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Automating underground coal

PAUL HAYES

The CSIRO and the Australian Coal Association Research Program (ACARP) are working together to research new technologies for the future of underground coal mining.

In late 2008 ACARP allocated a funding package of more than $3 million to the CSIRO's Exploration and Mining research theme to help Australia's coal industry improve safety, efficiency and reduce its environmental impact.

"The primary goals of this research are to make the industry more productive, more efficient, a safer place to work and to reduce, where possible, the impact on the environment," ACARP executive director Mark Bennett told *Australian Mining*.

Much of the research will focus on automation technology, which bodes well given the previous successful collaboration between the CSIRO and ACARP that resulted in the Automated Longwall.

"The research is a natural progression from our previous Longwall Automation work and we are very excited about it," CSIRO 'Maximising the Value of Mining' research theme leader Dr. Hua Guo said.

Proposed CSIRO research projects include improving dust control, reducing diesel exhaust emissions underground and improving gas drainage to reduce greenhouse emissions. Image courtesy of CSIRO.

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The research topics are chosen from various representatives of the coal industry who, in their relationship with ACARP, decide what they think will be best studied and explored to ensure the future of the coal mining industry.

"Those relationships will need to continue to be built, and if anything, they will need to become stronger in the years ahead," Bennetts said.

**For more on the research, go to the Underground Coal Mining feature, from page 24.*

Government approval comes too late for McArthur River

THE Federal Government has made a draft decision approving the McArthur River Mine expansion, however, the decision is too little too late, according to Xstrata Zinc Australia Chief Operating Officer Brian Hearne.

Xstrata had been unable to mine at McArthur River since a Federal Court ruling found the operation was wrongly approved.

Yesterday, Environment Minister Peter Garrett advised key stakeholders that he intends to approve, with conditions, the proposal for MRM's open-pit expansion.

"It is a pity that this decision has taken this long as it has put MRM in a difficult position. The cost of the delay to our business and our suppliers' businesses is irrecoverable," Hearne said.

"The reality is that we run out of our zinc-lead ore stockpiles at MRM within the next few days. During the week we sought to treat sub-standard ore which was unsuccessful and we therefore have exhausted stockpiles earlier than anticipated.

"Until we have a final decision from Minister Garrett, we have no choice but to transition to care and maintenance. This means ceasing all on-site operational activities in a safe, systematic and appropriate manner."

According to Hearne, with the mine in care and maintenance the workforce of 300 may drop under 40 in the coming weeks.

Refractory leaching solutions

Xstrata Technology Business Manager – Hydrometallurgy – Mike Hourn explains *The Albion Process*, which was designed to treat concentrates produced from refractory base and precious metals ores.

Miners today are facing more challenges than previous generations.

The mines that are being developed are more complex in nature, with lower grades, higher impurity content and generally more refractory in nature.

There is also increased emphasis on improving sustainability as well as treating all waste generated from processing.

One process that addresses these concerns is the Albion Process.

The Albion Process was developed to treat concentrates produced from refractory base and precious metals ores, and is based on the hot oxidative leach of finely ground concentrates at atmospheric pressure.

The process does not employ autoclaves, and does not rely on bacterial cultures, resulting in a low cost and effective way to recover metals in complex ore deposits. It can also treat dirty concentrates, particularly those containing arsenic, which restricts the material from being smelted, as well as being able to treat both low and high grade material.

The process, owned by Xstrata Technology, and marketed by Core Resources, uses the IsaMill to grind the refractory ore or concentrate down to ultrafine sizes.

Ultrafine grinding is required to increase the activity of sulphide concentrates to a point where they can be oxidised readily in conventional open tanks, without the need for high pressures, expensive reagents or bacteria.

IsaMilling provides a number of advantages in this process compared to other processes, in that it produces a narrow particle discharge sizing, reducing energy wasted in over grinding, as well as recovery loss to particles that are oversize.

The high energy efficiency of the process, as well as the inert nature of the grinding media, ensures maximum metal recovery for the lowest energy input.

Also the small footprint of the IsaMill, combined with the simplicity of the atmospheric leach tanks, make Albion Process plants relatively small in area and capital cost, as well as easy to maintain.

