

NOVEL “GREEN” POLYMERS OPEN THE DOOR TO LOW-COST REMEDIATION OF METAL-CONTAMINATED MINE WASTES

A newly developed polymer (X3) which facilitates plant growth in metal-contaminated soils has opened the way to effective, low-cost, and environmentally friendly in-situ remediation of mining and industrial waste sites.

This innovative economical, environmentally safe polymer has a high metal binding efficiency which greatly mitigates the risks of leaching or dispersion into the environment. More significantly it can reduce the bioavailability of toxic metals and salinity in root zones and reduce soil penetration resistance thus facilitating root growth and allowing plant establishment on highly contaminated mine spoils that otherwise would be lethal to any vegetation. This improvement will contribute to stable ecosystems with reduced erosion risks. The X3 polymer also acts as a temporary water reservoir delivering water to plants and enhancing their survival, a particularly useful characteristic in arid environments.

The X3 technology is quite radical and has been successfully demonstrated at all stages from basic soil leaching tests to germination trials in Petri dishes, small scale pot tests and major glasshouse trials with selected grasses. At each step, the technology has met or exceeded its expectations. It enables grass to grow on previously barren mine waste rock and tailings. The grass plants are healthy and the application of X3 results in significant soil quality improvement to the point that second generation plants have been observed. Preliminary research has answered each of the initial questions of scale-up positively. Questions still to be investigated are whether X3 is a robust and sustainable technology applicable to

many soil types and able to sustain permanent soil quality improvement and plant establishment in a field situation, through normal weather cycles and extremes. A long-term glasshouse trial will answer some of the questions but the technology will need to be successfully demonstrated in a field trial to establish a principal reference site.

Such trials are challenging and necessarily lengthy in order to cover natural variations and several regrowth cycles until a stable ecosystem can be confirmed. Meanwhile, X3 particle design will need to be further improved, optimised and tested to suit each specific contaminated soil condition. The benefits of X3 have been thoroughly assessed by the world-ranked mining and environmental specialists Golder Associates. They predicted that the X3 technology could be economically competitive compared to other available remediation techniques and has the potential to be effective at establishing a good vegetation cover on mining or industrial sites which in turn will



The photographs above illustrate the potential of the X3 technology, from successful seed germination, emergence and plant establishment, to healthy plant growth on mine waste that is otherwise completely toxic to plants. The once-off addition of X3 to the surface 50 mm of highly contaminated mine waste (highly acidic, saline, metal-contaminated and prone to acid mine drainage) on which no vegetation had been grown for 30 years enabled a native metal-tolerant grass (metallophyte) to germinate and grow vigorously with no visible signs of toxicity, reaching a height of 20 cm in three months and up to 1 m with flowering and viable seed set in nine months. Second generation grasses were also observed. In the absence of X3 (control pots), no vegetation was able to grow confirming field observations.

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result in high social acceptability. Technically, it will be logistically easy to implement, should have a lower maintenance requirement, and can be adapted to be used for many waste types. It now needs long-term investment, close partnership with the mining industry, to be demonstrated on a number of different site types to fully evaluate its use as a practical technology, and to further develop it into a proven rehabilitation tool. This is a unique opportunity for interested sponsors to invest into a promising technology at the cutting-edge of soil remediation with high potential for significant commercial, environmental and reputational benefits. The X3 innovative technology has been acknowledged by the mining industry and received the "Excellence in Environmental Management Award" at the 2011 Australia Mining Prospect Awards, and was a finalist in the 2011 Australian Innovation Challenge. It has also recently been nominated for the 2012 prestigious Australian Museum Eureka's Environmental research award.

The opportunity: AMIRA project P1063 GRASS (Green Remediation Advancement for a Sustainable Solution) aims to provide the research, case studies and methodology required to make application of this technology on operational sites commercially feasible. It is seeking sponsors for the work which will be conducted in two phases of two and three years respectively (with a go/no-go decision at the end of the first phase).

Researchers: A team of 16 experts in complementary disciplines at two leading Australian Universities, The University of Queensland and The University of New South Wales.

