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ASX Announcement

22 February 2024

QEM and UQ produce first vanadium pentoxide from Queensland industrial waste

Highlights:

- → **QEM has partnered with The University of Queensland (UQ) to produce the first high purity vanadium pentoxide (V2O5) from an industrial waste stream in Australia. V2O5 is the essential component of the electrolyte used in vanadium flow batteries.**
- → **QEM engaged UQ in this Circular Economy project to upcycle vanadium-bearing catalyst sourced from Queensland industrial waste.**
- → **UQ conducted a small-scale laboratory demonstration of all the processing steps in recycling the vanadium catalyst into a high purity vanadium oxide product (>99%).**
- → **This research and development project is part of the Trailblazer Universities Program for Resources Technology and Critical Minerals, led by Curtin University in partnership with The University of Queensland and James Cook University.**

Critical minerals explorer and developer QEM Limited (ASX: QEM) **("QEM" or "Company")** is pleased to announce the successful results of a vanadium-bearing catalyst recycling study being carried out on the Company's behalf by The University of Queensland Hydrometallurgy Research Laboratories, part of the School of Chemical Engineering (UQ).

QEM supplied UQ with the spent catalyst to be used in the project. On 27 June 2023, QEM announced it had entered into an agreement with Incitec Pivot Limited ("IPL" or "Incitec") to collect the vanadium-bearing spent catalyst from IPL's Mount Isa Sulphuric Acid Plant and process this waste into high purity vanadium pentoxide (V2O5). QEM also entered into a similar agreement on 7 March 2023 for the supply of spent catalyst from Sun Metals Corporation Pty Ltd's ("SMC" or "Sun Metals") Townsville Zinc Refinery.

These collaborations with Sun Metals and IPL represent Circular Economy opportunities where industrial waste can be repurposed to a higher use by extracting the critical mineral vanadium as V2O5. V2O5 is the essential component of the electrolyte used in vanadium flow batteries (VFB), critical to achieving Australia's carbon reduction targets.

Currently the spent catalyst removed from sulphuric acid plants ends up in waste facilities. This project aims to provide a circular economy solution to this industrial waste stream by extracting the vanadium and putting it back into the economy as a high value product.

Test work previously conducted by QEM and Clean-Teq Water, established that 90% of the battery grade vanadium present can be extracted using known techniques (see ASX announcement: QEM Annual Report dated 27 Sept 2023). The collaboration with UQ is a further step in demonstrating Vanadium recovery.

The first stage of the collaboration between QEM and UQ involved a small-scale laboratory demonstration of all the processing steps in recycling the spent catalyst into a high purity vanadium oxide product.

