and mineralogy. Her expertise lies in flotation, particularly surface chemistry, speciation, and reagent development for both flotation and metal refining. She has held numerous technical and leadership roles, combining strong scientific insight with practical application. Known for her structured problem-solving approach, she drives projects to successful completion while mentoring and developing technical teams. Natalie holds both an MSc and a PhD in Chemical Engineering from the University of Cape Town (UCT).

The removal of colloidal silica using DEHSCOFIX® SC12 in hydrometallurgical operations

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Silica is one of the most abundant constituents in the Earth's crust and is a common impurity in hydrometallurgical circuits. During acid leaching, silicates dissolve to form silicic acid, which can polymerise to amorphous colloidal silica. The presence of colloidal silica has a wide range of negative impacts on hydrometallurgical processes, including gelling during leaching, poor solid-liquid separation, high total suspended solids (TSS), ion-exchange resin fouling, and reduced solvent extraction (SX) performance through crud formation, continuity instability, slow phase disengagement, entrainment, and organic losses. This paper evaluates the use of DEHSCOFIX® SC12, a proprietary silica coagulant, for the removal of colloidal silica from hydrometallurgical solutions, with test work at an acid leach uranium mine used as the principal case study and prior copper applications used for comparison. This laboratory test work showed high silica levels in process streams and demonstrated effective colloidal silica removal by DEHSCOFIX® SC12. In the uranium case, colloidal silica removal exceeded 90% in selected streams; aqueous phase disengagement was restored from severe instability to practical operating times, and uranium extraction performance improved in laboratory SX testing when silica was removed upstream. Test work further showed that DEHSCOFIX® SC12 achieved up to 93% colloidal silica removal from IX feed material without measurable uranium or iron removal. Previous copper application work at operations including MMG/Kinsevere similarly showed improved TSS, phase disengagement, and overall SX performance. The results confirm that targeted removal of colloidal silica using DEHSCOFIX® SC12 can significantly improve process stability and downstream efficiency across both uranium and copper hydrometallurgical circuits.

Keywords: Colloidal silica, solvent extraction, coagulant, DEHSCOFIX® SC12, uranium, copper, acid leach

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Nobuzwe Makhotla is a Business Development Manager at Innospec Limited, with extensive experience across mining & metallurgy, process engineering, technology development, and commercialisation. She has led regional and global business development initiatives across EMEA, Asia-Pacific and the Americas, contributing to the growth of Innospec's mining business initiatives.

Her career spans over 25 years in technical and strategic roles with Innospec, Huntsman Corporation, Gold Fields, BHP Billiton to name a few. She has strong expertise in metallurgical testwork, process optimisation, stakeholder engagement, market expansion and strategic partnerships, with extensive project experience across South Africa, Ghana, Peru, Australia, Uzbekistan and Kazakhstan. Earlier in her career she spearheaded the design and commissioning of the first ASTER thiocyanate and cyanide treatment installation at Barberton Mines, a technology now successfully installed and in operation at 4 other mines globally.

Nobuzwe holds a B-Tech in Chemical Engineering, a Master of Science in Technology Management a Project Management Certificate from the University of Pretoria, and is currently finishing her MBA with the London School of Business and Finance. Her professional interests include mining innovation, sustainable process improvement, product commercialisation and the strategic growth of technology-led businesses across global markets.

Effective utilisation is not an assumption: Linking haul-truck productivity, support equipment, manpower structure and fleet capital outlay at prefeasibility stage

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At prefeasibility study (PFS) stage, haul-truck fleet sizing is often reduced to a calculation of annual material movement, payload, cycle time and assumed effective utilisation (EU). This approach can create a false sense of certainty when the selected EU is treated as an independent input rather than the outcome of an integrated mining system. In large open-pit uranium operations, where long mine lives, high waste movements, variable haul distances and strict production continuity are common, small changes in EU assumptions can materially alter the number of primary trucks required, the support equipment fleet, operator complements, supervision ratios, maintenance capacity and overall capital outlay.

This paper examines the relationship between haul-truck effective utilisation, support equipment availability, operational manpower structure and equipment capital cost during PFS-stage mine planning. It argues that EU is not merely a productivity assumption, but a system-performance indicator influenced by dispatch discipline, loading efficiency, road condition, dump management, refuelling arrangements, shift-change logistics, hot-seat practices, breakdown response, tyre management, field service capacity, traffic interaction and the adequacy of ancillary equipment. Where these supporting systems are under-designed or excluded from early capital estimates, PFS studies may understate fleet size, labour requirements and mining infrastructure costs, while overstating production reliability.

The paper proposes a practical fleet-planning framework suitable for uranium open-pit projects in Namibia and similar jurisdictions. The framework links material movement schedules to cycle-time modelling, EU sensitivity ranges, support-equipment ratios, manpower loading, maintenance response requirements and capital-cost scenarios. It demonstrates how optimistic EU assumptions can reduce apparent fleet numbers at study stage, but may transfer risk into execution through congestion, excessive operator demand, insufficient standby capacity, extended delays, higher maintenance pressure and reduced ore-delivery reliability. Conversely, conservative EU assumptions may increase initial capital estimates but improve decision quality by revealing the true scale of the operating system required to sustain planned production.

The analysis further considers the trade-off between smaller and larger haul-truck classes, particularly where smaller trucks may reduce road-width requirements and improve flexibility, but require more units, operators, supervisors and support interactions. Larger trucks may reduce fleet count and manpower intensity, but can require wider haul roads, different maintenance capability and higher unit capital. These trade-offs are material in long-life uranium projects, where early fleet decisions influence pit design, waste movement, workforce planning, contractor strategy, owner-mining readiness and sustaining capital over several decades.

The paper concludes that PFS mining studies should present EU not as a single assumption, but as a justified operating case supported by enabling equipment, people, infrastructure and process controls. Treating EU as a system outcome strengthens capital discipline, improves project execution readiness and provides boards, financiers and technical reviewers with a more reliable basis for approving uranium mine developments.

