

Energy Efficiency of Mineral and Metal Processing

About 3% of the world's energy is used in crushing and grinding rocks. This will only increase as head grades drop and ores become more complex, requiring more processing.

Industry and research has long searched for a breakthrough in comminution efficiency. But energy efficiency is more than just the efficiency of a grinding mill – it is about the way circuits are designed to suit the ore, and how the whole processing chain is integrated to get maximum benefit from minimum grinding power. For example, to remove MgO in smelting requires it to be fluxed and heated to 1300°C – this uses 10 times more energy than grinding it out.

We believe that improvements in energy efficiency of up to 50% can often be achieved by combining the existing tools of:

- Basic quantitative mineralogy
- Grinding models
- New grinding technologies
- Reproducible laboratory flotation tests
- Basic smelting thermodynamics.

The starting point is to use quantitative mineralogy to understand the ore and the implications for both concentrating and smelting. The most benefit, results from asking two simple questions:

- In roughing, **how coarse** can we grind and still get high recovery? In this stage the focus is on liberating enough gangue to allow the mineral to be recovered to a small stream for further processing.
- In cleaning, **how fine** do we need to grind rougher concentrate to make a high grade product? Now the focus is on mineral liberation, and we have to trade the energy needs of grinding with downstream smelting or leaching.

Some circuit designs grind the rougher feed (the big tonnage) too fine, but don't grind the cleaner feed fine enough. As a result, both concentrating and smelting use more energy than they could. The reluctance to regrind finer reflects concerns with the impact of both "sliming" and steel grinding media on flotation. However this has now changed with new grinding technology like the IsaMill™, which uses inert media and produces sharp size distributions, liberating minerals without harming downstream processes. This technology enables a profound change in the way we think about circuit design.

We don't need to look for new technological breakthroughs for a step change in energy efficiency. The tools are available now – we just have to combine them in the right way.

Joe Pease, General Manager, Xstrata Technology
jpease@xstratatech.com.au

New Personnel at XT



Kevin Arseneau – Procurement & Systems Officer

Kevin joined us in 2007, in his role of Procurement and Systems Officer for the IsaMill™ business. Kevin comes from a military logistics and manufacturing background in Canada. Kevin's role is to assist in the development of systems in the IsaMill™ spare parts business.



Jacinta Cribb – Senior Metallurgist

Jacinta is a metallurgist who joined the ISASMELT™ team to assist in process design, training and commissioning of the upcoming ISASMELT™ Projects. Jacinta has been involved with the ISASMELT™ at Mount Isa Mines, having commissioned and worked on the smelter, and has been involved in commissioning at the ISASMELT™ plants in Belgium and Peru.



Bev Coulter – Consultant Metallurgist

Bev joined the Minerals Processing team as a Consultant Metallurgist last year, where she is focused on sustainability and energy efficiency. Bev is a chemical engineer with MBA qualifications who has worked in an oil refinery, research metallurgy at Mount Isa Mines, and as an engineering equities research analyst with UBS in London.



Roy Stevenson – Technical Supervisor

Roy is a qualified electrician and instrumentation officer. Roy has spent over 20 years in this field in industries as diverse as milling, smelting, pharmaceuticals and food. Roy's role at Xstrata Technology is to provide electrical and instrumentation support for IsaMill™ installations.

David Prescott – Mechanical Engineer

David joined the engineering team in the Brisbane office in 2007. David is a mechanical engineer and has previously worked on maintenance and project roles in a coal mine operation. He now provides engineering support in ISASMELT™ and IsaMill™ projects.

Lisa Marshall – Customer Service Officer

Lisa comes from a Senior HR/Admin background, having worked for a large multinational third party transport and logistics organisation for ten years before joining XT. Her role is to ensure that our clients' IsaMill™ spare parts arrive on time as well as liaising with our sub contractors.

Joanne Weston – Cathode Manufacturing Manager

Joanne is the Cathode Manufacturing Manager for the for Townsville and Chile cathode plate manufacturing operations. Joanne is a Metallurgical Engineer, with significant expertise in Copper Heap Leach, SX-EW operations, as well as experience in research and development of the ISA PROCESS™.

Steven Pudney – Senior Mechanical Engineer

Steve has recently joined Xstrata Technology as a Senior Mechanical Engineer and project manages many of the IsaMill™ projects in South Africa. Steve has worked in mining and engineering companies over the last 20 years, including both smelters and concentrators at Mount Isa.