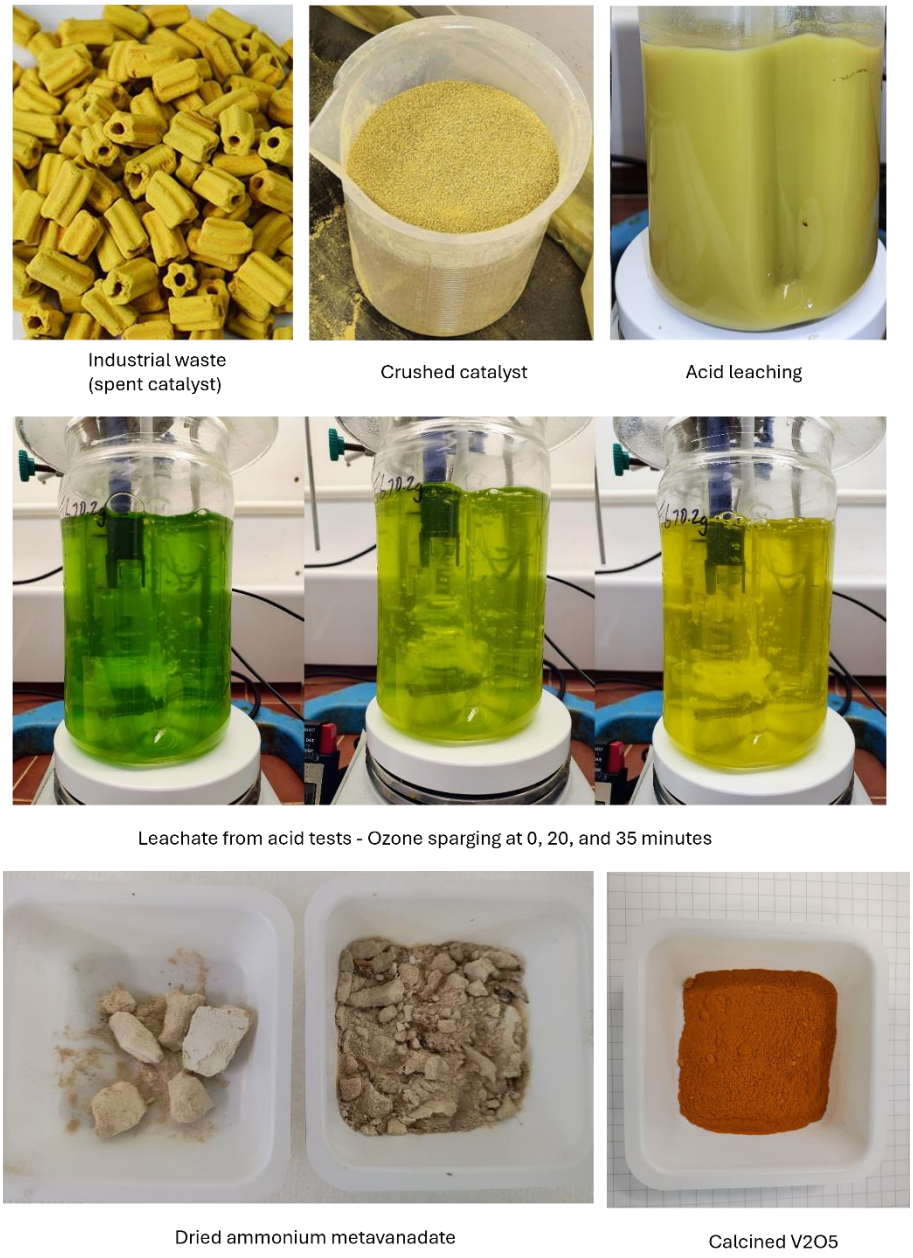

Figure 1 - Vanadium extraction from spent catalyst.

This research and development project is led by UQ Associate Professor James Vaughan and is part of the Resources Technology and Critical Minerals Trailblazer which aims to advance critical mineral processing technology readiness.

Associate Professor Vaughan said, "This project is an exciting demonstration of the circular economy of vanadium, the key ingredient in vanadium flow batteries which can provide large-scale and long-duration energy storage, complementing renewable electricity generation."

QEM Managing Director Gavin Loyden stated, "The waste recycling project with UQ ties strongly to our ESG goals to position QEM's projects and activities at the forefront of environmental and social responsibility within the mining and energy sectors."

"This collaboration with UQ builds on QEM's umbrella agreement with the university from September 2022 when The University of Queensland's Sustainable Minerals Institute (UQ SMI) commenced mineral characterisation and beneficiation work for QEM's flagship critical minerals project by characterising the mineralogy of QEM's Julia Creek shale post-oil extraction to assist in optimising vanadium beneficiation to further improve vanadium pentoxide yields.

"With UQ's assistance, QEM seeks to accelerate the introduction of Queensland-sourced and processed V2O5 into the market. QEM remains committed to its goal of supplying V2O5 from our primary vanadium resource at Julia Creek," said Mr Loyden.

Professor Rick Valenta, who leads the Trailblazer Universities Program for UQ and is Director of SMI, said: "The SMI is committed to supporting sustainable extraction of vanadium from the Julia Creek region, and in that context our partnership with QEM has been both strategic and important. This recycling project is an important part of this overall program.

"We are looking forward to continuing to work together to help develop these resources and contribute to the development of Queensland's critical minerals industry.

"This is exactly the kind of project the Trailblazer Universities Program was designed to promote and is an excellent example of universities, researchers and industry working together."

The work undertaken by UQ included laboratory test work to determine the required process conditions for an acid leach/solvent extraction flowsheet for the spent catalyst. The program also included assaying the V2O5 that was produced in the study to determine purity of the product.

Acid leaching tests were conducted with various solid loading concentrations, acid concentrations and different feed grind sizes. After filtration of the slurry, oxidation of the leachate and partial neutralisation were performed; then, solvent extraction was utilised to reject impurities and provide a more concentrated feed for ammonium metavanadate (AMV) crystallisation. Finally, calcining of the AMV was performed to obtain V2O5.

