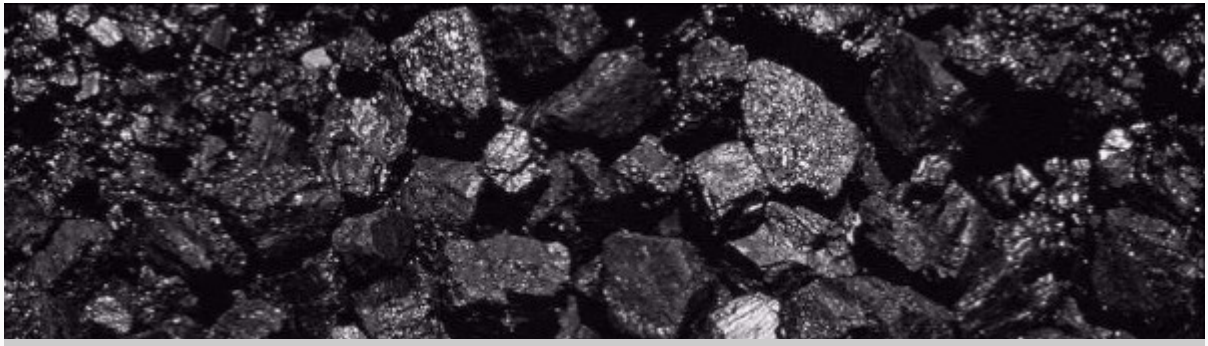
# ACARP Matters



## Turnkey Reflux Flotation Cell Results Indicate Commercialisation Within Sight

**The Reflux Flotation Cell (RFC) is well on track to commercialisation having succeeded at full scale during its first phase of testing and surpassing a series of industry separation performance benchmarks in its latest ACARP project.**

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In this project the RFC delivered almost complete recovery and cleaning at elevated throughput using ultrafine cyclone overflow, under industrial process conditions. Previous work had focused on carefully controlled experiments under laboratory conditions.

The low capex flotation technology with robust process control and elevated processing rates was developed by a University of Newcastle team led by inventor Kevin Galvin with licensee FLSmidth. The aim of the latest project was to confirm the scale up of the technology under industrial conditions and, in turn, consolidate the value proposition of the RFC with a view to commercialisation.

Prior to the full scale trial, local mines supplied the research team with around 100m$^3$ of coal, comprising two metallurgical flotation tailings and nine thermal coal feed samples from hydrocyclone overflow. Researchers, Jamie Dickinson and PhD student Matt Cole, investigated the 11 feeds supplied. Six of the feeds were examined under continuous operating conditions using a single stage of separation, four were tested using two stage processing, and two were analysed using a batch flotation technique via a 3.5 litre laboratory mechanical cell.

RFC separations were benchmarked through direct comparison with grade-recovery curves and the recoveries and product ashes obtained from batch flotation. An external laboratory produced recovery-grade curves of each feed using tree flotation analysis. In addition, coal grain analysis (CGA) of two feeds revealed the upper limit of separation based upon particle maceral composition and surface liberation.

Project lead Kevin Galvin said the separation performance of the RFC for all feeds exceeded the tree flotation curves and was consistent with the results from CGA.

“Within one separator, the Reflux Flotation Cell delivers extreme levels of product cleaning, well beyond that expected from the tree curve. This level of cleaning maximises the product value via a reduction in the ash and moisture levels, due to removal of clays. These benefits are achieved at high recovery,” he said.

“Improved tailings management and water savings are expected with the increase in yield, reaching 50% yield from some tailings.

“A key finding from the study, consistent with the standard principles of flotation, is that to preserve the recovery of valuable particles, it is necessary to maintain a consistent feed-to-gas rate ratio. Experimentally, it was shown that an increase in the feed rate, with no commensurate increase in the gas rate, led to a decrease in recovery, as would be expected. This is readily addressed by increasing the gas rate. The RFC permits this increase with little or no impact on the product grade.”

Kevin said the research team had developed a practical approach to optimising the interrelationship between grade, recovery and throughput. “In general, as the feed rate to a flotation cell increases, there is a tendency for the grade-recovery performance to deteriorate,

however for the RFC there is a large window where the strong performance is maintained. Ultimately, there is a clear interplay between the grade, recovery and throughput. This is being explored by Matt Cole in his PhD research," he said.

The RFC represents a step change in flotation technology, addressing numerous long standing flotation issues, many of which emanate from the management of the froth. The stability of a froth can vary significantly, impacting on the process control, recovery and overall separation performance.

The RFC is the first technology to operate with no froth. Instead, the system functions with an internal concentrated bubbly zone. This state lends itself well to powerful cleaning (low product ash values) through a downwards flow of wash water and to a very simple form of process control based entirely on the measurement of flow rates. Moreover, the system uses a lower system of inclined channels which help to prevent the loss of bubbles to the underflow tailings stream. This arrangement provides for a much stronger hydrodynamic capacity, permitting significant increases in the feed, gas and wash water rates beyond that possible in more conventional cells. The combined hydrodynamic advantage is approximately an order of magnitude over and above conventional cells.

Kevin said the RFC offered 'bolt on' and greenfields applications.

"A bolt-on solution is usually applied to low value tailings streams, materials deemed to have little or no economic value. This assessment of little or no economic value reflects two things, the first being the low quality of the flow stream and the second, the considerable capital cost of installing the equipment to recover the valuable particles. The bolt-on option is ideal for new technologies as they provide immediate benefit without impacting on existing production. Once successful as a bolt-on, the RFC can be deployed as a greenfield solution so that the benefits can be secured earlier in the process," he said.

"The Reflux Flotation Cell provides an order of magnitude increase in the processing speed compared to more conventional technologies, meaning the footprint and, hence, capital cost of an installation should be much lower. This shift in the capital cost potentially redefines what is a tailings stream."

Having completed the laboratory scale studies, the RFC is undergoing a full scale trial at a Hunter Valley mine site, having met all the necessary compliance measures. It has received its first 250$m^3$/h of fine coal tailings feed and has delivered very strong separation.

"Our goal is to undertake a series of long day campaigns to quantify the separation performance and benchmark that performance. Lower and higher rates will be applied. Some additional adjustments to the system will be introduced once we have exhausted the current

options in the testing program, then more work will be undertaken," Kevin said.

ACARP industry monitor Kevin Rowe said the project had the potential to change the industry's current understanding of flotation projects spend and deliverability. "Historically, the capital required has been extensive and through the development of this research, has highlighted an alternative approach that addresses the capital concerns of the producers whilst producing a product that meets all sales quality requirements," he said.


*The Reflux Flotation Cell (photo courtesy FLSmidth). FLSmidth has an R&D agreement with the University of Newcastle and an exclusive licence agreement to manufacture, supply and support the technology. FLSmidth has also been providing considerable support for the trial. Other key inputs have come from the*

*federal government through the Global Innovation Linkage scheme, ACARP, Glencore, Nalco and Advitech.*

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**For further information:**

The final report is available from the ACARP website. Report number C27025

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