

# FINAL PYROMETALLURGY RESULTS CONFIRM WORLD LEADING VANADIUM EXTRACTION

*Final reporting of test results of the roast-leach pilot testwork campaign has confirmed high combined vanadium roast / leach extractions up to 94.9%.*

## KEY POINTS

- Pilot scale testwork applying a well-established Grate Kiln technology demonstrates energy efficiency and adaptability for vanadium roasting.
- Process optimisation by roasting a concentrate representative of average early years mine production, has resulted in vanadium roast / leach extractions up to 94.9%.
- Roasting testwork conducted on concentrate representative of the average forecast for later years of processing produced optimum vanadium roast / leach extraction at 92.2%. Both results provide significant improvements compared to a traditional rotary kiln flowsheet as typically applied in vanadium processing.
- Completion of the pilot scale roasting program now enables the BFS engineering design for the concentrate preparation and grate kiln areas to be updated.
- Testwork was partly funded by the Australian Government's Cooperative Research Centre – Projects scheme entitled: "Production of 99.95% Pure Vanadium Pentoxide and Vanadium Electrolytes".

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Australian Vanadium Limited (ASX: AVL, "the Company" or "AVL") is pleased to advise that pilot scale pyrometallurgical testwork at the Metso testing facilities in the US has been completed and reported. The testwork comprised detailed testing and optimisation work on pelletised concentrates produced by AVL's 30 tonne Crushing, Milling and Beneficiation (CMB) testwork program. The pyrometallurgical work has confirmed the initial successful pilot test results announced in July 2020<sup>1</sup>

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<sup>1</sup> See ASX announcement dated 1<sup>st</sup> July 2020 'Pellet Roast Pilot Testing Delivers Uplift in Vanadium Extraction'

and is a significant step towards the Company's goal to design, build and operate the world's lowest cost primary vanadium operation which will be located in Western Australia's Mid-West region.



**Figure 1 Pellets being unloaded from the pot grate.**

The concentrates used as feed for the pyrometallurgical test program were generated during AVL's CMB pilot testwork in 2019. An early years (Y0-5) blend typical of the average of the first five years of forecast production and a later scheduled average blend (LOM) were campaigned separately. Vanadium recovery from the CMB circuit was exceptional, at 69% for Y0-5 and 76% for LOM, reflecting the unique characteristics of the AVL Gabanintha orebody. The concentrate grades achieved at the target particle grind size  $P_{80}$  of 75  $\mu\text{m}$  were similar, as can be seen in Table 1.

**Table 1. Comparison of Y0-5 and LOM Concentrate Grades**

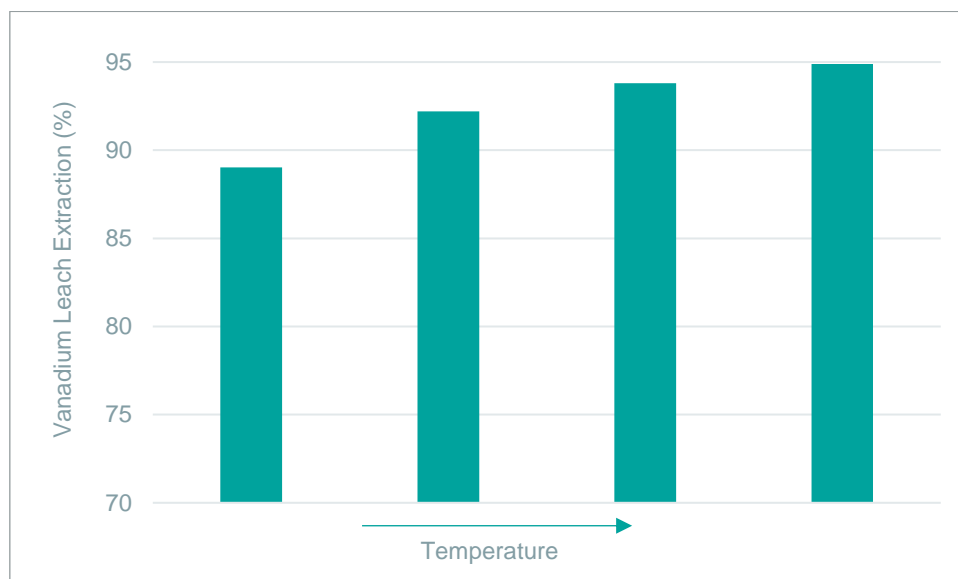
	V <sub>2</sub> O <sub>5</sub> (%)	SiO <sub>2</sub> (%)	Al <sub>2</sub> O <sub>3</sub> (%)	TiO <sub>2</sub> (%)	Fe (%)
Year 0-5	1.39	1.83	2.81	14.94	53.33
LOM	1.37	1.68	2.74	14.56	54.80

Albeit the concentrates have similar chemistry they differ in mineralogy. Hematite is the dominant iron mineral in the Y0-5 concentrate whereas magnetite is dominant in LOM concentrate (Table 2). These minerals are both hosts for vanadium and behave differently in the roast-leach process. Roasting testwork was centred around optimising process conditions for each of these two blends.