ISAMILL™ Service Team

The unprecedented demand for IsaMill™ technology has now resulted in over 40 IsaMills™ operating world wide, with many more being planned and designed. The parts support for these mills is undertaken by the IsaMill™ Service Team, who provide spares for operating mills as well as new mills being produced. The IsaMill™ Service team is headed by the IsaMill™ Service Manager, Tim Shea, who has been busy growing his team to include logistics and purchasing professionals, cataloguing, procurement and systems specialists.

Part of the regular system of continuous improvement at XT involves working with our partners to improve products and services. This involves regular inspections and meeting with

key manufacturing partners, Linatex and JC Smale & Sons. Ongoing improvement to part life, from full scale trials and R&D, involves working with our partners to incorporate the improvements into part design and manufacture.

XT has also improved logistics support for their clients, by choosing Kuehne & Nagel as the third party logistics provider. The XT spare parts stock holdings have been consolidated in Brisbane and Johannesburg. Warehousing support is being examined, to minimize the transport to client's sites, and a North American warehouse location is being negotiated to support IsaMills™ in the Americas.

Albion Process Update

Construction work has commenced on the world's first Albion Process plant, EnviroGold Limited Las Lagunas project located in Sanchez Ramirez province, in the Dominican Republic. The plant, when completed in late 2008, will process over 800,000 tonnes per annum of mine tailings to produce 87,000 ounces of gold and 510,000 ounces of silver. The tailings were generated during the processing of sulphide ores from the nearby Pueblo Viejo mine in the 1980's and 1990's, and consist of gold and silver housed in pyrite, and cannot be processed using conventional technology.

Xstrata Technology will supply the Albion Process technology to the project, including a M3000 IsaMill™ for regrinding of flotation concentrate prior to oxidative leaching.

The Albion Process is low cost technology for treating refractory concentrates, and uses an IsaMill™ to produce a highly activated, finely ground concentrate, which is then leached with oxygen at atmospheric pressure in agitated tanks. The atmospheric leach offers considerable capital cost savings over alternative technologies, such as pressure or bacterial leaching. The technology is applicable for refractory concentrates containing copper, nickel, zinc or precious metals, and is currently being



Pilot plant testing for the Las Lagunas project conducted at HRLtesting, Brisbane

reviewed for a wide range of projects, both within Xstrata and by external clients.

The Albion Process is marketed through Xstrata Technology's marketing partner, Core Resources. Two licences have been granted since marketing of the technology began, in late 2005, with the second licence going to European Goldfields Limited for the Certelj project in Romania.

Tankhouse Technology

The Combined Strength of ISA PROCESS™ and KIDD PROCESS



With the acquisition of Falconbridge, the ISA PROCESS™ and KIDD PROCESS were integrated in late 2006 to provide the best technology available for copper electro refining and electro winning. Together, the technologies are responsible for producing over 11 MTPA of copper production annually, with 98 licenses world wide.

The combined group provides clients with a range of permanent stainless steel cathode technology, such as BR Cathodes and HP Cathodes, mechanical and robotic high and low capacity stripping machines, as well as providing tankhouse design. Most importantly, in addition to the expert XT team, the group can now draw on first hand operating and designing experience from over 60 Xstrata tankhouse personnel. This platform, leveraged with our world wide representatives and core supplier teams, provides continuous expert support to existing and new customers.

The Tankhouse Technology group, including the ISA PROCESS™ and KIDD PROCESS, is lead by John Doolan, Xstrata Technology CFO, supported by 4 Regional Marketing Managers, responsible for individual regions:

- Mike Murphy representing China, Korea, Japan and Europe
- Graham Heferen responsible for Africa, South Asia, and Australia
- Phil Donaldson representing North America
- Anders Haag representing South America

Each Marketing Manager is assisted in their regions with regional support. This includes Michelle He supporting Mike in China, Mesco working with Mike and Graham as marketing representatives, PJ Garbutt in Africa, and PI International working with Phil in the US and Mexico. In South America, Anders has built the largest regional office, located in Santiago Chile, reflecting the market size and potential in that region.

The former marketing and project management relationship for KIDD PROCESS between Falconbridge and EPCM Services Ltd in Canada has been terminated.

Supporting the marketing managers is a team of engineers and process experts, providing technical assistance, process support and product development.