Protasius Aluvilu

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Protasius Aifete Aluvilu is a Namibian mining engineer, finance professional and natural resources entrepreneur with almost 15 years of experience in the uranium mining industry. His career has been built primarily at Rössing Uranium Mine, one of the world's longest-operating open-pit uranium operations, where he has gained practical exposure across the full mining value chain, including exploration support, mine planning, drill and blast, load and haul, processing, business improvement, project implementation, executive support, Life of Mine studies and mining finance.

Protasius holds a Bachelor of Science in Mining Engineering from the University of the Witwatersrand and a Master of Science in Metals and Energy Finance from Imperial College London, completed with distinction. This combination of technical mining training and financial expertise allows him to evaluate mining projects from both operational and investment perspectives, including reserve conversion, production strategy, capital allocation, operating efficiency, infrastructure trade-offs and long-term value creation.

At Rössing, Protasius has held several technical and leadership roles, progressing from Graduate Mining Engineer and Mining Engineer to Senior Adviser: Executive Support, Business Specialist, Acting Superintendent and Senior Mining Engineer. His experience includes mining operations management, processing interface work, departmental restructuring, process improvement, bulk explosives evaluation, pit design and scheduling, infrastructure planning, third-party agreements, and support to strategic Life of Mine expansion initiatives.

In his current work, Protasius is involved in the Z20 Life of Mine expansion and related uranium growth studies. His focus includes exploration access development, mining and reserves studies, equipment selection, manpower structure, haulage strategy, operating efficiency, contractor-versus-owner mining considerations, and the practical integration of geology, mining, processing and infrastructure requirements. This work has given him direct exposure to the technical and commercial decisions that shape uranium project development from early study phase through to operational readiness.

Protasius has also worked under both the Rio Tinto and CNNC operating environments at Rössing, giving him a valuable understanding of different governance, operational and investment models in large-scale mining. This exposure has informed his interest in how uranium assets can remain competitive through disciplined planning, effective utilisation of equipment, robust operating structures, safe production systems and technically defensible mine planning assumptions.

Beyond his corporate mining career, Protasius is the Founder and Chairperson of Pamwe Royalties and Streaming, a Namibian natural resources financing company focused on royalty and streaming solutions for mining projects. He is also a member of the Southern African Institute of Mining and Metallurgy.

Protasius' professional interests include uranium project development, Life of Mine optimisation, mining equipment strategy, operational restructuring, exploration-to-production pathways, and the role of disciplined technical studies in converting mineral resources into sustainable mining operations.

Overview on the development of the Jordan uranium project

M. Al-Shannag, M. Al-Naief
Jordan Uranium Mining Company (JUMCO), Jordan

The Jordan Uranium Project is a strategic component of Jordan's nuclear program, led by the Jordan Atomic Energy Commission (JAEC). Its objective is to secure a sustainable domestic uranium supply to support future clean nuclear power generation, while also positioning Jordan to benefit from opportunities in the international uranium market. To implement this vision, JAEC established the Jordan Uranium Mining Company (JUMCO) in 2013 as the Government of Jordan's commercial arm for uranium exploration, mining, and processing.

Since its establishment, JUMCO has undertaken extensive exploration activities in Central Jordan and, in accordance with the JORC Code, has estimated approximately 42,000 tons of U_3O_8 resources. In parallel, Jordan's phosphate deposits also represent a promising secondary uranium source through recovery from weak phosphoric acid streams, offering added value to the country's mineral sector.

JUMCO has made notable progress in developing hydrometallurgical technologies for uranium extraction from Central Jordan ores. Research has focused on optimising extraction parameters, particularly through dynamic alkaline leaching, which achieved uranium recoveries exceeding 90%. Laboratory-scale column studies also produced recoveries above 85%, and these encouraging outcomes were later confirmed on the semi-pilot scale. These results demonstrate the technical feasibility of alkaline heap leaching for Central Jordan uranium ores and provide a sound basis for future scale-up.

To bridge the gap between laboratory research and industrial application, JUMCO installed and commissioned a pilot-scale uranium extraction plant at its campsite in 2021, with an ore handling capacity of approximately 180 tons. The purpose of this facility is to master the developed extraction process and generate the engineering and operational data needed for detailed design and bankable feasibility studies. The pilot plant has already processed tens of tons of ore and produced several kilograms of uranium concentrate (yellowcake), marking an important milestone in Jordan's uranium development pathway.

As part of its scale-up strategy, JUMCO also advanced the design and construction of a demonstration heap leaching plant, which began operation in April 2025. Designed to process about 700 m3 of agglomerated ore, the plant produces around 100 kg of U_3O_8. It includes leaching, ion exchange, refinery, precipitation, and barren solution recirculation systems, allowing continuous operation under near-commercial conditions. The plant serves not only to validate technical and operational parameters, but also as a practical training platform for JUMCO engineers and technicians.

A particularly significant achievement is that all phases of the demonstration project—including engineering, construction, commissioning, and operation—were carried out entirely by JUMCO's internal team using 100% Jordanian expertise and without external technical assistance. This accomplishment highlights JUMCO's strong commitment to building national capacity across the nuclear fuel cycle and reinforces Jordan's emerging role in the international uranium sector.

JUMCO is also investigating recovery of associated value-added elements, particularly vanadium oxides, to improve project economics and maximise resource utilisation. In addition, close cooperation with the International Atomic Energy Agency (IAEA) enabled the establishment of an on-site analytical laboratory, commissioned in 2020, which has significantly strengthened JUMCO's in-house analytical and technical capabilities.

Currently, JUMCO is advancing the project toward commercial readiness through a three-stage development programme comprising (i) deep mineralisation drilling and characterisation, (ii) resource upgrade to Indicated and/or Measured categories under the JORC Code, and (iii) preparation of the Definitive Feasibility Study. Completion of this programme will provide the technical, economic, financial, risk, and ESG basis needed to support commercialisation and engagement with strategic investors and development partners.

