“Innovation - mining more for less”

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Melbourne Celebrates Mining dinner

30 October 2013

Innovation is the application of better solutions that meet new requirements or existing market needs.

Innovation differs from discovery or invention in that it fundamentally targets the application aspect.

Simply put, innovation can be defined as a new idea that works.

Australia has a proud tradition of innovation in the mining industry. As well as the mining companies themselves, there is a long history of mining equipment, technology and services companies (METS for short) stretching back to 1859.

METS employ 386,000 Australians with over 60% of the companies employing less than 100 people.

Last financial year they spent over $1.6 billion on R and D and exported more than $27B in services, equipment and materials.

So why is it so important to have a vibrant METS industry?

We all know that the products of mining have fundamentally supported the advancement of humanity to a point where today we cannot conceive of this planet being capable of allowing in excess of 7 billion persons to live, and in more and more cases thrive, without the materials that mining makes available.

But we are continually told that, by definition, mines tap into non-renewable resources. This is a favourite justification, by some politicians, to impose additional taxes and imposts “because once the resources are gone we’ll be left with nothing”.

So why is it that the world has not exhausted its ‘limited’ mineral resources well before now. After all, it is a long time since the first Copper Age smelters in Cyprus and the bronze workings of the Shang Dynasty in the twelfth century B.C.

I would contend that a long string of innovations that have been applied in mining have played the major role in supplying humanity with what in effect has been a renewable resource.

Let’s just look at three areas of innovation that have effectively delivered new streams of mining materials.

Thomas Newcomen designed the first steam engine in the early eighteenth century to draw water from tin mines in Cornwall. Setting out to improve the limited effectiveness of Newcomen's pump, James Watt, a technician at the University of Glasgow, invented the condensation chamber, thereby making a fortune with his friend Matthew Boulton. In 1784, the two associates patented the steam locomotive to move mine ore.

These innovations not only allowed access to deposits that had previously been inundated all around the world but the steam locomotive allowed the movement of large tonnages over long distances without having to rely on the existence of suitable waterways.

The second area of innovation was Alfred Nobel's invention of dynamite in 1867 and its very fast application to mining in all its forms. Huge productivity improvements allowed much larger quantities of rock to be broken in a relatively short space of time with fewer people involved in the process, thus unlocking lower grade deposits that were previously uneconomic.

The last of the innovations to be discussed involves the transformation of the metal that is locked in the matrix of the rock into a form that can be concentrated for transportation and treatment into metallic form. The development of the mineralogical and metallurgical processing of copper will illustrate the point.

The rise of the late nineteenth-century copper industry in the American West was due to the successful technological crossover of electrolysis and Bessemer ovens. Next came flotation, which emerged in Broken Hill, Australia, in 1903. It provided one of the most effective methods of separating minerals from the gangue, or the barren parts of mined rock, including copper ores. When copper prices collapsed in the 1970s, the industry survived by implementing the newly developed SX-EW extraction-by-solvent process.

All of these approaches to extracting copper from ore illustrate how adaptive mankind has been in applying better solutions that meet existing market needs and allow access to what is essentially new deposits that were previously unattractive as sources of supply.

From Newcomen to SX-EW innovation has allowed, what has effectively been, a continuous stream of non-renewable resources. Innovation moves mineral deposits along the conveyor-belt of supply from mineralisation to resources to reserves to mining and extraction. The endless application and adaptation of solutions unlocks problematic and uneconomic areas that had previously defied methods of mining and extraction.

Mining has always been a source of innovation, consistently striving for better efficiency, safety and environmental and social outcomes. I would like to finish with an example that attempts to address the conundrum of how to mine in a way that enhances efficiency while clearly improving the industry's environmental standing in the ongoing social debate around climate change.

Innovation must be applied if we are to meet both the ever growing demand for minerals while answering the call for lower carbon emissions.

Comminution is the grinding and crushing of ore.

65 to 80% of energy consumption in mining is consumed in processing while 20 to 35% is consumed in the actual mining itself.

98% of the energy used in comminution is lost as heat, noise and mechanical losses while only 2% is used in particle breakage.

Extensive research by the mining industry has already identified the following methods for improvement

1. Smart blasting
2. Pre-concentration
3. New grinding technology

Chemical energy is about 25 times more effective than mechanical energy for breaking rock even though current explosives are still only 30 to 60% of their theoretical potential effectiveness for breaking and moving rock. This is an area Orica is working on through better formulation of explosives and improved application in the field.

…..but I hear you say so what

Can mining provide what the world wants and address the need to reduce carbon emissions? Yes we can!

The world consumes about 150 billion mega watt hours of energy per annum, 20 billion mega watt hours of which is in the form of electricity.

The USA consumes 30 billion and 4.5 in electricity.
Australia: 1.1 billion mega watt hours and 0.24 billion or 240 million mega watt hours in electricity.

7.3% of the USA's power consumption is used for comminution and 3% of the world's total electricity is consumed in comminution in mining. This is equivalent to the total electricity consumption of Germany and 2.5 times the electricity used in Australia or over half the total energy consumed in this country.

So what does this mean for how we can go about our mining in a manner that is both efficient and even more socially responsible? To illustrate an innovative solution pathway I will use the example of an Open Cut Nonferrous Metal Mine.

Comminution accounts for 53% of the energy consumed on a typical metal mine site.

Emissions in open cut mines from diesel and electricity are typically 29-32 kg of CO2e per tonne mined whereas emissions from explosives are 0.2 to 0.4. Electricity accounts for approximately 55% of this output in a typical open cut coal mine and 75 to 85% in a nonferrous metal mine.

If you reduce the size of the feed material to the comminution circuit in a metal mine from 150mm to 80mm (F80) through using explosives more effectively you get about a 55% increase in throughput.

This means you can increase your output without spending more capital or you can reduce the energy consumption and emissions by around 30% for the tonnes mined.

If such an approach was applied around the world a significant contribution to reducing greenhouse gases would be achieved without impacting our lifestyle.

Energy efficient comminution strategies provide:-

1. improved overall environmental impact
2. improved social license to operate, and
3. improved outputs and earnings

As we exhaust easily accessible high grade ore bodies comminution efficiency will become increasingly important.

Through the more effective use of the chemical energy in explosives we can mine more for less impact.

Thank you.