**Table 2. Comparison of Y0-5 and LOM Concentrate Mineralogy<sup>2</sup>**

Mineral or mineral group	Y0-5	LOM
	Mass %	Mass %
Magnetite	21	51
Maghemite	13	10
Ilmenite	6	8
Hematite	37	16
Goethite	4	1
Chlorite	6	7
Quartz	2	1
Rutile	5	2

The full pyrometallurgical test program was completed in February 2021, after some delays due to COVID-19 and repairs to the kiln. The key process parameter for vanadium extraction from either the hematite or magnetite rich blend was the kiln operating temperature. Figure 2 illustrates the degree to which vanadium leach extraction changed when testing a range of potential kiln temperatures.



**Figure 2. Effect of roast temperature on vanadium extraction – Y0-5**

The effectiveness of the roast process over a range of relatively short residence times was demonstrated at an optimal temperature (see Figure 3). By testing a range of potential commercial

<sup>2</sup> Semi-quantitative x-ray diffraction analysis (XRD) results

roasting durations no appreciable difference in vanadium leach extraction resulted, indicating a robust process and rapid completion of the salt-vanadium reaction.



**Figure 3. Effect of roast residence time on vanadium extraction**

LOM magnetite rich pellets showed a marginally lower, but more consistent and repeatable vanadium roast-leach extraction, averaging 92% at the selected roast temperature. LOM blend material provided more than 9% higher vanadium recovery from the CMB circuit compared to the Y0-5 blend, more than offsetting its slightly lower roast performance.

The concentrates used for the pilot work were generated in the CMB pilot program and are impressively low in impurities. Silica, for example, was at 1.83% SiO<sub>2</sub> (0.86% Si) in the Y0-5 concentrate and 1.68% SiO<sub>2</sub> (0.79% Si) in the LOM concentrate. The objective for the pyrometallurgical roast is to maximise vanadium solubilisation and minimise extraction of silicon and aluminium present in the concentrate. This ensures a high-quality vanadium product. AVL has previously reported that for Y0-5 only 4.2% silicon and almost no aluminium<sup>3</sup> extraction occurred. This trend continued for the LOM concentrates with only 3.8% silicon extraction and again almost no aluminium.

The overall vanadium recovery forecast for the entire process is regarded as exceptional due to a combination of favourable ore characteristics and significant technical development by AVL.

### **Completion of Pyrometallurgical Testwork and Implications for the BFS**

With completion and reporting of the pyrometallurgical testwork program, AVL's engineers are in the process of updating the design of the grate kiln area to support the BFS.

<sup>3</sup> See ASX announcement dated 1<sup>st</sup> July 2020 'Pellet Roast Pilot Testing Delivers Uplift in Vanadium Extraction'

Ongoing work related to the Company's CRC-P Research Program for production of high purity vanadium products is aimed at further increasing efficiency and improving certainty in the vanadium purification flowsheet design, which will be part of the Australian Vanadium Project Processing Plant near Geraldton.

For further information, please contact:

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*This announcement has been approved in accordance with the Company's published continuous disclosure policy and has been approved by the Board.*

## ABOUT AUSTRALIAN VANADIUM LTD

AVL is a resource company focused on vanadium, seeking to offer investors a unique exposure to all aspects of the vanadium value chain – from resource through to steel and energy storage opportunities. AVL is advancing the development of its world-class Australian Vanadium Project at Gabanintha. The Australian Vanadium Project is currently one of the highest-grade vanadium projects being advanced globally, with 208.2Mt at 0.74% vanadium pentoxide ( $V_2O_5$ ), containing a high-grade zone of 87.9Mt at 1.06%  $V_2O_5$ , reported in compliance with the JORC Code 2012 (see ASX announcement dated 4<sup>th</sup> March 2020 '*Total Vanadium Resource at the Australian Vanadium Project Rises to 208 Million Tonnes*' and ASX announcement dated 22<sup>nd</sup> December 2020 '*Technical and Financial PFS Update*').

VSUN Energy is AVL's 100% owned subsidiary which is focused on developing the market for vanadium redox flow batteries for energy storage.

The Company confirms that it is not aware of any new information or data that materially affects the information included in the original market announcement and, in the case of estimates of Mineral Resources or Ore Reserves, that all material assumptions and technical parameters underpinning the estimates in the relevant market announcement continue to apply and have not materially changed. The Company confirms that the form and context in which the Competent Person's findings are presented have not been materially modified from the original market announcement.

## APPENDIX 1

The Australian Vanadium Project – Mineral Resource estimate by domain and resource classification using a nominal 0.4% V<sub>2</sub>O<sub>5</sub> wireframed cut-off for low-grade and nominal 0.7% V<sub>2</sub>O<sub>5</sub> wireframed cut-off for high-grade (total numbers may not add up due to rounding).

