

## TiVAN<sup>®</sup> PILOT TESTWORK COMPLETED WITH EXCEPTIONAL RESULTS FOR MOUNT PEAKE PROJECT

*Updated results to be included in the Mount Peake Feasibility Study*

### Key Points

- All phases of the improved TiVAN<sup>®</sup> flow sheet and pilot plant have been completed satisfactorily, within scope and to industry standards at the CSIRO's Hydrometallurgical Facility in Perth.
- Leach stages completed with improvement to > 95% vanadium extraction.
- Continuous run solvent extraction achieved > 99% vanadium extraction.
- Vanadium production successfully achieved with > 93% recovery.
- Vanadium assays of > 99% purity.
- Titanium production achieved with > 90% recovery
- Titanium product improved to up to 65% purity, providing ideal specification for refining to pigment grade.
- Results of the pilot plant trial now allows final design for the improved TiVAN<sup>®</sup> Process.

Australian exploration company and emerging strategic metals producer TNG Limited (ASX: TNG) is pleased to advise that the pilot metallurgical testwork program for the **TiVAN<sup>®</sup> downstream refinery** of its flagship **Mount Peake Vanadium-Titanium-Iron Project** in the Northern Territory has been successfully completed, delivering excellent results which have either met or exceeded expectations in all areas.

The TiVAN<sup>®</sup> testwork program was carried out at the world-class Commonwealth Scientific and Industrial Research Organisation (CSIRO) hydrometallurgical research facilities in Perth, with the appointed team of CSIRO experts providing significant input and improvements to the process before and during the trial. Selected photos from the testwork are included at the end of this release.

The program has confirmed the ability to achieve commercial vanadium recoveries of > 93% and produce high-purity vanadium pentoxide (V<sub>2</sub>O<sub>5</sub>) of > 99% purity, with high-purity iron oxide and titanium dioxide also recovered as valuable by-products.

An important development arising from these improvements is a significant improvement in titanium dioxide recoveries to > 90%, and the ability to obtain a low iron titanium dioxide concentrate of up to 65% purity. This has resulted in TNG and its consultants considering the production of titanium pigment (>90% grade) directly from this concentrate using an industry standard chloride process, allowing the Company to benefit from improved revenues. Titanium pigment currently sells for approximately US\$3000/tonne.

The testwork was conducted using bulk material from the Mount Peake Project, and was designed to prove the full sequence of hydrometallurgical extraction of vanadium, titanium and iron products from the Mount Peake titanomagnetite orebody, as well as to provide key inputs to the final engineering design and scale-up parameters for the fabrication and construction of the TiVAN<sup>®</sup> refinery.

The testwork program and results have been fully reviewed by Mineral Engineering Technical Services (METS) and global engineering group SMS Siemag, with both groups concluding that the program has demonstrated the technical and commercial viability of the TiVAN<sup>®</sup> Process.

The patent-pending and enhanced TiVAN® Process yielded significant improvements and value-add considerations in many sections of the refinery process.

The testwork phases were conducted as follows:

- **Crushing, grinding, beneficiation:** to produce a magnetite concentrate; achieved with positive results.
- **Feed preparation and pre-processing:** this was completed with positive results with further room for optimisation identified;
- **TiVAN® Leach phase:** this was completed with positive results with further room for optimisation being identified particularly on scale-up;
- **Solvent extraction:** Solvent Extraction (SX) feed preparation and SX operation was completed using industry standard unit operations including mixer-settlers, operating conditions and circuit configuration. This section worked extremely well on a continuous basis with all recycles taken into consideration.

