



## Step Changes or Hard Yards?

All of our companies seek a step change – in efficiency, in costs, in safety and environment. Correctly, we look to new technology for a breakthrough. But history tells us that the next step change will more likely come from what we already know, rather than a bold new discovery.

Over the last few decades, the minerals and research industry has made remarkable progress. We have developed wonderful new process equipment and analytical techniques that have transformed “black art” into science. A new generation of tools are being investigated now – ore sorting, electrofragmentation, microfluidics, to name just a few.

So the challenge is not whether we will have the tools to make a step change. The challenge is the vision, tenacity and the hard work to combine old and new tools in the right way. For example, quantitative mineralogy is one of the most powerful new tools developed, but too often it is either under-used, or, ironically, over-used so that it obscures the core message, delivering a fraction of its potential.

Even worse, anyone who visits another operation can usually see ways to immediately improve efficiency by applying decade’s old knowledge - good classification in grinding circuits, basic process control and stabilization, feed and flux preparation, electrolyte control. And huge gains are available by optimising the whole process rather

than unit steps within organisation “silos”. Look for smelting solutions in the concentrator and concentrator solutions in the mine. Get a fundamental understanding of the whole process – from orebody to consumer, and then see how to combine known technologies to address the underlying issues.

Easy? Definitely not. It takes hard work to rigorously sample our processes, to analyse mineral behaviour, to work with people upstream and downstream so we understand each other’s operations. To find time to look at other industries for ideas that could transfer to our process. And even then we may face the difficult management issue of needing to spend money in our department to improve efficiency in another department – or another company.

There is no simple answer to these questions – it involves buckets of hard work and devilishly complex management issues. But as engineers and scientists charged with improving efficiency, quite simply, that is our job.

Joe Pease, Chief Executive, Xstrata Technology (XT)  
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### Contacts for Albion Process Testwork

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## Jameson Cell – New Frontiers and 300 Cells!

With over 20 years of continuous development of the Jameson Cell since its commercialisation, Xstrata Technology has recently announced the sale of the 300th cell into Capcoal's Lake Lindsay coal operation in the Bowen Basin. This is in addition to other recently announced coal projects using Jameson Cells including expansion projects for Wesfarmers' Curragh and Gloucester Coal's Stratford operations (both in Australia), Riversdales' Benga Coal Project in Mozambique and Energy Resources' Ukhua Khudag coking coal project in Mongolia.

Le Huynh, Jameson Cell Manager at XT, said the interest in the Jameson Cell in coal preparation plants has remained strong, where operators needed dependable and reliable technology to treat fine coal, an important source of revenue for coal operators.

During 2010, the Jameson Cell business has also found success in other applications, including recovering organic from a copper raffinate stream at Xstrata-Anglo American's Collahuasi copper SX-EW plant in Chile.

Le said the consistent generation of very fine bubbles and the high intensity mixing in the Jameson Cell, was ideal for recovering very low concentrations of organic from raffinate streams, typically less than several hundred parts per million. High throughput in a small footprint, simple operation and extremely low maintenance due to no moving parts in the cell are distinct advantages in this application. The cell is designed with features specific to suit such hydrometallurgy applications including specialist materials, a flat-bottomed flotation tank with integrated pump box and tailings



*Moorlaben Coal Mines using 2 stage flotation with 4 x B6000/20 Jameson Cells (NSW, Australia)*

recycle system, and large downcomers. This will be the first cell of its type to be operating in Chile, although there are many other large cells installed in SX-EW plants in Mexico, USA and Australia to treat both raffinate and electrolyte streams.

Jameson Cells are also finding keen interest in the industrial sector, in particular phosphate and potash producers. Le said a number of projects are in various stages of development using Jameson Cells, including an operation in Saskatchewan (Canada) that has chosen the Jameson Cell technology for cleaning. Base metals applications will also continue to grow this year, including expansions and new operations in Asia and Africa.

## All Aboard with Albion

The Albion Process, Xstrata's innovative oxidative leach technology, was commissioned in July last year at Xstrata Zinc's San Juan de Neiva refinery in Spain. The demonstration plant treats approximately 9000 tpa of McArthur River Mine (MRM) zinc/lead bulk concentrate to produce 4000 tpa of zinc metal. Zinc recovery of 98 to 99% is being achieved by the plant. The concentrate is ground at MRM using IsaMills™ to produce ultrafine particles (P80 ~7µm), before leaching in the Albion Process.

