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Coal Operators' Conference

Faculty of Engineering and Information Sciences

2002

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Publication Details

This conference paper was originally published as Allan, B, Industry Impacts Outburst and Gas Management, in Aziz, N (ed), Coal 2002: Coal Operators' Conference, University of Wollongong & the Australasian Institute of Mining and Metallurgy, 2002, 30-33.

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INDUSTRY IMPACTS OUTBURST AND GAS MANAGEMENT

Bruce Allan[1]

Outbursts of gas, coal and rock are not a new phenomenon and have seriously impacted the safety of men and equipment within mines and the ultimate viability of the operations.

Operational and management techniques have been applied to mines in the Illawarra as a means of working with outburst issues, but a complete understanding of the phenomenon at the different mines and locations is still lacking.

Over the years specialists have championed the studies and investigations and significant advancements have been made in the safety of the mines. Extraction of quality reserves in otherwise unmineable domains has been made possible.

With the economic pressure now on the coal industry, studies and research into outbursts of coal and gas has declined worldwide, and we are at a crossroad for the future.

Outbursts have occurred in literally all the major coal producing countries of the world and over 35,000 outbursts have been noted worldwide in the past one hundred and fifty years, some with very serious consequences, and which on occasions resulted in loss of lives.

The outburst of gas, coal and rock is neither new nor isolated to any particular coalfield in Australia. This phenomenon has forced mine management to seek to develop an understanding of outbursts and develop methods for the management of gas within mines.

Initially outbursts were managed by practical experience but over the last sixty years scientific research and experimentation has led to a better understanding of the phenomenon.

A large number of gas outbursts have been recorded in the Illawarra coal fields from the 1890s to the present All have been within the Bulli Coal Seam from Metropolitan Colliery in the North to Kemira Colliery in the south to Oakdale and Brimstone Collieries in the west.

Coal gas outbursts types have varied from pure CH_4 to Co_2 and have ranged from small to quite large in intensity often liberating large quantities of coal.

Dr Alan Hargraves and Dr Ripu Lama had championed focussed research in the Illawarra from the 1960s to the late 1980s. Their work which was applied at a number of Illawarra mines led to the greatest advancement and understanding of the coal mine gas outburst phenomenon. Unfortunately this did not prevent the outbursts which resulted in the tragic loss of life at South Bulli (1991) and West Cliff (1994).

Outburst management plans were introduced into NSW and the Illawarra region following the South Bulli incident. The outburst management plans developed by mine management in 1991, tended to be based on the respective experiences of the mine to that date, lacked formal approval processes and "hard barriers".

In 1994 the Department of Mineral resources (DMR) called together coal mining industry operators from the Illawarra, and researchers together with the inspectorate to draft an outburst mining guideline which formed the basis for MDG 1004 – Mining Guidelines (July 1995). These guidelines now form the basis of outburst management plans at coal mines within the Illawarra and the state of New South Wales and have created a whole new approach to hazard management of coal gas outbursts, putting "hard barriers" into place in the management plans for coal mines.

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Significant documented material and experience is available worldwide for present and future mine planners and operators to understand the potential and liability for a coal seam to outburst. This can be broken down into the following key areas.

- Presence of faulting
- Structural related thrust or horizontal movement
- Seam variations and coal strengths
- Coal cleating and jointing
- Presence of dykes
- Seam permeability
- Seam gas content
- Gas pressure
- Seam gas type, i.e. CH_4 or CO_2
- Seam gas composition

The important issue in all this is to understand the broader picture of the resource to be mined and to accurately manage and understand the coal seam physical changes, be they large or subtle.

The present management and control of outbursts of gas and coal is based on the two following broad concepts:

- Develop methods, which reduce the likelihood of outbursting.
- Develop systems such that men and equipment can be protected from the effects should such an outburst event occur.

which can besimply expressed as Prediction, Prevention and Protection.

Prediction

- This requires detailed geological understanding of the source and interpretation of known Geological anomalies.
- In-seam exploration and seam gas contents
- Measurement of coal seam stress conditions
- Identification and training of employees

Prevention

- Application of the various types of gas drainage techniques
- Induced shot firing
- Water injection
- Remote mining

Protection

- Outburst gas management plans that are functional and auditable
- Control of ventilation and gas monitoring
- Provision of self-contained self-rescuers linked to self-escape systems
- Training and development of people in relation to outburst management

The prime objective of Illawarra coal mine outburst management plans is to facilitate exploratory inseam drilling and gas drainage aimed at reducing seam gas contents to agreed threshold levels in all areas of the mine, where development and longwall operations are to be carried out. This drives a "permit to work" philosophy.

