Ground breaking

Capable of crushing ore into super-fine particles without the need for energy intensive grinding, a recently unveiled South Australian innovation has exciting potential for the resources industry worldwide. **Megan Andrews** reports.

Designed and constructed in South Australia, new super-fine crushing technology was revealed last month in a launch ceremony attended by government delegates and representatives from local resources companies including BHP Billiton, Arrium and Nyrstar.

The innovation is the brainchild of South Australia's IMP technologies (IMPTEC) and has been designed to provide a wet or dry, media free, low energy route to ultra- fine products from hard minerals. It is expected to make minerals processing cheaper and more productive and has been described by some in the industry as 'game changing'.

Crushing is far cheaper than grinding, however, the transition from crushing to grinding occurs at relatively coarse sizes because conventional crushing devices are not designed to produce the finer end product required.

> This technology will provide significant cost and production improvements by reducing capital and energy costs; providing water savings; and reducing maintenance costs

Regardless of grinding method used, the cost escalates sharply as finer products are required from harder and finer feedstock.

Adelaide Hills-based Chris Kelsey, Technical Director at IMPTEC, combined his engineering knowledge with the fundamentals of particle size reduction mechanisms to come up with the innovative concept. Today's IMPTEC super-fine crusher is the end product of 18 years work and the third particle size reduction device to be built and tested over that time.

The project received global industry support at the International Mineral Processing Congress in October 2014. It has now been granted $136,000 in funding through the State Government's Mining and Petroleum Services Centre of Excellence and is moving into a commercial trial.

South Australian Minister for Mineral Resources and Energy, Tom Koutsantonis, said the technology has the potential to provide "significant cost and production improvements for the global resources industry".

"With cutting edge technology such as this at our disposal, we are creating a highly desirable environment for potential investors in South Australia's minerals and energy resources sector."

Director of IMPTEC John Doherty said the technology has important implications in reducing power consumption of mineral processing and the cement industry, and can reduce greenhouse gas emissions as well as global operating costs.

Recent pilot testing on banded hematite generated liberation size

The technology

The crusher consists of a rotating compression chamber with an internal gyrating mandrel.

The principle aim in designing the super-fine crusher was to perfect a mechanism able to initiate particle breakdown at a rate perfectly balanced to the rate of increase in particle population within the confined zone.

Feed entering the rotating compression chamber is accelerated into a rotating particle bed which lines the inside of the chamber, then high pressure compressive pulses are applied in the opposite direction to the rotating bed. The non-uniform compressive loading induces high tensile stress levels that lead to feed breakdown via tensile failure.

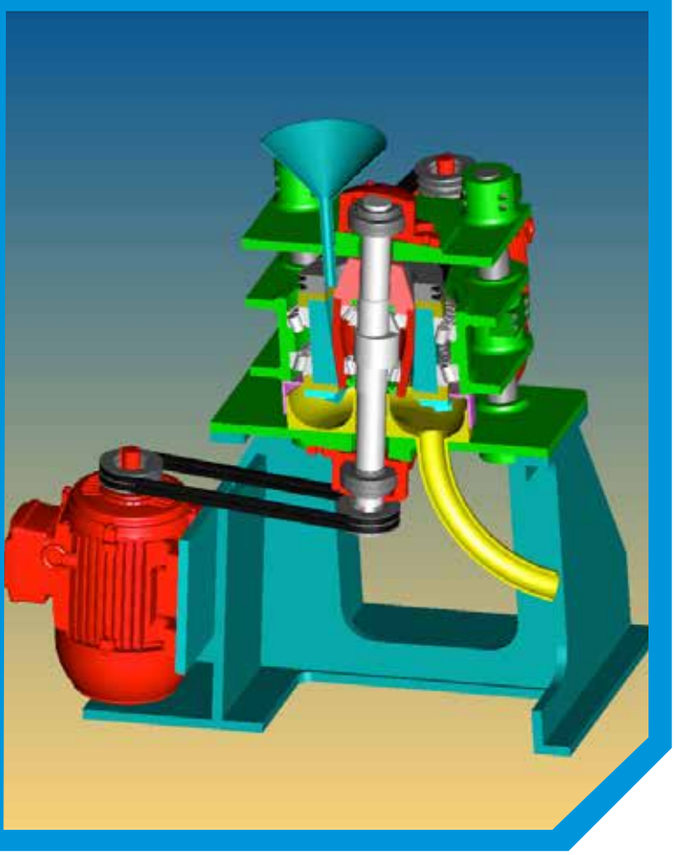
Whilst compression fracture, shear fracture and abrasion fracture occur simultaneously and contribute to the overall rate of breakage, tensile failure is the dominant mechanism.

Conventional fine and ultra-fine grinding devices rely to varying degrees on these same particle breakage mechanisms, however the super-fine crusher has the unique ability to contain the feed mass within a minimum active volume, which ensures extraordinary high levels of particle breakage strain energy can be transferred to the confined particle mass at maximum efficiency.

These high levels of fracture generating strain energy concentrated within the particle bed result in an explosive increase in particle population, which partially dilates the particle bed between pulses. Incoming feed displaces an equal mass of particles and the partial dilation of the bed enables the fine particles to pass readily through the voids.

An important characteristic of the super-fine crusher is the low level of heat generated during operation. Product temperature remains 3 to 4˚C above ambient, consistent with conventional crushers, despite the extraordinary high level of concentrated power.

The power density of the super-fine crusher is substantially higher than conventional state of the art fine and ultra-fine devices.



products of around 50 microns from single pass open circuit tests.

"This technology will provide significant cost and production improvements by reducing capital costs of comminution (reducing solid materials from one average size to a smaller average size); reducing energy costs by around 30 per cent; providing water savings; and reducing maintenance costs and machine downtime," Mr Doherty said.

"Importantly for industry, it also helps by increasing mineral recovery rates through finer product size."

Mr Doherty said the funding received through the Centre of Excellence has enabled the company to begin a commercial trial with South Australian-based mining and construction companies.

IMPTEC's test facilities in the Adelaide Hills are currently equipped with SFC100 and SFC150 pilot crushers. A commercial scale SFC 350 has been assembled and is undergoing proving tests.

Assessments of the trials will provide performance data for scale up to the larger SFC1000 with a projected ultra-fine product output of 20 t/h.

IMPTEC employees answer questions at the recent launch (pilot crusher in image)