The V2O5 sample obtained was then assayed by digestion and Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES); the largest impurity identified in the V2O5 sample had a value limit of 0.06% while four impurity elements reported a value of 0.02% each. Twenty-four potential impurity elements reported below detection limits. The results represent a V2O5 purity of >99%, which was the goal of the study.

UQ is optimising processing conditions for subsequent piloting, as well as producing larger samples of V2O5 for potential future marketing purposes.

Figure 2 - University of Queensland Hydrometallurgy Research Laboratories, part of the School of Chemical Engineering, analytical laboratory team members Tseveenkhuu Darinchuluun in the foreground and Vitor Loureiro and James Gudgeon in the background.

ENDS

This announcement was authorised for release on the ASX by the Board of QEM Limited.

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ABOUT QEM

QEM Limited (ASX: QEM) is a publicly listed company which is focused on the exploration and development of its flagship Julia Creek Project, covering 250km² in the Julia Creek area of North West Queensland.

The Julia Creek vanadium and oil shale project is a unique world class resource with the potential to utilise sustainable energy solutions in the production of energy fuels and vanadium pentoxide.

QEM strives to become a leading producer of liquid fuels and in response to a global vanadium deficit, also aims to become a global supplier of high-quality vanadium pentoxide, to both the nascent energy storage sector and the global steel industry.

This globally significant JORC (2012) Mineral Resource of 2,850 Mt @ 0.31% V2O5 is one of the single largest ASX listed vanadium resources and represents a significant opportunity for development. The resource is comprised of 360Mt @ 0.29% V2O5 in the Indicated category and 2,490Mt @ 0.31% V2O5 in the Inferred category, with the added benefit of a contingent (SPE-PRMS 2018) in-situ oil resource of 79MMBBls of Oil equivalent in the 2C category, and 696MMBBLs in the 3C category, contained within the same ore body.

The tenements form part of the vast Toolebuc Formation, which is recognised as one of the largest deposits of vanadium and oil shale in the world and located less than 6km east of the township of Julia Creek. Near to all major infrastructure and services, the project is intersected by the main infrastructure corridor of the Flinders Highway and Great Northern Railway, connecting Mt Isa to Townsville.

*The information in this announcement that relates to the mineral resource and contingent resource estimates for the Company's Julia Creek Project was first reported by the Company in its IPO prospectus dated 20 August 2018 and supplementary prospectus dated 12 September 2018 (together, the "Prospectus") and the subsequent resource upgrade announcements ("Resource Upgrade") dated 14 October 2019 and 7 April 2022. The Company confirms that it is not aware of any new information or data that materially affects the information included in the Prospectus and Resource Upgrade, and in the case of estimates of Mineral Resources and Contingent Resources, that all material assumptions and technical parameters underpinning the estimates in the Prospectus and Resource Upgrade continue to apply and have not materially changed.

ABOUT TRAILBLAZER UNIVERSITIES PROGRAM

The Australian Government is building new research capabilities, driving commercialisation outcomes and investing in new industry engagement opportunities through the $370.3 million Trailblazer Universities Program (2022–2023 to 2025–2026). Through this initiative, the Government is building additional capacity to focus on the problems that matter to the nation by driving research excellence and real-world impact.

The Trailblazer Universities Program is led by six select universities with dedicated investment to accelerate Australia's innovation agenda at speed and at scale. Trailblazer universities are demonstrating:

- commitment to boosting world-leading capability in a priority area, including, defense, space, food and beverage, recycling and clean energy, and resources technology and critical minerals technology,
- use of open, collaborative Intellectual Property (IP) agreements that are attractive for industry partners,
- use of incentives and rewards for research staff who engage with industry and commercialise research,
- co-funding commitments from industry partners, and proactive engagement with businesses,
- opportunities and pathways that promote strong industry engagement and job-ready skills, including development of educational qualifications and pathways with the Vocational and Education Training (VET) sector.

The information contained within this announcement relates to a small-scale laboratory demonstration of all the processing steps in recycling spent vanadium-bearing catalysts into a high purity vanadium oxide product. For the avoidance of any doubt, this announcement does not contain any public report of Exploration Results, Mineral Resources or Ore Reserves for the purposes of the JORC Code (2012).