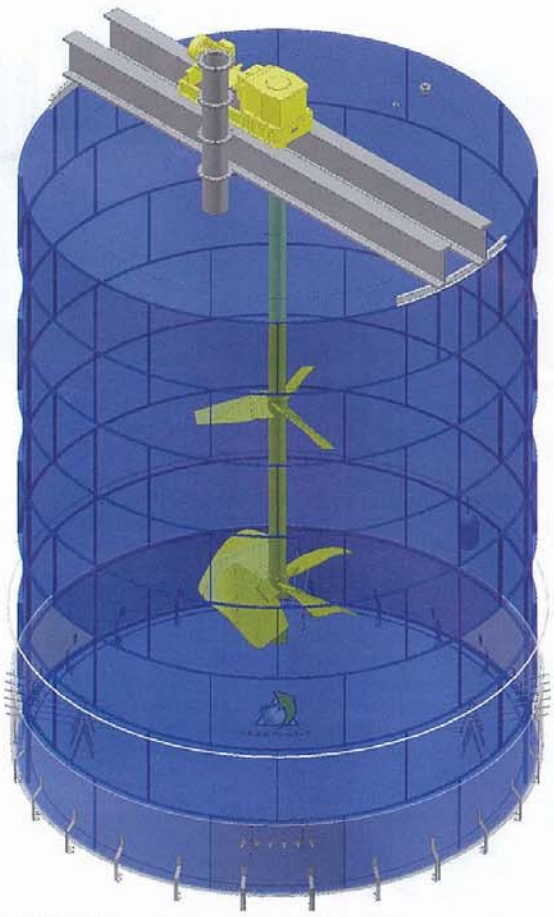
Importantly, IsaMilling the feed to the Albion Process introduces a high degree of strain into the mineral lattice, which in turn imparts fractures in the grain boundary and lattice defects in the minerals.

These defects lead to the "activation" of the mineral, allowing leaching to be carried out under less aggressive conditions.

The dramatic increase in the mineral surface area from ultrafine grinding also increases the rate of leaching, resulting in smaller tanks and lower capital cost. Passivation of the mineral surface by sulphur based leaching products is also minimised by ultrafine grinding.

Typically, precipitates that form on the surface of a leaching mineral will slowly passivate the mineral, by preventing the access of chemicals to the mineral surface.

Passivation is normally complete once this precipitated layer is 2-3 microns thick. Ultrafine grinding of a mineral to a particle size of 80% passing 8-12 microns will eliminate passivation, as the leached mineral will disintegrate prior to the precipitate layer becoming thick enough to passivate the mineral.



The Albion Process, image courtesy Xstrata Technology.

The Albion Process oxidative leach step can be carried out in either an acid or alkaline environment, depending on the mineralogy of the feed.

The leach is carried out in simple open tanks using modern, state of the art, hydrofoil impellers and high pressure gas sparging.

Acid leaching

Acid leaching is carried out for base metal concentrates of copper, nickel or zinc.

In the case of chalcopyrite, the finely ground concentrate is leached in raffinate from the solvent extraction plant, which supplies acid and iron to the leach.

Oxygen is injected into the leach tanks to facilitate leaching.

The leach slurry density is adjusted to produce a copper grade in leach solution of between 20 and 40g/l, depending on the configuration of the solvent extraction plant.

Leach extractions are typically 99-99.5 %.

The copper rich slurry is then neutralised with limestone slurry to control iron and acid ahead of the solvent extraction circuit.

The neutralised slurry is then filtered to separate the oxidised residue, with the rich solution forwarded to solvent extraction followed by conventional solvent extraction and electro winning technology to produce copper cathode from the rich leach solution. The oxidized residue is then pumped to tailings, with the iron safely discharged as goethite. In the case where arsenic is present, this material is fixed in the form of ferric arsenate, and reports with the goethite.

Alkaline leaching

Alkaline leaching is generally carried out when treating gold bearing refractory minerals in the presence of pyrite.

The alkaline oxidative leach conditions result in accelerated leaching of pyrite and arsenopyrite, with limestone slurry added to the leach continually to neutralise acid. This approach results in a single stage leach and neutralisation circuit without the need for any solid/liquid separation prior to the cyanide leach plant.

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