### Conclusions and Improvements:

Considerable testwork prior to and during the pilot run allowed many significant improvements to be made to the overall process, both in design and operation. These include:

- Analytical purity of products obtainable, grading<sup>1</sup>:  
 Vanadium Pentoxide: > 99%  
 Titanium Dioxide: > 65%  
 Iron Oxide: > 99%
- Feed preparation improved the quality of the feed to the TiVAN® leach offering early iron removal opportunity and additional downstream advantages;
- The higher concentrate feed allowed a higher titanium grade with consequent higher recoveries with higher grade concentrate production;
- An excellent TiVAN® leaching efficiency was achieved with high extraction of vanadium into the leach solution and excellent department of titanium to the leach residue;
- A new SX feed preparation stage and simpler organic system achieved extraction rates for vanadium of >99% in only 1 minute whilst maintaining excellent selectivity for vanadium over iron;
- Good continuous operation of the SX circuit with excellent stripping efficiency for vanadium, minimal crud formation or lock-up of metal in the organic phase;
- The combined feed preparation, leach and SX circuits worked well together and through the piloting a number of further optimisation opportunities have arisen to provide further process efficiencies and cost savings; and
- Value added improvement have also been identified and are to be incorporated into the design.

### Titanium Dioxide Pigment

The addition of refining the titanium dioxide concentrate through to pigment grade (>90% purity) represents an important improvement for the overall process. The improved recoveries and concentrate grade for TiO<sub>2</sub> are high enough and perfectly ideal for the production of high purity titanium dioxide pigment using an industry standard chloride process.

<sup>1</sup> Analytical purity of products is based on all test work and analytical assays conducted on TNG samples. Additional validation and optimisation work may result in grade and purity being improved further.

This provides the Company with an important high-value titanium product rather than a medium-grade product as was previously considered in the PFS. Titanium dioxide pigment is used extensively in chemical and high technology industry for a vast range of industrial and consumer goods. It currently sells for approximately US\$3000/tonne, compared to the US\$400/tonne used in the PFS.

TNG has commissioned Roskill to conduct a complete marketing and price forecast report for titanium and the results indicates a strong market demand with prices to potentially increase to over US\$4000/tonne in 2019.

TNG's Managing Director, Mr Paul Burton, said the successful completion of the TiVAN® testwork program was a key milestone for the Mount Peake Project.

"The testwork program has provided independent validation of the feasibility of the TiVAN® refinery process, paving the way for the commercialisation of the hydrometallurgical technology as well as completion of the Mount Peake Feasibility Study," he said.

"The TiVAN® process brings a number of important technical and economic benefits to the project. The main one of course is that we have proven the ability to produce three high-purity final product streams, allowing us to unlock the maximum value of the resource," he added.

"I would like to take this opportunity to thank all those involved in the exhaustive work carried out, particularly by the expert team at CSIRO, and our expert metallurgical consultants SMS Siemag and METS for all the great work they have done in bringing this program to a positive conclusion enabling our Mount Peake Feasibility Study to be finalised, which should be completed on time this month" he added.

Paul E Burton  
**Managing Director**

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## **About TNG**

TNG is building a world-scale strategic metals business based on its flagship 100%-owned Mount Peake Vanadium-Titanium-Iron Project in the Northern Territory. Located 235km north of Alice Springs, Mount Peake will be a 20-year plus project producing a suite of high-quality, high-purity strategic metals products for global markets including vanadium pentoxide, iron oxide and titanium dioxide. The project, which will be a top-10 global producer, has received Major Project Facilitation status from the NT Government.

The Mount Peake Feasibility Study is well advanced and due for completion by mid-2015, paving the way for project financing and development to proceed. An integral part of TNG's emerging strategic metals business is its 100% ownership of the unique and patented TIVAN® hydrometallurgical process, which offers significantly lower capital and operating costs, lowers risk and successfully extracts two other valuable metals from the resource in addition to vanadium – titanium dioxide and high-purity iron oxide.

Vanadium is a highly strategic metal which is used as an alloy in steel. It is also in strong demand for use in energy storage, with vanadium redox batteries used to store electricity generated by solar and wind power, and lithium-vanadium ion batteries used to power hybrid cars.