From single-parameter to multivariable sorting: full-spectrum XRF for uranium pre-concentration and mineralogical control

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Uranium deposits in Namibia exhibit significant lithological variability at the particle scale, including granite, calcrete, feldspar-rich units, carbonate, and Fe-bearing waste lithologies. While uranium occurs in discrete mineral phases such as carnotite and uraninite, deleterious minerals contribute to dilution and increased reagent consumption during downstream processing. Effective beneficiation therefore requires discrimination based not only on uranium grade but also on mineralogical characteristics that influence processing performance. This paper evaluates the application of full-spectrum X-ray fluorescence (XRF) ore sorting across three Namibian uranium ore types: a granite-hosted alaskite system, an intrusive alaskite-related system, and a calcrete-hosted system. Full-spectrum analysis enables simultaneous measurement of uranium together with associated elements such as Rb, Ca, Fe, and Sr, allowing classification based on both grade and mineralogical proxies linked to processing behaviour.

Calibration against laboratory assays shows that uranium response can be strongly correlated to grade in systems where uranium is well expressed, with R^2 values of approximately 0.95 and mean absolute errors in the order of 30–65 ppm U. In lower-grade granite-hosted material, uranium response is not sufficiently distinct for direct sorting, and separation is instead achieved through lithological proxies across the datasets, multivariable XRF sorting improves selectivity relative to single-parameter approaches. The results demonstrate that sorting performance in Namibian uranium ores is system-dependent, ranging from lithology-driven rejection to uranium-driven separation, with intermediate cases requiring combined multivariable control.

Keywords: uranium ore sorting, sensor-based sorting, multivariable sorting, mineralogical control, pre-concentration, acid consumption

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Nashlen Odiar is the Group Technical Director at Rados International Technologies, with over 15 years of experience in ore sorting, sensor-based algorithm development and minerals processing. He has led international commissioning, training and project delivery across multiple commodities in more than nine countries.

He previously served as a Process Engineer at Rados International Services, specialising in sorter calibration, commissioning, and R&D integration and as Project Chief Investigator at Mintek, where he led mineral processing testwork programmes involving advanced sensor sorting technologies.

Nashlen holds a BSc in Chemical Engineering from the University of KwaZulu-Natal and a Certificate in Data Analysis from the University of Cape Town. His experience spans base metals, precious metals and platinum group metals.

Integrated process development for uranium yellowcake production from central Jordan low-grade deposits

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Jordan Uranium Mining Company (JUMCO), Jordan

The Central Jordan Uranium Project (CJUP) comprises a large, near-surface, low-grade uranium resource that is amenable to low-strip-ratio open-pit mining and bulk processing. Owing to the carbonate-rich nature of the ore and its occurrence within friable to moderately competent sedimentary units, alkaline leaching was identified as a more suitable extraction route than conventional acidic processing. Given the relatively low head grade of the deposit, the development of a technically robust and economically efficient flowsheet is essential for future commercial exploitation. This paper presents the development and pilot-scale validation of an integrated process route for uranium yellowcake production from Central Jordan ores, incorporating ore preparation and agglomeration, alkaline heap leaching, ion exchange upgrading, and final uranium precipitation.

Crushed ore, typically within the 2–5 cm size range, was agglomerated using lime and cement to enhance bed permeability, improve mechanical stability, and maintain favourable hydraulic performance during extended leaching cycles. Sodium carbonate solution was applied during pugging to support early-stage reagent distribution and improve leach readiness of the agglomerates. Heap leaching performance was evaluated progressively from laboratory-scale tests on a few kilograms of ore to pilot-scale campaigns involving hundreds of tonnes. The leach system, based on sodium carbonate/sodium bicarbonate media, consistently achieved uranium extraction in the range of 80–88%, while maintaining acceptable hydraulic behaviour and good selectivity toward uranium dissolution from the carbonate host matrix.
Ion exchange was adopted as the primary concentration and upgrading step for the dilute alkaline pregnant leach solution. Several candidate resins were assessed in terms of loading performance, sorption kinetics, thermodynamic behaviour, and reusability over repeated operating cycles. The selected resin systems enabled efficient uranium capture and concentration into a comparatively small eluate volume, producing eluates in the range of 3000–6000 ppm U and achieving approximately 90% recovery across the ion exchange stage. These results confirmed the technical suitability of resin-based upgrading for alkaline heap leach liquors derived from low-grade uranium ores.

The final recovery stage comprised solution purification, sodium diuranate precipitation, redissolution, and uranium peroxide precipitation to yield the final yellowcake product. The developed downstream route delivered a final uranium recovery of approximately 97%, producing a yellowcake assaying about 69.6% U with a purity of 98.9%. On an integrated basis, the overall process recovery reached approximately 83%.

In parallel with uranium recovery, the process route was also evaluated for vanadium recovery as a potential by-product in order to enhance overall project feasibility and reduce the environmental burden associated with dissolved residual metals in process streams. The results indicated that vanadium valorisation could provide additional economic benefit while improving the overall sustainability of the developed flowsheet.
The results demonstrate that the proposed flowsheet is technically viable for Central Jordan low-grade uranium deposits and provides a sound basis for detailed engineering, scale-up, and future commercial project evaluation. This version aligns well with the process framing already reflected in your project draft and CJUP background notes.

Keywords: Central Jordan Uranium Project; low-grade uranium ore, alkaline heap leaching, agglomeration, ion exchange, yellowcake, pilot-scale processing

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Dr. Mohammad Alnaief is Plant Manager of the Entrepreneurial Uranium Extraction Plant at the Jordanian Uranium Mining Company (JUMCO), Jordan, and an Associate Professor of Chemical Engineering at the German Jordanian University. He leads R&D and scale-up activities for the Central Jordan Uranium Project, with emphasis on uranium hydrometallurgy, ion exchange, product purification, pilot-plant commissioning, process optimization, feasibility studies, and environmental assessment. His current work also includes by-product valorization, including vanadium recovery, as part of integrated uranium process development.