At Xstrata Zinc's Nordenham zinc refinery in Germany, a larger demonstration Albion Process plant has been recently commissioned and is also achieving zinc recoveries over 98%. The Nordenham plant produces 20,000 tpa of zinc metal from MRM concentrate. In addition to the Albion Process, both the San Juan de Neiva and Nordenham plants use Xstrata Technology's HyperSparge™ technology to supply oxygen to the leaching tanks.

The two Albion plants are the first stages of potentially much larger plants, with 70,000 tpa and 150,000 tpa of annual zinc production being studied for the San Juan de Neiva operation and Nordenham operation respectively.



*Xstrata Zinc's San Juan de Neiva Zinc Refinery, Spain*

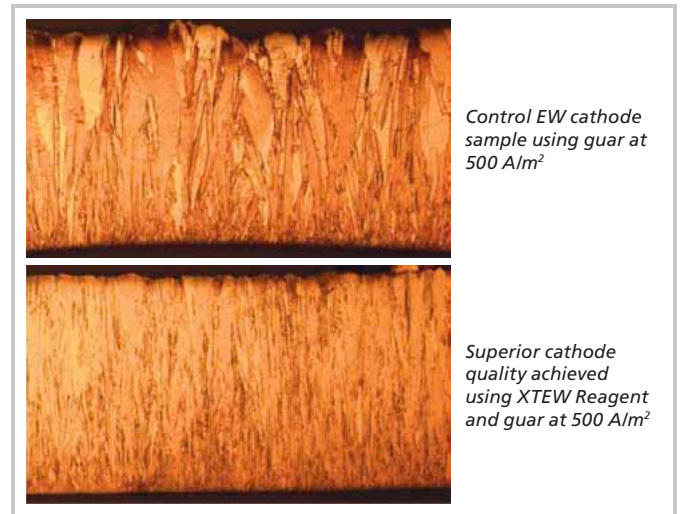
Mike Hourn, Hydrometallurgy Manager for XT, said the start up of the plants was trouble free, with zinc metal being produced from the plants during the commissioning phase. The start up of the process with the new HyperSparge™ at both operations went smoothly, with the longest running operation, San Juan de Neiva, not requiring any maintenance on the spargers in over 9 months of operation.

A third Albion Plant is scheduled to be commissioned late this year, with the Las Lagunas project in the final stages of construction. The Las Lagunas plant will recover gold and silver from refractory concentrates using a combination of the Albion process and conventional CIL.

## XTEW Reagent – On the Level for Copper Electrowinning

The discovery of a new reagent for copper electrowinning has the potential to deliver significant gains in cathode quality of electro-won copper at high current densities. Xstrata Technology has partnered with James Cook University (JCU) in the research and development of a new levelling agent for use in electrowinning, called XTEW Reagent. XT and JCU have been supported with a Research Industry Partnership Program (RIPP) grant from the Queensland State Government, to further the research and development of the XTEW Reagent. The research investigated the behaviour of a range of chemical structures, to identify the reagent with the best performance for copper electrowinning, as well as investigating analytical methods to measure the XTEW Reagent in the copper electrolyte. In parallel, XT conducted progressive scale up tests and trials using XTEW Reagent in copper electrowinning at laboratory scale, pilot plant scale as well as in an operating plant.

To date, the research has revealed that under typical electrowinning operating current densities, the use of XTEW Reagent in combination with guar resulted in superior cathode quality compared with using the reagents on their own. This behaviour can be compared with the combined electrochemical effects of using thiourea, gelatin, and chloride to produce high quality copper cathode in an electro refinery. Furthermore the research has shown XTEW Reagent



*Control EW cathode sample using guar at 500 A/m<sup>2</sup>*

*Superior cathode quality achieved using XTEW Reagent and guar at 500 A/m<sup>2</sup>*

displays superior cathode quality at high current density, in a zone where guar became less effective.

Further industrial trials using XTEW Reagent over a wider range of conditions in a copper electrowinning operation is planned for 2011.