Integration of cathode manufacturing and services saw a new and expanded role with Inppamet Catodos Ltda (ICL) in Calama, Chile. However the joint venture service center with Lanz in Antofagasta has been closed, as well as the termination of the former relationship between Falconbridge and Cobra Tecnologia Ltda in Chile.

XT has also combined the strengths of both ISA PROCESS™ and KIDD PROCESS Cathode offerings and brought the development and manufacturing functions together in one team lead by Joanne Weston. The new alliance with ICL provides XT with manufacturing and service capability in the Americas as well as in the Asia Pacific (Townsville)

As with cathodes, XT also offers an expanded range of electrode handling machinery, incorporating ISA PROCESS™ and KIDD PROCESS designs backed by core suppliers Mesco and Ionic Engineering. Through team work focused on development improvements, new designs have been available to customer projects and adopted to enhance performance. In the near future, further innovations will be brought to the market, once careful and thorough development programs are completed.

The new, larger technology range, provided by the Tankhouse Technology group, coupled with ongoing R&D, and in house expertise, ensures the technology stays at the forefront of the industry, providing clients with the most reliable and efficient technology for producing high grade copper.

Xstrata Technology Office in Santiago

South America, in particular Chile, is home to some of the biggest mining operations in the world. Xstrata Technology has supported this region for a number of years, with an office based in Santiago. Xstrata Technology, operating as Xstrata Technology Agencia en Chile (XTAC), is based in the Las Condes district of Santiago de Chile and has grown over the last 12 months to satisfy the increasing demand for XT's technology.

While historically Tankhouse Technology has been the main XT focus in this region, with over 20 installations using ISA PROCESS™ and KIDD PROCESS technology, interest has now grown in XT's Mineral Processing technologies. This has resulted in pilot plant trials using small scale IsaMills™ and Jameson Cells for several large mine sites, as well as enquiries about the Albion Process.

Anders Haag, Region Marketing Manager for South America, has increased the capabilities of the XTAC team to include Mineral Processing in addition to the Tankhouse Technology expertise and now has 8 staff supporting him. The team can also draw on further support from Canada and Australia. XTAC also has a close relationship to Xstrata Process Support, who provide expertise in operational support, growth initiatives and strategic development, (www.xstrata.com/corporate/commodities/technology/contact).



Seated (left to right): Claudia Adonis, Jimena Zenteno
Back Row (left to right): Humberto Termini, Ximena Carrasco, Anders Haag, Cecilia Arrue, Fernando Romero, Christian Pasten.
Absent: Karina Arburo.



MIG Circuits at Anglo Platinum

Anglo Platinum recently installed another four M10,000 IsaMills™ for coarse, mainstream inert grinding – MIG. Two mills were commissioned at the Mogalakwena Platinum Mine (Potgietersrust Platinum Limited – PPL A/B Sections) near Mokopane and two at Waterval UG2, near Rustenburg. There are now five M10,000 IsaMills™ operating in MIG applications at Anglo Platinum Concentrators, with a target grind size of 80% passing 53 microns.

As expected, the IsaMills™ have improved recoveries at both sites. The Anglo Platinum Mogalakwena Platinum Mine (Potgietersrust Platinum Limited), PPL C section M10,000 IsaMill™, has been operating for more than a year and recovery improvements have exceeded design. Future plans for Anglo Platinum concentrators include several IsaMills™ at various concentrators on both MIG and UFG (concentrate regrind) applications where target grind is 80% passing 25 micron. The next Anglo Platinum installation will be Amandelbult on the 75 to 210 ktpm expansion project and comprises 1 x M10,000 MIG IsaMill™ and 1 x M3,000 concentrate regrind IsaMill™.

Flotation circuits receiving ore from an IsaMill™ benefit from having a narrow particle size distribution and clean mineral surfaces (from using inert media).