Dr. Alnaief holds a PhD in chemical engineering from Hamburg University of Technology, Germany, and has built a parallel research profile in supercritical fluid technology and nanoporous materials, particularly aerogels and advanced functional materials for energy, catalysis, and water treatment applications. He has published widely, led several funded research projects, and presented his work at major international conferences in uranium processing, chemical engineering, and advanced materials.

Rethinking flocculant preparation in high-throughput mining applications: A techno-economic comparison of conventional batch vs continuous systems

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Continuous processing is generally preferred in high-throughput industrial applications due to improved process stability, reduced equipment sizing, and lower operational variability. Despite this, flocculant preparation systems within the mining and minerals processing industry remain predominantly batch-based, even as plant throughputs continue to increase.

Flocculant preparation is more complex than simple dissolution, requiring controlled wetting and hydration to achieve optimal polymer activation. Poor preparation can result in polymer agglomeration, inconsistent solution quality, and reduced downstream flocculation performance. While continuous polymer preparation technologies are widely adopted in industries with high and sustained polymer consumption, such as the energy sector, mining operations continue to rely largely on conventional batch systems.

This paper presents a techno-economic comparison between conventional batch flocculant preparation and continuous modular make-up systems for high-capacity mining applications. The assessment evaluates equipment sizing, installed power, footprint, operational stability, and modularisation potential using a representative minerals processing case study.

The analysis demonstrates that continuous systems fundamentally scale more efficiently than batch systems because equipment sizing is governed by steady-state process demand rather than intermittent peak demand associated with batch operation. The results show significant reductions in tankage, installed power, and operational complexity for continuous systems, while also improving process consistency and reducing operator dependency.

The advantages of continuous modular flocculant preparation are particularly relevant to modern hydrometallurgical operations, including uranium and critical minerals projects, where high throughput, water recovery, modular deployment, and operational reliability are increasingly important.

Keywords: Flocculant Preparation, Batch vs Continuous, Modular

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My professional career began in the design and application of heat transfer equipment for the mining and food & beverage sectors. I have since transitioned into process design consultancy, where I contribute to diverse projects within the oil & gas and mining industries. This trajectory has allowed me to lead design work across the full project lifecycle—from initial feasibility studies and detailed engineering to final commissioning.

Through these experiences, I have cultivated a versatile technical skillset and a proven ability to implement complex engineering solutions across multiple industrial sectors

Beyond the grade: Structural geology and rock mass characteristics as a first-order control on life-of-mine value

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Mine designs are predominantly grade driven. Resource models are constructed around the spatial distribution of mineralisation, and the pit shells, pushbacks and final slope geometries that follow are optimised largely against the ore envelope, with limited regard for structural and geotechnical contributions. Structural and rock-mass data often receive limited attention during the resource definition stage and are incorporated only later during detailed geotechnical design and operations. This sequencing creates a persistent blind spot: significant structures may be recognised only after mining of an area is already underway, resulting in structurally controlled failures, reactive redesign, increased costs and loss of recoverable ore. This study argues that structural and geotechnical inputs is a first order control on life-of-mine (LOM) alongside grade and belong in the front of the workflow together with resource definition. Many large open pits sit in structurally complex, fault-controlled settings (the Husab Uranium deposit among them), yet only a handful of structural and geotechnical drillholes are drilled to inform the design across large area. Structures therefore go unresolved until they intersected the pit, where they generate structurally controlled failures that must be managed reactively, at the expense of cost and recoverable ore. Earlier, purpose-targeted, structural and geotechnical drilling improves pit optimisation and reduces redesigns. The paper proposes a practical framework for embedding structural interpretation and rockmass characterisation into resource domaining from the earliest planning stages, rather than retrofitting it after failures occur. Early characterisation cost little against the LOM value it preserves, and structure-led design transfers readily to other commodities on the Damara Province and comparable settings.

Keywords: Grade; Life of Mine; Exploration, Mining, Structures; Mine design

Grantham Ockhuizen

Superintendent: Geotechnical
CGNPC Swakop Uranium

Grantham Ockhuizen is a highly experienced Engineering Geologist with 17 years in the mining industry. Professionally registered with SACNASP, he serves as Superintendent - Geotechnical at Husab Mine, Namibia, where he leads the geotechnical team in managing operational risks, slope design, and executing monitoring programs aligned with medium- and long-term mine plans. His role includes the continuous improvement of departmental systems to enhance efficiency and effectiveness in support of production targets. He supports operations and projects by implementing best-practice geotechnical standards in mapping, logging, structural analysis, groundwater assessment, and slope stability interpretation.

Beyond his operational responsibilities, Grantham served as Chairman of the SAIMM Namibian branch from 2013 to 2017 and remains an active affiliate member, demonstrating his strong commitment to professional excellence and industry advancement. Grantham is currently doing post graduate studies focused on structural complexities and deformation mechanisms in large open-pit mines, with research centred on the Husab Mine and the broader Damara Orogen at the School of Geosciences, University of the Witwatersrand.

Recovery of uranium from bra uranium deposits by nitric acid leaching

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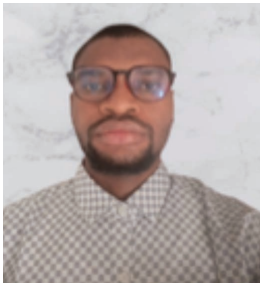
The rate of energy consumption is increasing tremendously. Uranium, a critical energy metal, plays a vital role in the advancement of the nuclear industry. In this paper, the extent of uranium ore dissolution was examined under various experimental conditions, including leachant concentration, reaction temperature, and particle size, among others. At optimal conditions (2.5 mol/L HNO_3, 75°C, -90+75 µm), approximately 92.1% dissolution rate was achieved within 120 minutes. The activation energy (Ea), estimated to be 19.67 kJ/mol, indicates that the reaction is a diffusion-controlled mechanism and more economical than other studies. However, the thermodynamic parameters, including ΔH, ΔG, and ΔS, respectively, were estimated. The positive value of ΔH affirms that the uranium dissolution by nitric acid solution is an endothermic process. Hence, this paper provides a valuable reference for future studies on Bra uranium deposits (Nigeria) combined with other uranium mines with similar mineralogical indices.



