Are our mines safe?

Coalbrook mine disaster revisited

The recent media attention on the trapped Chilean miners brings to mind South Africa's worst mining disaster which occurred when 437 workers died in January 1960. But what progress on safety has there been since then? **Nielen van der Merwe** outlines some advances but also argues that more research is urgently needed if we want to avoid similar collapses in the future.

On 21 January 1960, the Coalbrook coal mine near Sasolburg in the Free State Province collapsed, resulting in the death of 437 workers. It is still the single largest mine disaster in South African history.

Now, 50 years later, we can ask what we learnt from Coalbrook. Did we learn enough to prevent a similar accident from occurring?

COALBROOK DISASTER

First, we have to understand what happened at Coalbrook and why the mine collapsed.

We have to remember that before 1960, very little research was done in mining and people relied on experience more than anything else to do mine designs. For instance, today we use well established formulae to calculate the sizes of coal pillars (large blocks that are left unmined to support the overburden) but in 1960, there were no formulae. In fact, there were not even pocket calculators, never mind computers!

Coalbrook started mining in 1905. Over the next 50 years, the production tempo was gradually built up to around 500 000 tonnes per year. Then, in the early 1950s, came the important breakthrough. The mine was awarded two contracts to supply coal to power stations, Taaibos and Highveld.

This required that production increase to over 3 million tonnes per year, almost overnight. Perhaps the mine was not ready for this. The necessary development was not in place to supply that amount of coal so quickly.

Yet, the power stations had to remain operational. The mine tried whatever it could to increase production. They mined coal from the roof of the existing excavations and cut cubbies into the existing pillars. They even conducted an experiment to check that they could do this safely.

Section 10 was the experimental section. They mined to a final height of 6.1 metres. They observed the area carefully for three months and when nothing happened, they concluded that the experiment was successful and continued mining at a higher height.

There were two things that they did not realise. Firstly, by making the pillars higher, they also made them weaker. It is not just the size of a pillar that determines its strength, it is also the height.

Secondly, even a very weak coal pillar seldom fails immediately. It gets weaker over time and this was not understood. The three months observation time was not enough, but they did know this.

Things came to a head on 21 January 1960. On the afternoon shift, people heard cracking noises coming from the old experimental area. There was a sudden wind blast and the workers vacated the mine. The mine overseer and acting manager went underground to inspect.

They came to the conclusion that all was well. They thought the wind blast had been caused by a methane explosion, but they found no trace of carbon monoxide. Only the old section 10 area seemed to be affected and things had quietened down. They then sent the teams back into the mine to repair the ventilation walls that had been damaged by the wind blast.

At about seven o'çlock that evening, the cracking noises suddenly increased dramatically

and there was a massive wind blast. Realising that something was drastically wrong, they again vacated the mine. All came out safely, except for the people working in the far eastern part of the mine who were so far away they were not even aware that there was a problem. They continued mining...

By twenty past seven that evening, it was all over. The whole part of the mine where people were working, collapsed.

Rescue attempts started immediately. It was not possible to get to the trapped workers from underground, so they tried drilling holes down to the people. But, to no avail. After several days it became clear that none of the trapped, could have survived. The rescue attempt was abandoned.

INVESTIGATIONS

The investigation into the tragedy, with pressure from the government, started immediately.

They found that there were three major unknowns at the time of the disaster. Firstly, how strong is a coal pillar? Secondly, how does the load on a pillar underground work? Thirdly, how strong are the long, thin pillars that divide a mine into different sections?

To answer these questions, the South African government encouraged research. The Chamber of Mines responded by creating the Chamber of Mines Research Organisation (Comro) and recruited leading researchers from all over the world to work in it. Local researchers were identified and trained.

Researchers that became world famous joined Comro and eventually placed South Africa at the forefront of mining technology. The rest of the world followed us...

In the late 1960s, the first important results of the research became available. Salamon and Munro published their pillar strength formula, which was based on statistical back analysis of failed pillars. Bieniawski also published a formula, based on tests on large coal specimens.

The first of the three major unknowns was addressed.

Then, over the next years, the emphasis of the research shifted to deep gold mining problems. Between Salamon, Cook and others the concept of the Energy Release Rate was developed. This was used to plan deep level gold mines so that the probability of rockbursts could be reduced.

With the advent of computers, people like Deist developed programmes that enabled mining engineers to calculate stresses redistributed by mining even for very complex layouts. Energy Release Rates could also be calculated.

The early work of Salamon and Bieniawski on coal pillar strength was developed further by researchers like Wagner, Madden and Van der Merwe over the next four decades.

However, very little work was done on the remaining unknowns after Coalbrook. It was found that some of the matters could be addressed by using very sophisticated computer programmes, but nobody could develop easy to use, simple formulae to calculate the exact load on coal pillars. Using the programmes required very high levels of skill and experience. Those programmes are simply not useful on the mines.

Now, 50 years after the Coalbrook disaster, the situation is very much the same. Research has stagnated and preciously little new work is being done.

URGENT NEED FOR RESEARCH

What is the current state of knowledge and mining research in South Africa? To be honest, it could be better. Comro was transferred to the CSIR and the funding model changed. For various reasons, the researchers left the organisation. Some went overseas, some took early retirement, some became consultants. Now, almost no research in mining rock engineering is done by the CSIR.

Do we have all the answers? No, we do not. The number of pillar collapses has decreased substantially, but they still occur. After the pillar strength formula came into use, South Africa only had 23 cases of pillar collapse. Without the formula, we could have suffered 114. The situation has improved, but the problem has not been completely solved.

On the gold mines, the understanding of rockbursts has improved tremendously, but not yet enough to successfully predict or prevent them. The problem is still there.

In coal mining, we all know that we will need more electricity in the future. We also know that much as we want it, renewable sources like sun and wind electricity cannot supply enough of the energy we need. We will need more coal to be mined for the foreseeable future.

Meanwhile, we are coming closer to the end of the Witbank coal field's reserves. We will have to open new mines in new coal fields, like the Waterberg. The problem is, we are not ready for it. Things like roads, railway lines and water supply are simply not in place. We have no option but to continue mining in the Witbank field for as long as we can. In the process, we have to mine old pillars that we thought would not have to be mined. We have to develop new methods to do that safely.

The bottom line is that development can only be done after research has been completed. What the country needs is a rebirth of mining research. For the time being, we are still in good shape but if we want to continue being that, we had better start doing research again. LB

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