## Transforming Magnetite Circuits with the IsaMill™

IsaMills™ have been established for over 15 years in base metal grinding circuits, transforming the operations with their energy efficient grinding action. The technology is now being adopted by the iron ore industry, with the first IsaMill™ being planned for commissioning in early 2011 at Xstrata Copper's Ernest Henry Mine's Magnetite Project.

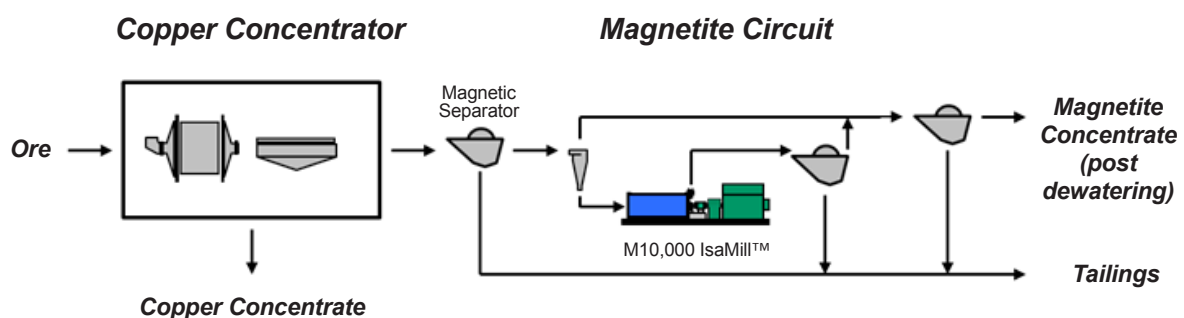
Xstrata Technology will be providing an IsaMill™ package for the project, that will include a M10,000 IsaMill™, powered with a 3MW motor, feed and discharge pumpboxes, surrounding steelwork, media collection hopper and the IsaCharger™ media addition system.

Like many magnetite operations, the magnetite needs to be ground down to ~40µm to enable a premium concentrate to be produced. This is an ideal size range for the IsaMill™. The magnetite

flowsheet treats tailings from the existing copper flotation circuit. Magnetic separators produce a rougher concentrate for regrinding in the IsaMill™, followed by a second stage of magnetic separators. The concentrator is planned to produce approximately 1.2 million tonnes of high quality magnetite concentrate per annum.

Katie Barns, IsaMill™ Strategy Manager, said that the IsaMill™ was selected because of its high power efficiency and its proven performance in other grinding applications, and it promises to play a major part in future magnetite circuits because of these advantages.

The circuit will include the new IsaCharger™, a simple feed system to top up the grinding media to the IsaMill™, ensuring steady power draw and optimal grinding conditions.



## Cleaner Lead Recycling with Natural Gas

Metal Reclamation (Industries) Sdn. Bhd. (MRI) has been successfully operating a secondary lead plant in Malaysia since 1972. MRI became the second smelter to install an ISASMELT™ furnace for secondary lead smelting in 2000. This furnace has been their major production furnace ever since, allowing MRI to meet Malaysia's increasingly stringent environmental requirements, with regards to sulphur emissions and slag disposal.

The MRI plant has been producing 25,000 to 35,000 tonnes of refined lead per year for the past decade through the ISASMELT™ from a feed consisting predominantly of spent lead acid batteries. The ISASMELT™ furnace produces a soft lead, which is further refined, and a slag that is granulated and discarded. The key to the MRI plant is the combustion of fuel in the ISASMELT™ lance. Initially, the lance was fired by diesel/air combustion, and was later converted by MRI to run with 20 tpd of additional oxygen. A recent modification has been to convert the plant so that it can use natural gas as fuel rather than diesel resulting in significant cost savings.

### Gas Conversion

Xstrata Technology, working with MRI, helped design and build the new lance for use with natural gas. Over several months in late 2009, and early in 2010, the ISASMELT™ furnace, lance and control systems at MRI were converted for operation with natural gas. Xstrata Technology personnel attended during the commissioning of the new equipment and were able to assist with the start-up. Since the successful completion of the natural gas conversion, the MRI smelter has operated well, with only minor interruptions due to the shortage of spent batteries.