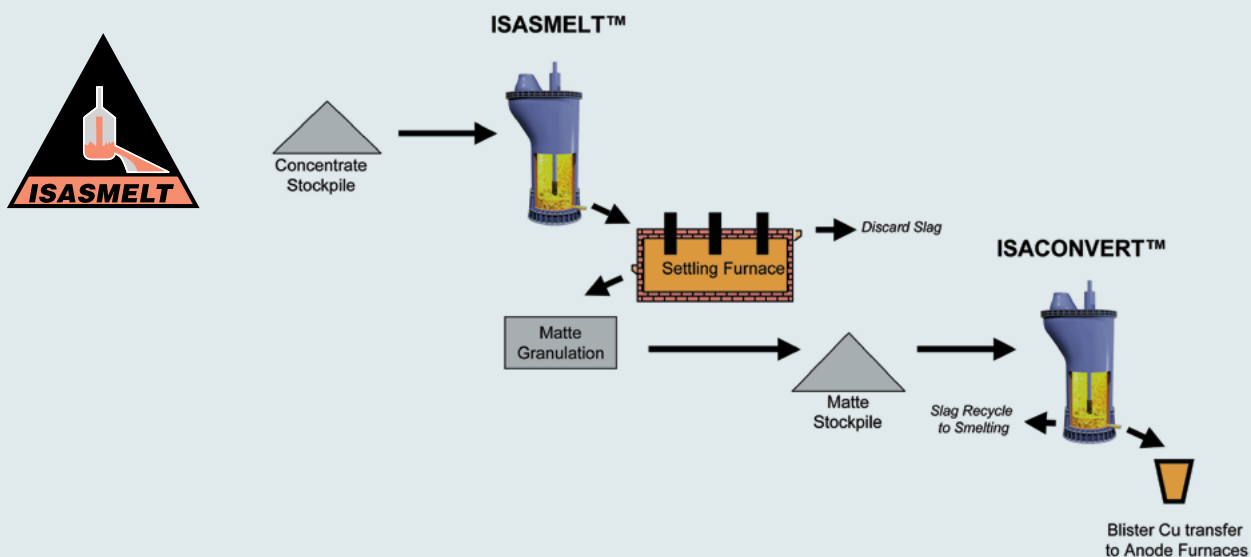
First ISACONVERT™ Plant under Construction

Xstrata Technology is currently designing the first ISACONVERT™ plant for installation at Mopani Copper Mines (MCM) at the Mufulira smelter in Zambia. Following the successful commissioning of their ISASMELT™ furnace in mid 2006, MCM decided to expand their converting capacity using the continuous ISACONVERT™ process. The ISACONVERT™ furnace will produce 50,000 tpa of blister copper from copper matte produced in the ISASMELT™ furnace, supplementing the blister copper produced in their existing converter aisle. Construction has commenced on site and the plant is due for commissioning in the first quarter of 2009.

The ISACONVERT™ process has been developed over the last 15 years and is ready for full scale industrial applications. It is set to replace the traditional Pierce Smith batch converters, and has all the advantages

of the ISASMELT™ process, including operational flexibility, high environmental performance, high strength gas for the acid plant and low smelting cost. Also, due to the inherent simplicity of the process, and the advanced process control used, personnel become competent within weeks of being introduced to the technology.

The ISACONVERT™ follows on from the success of the ISASMELT™ package, which has been provided to primary copper smelters around the world. ISASMELT™ Plants are also being used for recycling copper-bearing materials in Germany and Belgium, where an ISASMELT™ furnace is used in a two stage (batch) process, for smelting, followed by converting in a single furnace.



Jameson Cell Update

High activity in the mining sector has seen a continued demand for Jameson Cells in both coal and base metals. The duties have varied, but the common thread has been the need to produce high grade concentrate from a single cell in a small space at low cost.

Recent coal installations include the Moorvale Upgrade and Heilig Projects (a coal/iron application), and design of cells for the Lake Vermont and Middlemount Projects. Jameson Cells are ideal for fine coal applications, because they treat large volumes in a very small footprint, and don't need air blowers or compressors. This reduces capital and operating costs. The flexible cell design means they can be custom designed into the available footprint, ideal for plant expansions.

These same advantages have seen Jameson Cells installed at Red Dog in Alaska and the Consolidated Murchison Project, and chosen for copper pre-cleaning at Prominent Hill Project in South Australia. The high mixing intensity in the downcomer means fast floating minerals are recovered quickly in a small space. This enables efficient froth washing to reduce entrainment, meaning high grade concentrate is produced from a single cell. This makes Jameson Cells ideal for 'hybrid' circuits, to combine with conventional cells to create a smaller, more efficient circuit design. Fast floating liberated particles can be recovered at final concentrate grade in a pre-roughing or pre-cleaning Jameson Cell. A smaller number of conventional cells then recover the remaining slower floating particles from the Jameson Cell tails. This concept is particularly valuable for expansions of existing concentrators when space is short.