Resultant gas content levels ensure that the risk of an outburst, or other release of dangerous quantities of noxious or flammable gas, is minimised to allow normal mining operations to be carried out.

In exceptional instances where this objective is unattainable, the plan can make provision for alternative mining procedures to be used. These alternative mining procedures would be under strictly controlled and considered circumstances, which maximise protection to employees and the operation.

Outburst management plans in NSW are formulated in accordance with the Department of Mineral Resources (DMR) Outburst Mining Guidelines (MDG 1004) July 1995. Plans are reviewed and audited at intervals not exceeding two years.

Threshold levels for operating collieries mining the Bulli Seam vary from 5 – 9.5_m^3/t and is dependent upon the percentage of CH_4 or CO_2 in the sample.

To date, when mining below or within these agreed threshold values and subject to the presence of geological anomalies, no outbursts of coal or gas have been reported.

In a recent case at Tower Colliery where the gas threshold could not be reduced in the time available, it was agreed to remote mine the area. Development was slow, cautious and costly in order to protect men and equipment. This remote mining development driveage induced an outburst using an ABM20, continuous miner, whilst cutting through a known geological structure.

The current gas threshold levels in use in the Bulli coal seam do have a safety factor. Without greater factual and scientific information being available and understood, there is too high a risk to vary them.

Another issue that impacts the true threshold values is the reliability and accuracy of the sampling and analysis of the seam cores yielding the total gas content. The capture, sampling and testing for total seam gas analysis has wide and varied limits of accuracy and until they can be narrowed and precise measurements fully understood, the present threshold limits used in NSW have no supporting basis for change.

The drainage and removal of gas into a pipe range as practiced at most major mines operating in the Bulli coal seam is not without significant additional cost to the operation.

On average, for BHP Billiton Illawarra Coal mine gas drainage costs average $1.20 per run of mine tonne. This excludes the costs of owning and operating a surface gas extraction plant and excludes the cost of capital.

In the case of a predominant CH_4 environment some of this cost may be offset through the ability for power generation or steam raising, but in the case of Co_2 gases no viable alternate uses are in play.

In an area were gas drainage has not been effective or has been delayed due to particular circumstances or events, costly delays in development or longwall production can have major and lasting economic impacts on a mining operation. This can ultimately impact on the viability of the mine and Company.

Over 700 outbursts which have impacted on mine safety and production have been recorded in Australia over the past 100 years. During this period research has been somewhat variable in Australia. Overseas countries, which provided a large source of outburst related research in the past, have now closed either most or all of their coal mining industry.

In Australia, Alan Hargraves, applied some predictive techniques to outbursts, but it was not until the late 1970s that Ripu Lama, then working for the CSIRO, joined the effort by conducting micro seismic tests at West Cliff in an attempt to trace and predict outbursts of gas.

From the early 1980s a significant amount of in-house research and development (R&D) was undertaken by both AIS Collieries Pty Ltd and Kembla Coal and Coke Pty Ltd, to try to understand and manage the phenomenon of gas outbursts in the Bulli Seam. Both organisations along with external research groups utilised the support of the Federal Government NERDC funded programmes.

Many successful and valued projects grew out of the NERDDC research, one in particular being the West Cliff CH_4 gas extraction and 13 megawatt mine site CH_4 gas power project.

Today NERDDC has been replaced by Australian Coal Association Research Programme (ACARP) which continues to be highly supportive of projects related to gas drainage, drilling and outburst related research.

Since the early 1990's ACARP funded research into CH_4 gas drainage and outbursts has declined in Australia.

The focus and structure of research and development has changed today, from Research Institutes to industry funded collaborative research. The days of large centralised Research Institutions practicing research for the sake of research have gone.

Industry is looking for a highly applied focus to gas and outburst related research, but we lack the Champions of the past.

ACARP is trying to address some of these concerns by moving to "landmark" projects to stimulate research but projects are often awarded by priority.

CONCLUSION

As the coal mining industry today strives to find safe and economic methods to understand and manage the phenomenon of gas and coal outbursts we lack the drivers of this work from the past.

We appear to lack the ability to attract, support and house potential Champions whether it is in industry, research organisations or academia. Unless we move forward and develop our understanding and management of gas and outbursts by developing greater knowledge and quantifiable research we will be forced to turn away from coal reserves that have this phenomenon. If these resources are seen as too difficult to mine, there will be limited recovery of our declining high quality coal reserves.