Investment required: For an operating company AU\$172,900 for year one and AU\$142,200 for the second year of the first phase (two years); AU\$169,600 for year one, AU\$100,400 for year two and AU\$104,300 for year three of the second phase (three years). For a supplier sponsor the sponsorship is AU\$57,600 and AU\$47,400 for the first phase, AU\$56,500, AU\$33,500 and AU\$34,800 for phase two respectively.

Supplementary funding sources including government grants will be explored to cover cost of research.

Sponsor benefits: For operating companies these include preferential access to the technology, discounts on the commercial use of the patented product, the opportunity to have soil samples matched to X3 technology to test application potential, and the opportunity (one only) to provide the test site for the pilot field trial resulting in remediation at no cost.

The potential benefit to the industry and to individual companies of successful development of this technology is very significant in sight of the onerous legacy issues remaining from previous mining activity. The X3 technology is anticipated to be widely recognized and accepted as a safe, sustainable, economical, practical and less environmentally disruptive alternative to current soil remediation techniques. It will assist mining companies to reduce environmental impacts globally and enhance environmental compliance allowing relinquishing lease obligations and minimising rehabilitation costs and penalties. Sponsors, with preferential access to the technology, will benefit in the first instance.

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P1063 GRASS workshop in Brisbane (Queensland, Australia) on Tuesday 25 September 2012: A workshop will be held at the Sofitel Brisbane, 5:30 to 7:00 pm at the IMC conference. Details of the GRASS program will be discussed and all companies interested are welcome to attend (please RSVP through AMIRA International).



From left to right: Drs Laurence Rossato, Michael Whittaker and Alex Pudmenzky receiving the 2011 Mining Australia Award for Excellence in Environmental Management for the X3 technology.

APPLYING STRATEGIC LENS TO WATER CHALLENGES IN THE INDUSTRY - A SCENARIO APPROACH SOLUTION



The mining industry is experiencing a multitude of pressures: market pressure to expand due to an increasing demand for commodities; environmental constraints given that mining activities frequently take place in areas which are considered water-stressed; process intensity because of the decline of ore grades (which increases waste and hence water consumption); climate change impacts exacerbating existing water issues (flooding in water-rich areas and water shortage in arid and semi-arid regions); threats to water security (availability and quality) of water for competition with other domestic, industrial and agricultural users; and also community demands for companies to limit their impact on the local environment .

This strategic AMIRA project P1084 aims to understand and assess major water challenges affecting the industry providing the necessary data and analysis to initiate a step change in water efficiency. The project has a carefully selected global team with a wide range of expertise. CM Solutions is a global metallurgical consulting, design and training company. The Centre for Water in the Minerals Industry (within the Sustainable Minerals Institute, at The University of Queensland) conducts research towards achieving sustainable water management in the mining industry, and develops key technologies for the measurement, monitoring and modelling of water in mining. Fundacion Chile's SMART WATER program supports the mining industry in developing innovative solutions aimed at water efficiency, water quality and water management to deal with social and environmental challenges. The Industrial and Mining Water Research Unit (at The University of Witwatersrand) brings a history of industry experience and research to the project.

The AMIRA P1084 project is proposed to be conducted in three phases. The first phase will begin by classifying major water challenges faced by the minerals industry, supported by case studies of mining operations in strategically selected regions (Australia, Africa, South America and North America). A number of sites, which have previously identified water management challenges, will be assessed in each country and water accounts will be constructed. These sites will form the basis for scenario planning and be further validated in phase 2. In the case of South America, it is expected to cover the main mining countries, whose environmental challenges are more strongly linked to water security and social demands, especially in relations to the impacts of mountaintop mining.

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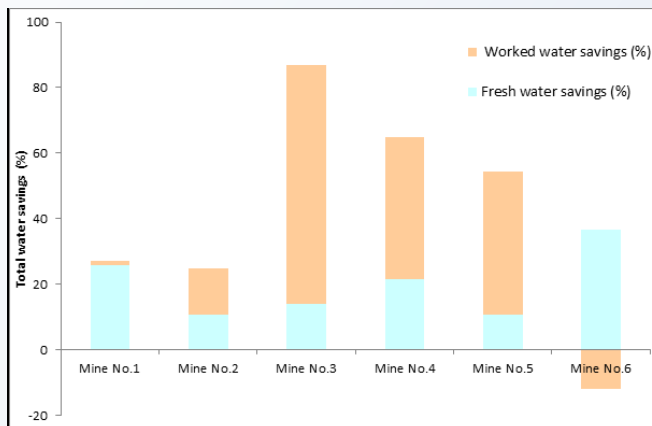
In phase 2, additional sites will be assessed to establish benchmarks of best-practice in water management. The study will conclude in phase 3 with the development of a roadmap towards a more water-efficient outcome for the mining and metallurgical industry.