Mustapha Adekunle Raji

Postdoctoral Fellow
North-West University

Mustapha Adekunle Raji is a Postdoctoral Fellow at North-West University, Potchefstroom, South Africa, where he specializes in hydrometallurgy within the Research Focus Area of Chemical Resource Beneficiation (RFA: CRB) – Hydrometallurgy Group. His academic journey began with a First-Class Honours degree in Industrial Chemistry, which laid a solid foundation for his expertise in hydrometallurgical processes. He holds a Ph.D. in Industrial Chemistry from the University of Ilorin (2024). His area of research covers analytical, industrial, and materials chemistry in general, with special interests in solid minerals and materials processing through hydrometallurgical routes, including leaching, solvent extraction (SX), pertraction (PX), precipitation, crystallization, among others.

His dedication to research excellence earned him the prestigious INSA JRD-TATA Research Fellowship Award at the Metal Extraction and Recycling Division, CSIR – National Metallurgical Laboratory, Jamshedpur, Jharkhand, India. Additionally, he had the unique opportunity to represent Africa at the G20 RIIG Conference on Circular Bio-Economy held in Dibrugarh and Itanagar, India, which significantly broadened his research perspective and international experience. As a recognized expert in hydrometallurgy for industrial value addition, he received the Prof. Adewoye Memorial Prize for the Best Award Paper Presentation entitled "Preparation of Industrial Ammonium Diuranate from a Boltwoodite Ore as a Mediator in Nuclear Fuel Cell" at the 22nd Annual International Conference of the Materials Science and Technology Society of Nigeria.

To his credit, he recently won the Dr. Cynthia Jackson-Hammond Prize as the Best Participant from Other African Countries (scoring 29,145 points among 11 international participants) on the Virtual Institute of Capacity Building in Higher Education (VICBHE) Module 10: Basic Cybersecurity for Higher Education, organized by NUC-NOUN VICBHE, Global University Network for Innovation-Africa (GUNi-Africa), and Tertiary Education Trust Fund (TETFund).

He has contributed significantly to hydrometallurgical science throughout his career, with over 27 peer-reviewed journal articles, 18 conference paper presentations, 13 book chapters, 5 technical papers, and 2 conference proceedings. He is a reviewer for several high-impact journals, reflecting his dedication to maintaining research quality and integrity. He is a member of several professional bodies, including the Materials Science and Technology Society of Nigeria (MSN), American Chemical Society (ACS), Materials Research Society (MRS), Chinese Chemical Society (CCS), and Association of Cyber Security Practitioners (ACSP), among others. He has supervised and co-supervised 2 M.Sc., 5 B.Sc. Honours, 2 B.Eng. students, and still counting. He was a B.Eng. student project co-supervisor of the Best Poster Presentation award of the School of Chemical and Mineral Engineering, North-West University, Potchefstroom, South Africa, in the 2025/2026 academic session. His leadership skills have been honed through his experience as the Former Acting Research Director at Ahman Pategi University, Nigeria.

Techno-economic drivers in uranium processing: A case-based framework for optimal flowsheet selection

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Understanding the relationship between uranium orebody characteristics, mineralogical variability, gangue and impurity deportment is fundamental to developing technically robust and economically viable processing routes. This paper evaluates a range of uranium deposits, from complex polymetallic orebodies to calcrete and sandstone-hosted systems, by examining grade distributions, various lithologies, gangue mineralogy, impurity profiles, and subsequent metallurgical responses.

Through comparative case studies drawn from technical studies led by DRA as well as current global operations, this paper assesses how ore characteristics influence process selection and flowsheet selection. Key areas evaluated include, among others, beneficiation strategies, alkaline versus acid leaching, ion exchange (IX) and solvent extraction (SX) circuits, impurity management, gangue management and the application of pre-concentration technologies.

The analysis integrates geometallurgical insights, process modelling, and economics to quantify how early-stage identification of key technical and economic drivers reduces technical risk, focuses testwork campaigns, optimises operating cost, improves final product quality, and ultimately enhances project economic resilience.

The paper provides a practical, case-based framework to guide engineers, metallurgists, and project developers in selecting optimal and sustainable flowsheets for diverse uranium deposits under dynamic economic, regulatory, and environmental constraints.

Aveshan Naidoo

Specialist Engineer – Hydromet and Economics
DRA Global

Aveshan, employed by DRA Global, is a professionally registered engineer and Specialist Engineer in Hydrometallurgy and Economics, with more than eighteen years of experience in testwork definition and supervision, process design and consultancy, construction management, commissioning, and financial model development and analysis. His career has centred on delivering technically robust and economically optimised solutions across a range of commodities, with a strong emphasis on uranium.

Aveshan holds a Bachelor of Science in Chemical Engineering from the University of KwaZulu-Natal and a Master of Business Administration from the University of the Witwatersrand. He is a registered Professional Engineer with the Engineering Council of South Africa (ECSA) and a member of the Southern African Institute of Mining and Metallurgy (SAIMM).

Over the course of his career, Aveshan has built deep technical expertise across the full project lifecycle, from testwork definition and supervision to process modelling, engineering definition, risk analysis, cost estimation, and commissioning support. His experience spans numerous African jurisdictions, including South Africa, Namibia, Tanzania, Liberia and Ghana, as well as various international engagements.

