Joe Pease & Dr Bill Johnson

New technology doesn't just come into our industry. It is the combination of a set of events, timing and people with passion. If one of these ingredients is missing then the technology doesn't eventuate. People with passion fill a variety of roles in the technology development. Initial inventors are the source of the "spark", that important event that brings to light the innovation. As important are the teams of engineers, operators and scientist who work with the inventors to further develop the idea into something that can be touched, be used and mark the way to a commercial product. And finally there are the first users to adopt the technology – believers who take the risk of breaking away from "tried and tested" routes, hoping to bring to their project advantages that wasn't possible in the status quo.

Joe Pease

Joe Pease, former COO, Xstrata Technology has been in the mining industry for over 30 years, in a range of technical and managerial roles. A large part of his career was at Glencore's Mount Isa Mines (MIM), and more specifically, in the lead/zinc concentrator at that site. During this time, the "spark" of using small scale industrial fine grinding into mineral processing was initiated in the labs at MIM to combat the company's deteriorating ore quality, which led to the birth of IsaMill™ comminution technology.

However, to get to the point of a robust, commercial technology, many steps were needed after the initial spark, lab scale testwork and initial prototype development. This is where Joe has played a vital role in the IsaMill story. He knew the fine grained orebodies at Mount Isa, as well as the deposits at McArthur River, needed this technology for their survival and development, and it needed to work. No other technology could grind economically to the sizes that were required to liberate the minerals. Working with engineers, development teams and his operators, Joe was a key player in the advance of the technology at the Mount Isa operations, leading to increased metal recoveries and developing the IsaMill into the robust and accepted technology it is today.

The original detailed flotation studies of the lead-zinc ores at Mount Isa and McArthur River were carried out by Dr Bill Johnson *(see detailed section below)* and he defined the requirement for an ultrafine grinding mill. The Netzsch company in Germany worked with MIM to build the early mills and the project became a commercial venture when they were successful. The work has been excellent and the results have been most satisfactory.

The turning around of zinc recovery at MIM and the eventual development of McArthur River based on IsaMill technology, is a credit to the work done by Joe and the rest of the engineers and operators in developing the new technology. Several papers document the success at these operations, *Improving Fines Recovery by Grinding Finer and Developments in Milling Practice at the Lead/Zinc Concentrators of Mount Isa Mines Limited* from 1990, co-authored by Joe and other engineers, with Joe always keen to discuss with doubters of the new technology and new concentrator practices – "You can grind fine...and you can float fines!"

After Mount Isa, Joe joined Xstrata Technology (XT), a subsidiary of Glencore Xstrata responsible for marketing and further developing technology from its operations. Joe has overseen IsaMill technology develop from being a "niche" application used mainly at Glencore Xstrata sites, to an accepted grinding technology in coarser applications worldwide. Through Joe and the IsaMill team at XT, the passion to implement energy efficient comminution technology in a variety of minerals and duties is still as strong today as it was when the technology was first developed, with over 120 mills being installed, large mills and technology packages being developed, as well as the promotion of user groups for further advances in technology.
The roles Joe has played in being a joint developer and first user of IsaMills, and his role in its commercialisation, as well as a passionate leader and motivator of the IsaMill business at XT, is why he was nominated as a worthy candidate for the *International Mining Hall of Fame.*

Joe in his own words: "My role at MIM was initially as manager of the lead-zinc concentrator, where we worked with Bill to develop and apply the IsaMill from small scale, in several stages of scale up, to the 1 MW scale used in our projects at Mount Isa and McArthur River. After development to full scale, I led the concentrator team to apply the technology

in several parts of the circuit in a staged regrind and flotation approach to achieve the high recovery increase. After that I was CEO of Xstrata Technology which further developed and commercialised the technology to the industry. This included scale up to 3 MW (and design of an 8 MW mill), development of a low cost ceramic media and integral media addition and recovery system, and the application of the technology – and the staged regrind and flotation approach – in copper, nickel, platinum, iron ore, gold, lead zinc and coal industries; and the application of ultrafine grinding to leaching flowsheets as well as flotation (including the Albion process, replacing roasting at Kalgoorlie Consolidated Gold Mines, and the Phelps Dodge Morenci chalcopyrite leach). The rapid development and commercialisation led to significant metallurgical improvements in multiple commodities and countries, and was enabling technology for many. Once external adoption commenced, our team achieved rapid global adoption of over 100 MW installed power in a few years. The IsaMill, and derivative high-speed inert stirred mills, are now a standard industry tool, and an essential one to deal with reducing grain size and increased impurities in mineral deposits."

Bill Johnson

Dr Bill Johnson led the development of the IsaMill, and the application of ultrafine grinding and flotation to the minerals industry. Bill was head of Minerals Processing Research at Mount Isa Mines in the 1980s and 1990s, when he was tasked with finding a treatment solution for the extremely fine grained McArthur River lead-zinc-silver deposit in the Northern Territory of Australia. This large high grade deposit was discovered in the 1950s, but had defied economic processing due to mineral grain size that was below 5 microns – finer than the size many people regard as unfloatable "slimes". Instead, Bill knew that fine particles with fresh surfaces were easy to float, but that the barrier was technology to economically grind to this size.

Tumbling ball mills with large steel balls cannot practically grind to below 10 microns; even the relatively new (in the 1990s). Tower mills were not practical – their energy efficiency drops rapidly below 20 microns. Further the large amount of steel media (inefficiently) consumed contaminated the surface of fine particles with iron hydroxides, making it very difficult to get flotation selectivity and recovery. Bill knew that if there was an answer to economic ultrafine grinding, it would not be found in the minerals industry. Instead, he looked in manufacturing, where he found small scale batch mills grinding specialist (high value) products like printer ink, paint pigments, pharmaceuticals and cocoa for chocolate. These mills used very fine, expensive media stirred at high speed in a small batch mill. Bill then set him team about solving several problems to apply this to the minerals industry:

- The mills needed to be scaled up 1 or 2 orders of magnitude larger than the manufacturing mills

- They had to operate on large tonnages of low value product treated continuously, not in small batches
- To operate continuously, they needed a way to discharge fine product while still retaining the fine (1-2 mm) media
- The media needed to be inert (not steel) to give minerals a clean surface needed for selective fines flotation
- The media also needed to be low cost – manufacturing applications (with high value product) used specialist glass media that cost over $20,000/tonne in 1990. Bill knew the minerals industry needed a cheaper alternative.

By working with the German manufacturer Netzsch, Bill and his team developed the IsaMill, with the following features:

- It used grains of smelter slag as a source of free grinding media, stirred at high speed (up to 20 m/s).
- It retained media in the mill with a centripetal separator at the mill discharge, which retained coarse particles of media and ore, while passing water and fines. An added benefit was that this provided both grinding and classification in the one device.
- The inert grinding environment provided fresh clean particle surfaces that responded well to flotation. At McArthur River, about 96% of the particles were below 2.5 microns, and were recovered at high grade and high recovery in conventional flotation cells.
- The IsaMill technology was far more energy efficient than tumbling or tower mills to grind below 20 microns, and had further significant benefits from the improved surface chemistry and flotation.
- The mills were first installed at the Mount Isa lead zinc concentrator, where they increased lead performance by over 5%, and zinc performance by over 15%.
- Once developed, the IsaMills enabled the development of the McArthur River deposit (and several others since).
- The IsaMills spawned a range of similar technologies for ultrafine grinding, including the SMD, VTX, Deswik and HIG mills.