Sponsorship opportunities are available, with sites selected for study receiving a world-class appraisal of their water use and performance, how they compare to other sites faced with similar water management challenges, identification of areas to improve, and the ability to report on their water usage in a sustainable reporting format.

Technology transfer to Sponsors will be accomplished through several mechanisms including regular reporting on the overall project, Sponsors' review meetings, site feedback and opportunities to discuss the findings in detail.

Investment An estimated US\$4.17M will be sought from sponsors over the three phases of the project life, and Sponsorship investment will depend on the total number of companies participating. For this project to successfully deliver the outcomes proposed, full Sponsor engagement is necessary, hence a single tier sponsorship model is proposed: Sponsorship for companies will include their nominated case studies and access to all project deliverables as outlined in the proposal. The proposed starting date for this project is November 2012, taking approximately 3.5 years to complete.



In a benchmarking study conducted by The Centre for Water in the Minerals Industry (SMI, at UQ) across the coal industry in Queensland, significant total and freshwater savings was derived from mines adopting leading practises: the graph illustrates the savings of six coal mines which formed part of the study. This example demonstrates the potential savings possible in a regional setting; the P1084 project brings strategic focus to global water challenges with an view to establishing a blue print for future scenario planning.

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P1060 – ENHANCED GEOCHEMICAL TARGETING IN MAGMATIC-HYDROTHERMAL SYSTEMS

The P1060 project continues the work done in P765/P765A to investigate and define a series of mineral chemistry vectors within porphyry copper systems to allow the primary deposits to be “seen” from much further away than previously. The project focuses on two problematic environments surrounding or overlying mineralized systems – “green rocks” and lithocaps. Case studies and blind sites from around the world provide a growing dataset of simple minerals which are commonly found in such systems and can easily be identified by field geologists.



Dave Cooke (co-project leader, CODES) leads discussion on outcrops on the Cottonwood Canyon transect.

The project, being led out of CODES (University of Tasmania) with research collaborators including Lakehead University and Imperial College, is in its second year. A successful 3rd sponsor review meeting was held in Salt Lake City in July 2012. The meeting was attended by 36 participants who also visited Cottonwood Canyon to view exposed intrusions (inferred to sit under Bingham Canyon) and Kennecott’s Bingham Canyon mine. Visiting these sites allowed sponsors to put into context some of the project’s current research on lithocap and green rock environments.

For more information about this project contact: Adele Seymon [adele.seymon@amirainternational.com] - Exploration/Geoscience Program Manager

NEW MEMBERS

AMIRA welcomes Gryphon Minerals Limited as a Member.

Gryphon Minerals (ASX:GRY) is an Australian company committed to becoming a significant West African gold producer with an immediate focus on advancing its 100%-owned Banfora Gold Project in Burkina Faso, as well as its pipeline of new and exciting projects in Mauritania.



P1060 sponsors and researchers at the visitors centre of Kennecott's Bingham mine.

WHAT IS AMIRA INTERNATIONAL?

AMIRA International is a GLOBAL organisation

- An association of the worlds minerals companies and their suppliers
- Compiler of global research teams from our network of quality research providers
- Facilitator of global research projects with study sites from around the world.

AMIRA International ensures MAXIMUM BENEFIT from research spend

- We secure maximum funding to enable effective research
- We source research ideas from a global network of innovative thinkers
- We aid the take-up of project outcomes by ensuring well defined project outcomes meeting member company needs.

AMIRA International MANAGES across the project life cycle

- We promote research to the benefit of members
- We work to balance industry and academic needs (often contrasting drivers)
- We ensure timely provision of deliverables.

Stay tuned for the next newsflash to learn what AMIRA is not...

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