

Comminution

Written by RE Robinson
Monday, 01 March 2010 02:00

'Keep right on to the end of the road Though the way may be long, let your heart be strong. Keep right on to the end' Words from a Scottish Ballad...

I must confess to reading the papers in this issue with much interest and a measure of excitement. I have been involved with comminution since 1955, not directly but circumstantially.

It has been a long and fascinating road. In my first association, the rod milling plant at the Daggafontein Gold Mining Company terrified me by its immensity, its violent activity, and the outrageous noise level. My assignment was to explain the discrepancy in the gold 'Mine Call Factor'. I soon came to learn that any one of these rotating monsters could hide away many times my annual salary in the form of small gold particles. It was a fitting introduction to the enormity of the comminution process in the South African gold mining industry. Every day a million detonators were exploded underground. Every year over 70 million tons of rock were blasted from underground, brought to the surface, and ground to face powder in what was the biggest mining operation in the world. It was a costly process in terms of power, materials, and maintenance. The feed material was highly variable in size and character, and mine managers demanded, and generally achieved, high gold recoveries (99%), with ever increasing savings in costs.

The problems associated with comminution in the platinum mining operations have been perhaps more demanding and the correlation needed between the comminution and the complex flotation process has been the focus of much R&D over many decades.

In the past 50 years, the metallurgists, mineralogists, chemical engineers, instrument developers, and process control specialists have done a remarkable job in optimizing and streamlining these huge comminution operations with invaluable international collaboration, which has been well recorded in the previous nine conference proceedings.

This has enabled the online control simulation programs to be developed to optimize the comminution operation's costs and benefits. This work has been extensive and, in general, highly effective to a point where the outcomes are probably as good as can be reasonably expected, and predictable. This is well illustrated by the several computer programs used in the papers in this issue to calculate the economic feasibility of hypothetical operations. As a relative layman in this field, I was most impressed with the obvious credibility of such calculations. But like many who are not specialists, I was under the impression that there was little room to anticipate further cost savings in the comminution component to counteract the impact of greater depths and indeed on a world basis, the dwindling grades of most mineral resources.

But new challenges have appeared on the gold front in South Africa with the inauguration of the operations of the South Deep Mine of Goldfields, the path finder in ultra deep mechanized mining. As is well known, there is potentially the largest known resource of gold waiting to be exploited when this new mine is proven to be economically feasible, in spite of increased power costs. A new era of gold mining is in the balance.

What has excited me in reading the papers in this Journal, is the indication that maybe we have not reached the end of the road in cost improvements in comminution technology.

Comminution

Written by RE Robinson
Monday, 01 March 2010 02:00

The suite of papers on the high pressure grinding rolls (HPGR) was an eye-opener in revealing the potential of this technology for innovative opportunities. It not only reduces costs but also solves several of the fundamental limitations of the established processes.

The paper by Chris Morley was a masterpiece in providing a thorough account of the fundamental principles and engineering features of currently available commercial units. I strongly recommend this as the starting point to the many readers who wish to benefit from the technology transfer offered in these papers. In passing, let me mention the absolute necessity and pleasure of being able to digest and, if necessary, re-examine the critical information in the printed word and graphical and tabular matter. It is a privilege and duty for SAIMM to make available to our readers the outcome of what must have been an exciting conference in the UK.

What excited me in this collection of papers was the confirmation of the impression that I had formed when I first made acquaintance with HPGR some years ago: namely, that there was a fundamental difference in the nature of the forces causing breakage of the rock. In the HPGR system, fractures are caused by direct high pressure compression forces imposed by the surrounding particulate matter. The abrasive 'smearing' of the different minerals over each other is avoided. The cleanliness of valuable mineral surfaces is of immense importance.

So many of the rock structures that are of major importance, such as the sedimentary conglomerates both from primary or secondary origin of the Witwatersrand gold resources or the platinum deposits of the Bushveld Igneous Complex, are in the nature of much weaker interstitial heterogeneous filling between solid pebbles of quartz or the crystalline grains of chromite. In my layman's terms, it should be much easier to pulverize the matrix interstitial material and expose it to leaching or flotation in the case of the platinum minerals, without having to smear it over the much greater bulk of gangue material.

Another thought provoking paper was that of Katrin Andres on vibration milling. This novel equipment could also have a profound impact. Having achieved a selective pulverization to the interstitial material in the conglomerates, it would be of great value to have equipment to cleanly separate the finer material from the coarse particles. And it is not impossible to visualize that the vibration milling would be excellent for this function. The reference of the author to 'activation' of the surfaces of the crushed particles is highly pertinent. It incites thoughts of potential benefits in leaching or adsorption of flotation agents. With such new concepts, can we begin to think of automated underground milling coupled to selective blasting with some measure of waste separation for back filling?

It would be presumptuous of me to imply that these and probably many other opportunities for moving into new innovative areas have not already been recognized by those skilled in the art. Anglo Platinum, for example, is well in the forefront with an HPGR installation.

It is, however, important for the mining and metallurgical industry, together with all those involved in the business of promoting major future developments, to recognize that in this field we are not at the end of the road and indeed across the world there is much exploratory and

Comminution

Written by RE Robinson
Monday, 01 March 2010 02:00

engineering work to be done in comminution. Most of all in Southern Africa's new gold mines, including the much hoped for extension to greater depths in the Witwatersrand Complex, are progressively closer to taking place. In the DRC and other African countries plans are well advanced.

The next comminution conference is to take place in South Africa in April this year. I am sure it will be as exciting as the one reported in this issue. Certainly we must keep walking along this road.