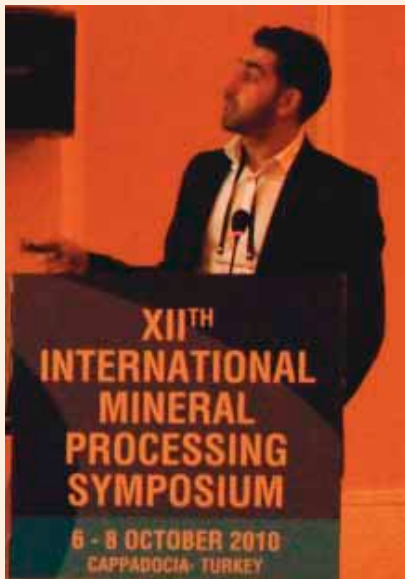
When asked about the ISASMELT™ furnace operation since the conversion project, MRI assistant plant manager Andrew Lim said,



*The MRI Secondary Lead Plant*

“The switch over to natural gas from medium fuel oil has been nothing but beneficial both in terms of cost and operations. We now experience improved lance life, faster heat ups and reduced sulphur in our off gas among other things.”

The successful natural gas conversion at MRI has led to significant fuel cost savings for the smelter, as well as making it easier to control. A similar conversion was undertaken at the Mount Isa Copper ISASMELT™ in 2000 which has operated consistently on natural gas since the conversion. This shows again that the ISASMELT™ furnace is a flexible technology that can be adapted to changes in the economics of fuel and feed supply to suit prevailing circumstances.



## XT Office in Europe

Rakan Rahbani, Process Engineer, has recently set up Xstrata Technology's newest Mineral Processing office in London. Rakan has been in mineral processing for over 4 years, and has been involved in commissioning of many of the recent IsaMill™ installations.

Rakan said the interest in Jameson Cell and IsaMill™ technology in Europe and Russia has been incredible, with the M4 IsaMill™ test unit being heavily booked by clients for the first half of this year. The new office will ensure better support with European clients due to close proximity and similar time zones. Regular client visits are planned.

Rakan is planning to be at many of the mineral processing conferences in Europe this year, including the VIII CIS – Conference for Mineral Processing Engineers in Moscow, 22nd World Mining Congress in Istanbul Turkey, Mining World Central Asia in Kazakhstan as well as others.

He is also supported by Labris in Turkey who currently operates the IsaMill™ rig and assists in IsaMill™ testwork, particularly on gold and base metal projects.

**For any Jameson Cell or IsaMill™ enquiries please contact Rakan on +44(0) 2077 462 721 or rrahbani@xstratatech.com**

**BREAKING NEWS**  
 XT is currently designing  
 and constructing the first  
**ZipaTank™** for Xstrata Zinc  
 (www.zipatank.com)

# IsaMills™ Southern Comfort

The years of work undertaken by XT's Chilean and Canadian offices has eventually been rewarded, with a number of IsaMills™ recently being selected for projects in South America.

The first order, was for Xstrata Copper's Antapaccay project, situated in Southern Peru, which has selected two M3000 IsaMills™ for copper regrinding. The target grind is finer than 40 microns to achieve concentrate quality and recovery. This will be assisted by the flotation benefits from the inert ceramic media. The mills will come complete with the entire regrind plant design and supply, including feed and discharge hoppers, surrounding steel work, and the proprietary IsaCharger™ media addition system.