Secondary uranium mineralisation in Tumas East, Erongo Region, Namibia

R.G. Viring
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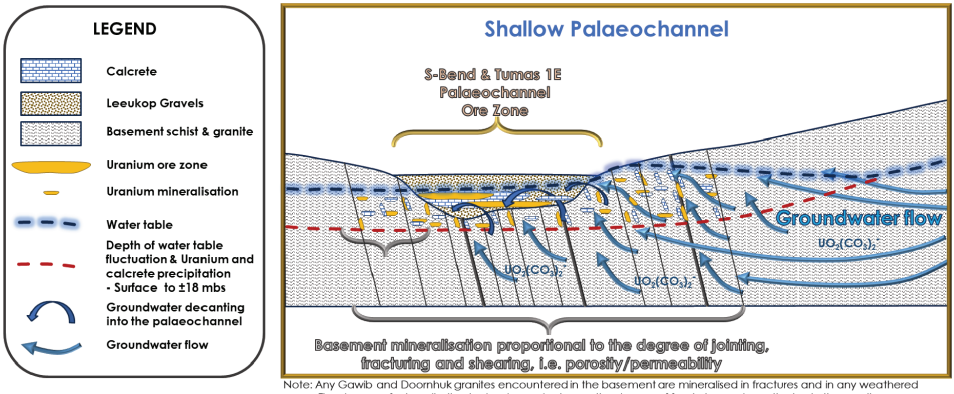
The uranium mineralisation in the Tumas East secondary environment is dependent on the following parameters. A readily leachable source of uranium, a well-established conduit system allowing the groundwater to flow to the site of mineralisation, a favourable host rock to mineralise, and time. In the Tumas East area, the source of the leachable uranium is considered to be the Bloedkoppie granite suite, and associated sheeted granites located in the Tinkas and Hureb Formations and the S-type Donkerhuk granite suite and associated sheeted granites in the Hureb Formation. The uranium is transported as a carbonate complex via groundwater in the shear zones associated to the Tinkas, Okahandja and North Donkerhuk lineament shear zones. In the Tumas palaeochannel area, the basement is highly fractured and faulted due to continuous deformation events related to the Damara orogeny. This resulted in the creation of the deep Tumas valley as part of the development of the Namib unconformity surface, post-Gondwana breakup. This palaeo-valley was subsequently filled with coarse grits and pebbles of the Leeukop Formation. Fertile uranium bearing groundwater rises to the surface in the palaeo-valley along the sheared and fractured basement schists where the highly porous and permeable basement and palaeochannel were ideal hosts, allowing the precipitation of both carnotite and calcrete. The degree of mineralisation in both the palaeochannel and the fractured and sheared basement is controlled by the degree of porosity and permeability of each rock type. The highly porous and permeable palaeochannel allowed for the maximum precipitation of uranium and calcrete mineralisation, whilst in the basement, the lower porosity and permeability have resulted in a lower grade of uranium and calcrete mineralisation. However, the greater volume of basement exposed to mineralising groundwater may result in a lower grade, but a concomitant larger volume of mineralisation



Note: Any Gawib and Doornhuk granites encountered in the basement are mineralised in fractures and in any weathered zones. The degree of mineralisation is also dependent upon the degree of fracturing and weathering in the granite.

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Richard Gerardus Viring

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Richard is a Professional Geologist and Mining Executive with over four decades of multi-commodity experience across Southern Africa and Namibia. His career is built on a foundation of technical excellence and strategic resource management, supported by a Masters in Mineral Resources, an Honours in Mineral Economics, and a BSc in Geology and Earth Sciences.

Currently, he provides consulting services to exploration in Namibia, focusing on uranium deposits within the Damara orogeny.

His background spans the full mining lifecycle—from grassroots exploration in the Witwatersrand Gold Fields and Ecca coal deposits to executive leadership as Mine Services Manager at Northam Platinum, Economic Resource Manager & Chief Mine Planner at Anglo American Platinum and Project Manager at Sedibelo Platinum Mines Ltd.

He is a Fellow of the Geological Society of South Africa (GSSA) and a Registered Professional Natural Scientist (Pr.Sci.Nat.) with the South African Council for Natural Scientific Professions (SACNASP).

Technical Mastery: Experience in surficial & granite-hosted uranium deposits related to the Damara orogeny, Ecca coal deposits, the geology of the Bushveld Complex as well as the Witwatersrand Gold Fields.

Designing uranium heap leach circuits with limited test work availability: A modelling-focussed approach

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CM Solutions Metlab, South Africa

With declining ore grades and increasing energy and water constraints, heap leaching offers a comparatively low-cost and low-energy method for metal recovery, supporting the sustainable utilisation of mineral resources and reduced processing footprints. In the context of growing interest in nuclear energy as a low-carbon power source, heap leaching presents a viable option for the economic extraction of uranium from lower-grade and more complex deposits. Despite its apparent simplicity, heap leach performance is governed by complex interactions between hydraulic behaviour, solution chemistry, and mineralogical variability, all of which critically influence uranium extraction efficiency and reagent consumption. Conventional design approaches typically rely on rules of thumb and steady-state representations of heap leach circuits, supported by laboratory test work. While these methods provide valuable insight into average circuit behaviour, they are inherently limited in their ability to capture the transient dynamics of heap systems – particularly during curing, start-up, irrigation cycling, and periods of changing operating conditions. This paper evaluates the implications of steady-state versus dynamic simulation in the modelling of uranium heap leach circuits. Building on established characterisation methodologies, a dynamic modelling framework developed within Cycad Process integrates laboratory test data with uranium dissolution kinetics and solution transport behaviour. The approach enables calibration against available data while allowing iterative refinement as additional information becomes available. A key advantage of the dynamic approach is its ability to support design and operational decision-making under conditions of limited test work – a practical constraint frequently encountered in uranium project development. The comparison highlights the respective strengths and limitations of each approach, demonstrating how dynamic simulation can reduce uncertainty, improve confidence in scale-up, and provide a more robust basis for evaluating uranium heap leach circuit design and performance.

