

ASX ANNOUNCEMENT

5<sup>TH</sup> FEBRUARY 2020

# HIGH VANADIUM EXTRACTION CONFIRMED AS PYROMETALLURGICAL PILOT BEGINS

*Bench-scale testing of pellet roast leach flowsheet achieves vanadium leach extraction up to 95.5%*

## KEY POINTS

- Innovative roasting testwork to simulate a Grate Kiln process indicates improved vanadium extraction.
- Beneficiation circuit concentrate representing the average first five years of forecast production is currently in transit to the Metso pyrometallurgical testing facilities in Danville, Pennsylvania, USA.
- The objective of the pilot Grate Kiln testwork is to optimise economics and define full scale process design criteria.
- The Grate Kiln is an efficient, low risk and proven technology for pelletising iron concentrates.
- AVL is adapting proven industrial technology to modify and improve the traditional vanadium salt roast processing techniques as it moves to deliver The Australian Vanadium Project near Meekatharra in Western Australia.

Australian Vanadium Limited (ASX: AVL, “the Company” or “AVL”) is pleased to announce the successful completion of bench-scale pelletising, roasting and leaching testwork and the commencement of a detailed pilot scale test program with Metso in the USA.

Laboratory testwork completed in 2019 in Brisbane indicated that a pelletised roast and water leach of AVL’s vanadium rich concentrate can deliver improved vanadium extraction relative to traditional rotary kiln processing applied as the basis of the Pre-Feasibility Study (PFS)<sup>1</sup>. AVL is aiming to develop a processing flowsheet with the world’s highest primary vanadium recovery from vanadiferous titanomagnetite (VTM).

<sup>1</sup> See ASX announcement dated 19 December 2018 ‘*Gabanintha Pre-Feasibility Study and Maiden Ore Reserve*’

Between August and December 2019, a metallurgical test programme involving pelletising and oxidative salt roasting was carried out in Brisbane. The purpose of the programme was to investigate the performance of the oxidative salt roast in a pot rig, which simulates a commercial straight Grate Kiln. Approximately 587kg of preliminary beneficiation concentrate was tested to characterise pellet performance, vanadium extraction, reagent usage and operating conditions for the Grate Kiln pilot testing scheduled at Metso in quarter 1 and 2 of 2020.

Results of the bench-scale testwork show:

- High quality pellets, with the mechanical strength required to survive the roasting process, can be produced without additional binders or processing steps.
- Vanadium roast leach extraction was as high as 95.5%, varying between 86.9% at low roast temperature and 95.5% under optimised temperatures, bed depths and retention times. All tests were performed at 4% soda ash addition, which was the basis for the PFS.

The particle size required for pelletisation was confirmed to be similar to the particle size of the final concentrate generated in the crushing, milling and beneficiation (CMB) pilot.

Managing Director, Vincent Algar comments: 'AVL is increasing its competitive advantage through process innovation. Our vanadium ore is very well suited to the traditional salt-roast methods, but we see opportunity in our testwork for processing improvements that could lead us to a world leading position when in production. Improved vanadium recoveries, coupled with the potential to reduce gas consumption and related operating cost reductions, further reinforces the Project's position as a desirable investment. Utilising the Grate Kiln technology, which is well-understood and with a proven track record in the iron ore, titanium and steel industries, is an innovation that our highly technical team has pursued as a result of the diligent testwork they are undertaking. Improving the economics of our Project is the Company's key driver as we take each step forward.'



**Figure 1: Two Tonne Sample of Beneficiation Circuit Concentrate Shipped to Metso**

Technical data and learnings from this comprehensive bench-scale testwork will be applied in the next phase of piloting. Metso is currently developing flowsheet mass and heat energy simulations based on these results, in preparation for the pilot testwork beginning in February. A two tonne sample of vanadium concentrate produced from CMB pilot scale testwork in Perth is in transit to Metso at its Pyro Technology laboratory located in Danville, Pennsylvania, USA (see Figure 1). The objective of the Metso pilot testwork programme is to optimise process economics and confirm design parameters for The Australian Vanadium Project's Grate Kiln flowsheet. Completion of this phase of pyrometallurgical testwork is expected to deliver a high degree of certainty in forecasting full scale Grate Kiln performance and in the estimation of associated capital and operating costs for the Definitive Feasibility Study (DFS).

