

## Journal Comment

### Breakthrough Technologies

The ten papers in the July edition would appear, at first glance, to have little in common. Upon a second glance, they can be grouped into three broad themes:

- Environmental (two papers)
- Technology (four in metallurgy and two in mining)
- Human knowledge (two papers). I admit that it's not a very imaginative analysis, but it's the best that I can do!

The minerals industry is the proverbial 'whipping boy' for the environmental constituency, and there is, regrettably, more than enough historical cause to justify that label. The industry should make no excuses, take the criticism on the chin, green our mining and processing technologies, and move on.

That said, the paper using satellite images to determine the impact of marble quarrying in Turkey on the natural vegetation invites comparison with other industries. If one were to analyse the entire planet using satellite imagery to determine the percentage of the natural vegetation that has been destroyed for the sake of mining, what would that number be? Probably less than a fraction of one per cent, I suspect. Compare that with the devastation caused to the natural environment by food production – the massive loss of biodiversity through the cultivation of a few plant and animal species that we eat, and over-exploitation of the ocean's fish resources – and mining looks relatively benign! Why does turning a significant percentage of the earth's surface into monoculture wastelands to produce food attract little criticism, but an application to open a new mine to produce the minerals and metals required to build houses and cities does? The deafening silence when Cape fynbos is ripped out to make way for another wine estate is telling. Point made – time to move on.

The six technology papers cover widely differing topics, and it seems almost unfair to single out one for detailed comment. The only aspect of commonality is that the papers all extend the boundaries of existing technology in innovative ways. So, for example, we see the results of using high-pressure grinding rolls for treating copper, iron, and gold ores; anode and cathode electrodes being used in DC arc furnaces instead of a submerged hearth anode; moisture reduction in fine coal filter cakes by increasing the flow of air drawn through the cake; measurement and modelling the pressures generated using non-explosive expansion materials used in hard rock fracturing.

This leads conveniently to a theme that I have discussed before at SAIMM events – the different risk-and-reward profiles of incremental and breakthrough research.

Incremental research is based upon the premise that whatever technology is currently being used today it can be improved. The technology can be made more energy efficient, the recoveries can be improved, the operating costs can be reduced, the environmental impacts can be minimized, and so on. Each improvement is relatively small, but when many such improvements are made over time the cumulative effect can be significant. The advantages of this type of research are that the investment costs are low, the time to implement is

fast, and the technical risk is low. All the papers in this edition of the Journal fall into the incremental category.

Breakthrough research is based upon the premise that existing technology has run its course, that no more improvements are possible, and that further advances require something completely new. Examples from the not-too-distant past include the development of the CIP process for gold and the HPAL (high pressure acid leach) process for the recovery of nickel from lateritic ores. CIP was intensively researched in the laboratory, on a pilot-plant scale, and even operated on a full scale using re-pulped filter plant tailings before being extended to large plants treating ROM ores. I cannot imagine the total cost of the research conducted in South Africa in today's Rands (a figure has been calculated in one of Mintek's Application Reports, but most certainly underestimated), to which must be added the equivalent costs in Australia and the USA. The technology worked, and the benefits more than justified the costs.

At that time most new mining projects were financed off balance sheet or with the issue of equity, and the decisions regarding the choice of technology were left exclusively to the mining houses themselves. By the time HPAL came along the financial climate of the world had changed significantly. It was now more common to leverage mining projects via debt, and a long, protracted, and costly research phase was just not acceptable to the lending institutions any more. Quick returns were the order of the day. The outcome of fast-tracking HPAL was technical and financial agony for those involved, and leading edge technology was renamed bleeding edge technology.

Today the situation is much, much worse. The risks associated with the health of the world economy, the uncertain demand for resources, fluctuating interest and currency exchange rates, and the time and cost of research have escalated so rapidly that investors simply do not want to be burdened with the risks associated with being the first implementer of breakthrough technology. Use proven technology is the new order of the day. And yet, given the combined impacts of deeper ores, falling grades, stagnating real metal prices, and constraints on energy and water availability, the need for breakthrough technology that is significantly better than what we have at present is escalating rapidly. How is this paradox going to be resolved?

There is never a simple answer to such a question, and I will leave the debate to another time and place. What is undoubtedly critical to the industry's long-term sustainability in South Africa is the education and retention of our mining and metallurgical engineers, and the ability of companies to maintain their critical in-house knowledge bases given the mobility of their workforce. The last two papers in this edition of the Journal address this particular topic. ◆

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