B5400/18 Jameson Cell operating at Red Dog, Alaska

Jameson Cells are also designed with a recycle mechanism that enables them to respond quickly to upstream fluctuations, ensuring stable operation during any plant disturbance or short plant shutdowns. They also come fully automated, enabling variables such as froth depth, air flowrate and washwater flowrate to be adjusted easily to optimise flotation performance.

Tankhouse Technology Project Update

Two new tankhouse projects are being developed by Tankhouse Technology in Bulgaria and China. These state of the art plants will incorporate ISA PROCESS™ technology, and each will have a capacity of 180,000 tonnes per annum of LME grade copper.

Yunnan Refinery, Kunming, China

The Yunnan refinery is owned by Yunnan Copper Company Ltd, which already operates an ISASMELT™ at this site.

The project was won by international tender for a complete package of electrode handling equipment, and contracted to Tankhouse Technology in December, 2006. Tankhouse Technology experienced process engineers, worked with its technology package partners MESCO Inc of Japan and Kuenz GmbH of Austria to review basic engineering, plant process operations and also equipment design with the Yunnan Copper project engineering team throughout 2007.

Commissioning and plant production is now planned to commence in October, 2008, with Yunnan Copper's operators scheduled to obtain valuable hands on training at Xstrata's Copper Refineries in Townsville, Queensland, followed by final, on-site training at the new refinery.

Pirdop Refinery, Bulgaria

The Pirdop plant is owned by Cumerio Med JSCo, and is a sister plant to the Olen Copper Refinery in Belgium (350,000 tpa), both of which are owned by the parent company Cumerio Med. The Olen plant has used the ISA PROCESS™ in its operations since 1996.

The contract to supply the new refinery with ISA PROCESS™ technology was signed in July 2006, and involved Tankhouse Technology engineers



Civil Construction of Yunnan Copper's new 180ktpa copper refinery tankhouse

conducting basic engineering and plant process operational reviews with the Cumerio project engineering team, in early 2007. Since then the cathode plates have been manufactured, and delivered in November 2007. Commissioning and plant production is planned to commence in May, 2008, with Tankhouse Technology personnel providing 8 weeks of on-site training for the refinery operators.



Chilean Manufacturing Partner for XT

XT has expanded its cathode manufacturing capability with the recent signing of Chilean company ICL (based in Calama, Northern Chile). This addition to the base manufacturing facility in Townsville, Australia, furnishes XT with additional capacity and geographic reach. ICL and XT engineers have worked closely to transfer know-how and manufacturing skills for both ISA PROCESS™ and KIDD PROCESS style cathodes ensuring that all XT cathodes meet the highest quality standards. Whilst the Calama site is envisaged to predominantly service the South American market, capability is there to leverage both sites to fill orders anywhere in the world.



Top: Cathode Plate Manufacture in Townsville.

Below: Part of the Tankhouse Technology Team, Vic Horwood (leading hand), Bill Smith (plating shop coordinator), Rhett Pruden (production & maintenance supervisor) and Geoff Lynch (production supervisor).

In 2007, a record number of cathodes were manufactured (more than 150k) across the two sites. 2008 is targeting yet another record year with the schedule already heavily booked. Further increases in capacity will come on line during 2008 as improvement programs are completed across the sites.

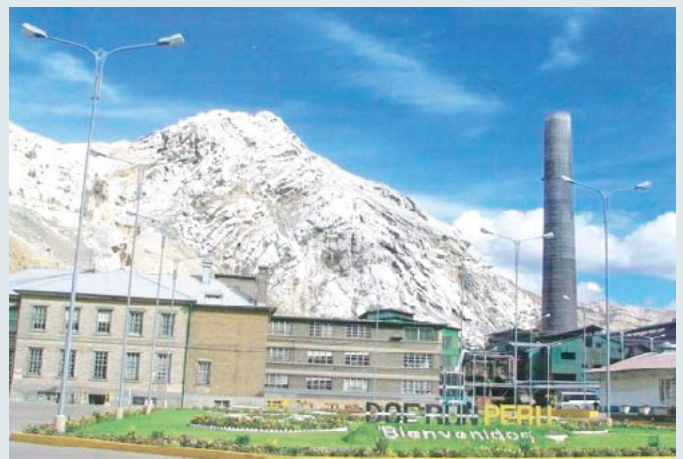
One of the most exciting innovations XT brought to the market in 2007 was the introduction of LDX steel as a 316L substitute. Rigorous testing and careful development of surface finish techniques has enabled XT LDX steel to perform alongside 316L and deliver comparable results, or sometimes, improved performance. Testing and development has focused on SX EW applications, with the largest order to date being 20,000 plates which will be manufactured and delivered this year. Orders for LDX are expected to grow rapidly as the news spreads.