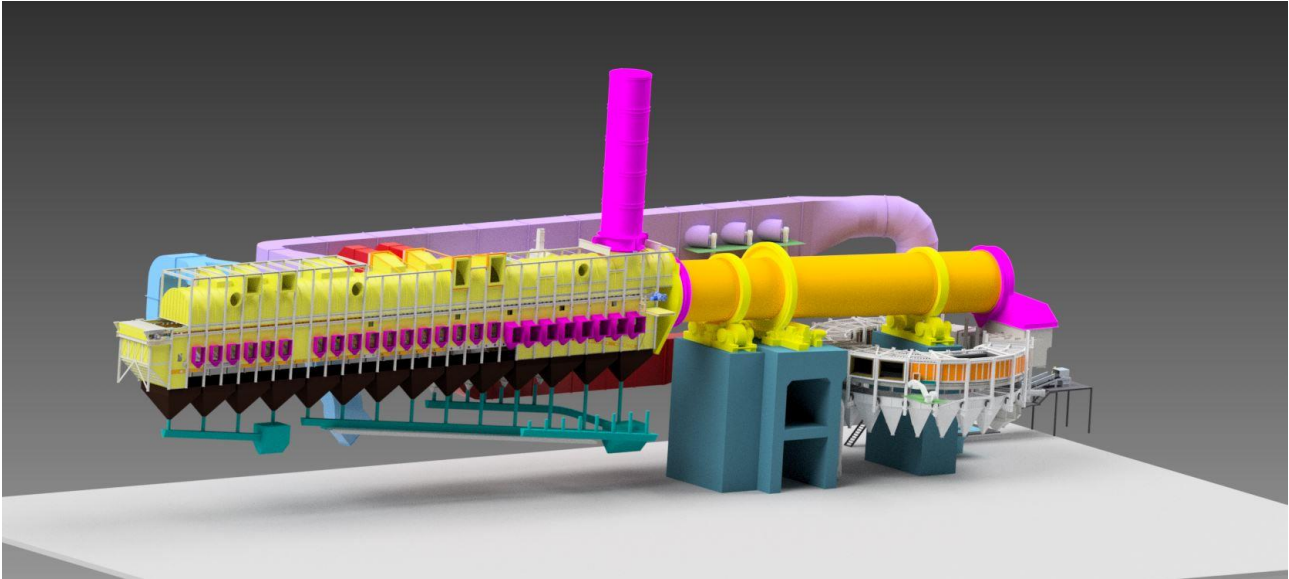
AVL's bench-scale pelletising testwork demonstrated that vanadium roast leach extractions rose to an average of 92%, compared with a traditional rotary kiln extraction of 85-88%. Vanadium roast extraction in the AVL PFS was 87.9%<sup>2</sup>. Figure 2 shows the vanadium rich iron concentrate pellets that were produced during bench-scale roast testing in 2019.



**Figure 2: Vanadium Rich Iron Concentrate Pellets Produced During Bench-scale Roast Testing**

The Grate Kiln process illustrated in Figure 3 combines a travelling grate furnace for the drying and heating stage, a rotary kiln for roasting to convert vanadium to a soluble vanadate and a packed bed cooler for the final step. The pellets pass progressively through hotter gases to accomplish gradual and controlled drying and heating. The process also enables much of the energy from the hot kiln exhaust gases to be recouped and additional heat recovery from the cooling step, which reduces the fuel demand and therefore the operating cost for this stage of processing. Using the rotary kiln in only the roasting section of the process results in control and performance efficiencies compared to traditional vanadium processing whereby a granular salt and concentrate feed mix is dried, heated and roasted in a single rotary kiln.

<sup>2</sup> See ASX announcement dated 28<sup>th</sup> May 2019 'High Purity Vanadium Pentoxide Produced'



**Figure 3: 3D Model of Metso Grate Kiln Showing Travelling Grate**

Pellet processing using the Grate Kiln process for vanadium extraction has the following advantages:

- Higher reaction progress due to intimate contact with reactants.
- Greatly reduced kiln build-up due to melting compounds being contained in the pellet.
- Significant reduction in dust loss due to agglomeration of fine particles into pellets.
- Ease of process control and heat recovery by incorporating a travelling grate and packed bed cooling.
- Incorporating a rotary kiln which evenly heats pellets to further enhance desired reactions.

The Grate Kiln process is a proven technology which is successfully used for processing a variety of different types of concentrates where pelletising enhances reactions. The process has traditionally been used to treat fine iron concentrate prior to feeding to a blast furnace, but has also been adopted for other processes such as titanium and phosphate reduction. In the early development of the Grate Kiln process it was used to produce lime and cement. The Grate Kiln process has been proven successful for several non-traditional processes, highlighting its flexibility in design. An example of a commercial Metso Grate Kiln is illustrated in Figure 4.





**Figure 4: Commercial Metso Grate Kiln**

For the Grate Kiln vanadium process, the rotary kiln is still the heart of the procedure. This reduces the risk of building a completely new processing scheme. The Grate Kiln process utilises the rotary kiln as the final roasting process but is enhanced by incorporating pelletising, a travelling grate and a packed bed cooler. Collectively this system enables higher vanadium recovery, lower energy costs and reduced process risks using a proven technology.

On 27<sup>th</sup> November 2019 Metso announced that it had committed to a 25% reduction in carbon emissions in production by 2030, by investing in renewable energy and improving the energy efficiency of the production processes. This in turn assists AVL with its commitments to reduced carbon emissions.

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. The Australian Vanadium Project is currently one of the highest-grade vanadium projects being advanced globally with 183.6Mt at 0.76% vanadium pentoxide ( $V_2O_5$ ), containing a high-grade zone of 96.7Mt at 1%  $V_2O_5$  with an Ore Reserve of 18.24Mt at 1.04%  $V_2O_5$  comprised of a Proved Reserve of 9.82Mt at 1.07%  $V_2O_5$  and a Probable Reserve of 8.42Mt at 1.01%  $V_2O_5$ , reported in compliance with the JORC Code 2012 (see ASX announcement dated 19 December 2018 ‘*Gabarintha Pre-Feasibility Study and Maiden Ore Reserve*’).

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.

## ABOUT METSO

Metso is a world-leading industrial company offering equipment and services for the sustainable processing and flow of natural resources in the mining, aggregates, recycling and process industries. With unique knowledge and innovative solutions, Metso helps its customers improve their operational efficiency, reduce risks and increase profitability. Metso has world-renowned expertise in Grate Kiln processing solutions.

Metso is listed on the Nasdaq Helsinki in Finland and had sales of about EUR 3.2 billion in 2018. Metso employs over 14,000 people in more than 50 countries.

## 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. B.Sc Extractive Metallurgy), Mr McNab is a Member of AusIMM. Brian McNab 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.