

# AVL LODGES PATENT APPLICATION FOR VANADIUM PROCESSING CIRCUIT

*Unique processing route to be protected by patent application.*

## KEY POINTS

- AVL submits unique vanadium processing flowsheet provisional patent application.
- The processing circuit is at the core of AVL's ongoing BFS engineering study as part of the Company's plans to develop the Australian Vanadium Project at Gabanintha, in Western Australia.
- Recognition sought to protect process innovations developed by AVL in the development of its vanadium project.
- The patent will be recognised across 177 countries through the Patent Convention.
- Application relates to a specific method of preparing high purity vanadium pentoxide and preparing a marketable titanium and iron coproduct from vanadium bearing titanomagnetite (VTM), in a cost effective and environmentally sustainable manner.
- AVL's unique combination of physical beneficiation, pyrometallurgical and hydrometallurgical steps combine to underline the patent application.
- The patent application process has no effect on the BFS timeline.

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Australian Vanadium Limited (ASX: AVL, "the Company" or "AVL") is pleased to advise that it has filed a provisional patent application for its unique vanadium processing route. The patent application relates to a method for preparing high-purity vanadium pentoxide. AVL's primary objective with the filing of this patent application is the protection for the Company and its shareholders of the unique and efficient processing design that has been developed on the pathway to bringing the Australian Vanadium Project at Gabanintha, near Meekatharra into production.

The inclusion of a saleable iron-titanium coproduct contributes to the uniqueness of this process.

The patent application covers a combination of individual physical beneficiation steps, pyrometallurgical steps and hydrometallurgical steps that are designed to meet the specific objectives of preparing the vanadium product.

Managing Director, Vincent Algar, comments, “The positive impact of vanadium in global carbon emission reduction <sup>1</sup> will increase its demand in both steel and battery applications. This processing patent application by AVL is another important milestone along the way to production for the Company, further enabling the development of the Project, and meeting that growing demand.”

“One of AVL’s many strengths is the depth of vanadium knowledge within the team and its associates. The innovative work by the team during the study phase has culminated in an insightful processing circuit that has benefits to AVL and the wider vanadium industry.”

## Background

Vanadium extraction from vanadium bearing titano-magnetite (VTM) ores, such as AVL’s, is currently achieved through well-known, standardised roast-leach and precipitation routes. This technology has been in-place and essentially unchanged since it was developed in the 1950s. Standard VTM processing involves production of a magnetic concentrate, which is then roasted with sodium salts to produce a water soluble vanadium salt. This is then leached in water via tanks or vats, precipitated and converted to vanadium pentoxide.

Alternative processes for VTM ores have been developed and patented, with the aim of reducing capital and energy costs for the extraction of vanadium from VTM ores and concentrates. These generally involve hot acid leaching followed by multiple steps of solvent extraction and precipitation or reduction, crystallisation and centrifugation. These processes are yet to be implemented commercially. Vanadium can also be recovered using roast-leach processes from VTM ores via the slag generated from steel production, which is the main method used in China.

AVL has built on the traditional, established roast-leach technology. Through rigorous pilot work AVL has developed a high recovery process, capable of delivering high purity vanadium oxides. The process produces a low silica concentrate, high vanadium extraction in roast and leach, and low silica FeTi coproducts. Roasting improvements have also been shown to lower carbon emissions versus standard kiln technologies.

Work contributing to this patent application was partly funded by the Federal Government’s CRC-P grant.

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<sup>1</sup> Punching Above its Weight: Life Cycle Energy Accounting and Environmental Assessment of Vanadium Microalloying in Reinforcement Bar Steel by Pranav Pradeep Kumar, David A Santos, Erick J Braham, Diane G Sellers, Sarbajit Banerjee and Manish K Dixit

Work previously announced by the Company during the course of its feasibility studies forms part of the innovative aspects of the patent application, including the following announcements:

- 16<sup>th</sup> March 2020 ‘Pilot Study Programme Confirms High Vanadium Recoveries and Concentrate Quality’
- 10<sup>th</sup> July 2020 ‘Pellet Roast Pilot Testing Delivers Uplift in Vanadium Extraction’
- 20<sup>th</sup> August 2020 ‘Iron-Titanium Co-Product Sales Opportunities to Differentiate AVL’

### **Next Steps**

The submission of the provisional application in Australia establishes a priority date for the invention. This is recognised in 177 countries through the Patent Convention. This priority date provides a 12-month period in which, for example, an international (Patent Cooperation Treaty) patent application can be filed claiming priority. Applications in non-Patent Cooperation Treaty countries can also be filed claiming priority during this time.

A global search of the databases of international patent authorities will be conducted by Wrays Patent and Trademark Attorneys. It will focus on a review of existing patents in the field of vanadium ore processing and extraction. It is anticipated the results will confirm the uniqueness of AVL’s beneficiation and extraction processes and the need for protection of the Company’s Intellectual Property. This process is necessary to fulfil one of AVL’s objectives, which is to protect the Company’s inventions as they will be applied in the development of the Project and to facilitate licensing of the beneficiation and extraction technology to other vanadium producers who are developing their own extraction capabilities.

For further information, please contact:

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*This announcement has been produced 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.