Stephen van Huyssteen

Process Consultant, Senior Engineer
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Stephen is a Chemical Engineer who began his career in chemical recovery and digestion within the pulping sector, before focusing on mineral processing and hydrometallurgy. He currently works as a Senior Process Engineer within the consulting team at CM Solutions, with a specific focus on simulations and process modelling. Stephen has experience in the research and development of hydrometallurgical processes, guiding projects from conceptual studies through to pilot-scale implementation, and has developed flowsheets across a range of commodities, including base metals (Cu, Ni), precious metals (Au, PGMs), U and rare earths.

Sulphuric acid - A commodity in conflict

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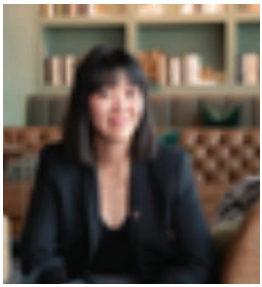
Namibia is both a net sulfur and sulfuric acid importer due to the closure of Tsumeb, driven by a lack of copper concentrates, and a growing base of sulfur consumers from the uranium and copper industries. Supply constraints for both products leave the country exposed to higher raw material and transport costs. This paper will explain how the global sulfur and sulfuric acid deficit emerged and explore Namibia's sulfur and sulfuric acid supply and demand balance between 2026 and 2030.

We will also examine, with Namibian market participants, the challenges faced by the global industry as exposed by the Middle East conflict and discuss the survival strategies adopted by buyers amid supply constraints, including stockpiling, sourcing diversification, raw material substitution and supply chain modifications.

Sulfur and sulfuric acid trade flows have been tested repeatedly over the past decade, from the global lockdowns triggered by the Covid-19 pandemic, which paralysed supply chains, to the Russia-Ukraine conflict that caused sharp price volatility in sulfur and natural gas, and the Red Sea crisis that drove freight costs higher. The Middle East conflict, however, has placed sulfur and sulfuric acid supply chains under the most severe strain.

For many industries, sulfur and acid are no longer by-products of the oil, gas and base metals sectors. As the range of end-users has expanded, both commodities have become strategic resources, with governments increasingly focused on securing supply and restricting exports, including China's ban on acid exports and Russia and Turkey's bans on sulfur exports.

Over 90% of Southern Africa's sulfur imports come from the Middle East, meaning the effective closure of the Strait of Hormuz has put this supply on hold since the conflict began. Alternative sources have therefore been secured from the Red Sea, Vancouver and the US Gulf Coast. End-users in the region have had to absorb increased transport costs while competing for scarce volumes with nickel producers in Indonesia and fertiliser producers globally.



Freda Gordon
Director
Acuity Commodities

Freda focuses on short-to-medium term analysis of the global sulphur and sulphuric acid markets, which she has dedicated her career to since 2010. She reports on Asia, China, Middle East, Africa and Europe. Freda honed her experience and analytical skills editing several key price assessment publications and giving papers at international conferences. Her previous roles span journalism, business strategy, communications, marketing, public relations, and social media.

The Dasa uranium project (Part 1): Discovery, geology, mine development, and infrastructure in the Tim Mersoi Basin, Niger

S.G. Roman, S. Faucher
Global Atomic Corporation, Canada

The Republic of Niger has been a significant contributor to global uranium supply for more than five decades through mining operations located within the Tim Mersoï Basin. Uranium production in the region has historically been centred around the mining district near Arlit, where sandstone-hosted uranium deposits have supported large-scale operations since the early 1970s. Continued exploration within the basin has identified additional mineralisation south of the historical mining district, culminating in the discovery of the Dasa deposit by the Canadian exploration company Global Atomic Corporation. Dasa is the most significant uranium deposit ever discovered in the Republic of Niger.

The Dasa deposit, located approximately 105 km south of Arlit, was discovered in late 2010 through systematic exploration of the Adrar Emoles permit area. Uranium mineralisation occurs within Carboniferous fluvial sandstones and is structurally controlled in a graben which hosts permeable channel systems. Mineralisation is dominated by coffinite and pitchblende and occurs primarily along redox interfaces characteristic of sandstone-hosted uranium systems. Several mineralised zones have been delineated, with the high-grade Flank Zone forming the basis for the initial mine development. Reserve grades exceeding 0.5% U_3O_8 place Dasa among the highest-grade uranium deposits currently under development globally.

The geometry and grade distribution of the Flank Zone support an underground mining approach designed to maximise recovery of high-grade mineralisation while maintaining operational flexibility and geotechnical stability. Mine access is provided through a decline developed in the footwall of the deposit, with production levels spaced to optimise long-hole drilling geometry and stope sequencing. Mining will utilise mechanised transverse long-hole open stoping with cemented backfill. The mine design incorporates careful management of groundwater inflow, geotechnical conditions, and the operational requirements associated with mining high-grade uranium mineralisation.

The development of the Dasa Project also presents significant logistical and infrastructure challenges associated with constructing and operating a large-scale mining project in a remote Sahara Desert environment. The project site lies in a sparsely populated region; however road, power and water infrastructure are available and will be upgraded to support a large-scale mining operation. Infrastructure development includes upgraded roads, housing, communication systems, and water treatment facilities. The Dasa Project is designed to withstand the harsh desert environment including high summer temperatures, sandstorms, and seasonal rainfall events. The project design follows EP4 and IFC Performance Standards and will be among the most modern uranium operations globally with commissioning to begin in Q4 2027.

This paper presents an integrated overview of the geological setting, resource development, and mine engineering strategy for the Dasa Uranium Project. Particular emphasis is placed on the relationship between deposit geology and underground mine design, as well as the practical challenges associated with developing a high-grade uranium operation in a remote desert environment.

Santiago Faucher

Chemical and Metallurgical Product and Process Developer
Global Atomic Corporation

Ph.D. in Chemical Engineering and passionate about design, implementation and operation of sustainable technologies for the production of chemicals and materials. Twenty-six years of experience spanning R&D, process development, production plant design - construction - commissioning and operations on four continents.