ISASMELT™ being used in the DRP Project, Peru

Following the success of the installation and commissioning of the ISASMELT™ furnace at the SPCC copper smelter in Peru, XT signed agreements with Doe Run Peru (DRP) in March 2007 to provide ISASMELT™ as the core smelting technology for the DRP copper smelter modernization project in La Oroya, Peru. The La Oroya copper smelter is situated 175 km east of Lima at 3,800m above sea level in the Andes. New environmental regulations that will come into force in 2009 necessitated a change to environmentally friendly smelting technology such as ISASMELT™ so that the smelter can continue to operate in this region. Also, the need to achieve separation of minor elements into the off gas stream for collection and further treatment, was another reason why ISASMELT™ technology was chosen for the project.

XT is providing a design and equipment supply package for the ISASMELT™ plant. The design package covers process design, structural design and detailed mechanical and instrumentation and control design. The equipment supply package includes proprietary ISASMELT™ equipment, instrumentation and control equipment and a waste heat boiler.

The ISASMELT™ furnace will have a nominal capacity of approximately 280,000 tonnes per annum of new concentrates and produce matte containing 62% copper and discard slag. DRP are to convert an existing reverberatory furnace into a settling furnace, where the matte and slag tapped from the ISASMELT™ furnace will be separated.



Copper concentrate treatment using ISASMELT™ technology in Latin America will total approximately 1.5 million tonnes at the end of this project and we expect further interest in the process once the DRP plant is commissioned.

New Developments in XT Tankhouse Technology

RFID

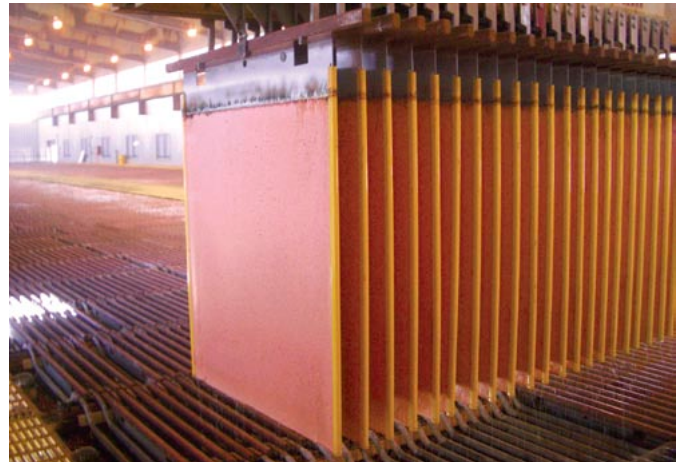
XT and their technology partners, VRT Systems, have been developing an RFID based solution for tracking permanent cathode plates. The system encompasses fixed readers identifying plates passing through the stripping machines and the use of sophisticated tracking and database software for cathode asset management and improved operational control strategies. The performance of individual plates and batches of plates can be tracked through a full service history, which can provide a range of data including individual plate efficiencies, weights, edge strip performance etc.

Long term trials are still being undertaken, with encouraging results to date. Clients getting plates manufactured can have the RFID “starter-packs” fitted in their plates that will allow the RFID system to be fitted to their plates in future.

LDX Cathode Plate

Over the last 5 years XT has been trialling different types of stainless steel for use as a cost effective alternative to the 316L stainless steel used in electrowinning (EW) applications. After successful plant trials in Australia, as well as at a large EW operation in Arizona, USA, the Duplex stainless steel has shown to have good physical properties for EW cathode plate applications.

The ferritic/austenite matrix in the Duplex microstructure provides the required physical characteristics for the cathode, comparable to 316L stainless steel, while the lower molybdenum and nickel content keeps the pricing below comparable 316L cathode plates.



Harvesting the duplex cathodes at the test facility in Arizona

The stainless steel forms the basis of the new patented XT LDX Cathode Plate, which is being installed in several new projects this year.

The advantages of the Duplex stainless steel include:

- Comparable corrosion resistance to 316L in tankhouse environments
- Low cost due to lower molybdenum and nickel content
- Significantly higher mechanical strength over standard 316L cathode plate
- Plates are conditioned with a unique surface finish to facilitate the adhesion of copper and enhance the stripping performance.

