Address by Mr J.J. Geldenhuys*—5th International Backfill Symposium, 13 September 1993

Ladies and gentlemen, it is a privilege to be able personally to welcome you to the opening of this Symposium. It is particularly pleasant to be able to extend a warm South African welcome to all our visitors from foreign shores. We trust you will enjoy your stay in our country.

It is a singular honour for me to be present here today, and to have been asked to open this international Symposium.

MINING IN SOUTH AFRICA

Mining is the single most important contributor to this country's foreign-exchange earnings. Minerals and processed mineral products together account for about 70 per cent of South Africa's total foreign exchange earnings. The mining sector employs in excess of 670 000 people, and is one of the largest employers in the country. The construction and development of cities and towns like Johannesburg, Welkom, Orkney, Springs, Benoni, Witbank, and Klerksdorp is a direct result of the contributions of the mining industry to economic activity in these areas, as well as of the multiplier effect of secondary industries.

South Africa is a veritable treasure trove, with extensive reserves of minerals ranging from antimony to zirconium. For instance, the manganese ore reserves account for about 80 per cent of the world's total, and platinum-group metals and chromium account for about 75 and 70 per cent respectively. It has been estimated that as much gold still remains underground as has been mined in the last 100 years, and South Africa has nearly 40 per cent of the known international reserves. Primary mining will, therefore, remain the vital backbone of South Africa's economy for a long time to come. The industry is determined that mining will continue to be the engine for growth and a substantial creator of wealth in the new and very challenging era we are entering in this country.

However, the economic constraints and environmental issues facing mining across the globe are of grave concern to our industry, as I am certain they are to the mining industries of other countries.

ECONOMIC PRESSURES

This 5th International Backfill Symposium is taking place at a time when stagnating commodity prices are exerting fierce economic pressures on most mining operations. Although the demand and supply fundamentals for certain metals have improved in the past few months, industrial base-metal prices are likely to continue their poor performance as the world economies struggle to regain momentum. The ever-increasing demands to meet environmental standards add further to the economic difficulties of mining. Mining is becoming an increasingly expensive business. In addition, there is considerable and continual pressure on the industry to improve safety standards. This is reflected, among other things, by the decision of the International Labour Office to place the question of mine safety on the agenda of the 1994 ILO Convention. Closer to home, a commission of inquiry into health and safety in the mining industry has been appointed. Everywhere that we look, we are confronted by factors that tend to increase costs.

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FEATURES OF BACKFILL

Now, I know that I am about to preach to the converted, but I ask you to bear with me for a few moments. I am keen to explore with you just a few of the important features of backfill that may help us to neutralize some of those negative forces that are impacting, or threatening to impact, on our industry.

I believe that backfilling of mined-out excavations can play a major role in circumventing many of the problems that I referred to earlier.

From a purely environmental point of view, it makes good sense to return waste rock to where it came from—underground. Not only does this reduce the volume of rock that has to be dumped on the surface, but it can also stabilize excavation walls, and minimize ground movement that could damage surface structures. Backfilling of underground excavations has been practised widely in Europe's coal-mining districts, which are situated in densely populated and highly industrialized areas. As you know, many examples are to be found in the coal-mining districts of the United Kingdom, Germany, and Poland.

These examples bear eloquent testimony to the effectiveness of backfill as a method of reducing or limiting environmental damage. There can be little doubt that this sort of application of backfill will become more important in future, especially since environmental lobbies and the Green movement appear to be one of this century's remarkable growth industries.

One of the critical success factors in low-grade underground mining operations is grade control. Dilution of the ore as a result of rockwall instability can have disastrous consequences on the economics of mining. Dilution not only affects the costs of all post-stoping operation, such as transport, hoisting, milling, and processing, but the irregular size of waste rock from collapsing rockwalls also impacts on the stoping operation itself. Draw control can become very difficult, and secondary blasting to reduce the large blocks of waste rock can become a time-consuming, costly, and often dangerous activity. Frequently, the dilution factor can make the difference between the success or failure of a mining venture.

The filling of large underground excavations with cemented backfill can overcome many of these problems. The only other solution is to leave portions of the orebody unmined to form support pillars and to reduce the span of unsupported roof. In the case of wide orebodies, the pillars have to be fairly large to ensure their stability. This can lead to considerable losses of ore reserves, and dangerous situations should these support pillars be underdesigned.

Apart from improving the stability of underground excavations, backfill offers other advantages. One of the most important of these is that it can provide a natural working platform for equipment and mining personnel. This results in improved productivity and equipment utilization. Backfill can also be very beneficial from a ventilation-control point of view—and consequently also leads to a reduction in working costs associated with refrigeration.