2020 Feb	Category	Mt	V <sub>2</sub> O <sub>5</sub> %	Fe %	TiO <sub>2</sub> %	SiO <sub>2</sub> %	Al <sub>2</sub> O <sub>3</sub> %	LOI %
<b>HG</b>	Measured	10.1	1.14	43.9	13.0	9.2	7.5	3.7
	Indicated	25.1	1.10	45.4	12.5	8.5	6.5	2.9
	Inferred	52.7	1.04	44.6	11.9	9.4	6.9	3.3
	<b>Subtotal</b>	<b>87.9</b>	<b>1.06</b>	<b>44.7</b>	<b>12.2</b>	<b>9.2</b>	<b>6.8</b>	<b>3.2</b>
<b>LG 2-5</b>	Indicated	44.5	0.51	25.0	6.8	27.4	17.0	7.9
	Inferred	60.3	0.48	25.2	6.5	28.5	15.3	6.7
	<b>Subtotal</b>	<b>104.8</b>	<b>0.49</b>	<b>25.1</b>	<b>6.6</b>	<b>28.0</b>	<b>16.1</b>	<b>7.2</b>
<b>Trans 6-8</b>	Inferred	15.6	0.65	28.4	7.7	24.9	15.4	7.9
	<b>Subtotal</b>	<b>15.6</b>	<b>0.65</b>	<b>28.4</b>	<b>7.7</b>	<b>24.9</b>	<b>15.4</b>	<b>7.9</b>
<b>Total</b>	Measured	10.1	1.14	43.9	13.0	9.2	7.5	3.7
	Indicated	69.6	0.72	32.4	8.9	20.6	13.2	6.1
	Inferred	128.5	0.73	33.5	8.8	20.2	11.9	5.4
	<b>Subtotal</b>	<b>208.2</b>	<b>0.74</b>	<b>33.6</b>	<b>9.0</b>	<b>19.8</b>	<b>12.1</b>	<b>5.6</b>

The Australian Vanadium Project - Ore Reserve Statement as at December 2020, at a cut-off grade of 0.7% V<sub>2</sub>O<sub>5</sub>

Ore Reserve	Mt	V <sub>2</sub> O <sub>5</sub> %	Fe <sub>2</sub> O <sub>3</sub> %	TiO <sub>2</sub> %	SiO <sub>2</sub> %	LOI%	V <sub>2</sub> O <sub>5</sub> production kt	Ore Reserve	Mt
Proved	9.8	1.08	59.9	12.4	8.7	3.5	63.2	Waste	244.5
Probable	22.4	1.04	61.7	11.8	8.3	2.8	158.9	Total Material	276.7
<b>Total Ore</b>	<b>32.1</b>	<b>1.05</b>	<b>61.2</b>	<b>12.0</b>	<b>8.4</b>	<b>3.0</b>	<b>222.1</b>	Strip Ratio	7.6

### COMPETENT PERSON STATEMENT — MINERAL RESOURCE ESTIMATION

The information in this announcement that relates to Mineral Resources is based on and fairly represents information compiled by Mr Lauritz Barnes, (consultant with Trepanier Pty Ltd) and Mr Brian Davis (consultant with Geologica Pty Ltd). Mr Barnes and Mr Davis are both members of the Australasian Institute of Mining and Metallurgy (AusIMM) and the Australian Institute of Geoscientists (AIG). Both have sufficient experience of relevance to the styles of mineralisation and types of



deposits under consideration, and to the activities undertaken to qualify as Competent Persons as defined in the 2012 Edition of the Joint Ore Reserves Committee (JORC) Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves. Specifically, Mr Barnes is the Competent Person for the estimation and Mr Davis is the Competent Person for the database, geological model and site visits. Mr Barnes and Mr Davis consent to the inclusion in this announcement of the matters based on their information in the form and context in which they appear.

### **COMPETENT PERSON STATEMENT — ORE RESERVES**

The technical information in this announcement that relates to the Ore Reserve estimate for the Project is based on information compiled by Mr Ross Cheyne, an independent consultant to AVL. Mr Cheyne is a Fellow of the Australasian Institute of Mining and Metallurgy. He is an employee and Director of Orelogy Mine Consulting Pty Ltd. Mr Cheyne has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity being undertaken to qualify as a competent person as defined in the 2012 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves. Mr Cheyne consents to the inclusion in the announcement of the matters related to the Ore Reserve estimate in the form and context in which it appears.

### **COMPETENT PERSON STATEMENT – METALLURGICAL RESULTS**

The information in this announcement that relates to Metallurgical Results is based on information compiled by independent consulting metallurgist Brian McNab (CP. BSc Extractive Metallurgy). Mr McNab is a Member of AusIMM. He is employed by Wood Mining and Metals. Mr McNab has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity which is undertaken, to qualify as a Competent Person as defined in the JORC 2012 Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves. Mr McNab consents to the inclusion in the announcement of the matters based on the information made available to him, in the form and context in which it appears.