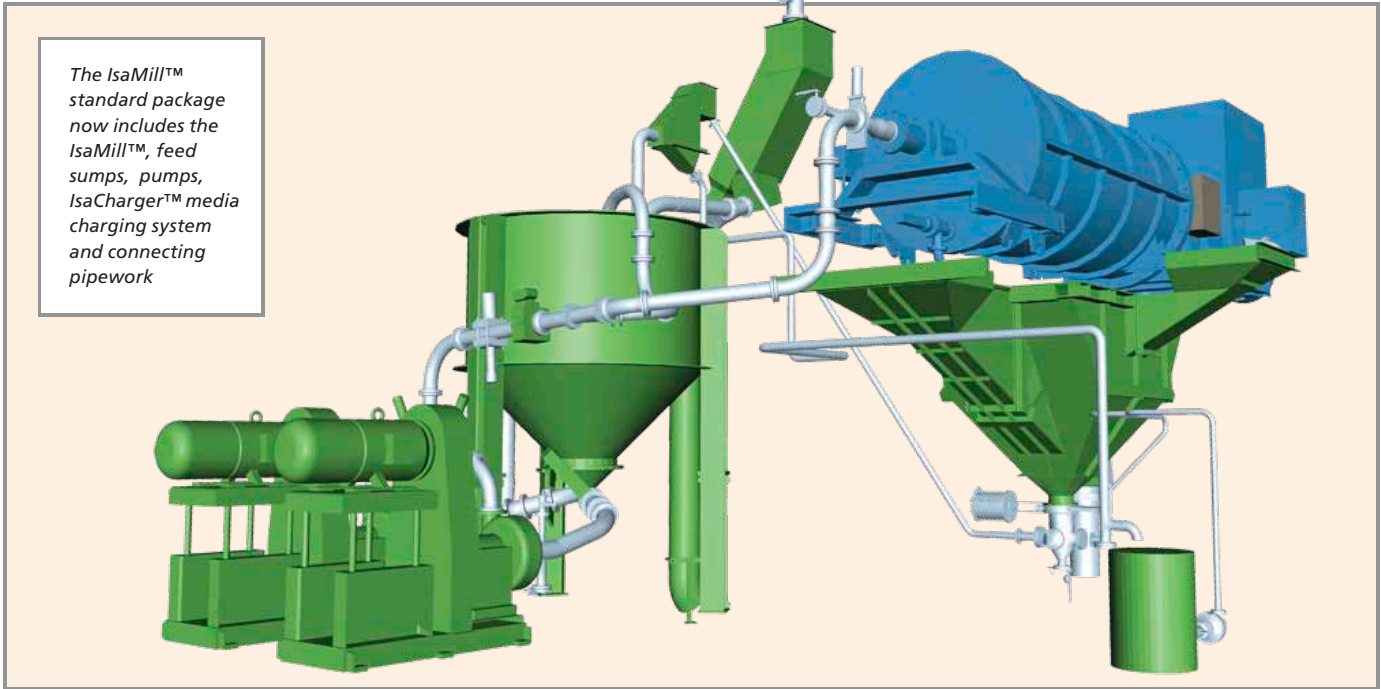
Steve Schmidt – Operations Manager – Mineral Processing at XT, said this project is part of Xstrata Copper's innovative standard concentrator design concept, where equipment and engineering standardisation has resulted in reduced capital costs and delivery timelines, and spare parts, training, operating and maintenance savings. Xstrata Copper undertook rigorous comparisons of a variety of regrind equipment, and selected IsaMill™ technology based on its superior energy efficiency. This is important, particularly in regions of South America, where power costs are high.

The other major order recently announced for the region was for 3 X M3000 IsaMills™ for Xstrata Copper's Las Bambas copper project in the Apurímac Region of Peru. The concentrator will treat 140,000 tpd to produce 400,000 tpy copper in concentrates. High Flow IsaMills™ were chosen for concentrate regrinding to achieve high grades and recoveries.

Karina Arburo, South American IsaMill™ Manager at XT's Santiago Office said that as well as the Antapaccay and Las Bambas IsaMills™, design work is also underway for the IsaMill™ selected for Exportadora Aurifera gold mine in Ecuador. The gold project will be using the 75 kw M100 IsaMill™. This is the smallest in the IsaMill™ range and well suited to small tonnage operations that need high energy efficiency

Karina said "South America will have significant new copper mines and expansions in the future, and the energy efficiency and inert chemistry of the IsaMills™ offers a much better solution to produce high quality concentrate at high recoveries."

Commissioning of the Antapaccay IsaMills™ is planned for the second half of 2012, while production of the Las Bambas project is scheduled for startup in 2014.



Left – The recently released IsaCharger™ being used to charge IsaMills™ automatically to maintain power set point with no moving parts

## Another IsaMill™ for Lonmin

Lonmin has chosen IsaMill™ technology as part of its upgrade at its new Eastern Platinum Tailings Treatment Plant located at Marikana, South Africa. A M3000 High Flow IsaMill™ has been chosen for the fine grinding circuit in the plant which will treat tailings from both the EPL and EP-C Concentrators. This mill will be in addition to the other M3000 IsaMill™ operated by Lonmin, operating in the EP-C Concentrator, which was installed in 2002, treating fine platinum in a flotation cleaner tail stream.

