

16<sup>th</sup> November 2021

## UPDATE ON ESG TECHNOLOGY DEVELOPMENT

### HIGHLIGHTS

- ◆ **Highlights of metallurgical test-work:**
  - Carbon Monoxide (CO) can be used exclusively as a reductant
  - >95% selective extraction of Iron and Vanadium at low reductant addition
  - Excellent recoveries >99% Iron and Vanadium at higher reductant addition
  - Iron and Vanadium intermediates in a form amenable to separation and purification
  - >97% Titanium extraction in the second stage of the process
- ◆ **Highlights of Engineering Studies:**
  - Multi-disciplinary engineering group Resonant Nuteq appointed as project engineering support partner
  - Process thermochemical computation and mass balance conducted
  - Overall process Block Flow Diagram developed
  - Hazard & Operability Analysis (HAZOP 1) completed
- ◆ **ESG technology is being developed completely independent of VR8's flagship Salt Roast Process on which the recently completed PFS-results (see announcement 22 June 2021) are based**
- ◆ **Aim of ESG Technology is to supplement and improve VR8's planned production outcomes and to investigate the production of additional products that may be derived from the Steelpoortdrift ore**
- ◆ **Joint Venture company with TCM Research Ltd incorporated in the Republic of Ireland**
- ◆ **Intellectual Property (IP) transferred to JV company and IP review conducted, with the conclusion that no serious roadblocks exist in the application of the proposed process or areas identified where IP protection could be pursued, including in CO<sub>2</sub> capture and production of high value products**
- ◆ **Company initiated discussions with South African university to establish a master's degree level research group to optimise potential ESG and Salt Roast processes**

**Eugene Nel (Chief Executive Officer) commented:** *"The development of new and novel processes requires a focussed and phased approach, with the eventual success of such process developments heavily dependent on early outcomes. The initial results reported for the ESG technology process is not only encouraging in our view but have exceeded initial expectations by achieving first phase recoveries in excess of 95% for both iron and vanadium, as well as elevated titanium recoveries. These initial results have ensured a very solid basis from which the technology can be advanced into downstream processes, to*

**Vanadium Resources Limited (ASX.VR8)**

ABN: 47 618 307 887

7/63 Shepperton Road, Victoria Park, WA 6100 Australia  
08 6158 9990 • [contact@VR8.global](mailto:contact@VR8.global) • [www.VR8.global](http://www.VR8.global)

*economically produce a wide range of high purity specialised products. The Company is very excited by the prospects that these results indicate, especially in our drive towards an environmentally sustainable mining operation for the future.”*

**Vanadium Resources Ltd (“the Company” or “VR8”)**, is pleased to provide an update on its ESG technology acquisition. Following the acquisition of an integrated ESG processing technology (Refer ASX announcement 1 April 2021: *VR8 to acquire integrated ESG processing technology by way of an earn-in JV, and capital raising*), the JV company (TCM-VR) has successfully been registered in the Republic of Ireland (reg no 699830). This forms part of the earn in agreement, whereby the Company can acquire up to a 74% interest in an ESG integrated extraction, processing, refining and manufacturing technology developed by TCM Research Ltd (TCM), that innovatively utilises existing processing methodologies to produce battery grade Vanadium Pentoxide and high-end Vanadium products, including other products arising from the Steelpoortdrift Ore such as Iron, Titanium, Silicon and Aluminium, which are not currently extracted using conventional processing methods.

The ESG technology development is being conducted completely independent of the current mine design and will not impact the current process design costs or timelines. The technology is being developed with the view of it being an additional revenue stream supplementary to the base design, to unlock additional value from by-products such as Titanium and Iron present in the concentrates.

All the Intellectual Property (IP) has been transferred into the newly registered JV company and a Preliminary Feasibility Study (PFS) has commenced. For the purpose of the PFS, international multi-disciplinary engineering group Resonant Nuteq (<https://www.resonant.co.za/>) has been selected as the preferred engineering support contractor. Resonant Nuteq experience includes:

- multi-disciplinary engineering business active in the metals, minerals, chemicals, oil & gas and infrastructure sectors.
- ISO 9001:2015 certified
- Offices and workshop in Pretoria, South Africa, manufacturing/fabrication in Johannesburg and Queensland Australia (manufacture equipment: furnaces, gas cleaning, industrial fans, etc.)

Support for major tasks that will be performed during the pre-feasibility study phase are:

- Value engineering studies;
- Development of the plant concepts/philosophies;
- Relevant safety assessments like HAZOP studies;
- Independent evaluation of CAPEX and OPEX, including EPC costs.

The engineering study is progressing well and to date the mass balance has been updated based on the information provided, with metallurgical testwork results conducted by TCM Research. The mass balance is dynamic and plant parameters can be altered resulting in an automated update thereof.

The first drafts of the Block Flow Diagram have been reviewed and the Design Basis Document encompassing the entire engineering scope for the Process Plant and all its supporting systems required for full operations have been compiled. The preliminary plant systems identified are defined in the System Breakdown Structure with the plant and supporting systems to be automated as far as practically possible. A preliminary hazard review has been successfully completed to identify safety, health and environmental aspects of the materials in the process to provide information for compiling an environmental impact assessment (HAZOP 1) .

