JULIA CREEK PROJECT

Vanadium
Oil Shale

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Second Pilot Plant Testing Achieves Excellent Results, Underpinned by Increased Extraction Yields

Highlights

- **Second round of bench-scale pilot plant testing delivers improved vanadium and oil extraction rates with a larger sample size (T2)**
  - This enhances confidence in the potential viability of the extraction process at a more significant scale
- **Substantial rise in vanadium extraction rates above 90%**
  - Significant improvement to vanadium extraction rates, compared to first tests (T1).
- **Latest oil shale extraction results indicate oil yields of ~170% of yields under a Modified Fischer Assay (MFA)**
  - The first (T1) extraction test result was 142% of yields reported under an MFA
- **The bench-scale pilot plant continues to operate effectively following the optimisation, with key run targets for autoclave temperature and pressure achieved again**
- **Samples of oil produced will now be sent to Lytton refinery in Brisbane for petrology analysis**

QEM Limited (ASX: QEM) **("QEM" or "Company")** is pleased to announce vanadium and oil extraction results from the second round of the Company's bench-scale pilot plant test program.

The first round of extraction testing (T1) at the vanadium and oil shale bench-scale pilot plant was completed at the Melbourne headquarters of HRL Technology Group Pty Ltd ("HRL") last month (see ASX announcement dated 9 August 2022). The first round of testing delivered promising results, with opportunities for extraction optimisation proactively identified and the pilot plant subsequently modified for the second round (T2) of testing conducted at HRL.

QEM Managing Director Gavin Loyden said the latest test results ticked all the right boxes for the Company.

"To put it simply, these test results are excellent. The pilot plant modifications made after test T1 led to significantly improved operation for test T2.

We have achieved increased extraction yields across both vanadium and oil, eliminated the deposit build-up issues, and demonstrated the effective operation of the pilot plant once again," Mr Loyden said.

"We have enhanced the confidence in our extraction process beyond laboratory scale test work, which was our primary objective in these early tests. We will now continue this good work to assess additional optimisation potential, through adjustments to operating parameters."

Sample Details and Test Methodology

The first round of testing (T1) was conducted with six kilograms of fresh oil shale feed from the Julia Creek project mixed with six kilograms of a hydrogen donor solvent. The volume of the oil shale feed utilised in the pilot plant for the T1 testing was significantly greater than previous laboratory test work, which was conducted at the 8 grams to 12 grams range.

The T2 testing expanded further on the amount of material processed, using eight kilograms of oil shale feed from the Julia Creek project mixed with 16 kilograms of solvent. This result bolsters confidence in the potential viability of oil extraction at the Julia Creek project at a greater scale.

As with the T1 test, the solvent extraction test work in the second T2 round involved heating a slurry of oil shale and solvent to achieve the targeted autoclave temperature. Under these supercritical conditions, the kerogen in the shale is converted to liquid and gaseous products.

QEM's bench-scale pilot plant operating at HRL's headquarters in Melbourne.

Testing Optimisation and Plant Modifications

Following the T1 test work, modifications to the pilot plant and the operating parameters were swiftly implemented to optimise the performance of the bench-scale pilot plant for the T2 round of testing. Major changes included a revised plant configuration, drying the feed sample, increased solvent to shale ratio, and delayed pressurisation of the system to enable the solvent to reach boiling point.

These alterations, among others, resulted in improved pilot plant performance, including the elimination of a build-up of solid deposits (naphthalene) in the oil product collection equipment, and related pipework, which was an issue previously flagged from the first round of testing.

Crucially, these alterations and an increase in acid leach time to 24 hours resulted in increased vanadium and oil extraction results, which are detailed below.