Cedric Walstra, South African Manager Xstrata Technology SA, who has been working on the project, said the new Lonmin mill will be treating some extremely hard chromite bearing material containing PGM's from a concentrator tailings stream. A series of classification stages in the new plant treating the concentrator tailings will deliver a coarse product to a ball mill circuit, followed by the IsaMill™ to liberate the locked PGM particles prior to a 3 stage flotation circuit. The IsaMill™ will be required to produce a grind size of 85 to 90% less than 75um.

Cedric said Xstrata Technology will also supply the new IsaCharger™ media addition system to add the ceramic grinding media to the



*The first Lonmin IsaMill™ (M3000) operating at the EP-C Concentrator*

mill via the feed pumpbox. This proprietary media system has been developed to handle a range of media types and sizes, and to charge media at both low rates during normal mill operation to maintain steady power draw, and at high rates to recover to full power after mill shutdowns. The whole IsaMill™ package will be delivered to the Lonmin site in the middle of 2011, with engineers from Xstrata Technology to supervise installation and assist with commissioning.

## Growth and Development of Copper EW and ER Technology

Surrounded by some of the worlds largest copper mines, and looking out on the spectacular Atacama desert, Xstrata Technology's copper refining and electro-winning customers gathered at San Pedro de Atacama in northern Chile for three and half days of technical presentations, workshops and mine site tours, in November, 2010.

Over 100 customers and XT supplier partners attended the conference, where delegates were updated on new technology developments, workshopped and discussed latest operating practices and issues, and took the opportunity to inspect nearby tankhouses at the giant Chuquibambilla and Radomiro Tomic mines. The conference also visited XT's local Chilean cathode manufacturer, ICL Cathodos in Calama.

"This unique gathering is well known for providing a relaxed and open forum for industry technologists and operators to share knowledge and insights gained from their respective experiences. Old acquaintances are renewed (some going back

more than 20 years), and new friendships forged," said John Doolan, Chief Financial Officer and General Manager Tankhouse Technology.

Attendees came from Germany, Austria, Spain, Belgium, Sweden, Africa, India, China, Korea, Kazakhstan, Japan, Philippines, Australia, Canada, USA and Chile.

"This regular event continues to be a wonderful testament to the pioneers that first developed and implemented stainless steel production cathodes in Townsville in the late seventies, and then at Kidd Creek some years later." commented John.

The Townsville Copper Refinery was the first tankhouse in the world to convert to permanent stainless steel cathodes and since that time the technology has grown and developed around the world, introducing a range of advances in cathode plate development as well as versatile stripping machines, that are now the centre piece of all modern copper refineries.

## Albion for Ararat, Armenia

Xstrata Technology has recently been working on two feasibility studies for the Zod project in Armenia. The client for both studies is GeoProMining LLC. The feasibility studies on the Zod project, based near the town of Ararat in western Armenia, involves investigating the refurbishment of an existing plant as well as the potential of an Albion Process oxidative leach plant.

The Zod gold/silver deposit is situated in eastern Armenia and is mined by an open cut mine. Ore is then railed 240 km to the Ararat processing plant near the Turkish border. The Zod deposit originally consisted of weathered oxide ores overlying deeper sulphides. The oxide ores have now been largely depleted, and the operation is starting to process the deeper, more refractory sulphide ores. Arsenopyrite and pyrite are the major source of gold and silver. To improve gold and silver recovery from the sulphide ores, GeoProMining is examining the potential of an Albion Process oxidative leach at Ararat.

The first part of the project involves a feasibility study to investigate the existing concentrator at the Ararat site, with options being examined to increase the throughput of the concentrator from 500,000 tpa to 1,000,000 tpa. The existing concentrator was constructed in 1973 to process local gold ores, and requires

modernisation and upgrading. XT is also assisting GeoProMining in the study looking at various options for upgrading infrastructure between the Zod mine and the processing facility in Ararat. The second part of the project involves studying the use of an Albion Process, which would oxidise the flotation concentrate ahead of a conventional CIL plant to improve gold recovery. XT has also been working with Core Resources, the owner's representative, on the feasibility study.