## **Forward-Looking Statements**

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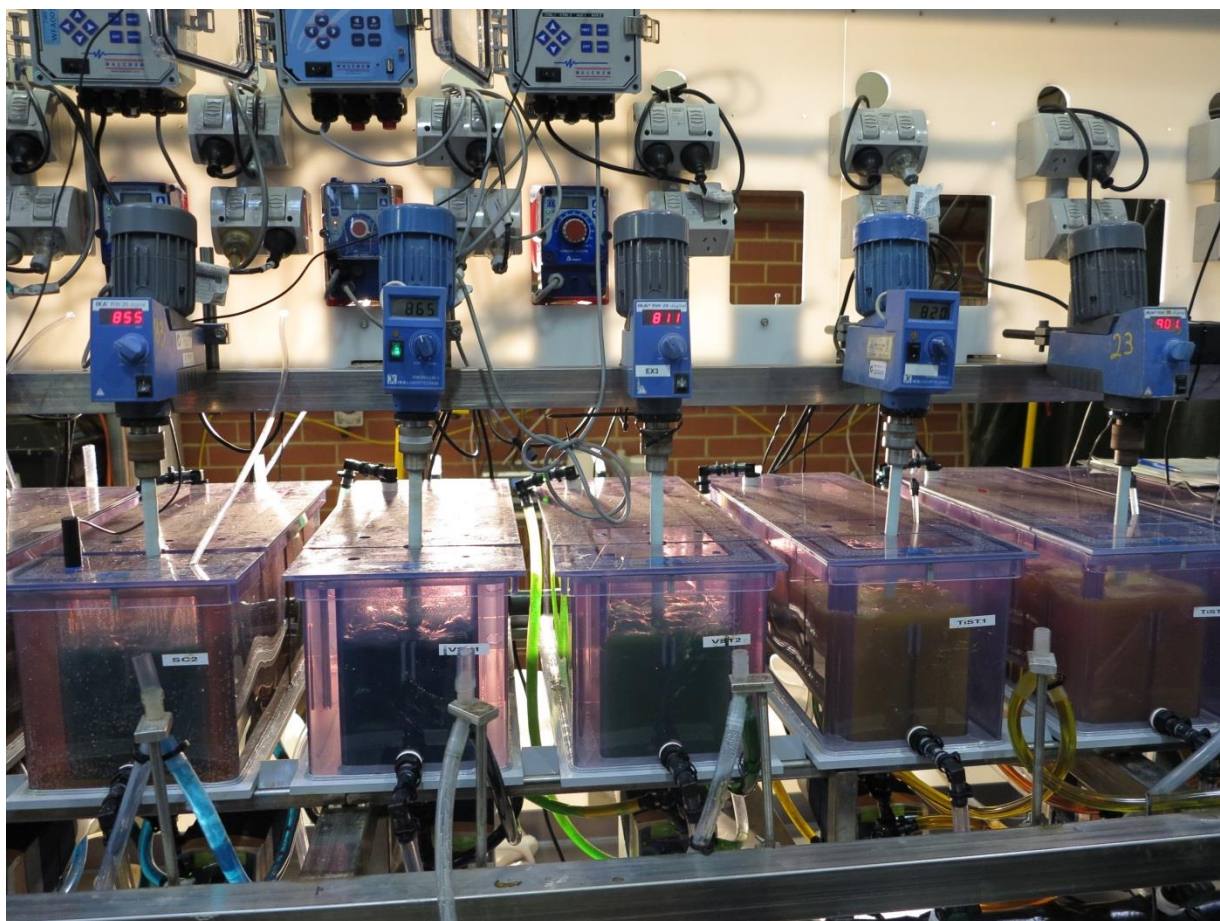
TNG TiVAN® pilot plant, CSIRO.



Dr Goutam Das, (CSIRO), with Mr Damian Connelly and Dr Denis Yan (METS) at TNG's TiVAN® pilot plant, CSIRO.



Dr Wensheng Zhang, (CSIRO) explaining the operation of the industry standard solvent extraction circuit.



TNG's TiVAN<sup>®</sup> solvent extraction (SX) pilot plant in operation. Note vanadium extraction in progress (green/blue).



Left to right: From CSIRO: Dr Chris Vernon, Program Director and pilot plant team members: Daniel Hewitt, Paul Breuer, Nick Kelly, Goutam Das, Wensheng Zhang; METS: Denis Yan and Damian Connelly and TNG: Paul Burton.