The First IsaMill™ Technology in Canada



The first IsaMill™ installation in Canada is now operating at Blue Note's Caribou Project. The Caribou Project is located 50 kilometres west of Bathurst, New Brunswick, and includes two mines and a 3000 tonne per day concentrator. While the operation has run previously, it had been on care and maintenance since 1998.

Three M1000 IsaMills™ have been installed in the concentrator to produce separate lead and zinc concentrates. All these mills are designed with a 1000 litre grinding chamber, powered with 500KW motors, and use Magotteaux Keramax®-MT1™ as the grinding media.

In the lead circuit, two of the IsaMills™ operate in parallel and reduce the lead rougher concentrate down to 12µm (P80), while the third IsaMill™ regrinds the first lead cleaner concentrate down to 8 µm (P80). The mills are all rubber lined, and use 7 grinding discs to achieve the grinding duty. The mills are operated in open circuit, with a unique particle separator included as part of the mill, to retain media within the mill without the need for fine screens.

Xstrata Technology personnel, Greg Anderson and Danielle Kowal, based in the Xstrata Technology office in Mississauga, Canada, assisted in development, start up and commissioning of this project.

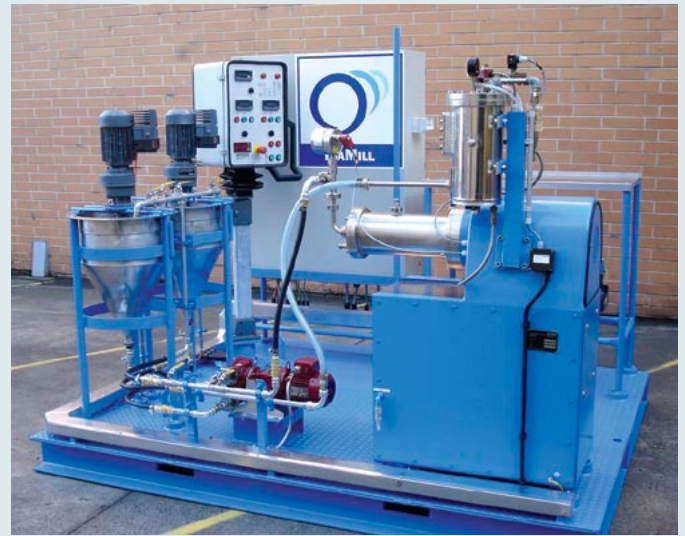
Scale Up of IsaMills™

One of the biggest advantages of the IsaMill™ is that it provides accurate scale up from the small scale pilot rigs to the full scale models. This has been proven using the small scale M4 IsaMill™, and comparing it to the M10,000 in operation at Anglo Platinum's WLTRP in 2003.

The M4 IsaMill™ is a 4 litre mill that operates with a 2.2kW motor. The current M4 rigs are located on a platform that allows them to be containerized, including feed and discharge pumps and control system. Currently there are a number of M4 IsaMills™ in operation around the world that can undertake testwork on a client's sample, to provide the power consumption per tonne for a given size reduction. Testwork generally requires 30 Kg of sample, with two individual tests being conducted (i.e. 15 Kg required per test). Comparison test can also be undertaken at this scale using different media types.

Contacts for IsaMill™ Testwork

G&T Metallurgical Services	Canada	www.gtmet.com
SGS Lakefield	Canada and Chile	www.met.sgs.com
JKTech	Australia	www.jktech.com.au
Ammtec	Australia	www.ammtec.com.au
HRLtesting	Australia	www.hrltesting.com
CSIRO	Australia	www.csiro.com



Australian Awards

During last year, Tankhouse Technology won the Townsville Region Export Award in Manufacturing. The large amount of work being handled by the team in Townsville secured this award for their region. This was followed by Xstrata Technology winning the Large Advanced Manufacturer Award in The Premier of Queensland's Export Awards 2007, which led to XT becoming a National Finalist in the Australian Export Awards.

While getting recognition at these events is a great honour, the best recognition we hope to receive is by another successful installation using our technology, and we thank our clients for giving us the opportunity to do so.



*The Premier of Queensland's Export Awards 2007 Ceremony:
Left to Right: Michael Young (Xstrata Technology), Sean Birchley Manager – Corporate Banking, HSBC, Anna Bligh Premier of Queensland, Brendan O'Rourke (Xstrata Technology)*

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