## Green thumbs up for UQ mine rehabilitation technology

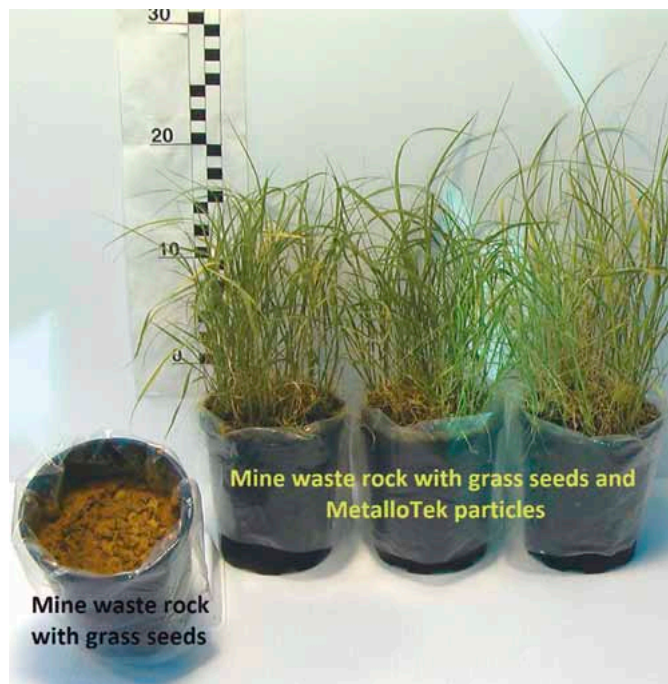
University of Queensland (UQ) start-up venture MetalloTek will progress greenhouse and field trials of a new technology that promotes vegetation growth at mine sites contaminated by heavy metals, thanks to financial support from Xstrata Technology.

The technology, developed as an outcome of a multi disciplinary research program at UQ, has the potential to be a low cost and effective tool for helping to rehabilitate metal-contaminated mine sites. UniQuest, UQ's main commercialisation company, established MetalloTek Pty Ltd to manage further development and commercialisation of the technology in partnership with industry stakeholders.

MetalloTek's lead researcher, Dr Laurence Rossato from the Centre for Mined Land Rehabilitation (CMLR) within UQ's Sustainable Minerals Institute (SMI), said the technology was developed in response to a major challenge for rehabilitating contaminated land where mine wastes would not support plant growth. "Rehabilitation is a vital part of environmental sustainability associated with mining. Our innovative approach has the potential to promote sustainable plant growth on soils contaminated with soluble toxic metals," said Dr Rossato. "We add metal-binding polymer particles to the contaminated soil where they bind to toxic metal ions, reducing their concentrations and thereby allowing vegetation growth. MetalloTek's particles also act as a temporary water reservoir and deliver water to plants, which is particularly useful in arid environments. With increased vegetation cover, soil erosion, metal contamination and leakage into the surrounding environment are mitigated."

In 2010, a preliminary glass house trial demonstrated the effectiveness of the MetalloTek technology on waste rock from a heavily contaminated mine site. The Queensland Department of Employment, Economic Development and Innovation (DEEDI) supplied contaminated mine site soil for the glasshouse trial. Results included plant germination, healthy shoot growth and root development on the mine waste on which no vegetation had been grown for the 30 years.

Xstrata Technology CEO, Joe Pease, said the research showed the potential to deliver smart and sustainable ways of dealing with metal contamination in soils – a critical concern for mining companies



committed to sustainable rehabilitation. "Typically rehabilitation processes involve capping mine waste with scarce topsoil, or trying to establish vegetation on waste which may contain soluble metals which hinder plant regeneration or may leach into the groundwater," Joe said. "While the MetalloTek technology is still in its infancy, it is hoped that the metal binding attributes will "tie up" the soluble metals and allow plants to become established on rehabilitation sites, eventually forming stable ecosystems."

UniQuest Managing Director, David Henderson, said the financial support from Xstrata Technology reflected confidence in the capacity of university research to help major economic sectors like mining address sustainability issues. "The University of Queensland boasts some of Australia's leading environmental experts working in multi-disciplinary teams to resolve problems that industries all over the world are facing. Through start-up ventures like MetalloTek, and with commercial support, we can accelerate the transfer and sharing of ideas," Mr Henderson said.

The financial input from Xstrata Technology will help fund MetalloTek's plans for a long-term glasshouse pot trial and further testing to ready the technology for a pilot field trial at a mine site.

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