These few examples show that there is considerable scope for the use of backfill in underground mining. Having said all of this, the question that begs an answer is: 'Why is backfill not used more extensively?'

One answer is that backfilling is an additional activity which, if not properly planned and managed, can become a problem in its own right.

Another reason is that the costs of the backfill operation are clearly visible, whereas the benefits are often less obvious, particularly the economic benefits. For example, improvements in grade control are sometimes difficult to quantify and can be determined only by comparisons between stopes that have been backfilled and those where no backfill has been employed. The same is true for reductions in transport and ventilation costs.

Another factor is that the immediate cost of leaving a pillar to stabilize rockwalls is often not calculated, whereas the implications of leaving pillars over the life of a mine can be substantial.

Yet another reason why backfill systems are sometimes unsuccessful is that, in the design of the system, emphasis is usually placed on the properties of the fill material and not on the design of the backfill system. As a result, systems tend to be unreliable, and the quality of the placed fill is often not as good as planned.

The answer—and this is the crux of my argument—is that backfill must be seen as an integral part of the mining system, and not as an add-on, as is so often the case.

BACKFILLING IN DEEP-LEVEL MINING

Let me now deal briefly with some exciting applications of backfill in deep-level mining. Fundamental research into the rock pressure problem in deep mines has shown that the amount of closure that takes place in the mined-out area is a significant factor which, among others, controls the stresses at the working face and the energy changes caused by mining.

One of the obvious ways of controlling closure in the mined-out area is to fill the void created by the extraction of the gold-bearing reefs with a high-density fill material. The fill will be compressed as stope closure takes place, and will resist further rock movement. One of the important side effects that has been found is that backfill not only reduces stress and energy changes resulting from the extraction of the reef, but it also improves the stability of the immediate roof strata, thereby minimizing the damaging effects of seismic activity. Much will be said about these aspects at this Symposium.

There is, however, another important and useful consequence, and this is that the amount of heat that flows from the surrounding rockmass into the mining excavations can be reduced substantially by filling these excavations.

Theoretical studies and fieldwork have shown that the heat flow can be reduced by 50 per cent or more by the extensive use of backfill. I hardly need to remind you that the cooling of underground workings is one of the major cost factors in deep-level mining. Since the cost of cooling is roughly proportional to the amount of heat that has to be removed from underground, backfill can make significant contributions to the economics of deep-level mining.

In deep-level mining, the benefits of backfilling go further than merely its contribution to the reduction of the cost of refrigeration. For instance, from purely a rock mechanic's point of view, backfilling enables mining to take place at much deeper levels.

These examples serve to emphasize the great value of fully exploiting the systems aspects of backfilling.

BACKFILLING IN SOUTH AFRICA

Before I finish, I would just like to mention that backfilling is not a new concept in the history of the South African gold-mining industry. At the beginning of the century, and in particular during the period between 1910 and 1930, the mines on the central Witwatersrand made extensive use of sandfill, which is the product of stamp mills, to improve mining conditions. The available information indicates that by 1930 more than one million tons of sandfill were being placed underground each month.

However, although the depth of mining increased in the 1930s, sandfill operations came to a halt during this time. One of the main reasons was the move away from stamp mills towards the introduction of ball and rod mills. It was soon found that the product of ball and rod mills was unsuitable for backfilling because it was much finer than that of stamp mills, and did not drain as readily.

A second reason for the rapid decline in backfilling operations during the 1930s were difficulties, often related to transportation, in maintaining a constant and adequate supply of sand to the deep stopes. This experience proved to be a warning for the future.

A renewed interest in backfilling in the South African mining industry began to develop in the late 1970s, and this was followed by a rapid expansion in backfilling in the 1980s. During that time, the amount of backfilling throughout the mining industry rose from 200 000 to 500 000 tonnes per month. At present, 24 mines, including base-metal and platinum producers, are placing backfill. Backfill plants commissioned to date are capable of producing 1,5 million tonnes per month, but full utilization is prevented by technical and financial problems. After more than half a century, therefore, we are still facing the problems of material preparation, and transportation.

In conclusion, I urge you, during the course of this Symposium, to consider backfill holistically, and to concentrate on a systems approach rather than on a very narrow view of specific aspects of backfilling. Backfill represents a major opportunity for the mining industry, and if it is to be properly harnessed, it must be approached in a thorough and thoughtful manner.

Mining operations world-wide can benefit enormously by the development of practical, efficient and reliable backfill systems. I encourage everyone at this Symposium to learn from one another, so that we might develop backfill technology and systems that can be applied on a large scale in our underground mines.

I wish you well in your deliberations, and success in your endeavours to find solutions to some of our industry's most pressing problems.