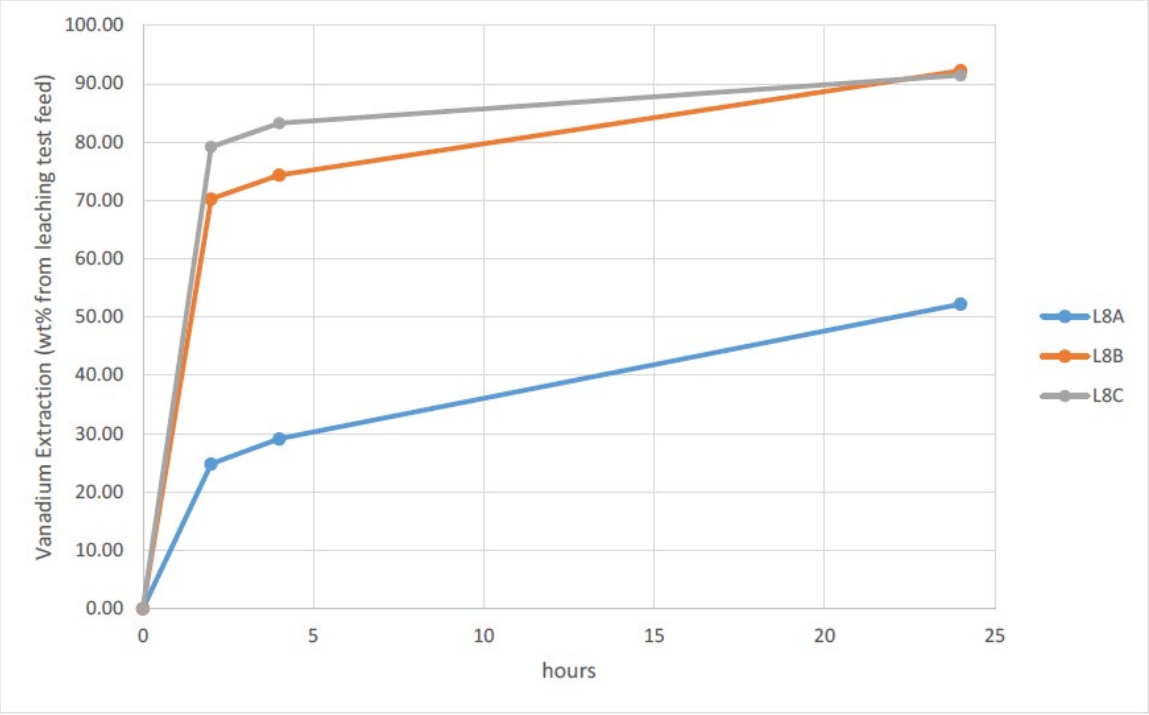
T2 Vanadium Extraction Results

Samples were collected after 2 hrs, 4 hrs and 24 hrs (final sample).

For the roasted samples the majority of vanadium is extracted after 4 hours, with a small increase through to 24 hours. For the unroasted sample there is an appreciable increase in vanadium extraction from 4 hours to 24 hours. These observations are consistent with the previous results from 24-hour testing for the OSU and OSL samples (L1 to L6)

Vanadium extraction values above 90% were achieved, based on the feed to the leach test, for the two samples roasted at 700°C and 900°C (L8B & L8C) with a 24-hour leach time.

Plot of Vanadium Extraction Versus Time for T2 Acid Leach Tests



Vanadium extraction for the unroasted sample (L8A) is appreciable at about 52% but significantly lower than for the roasted samples.

Vanadium Extraction for T1 and T2 Acid Leach Tests

Sample ID	Feed	Roasting	Leach time (hrs)	Vanadium extraction (wt% from acid leach test feed)
T2				
L8A	T2 washed residue	No	24	52.2
L8B	T2 washed residue, roasted	700 deg C, 1 hr	24	92.3
L8C	T2 washed reside, roasted	900 deg C, 1 hr	24	91.4
T1				
L7A	T1 feed, washed, roasted	900 deg C, 1 hr	4	55.1
L7B	T1 residue	No	4	26.6
L7C	T1 residue, washed	No	4	29.5
L7D	T1 residue, washed, roasted	900 deg C, 1 hr	4	59.0
Previous testing				
L1	OSU roasted	Heated to 700 deg C	24	58
L2		Roasted at 900 deg C	24	91
L5		Roasted at 1000 deg C	24	58
L3	OSL roasted	Heated to 700 deg C	24	65
L4		Roasted at 900 deg C	24	92
L6		Roasted at 1000 deg C	24	68

T2 Oil Extraction Results

Estimated oil yield for T2 increased to 12.5 dry wt% (as collected sample) and 13 dry wt% (washed sample).

Such an oil yield is at the lower end of the oil yields determined in the previous small-scale tests although significantly higher than T1 and appreciably higher than the MFA yield.

The latest results also indicate that the oil yields achieved from the pilot plant were approximately 170% or 1.7 times greater than yields reported under a Modified Fischer Assay (MFA). In comparison, the T1 tests delivered oil yields up to 142% of yields reported under an MFA.

NB. *MFA is the industry standard used to measure the oil yield in litres per tonne of kerogen (oil equivalent) in the oil shale at zero moisture.*

Next Steps

QEM is currently assessing the ability to further optimise the performance of the bench-scale pilot plant, with the testing program scheduled to conclude by the end of December.

Further improvements have been made for the third test (T3), including installation of additional gas meters to capture and measure all gas units.

Beneficiation work will now be conducted on the solid material, post oil extraction, to further improve outcomes for metals recovery and reduce acid consumption.

Alkaline leaching tests are now being conducted, so that proper comparison can be made between acid and alkaline methods, the results of which will lead to a selection being made for the take forward case.

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 focussed on the exploration and development of its flagship Julia Creek Project, covering 250km² in the Julia Creek area of North Western Queensland.

The Julia Creek vanadium / oil shale project is a unique world class resource with the potential to utilise and deliver innovative and sustainable energy solutions, through 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 Australian 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 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 16km east of the township of Julia Creek. In close proximity 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.