#### INITIAL METALLURGICAL TEST WORK RESULTS

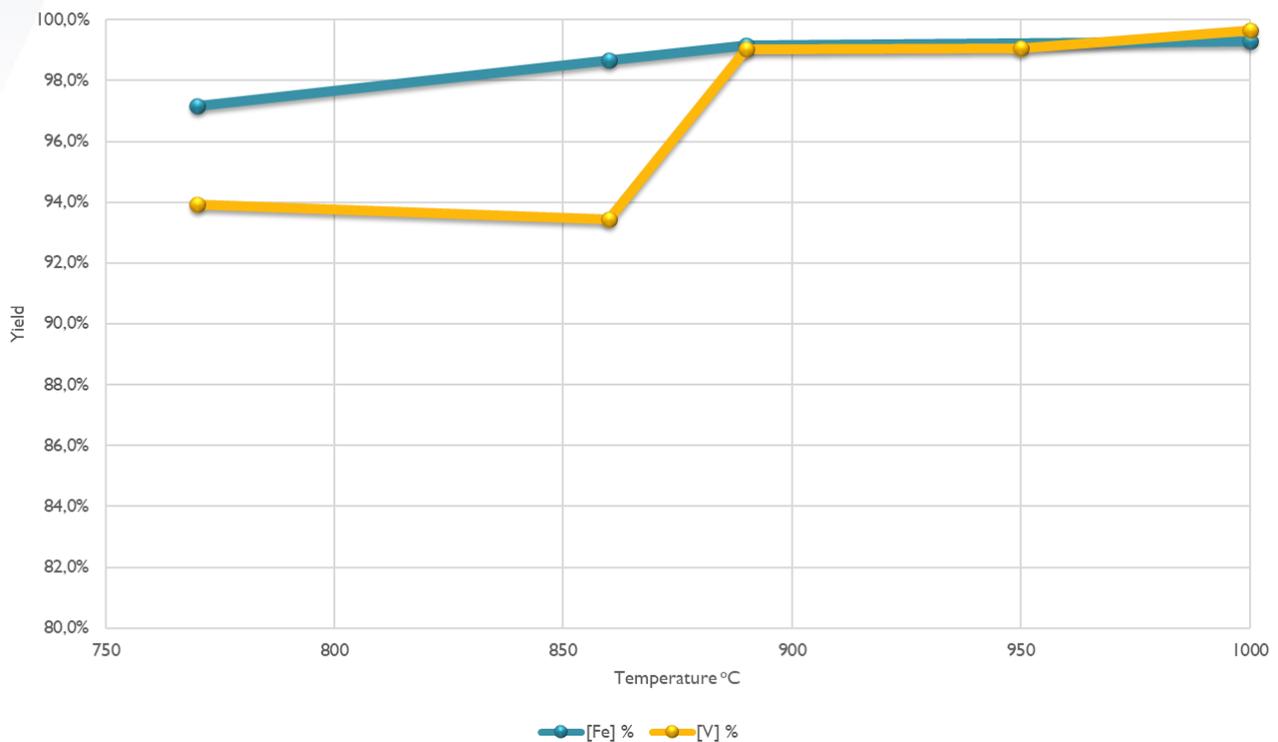
Initial metallurgical test work has been conducted on concentrates produced from the Steelpoortdrift project and the results from this test work indicate:

- Iron and Vanadium extraction rates in excess of 95% could be achieved during the first stage of the process
- High Titanium and Aluminium extraction rates were achieved, indicating potential for selective extraction of these elements in a second processing step
- Carbon Monoxide (CO) can be used exclusively as the process reductant, which is highly beneficial as no solid Carbon is required and allows for Carbon Dioxide (CO<sub>2</sub>) emissions recycling; reusing Carbon Monoxide (CO) and utilizing the Oxygen (O<sub>2</sub>) in later process stages for the production of High Purity Oxides



*Figure 1: Test furnace setup*

**Dependence of Iron and Vanadium yields on temperature**



*Figure 2: V and Fe recovery at varying temperatures*

The metallurgical test work is continuing with the main focus in the second phase of test work being to optimise Ti extraction, as well as validate downstream processes.

#### **POTENTIAL ENGAGEMENT WITH UNIVERSITY GROUP IN SOUTH AFRICA**

The Company has also initiated engagement in South Africa with university groups in the school of Metallurgical and Chemical Engineering, to establish a Masters Degree level research group. The purpose of this research group would be to further optimise and validate the ESG technology process, as well as optimise the current Salt Roast based process design further. Should any of these discussions lead to a formal engagement, the Company will update the market inline with its continuous disclosure requirements.



*This announcement has been authorised for release by the directors of Vanadium Resources Limited.*

For further information please contact:

Eugene Nel

Chief Executive Officer

**VANADIUM RESOURCES LIMITED**

[contact@VR8.global](mailto:contact@VR8.global)