

Safety in Mines Research Advisory Committee

Project Summary: COL 713

Project Title:	Prevention of spontaneous combustion of backfilled plant waste material		
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Report Date:	June 2003	Related Projects:	COL 604
Category:	Coal	Applied Research	

Summary

Coal waste material can burn due to its fixed carbon content. The aim of this research was to examine the possible risk and to determine a method of backfilling the coal waste to prevent the occurrence of spontaneous combustion.

A method of backfilling combustible waste material into pre-built and sealed compartments was developed to solve the spontaneous combustion problem at Grootegeluk Mine.

Grootegeluk Mine has been in operation since 1980. The total tonnage mined, about 54 Mt per year, coupled with a 50 % yield of clean coal from about 34 Mt of raw coal production per year, means that the mine produces large amounts of waste material. The relatively high carbon content of this material makes it liable to burn.

Since 1980 spontaneous combustion has caused major pollution problems for Grootegeluk Mine. As a result, a number of tests were carried out during the 1980s to determine the factors that contribute to the spontaneous combustion phenomenon. No successful method for preventing or containing the problems was formulated.

This project studied and re-analysed the problem, covering all contributing factors and the preparation of new tests. This resulted in the development of a contributory model, together with a mathematical risk model, as well as the formulation of a crucial theory which was verified as being suitable for the determination of operational specifications.

It was important for environmental and economic aspects to backfill the waste material into the pit. It was decided to backfill, according to the theory developed through this research, all the inter-burden material without bench 7B over a one-year period and to monitor the conditions. Overburden (the weathered top layer), which is available in bulk, was tested and found to be the most effective material for sealing the compartments. On 20 May 2000, large-scale testing of reactive backfilling material commenced. In addition, two other large-scale tests of plant discard material and inter-burden material containing bench 7B were carried out under the same backfilling conditions. The principles and methods covered in this thesis were implemented successfully and temperatures within all constructed compartments were measured and found to be stable. The successful backfilling of waste material into pre-built compartments

in the operating pit led to considerable cost savings.

Further Research Recommended

If, during current backfilling practices, this theory fails for any reason, it is proposed to focus further research on alternative methods to avoid or minimize the risk of spontaneous combustion.

The most applicable and realistic is the use of plastic foils in conjunction with a sealing method, within the top sealing layer. The plastic will allow the building up of a water sub-level, which will allow good rehabilitation due to the moisture within the humus layer.

It is proposed further to consider blowing an inert gas into dumps from a channel at the bottom of the compartments. This method could use exhaust gases from the nearby power station, but only if the 6 % oxygen remaining in the exhaust gases can be eliminated and the toxic gases neutralized or absorbed. Another source of inert gas could be the natural earth-gas within Grootegeluk's coalfield. This method, however, has the potential risk of causing a methane explosion in the operating pit.

To avoid the risk of spontaneous combustion, it is proposed to change the reactive material into an inert or very low reactive material, not liable to burn. The most practical methods are to implement new beneficiation technology, increasing ash content of plant discards to above 90 % and allowing the beneficiation of inter-burden. It is also possible for Grootegeluk to build its own power station operating on low CV coal as coal waste. However, the cost of this energy is predicted to be four times more expensive than the energy provided by Eskom.

Another method of minimizing the reactivity of plant discards is to build a plant for the production of briquettes beneficiating the current coal waste. The market for briquettes can be considered as being local, i.e. the consumption of briquettes by the local communities. This would result in reduced consumption of wood with the associated environmental benefits. The reactivity of the waste material could also be minimized by heating up the waste before stacking it, thus "ageing" the material quickly.

All these alternatives have been found to be viable, but must be evaluated in terms of their financial feasibility and, just as important, their environmental impacts. The

latter is becoming increasingly more critical given the number of regulations that are being formulated and the increased public awareness concerning environmental issues.