Specialties: Process Development and Piloting, mineral processing, hydrometallurgy, pyrometallurgy, granulation and powder production technologies, specialty cement design, technology development, expert witness, technology due-diligence, process research and development, materials synthesis and development (polymers, industrial minerals, metals), intellectual property, process scale-up, basic through detailed engineering, chemical plant construction management and commissioning, cost estimating and process economics, strategic change management, team building and leadership, operations management, problem solver and teacher. Fluent in english - french - spanish.

The Dasa uranium project (Part 2): High-solids pug leaching, metallurgical testwork, and hydrometallurgical plant design

S. Faucher[1], S.G. Roman[1], A. Stammitti[2]
[1]Global Atomic Corporation, Canada
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The Dasa Uranium Project represents one of the most significant new uranium developments currently under construction globally. Located in the Tim Mersoi Basin of Niger, the deposit hosts high-grade sandstone uranium mineralisation dominated by coffinite and pitchblende. The mineralogical characteristics of the ore and the presence of clay-bearing gangue minerals required the development of a modified hydrometallurgical flowsheet to achieve high uranium recovery while minimising reagent consumption and downstream processing challenges.

Metallurgical investigations demonstrated that uranium could be effectively liberated at relatively coarse particle sizes, enabling a milling strategy targeting approximately minus 1 mm. Conventional slurry leaching approaches similar to those employed at Namibian uranium operations resulted in elevated acid consumption and clay exfoliation which adversely affected downstream filtration performance.

To address these issues, a high-solids acid attack stage was developed in which milled ore is contacted with concentrated sulfuric acid and oxidant in a pugging system operating at high solids concentration. Under these conditions the acid reacts with uranium-bearing phases prior to dilution, promoting rapid uranium dissolution while minimising clay exfoliation. The partially reacted material is subsequently transferred to agitated leach tanks where lixiviation is completed. This same process has been practised in other uranium bearing sandstones historically, including in Niger, for over 50 years.

Despite improved extraction and reduced acid consumption, clay dispersion created challenges in solid-liquid separation. Filtration performance was improved by modifying the surface potential of fine particles through controlled addition of coagulants followed by a second-stage flocculation step. This coagulation–flocculation strategy enabled effective belt filtration for recovery of the loaded leach solution.

Additional filtration challenges occurred during sodium diuranate precipitation where fine precipitates initially produced poor filtration characteristics. Custom precipitation reactors were developed to control nucleation and promote large crystal growth, resulting in improved filtration rates and high uranium recovery without requiring coagulants or flocculants in the precipitation circuit.

The resulting process flowsheet combines high-solids pug leaching, optimised particle management, and controlled precipitation to deliver a robust hydrometallurgical solution tailored to the mineralogical characteristics of the Dasa orebody and the operational realities of a remote desert mining operation.

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Assessment of thermal comfort and breathability performance of disposable protective apparel and its impact on PPE compliance in mining and processing environments in Sub-Sahara Africa

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DuPont Personal Protection, Sub-Saharan Africa

Mining and processing environments in Sub-Saharan Africa present a complex combination of radiological, solid particle, chemical and environmental hazards, frequently encountered under conditions of elevated ambient temperature, high humidity, and sustained physical workload. Disposable protective garments are widely used to prevent exposure of hazardous substances to the skin; however, limitations in thermal comfort and moisture vapour transport are well-documented contributors to poor wearer tolerance and reduced compliance, particularly during prolonged or heavy-duty tasks.

This paper presents an overview of the application of disposable protective apparel in mining environments where there is a risk of particle and light chemical splash; explains the mechanism of how the body manages thermal comfort; investigates the methodology of comfort assessment, concluding with the implications for uranium mining and processing.

The analysis highlights the relationship between comfort performance and physiological heat stress, behavioural responses, and PPE compliance in typical mining operations. The key enablers of fabric comfort viz. reduced evaporative resistance and improved moisture management are shown to support effective heat dissipation, thereby enhancing wearer tolerance and enabling sustained use of protective garments in hot and demanding environments. Furthermore, improved comfort performance reduces the likelihood of improper garment use, a common occurrence on mining sites, which may otherwise compromise occupational safety.

The findings highlight the importance of integrating comfort science into the design and selection of disposable protective clothing for mining and mineral processing. By improving worker acceptance to protective clothing, next generation fabrics have the potential to support better compliance, reduced heat stress related risks, and strengthen contamination control strategies.

Keywords: Uranium mining, PPE compliance, evaporative resistance, moisture vapour transmission, heat stress, protective clothing, contamination control, wearer acceptance

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Sales Manager
DuPont

After graduating from the University of KwaZulu-Natal (UKZN) with a B.Sc. (Chemistry & Applied Chemistry) degree, Ajen spent five years as Works Chemist for an oil refining company. In 1995, he moved from production into marketing, after joining Huls Southern Africa (now acquired by Evonik), as Technical Sales Manager: Emulsions and Engineering Polymers, where he was involved in the technical sales of polymer products to a diversified end-user base. During this period, Ajen also completed an MBA at the UKZN.

Having joined DuPont in 1997, as Territory Manager for Advanced Fibers & Nonwovens, he has established a leading position for DuPont in the high-performance materials space in Sub-Sahara Africa In 2013, he relocated to the DuPont European headquarters in Geneva, Switzerland where he was Business Leader for the DuPont Kevlar® Life Protection business for Europe, Middle East and Africa.

In 2018, he was appointed as Country Leader for DuPont South Africa in addition to his responsibilities as Business Lead for DuPont Safety in Sub-Sahara Africa. In 2021, Ajen was appointed as Country Leader for the DuPont legal entity in Kenya, and in 2023 he became a Director of the DuPont legal entity in Nigeria.

Ajen lives in Johannesburg with his family, and enjoys golf, cycling & hiking