The Australian Mine Ventilation Conference 2017

Paper Number: 87

Optimal goaf hole spacing in high production gassy australian longwall mines-operational experiences

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ABSTRACT

In a pre-drained gassy coal mines, ventilation control plays a secondary role to the longwall goaf drainage systems to safely manage panel return gas levels. Typically, the longwall specific gas emission (SGE) estimation models provide anticipated goaf gas emissions and arriving at required gas drainage capacity for various coal production scenarios. A study comparing the various longwall goaf gas hole spacing patterns with weekly production rates of up to 270ktpw of an operating mine with high SGE rates (~20 m3/t)was carried out. The goaf capture efficiency of longwall panels ranged from 64 % to 85 % based on the gas emissions, goaf gas purity at respective longwall panels as well as the performance of the goaf gas system. For the first time, gas content of upper seam data post longwall retreat were used to verify the current SGE prediction models. Operational experiences have indicated that an average of 50 m goaf spacing is optimal for management of high production retreat gassy longwall panels in presence of multiple upper and lower seams with zone of influence reaching up to 200 m above workings. Due to the horizontal stress direction related geo-technical issues, goaf hole failures just behind the longwall face is a recurring challenge resulting in significant and immediate increase in LW panel return gas levels. This paper highlights the accuracy of current SGE prediction models, evolution of 50 m goaf hole spacing embedded in design process in managing the gas levels.

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Paper Number: 67

Full-scale numerical modelling of methane explosions in underground roadway and parametric study

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ABSTRACT

Underground coal mine methane explosion is a devastating hazard. So far behaviour of explosion shock wave propagation is mainly derived from experiments and simulations in small scale facilities such as pipes and ducts. Although some experimental explosions has been undertaken in large scale roadways in United States and China, there are still doubts about the impact factors such as wall roughness, cross-section shapes and size, methane distribution volume and obstacles. This paper adopts Computational Fluid Dynamics (CFD) modelling to investigate methane explosion and propagation mechanism of pressure, flame and temperature. The comparison will be made between arched roadway and rectangular roadway, roadways with different wall roughness, roadways with and without obstacles, roadways with different methane concentration and distribution length. The results can provide a basis for the design optimization of the underground roadways and the location and strength of mine seals construction to withstand the explosion shock wave and to protect equipment and personnel from damage.

The Australian Mine Ventilation Conference 2017

Paper Number: 36

Designing for overpressure

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ABSTRACT

Coal mine explosions have been occurring for almost 400 years, and they continue today. Despite all that we have learned, coal mines are still being under designed for protection from overpressures resulting from gas or dust explosions. There is no regulatory guidance for overpressure protection for main fans.

Overpressure protection has been investigated and researched in countries around the world for decades and somewhat regulated in Australia in the wake of the Moura 2 explosion (Queensland 1994), Sago (USA 2006), and Pike River (New Zealand 2010). Main fan protection has been regulated in the UK since 1887.

For centuries in the UK, it has been recognised that up to 7/8's (or almost 90%) of fatalities from mine explosions are not from the explosion itself, but from the after gases and the disruption to ventilation. In Australia ventilation devices are damaged in explosions and fans are not constructed with sufficient pressure relief.

There is no doubt that preventing mine explosions must be the primary focus. However, mitigating their consequences must also be a priority. Main fan protection is grossly inadequate and even the recommendation that the overpressure relief be at least equivalent to 100% of the cross sectional area will prove to be ineffective.

We can, AND MUST, improve the overpressure resistance of our coal mine ventilation systems. We don't need another Royal Commission into the next coal mine disaster to recommend that we should have had a better designed ventilation system. Sadly, it looks like that's what it might take.

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Paper Number: 37

Introducing a new age of highly effective, automatic explosion suppression barriers

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ABSTRACT

There are several well-known, extensively researched and tested methods of suppressing a coal mine explosion. The choice of method used is dependent on the legislative requirements of each country, which in turn are influenced by mining conditions in that jurisdiction. For example, seam gas content and the dustiness of the coal will combine to create the hazard, while the physical and chemical properties of the seam might influence the possibility of ignition sources such as frictional ignitions. The mining method and layout will also influence the choice of preventative or proactive suppression devices. The decision as to which method is approved and adopted should be based on current technology and the latest research outcomes and should be subjected to a rigorous risk assessment, since a methane explosion propagating into a coal dust explosion cannot be countenanced.

Every new technology must undergo stringent tests and these tests must be certified by accredited research facilities or laboratories. Upon approval an explosion suppression system or the critical components of such a system should then be tested in a more realistic environment. This environment can ideally be found underground in a mining section. Based on the insight gathered in such an environment, a realistic evaluation of the effectiveness of a potential system can be carried out. The explosion suppression systems described in this paper has been tested on numerous occasions at accredited institutes. The technology described in this paper has been used in various operational applications underground and has been adapted to fulfil and exceed the requirements set out for methods currently in use. This paper describes the testing procedure as well as the results performed by a new automatic explosion suppression roadway barrier. In a recent test conducted in the intake airway of a working section the active roadway barrier performed successfully.

The Australian Mine Ventilation Conference 2017

Paper Number: 27

Inertisation of coal augering holes

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ABSTRACT

An investigation into the reliability of the data being collected at Mount Isa Mines (MIM) site operated by Glencore in Queensland allowed the onsite Ventilation advisor to scrutinise collected pressure measurements. Constant monitoring of an operations ventilation network is imperative to ensuring that the underground atmosphere provides a safe and healthy workplace as a standard duty of care. The investigation effectively identified discrepancies being reported back to the onsite remote monitoring system. The difference between real-time and static monitored measurements effectively identified that the insitu pressure transducer annubar system installed on the P63 RAR shaft was not operating correctly. This indicated a deficiency of approximately 30% reporting back to the remote monitoring software versus live readings with the pitot pressure bomb. The site has been in operation since the 1930's with many of the sub-surface vertical shafts being installed in 1960-70's. Further benefits to real-time monitoring allows for the early indication of network failures and promotes increased utilisation and availability. An innovative approach to overcome / out engineer the antiquated equipment from the 1970's was sought.

The introduction and implementation of a reliable product for real-time monitoring was a challenge. But hence a solution was found through thinking and looking outside of the box. The future is here, and the use of ultrasonics in the mining industry is not new with Ventilation on Demand (VOD) and Ventilation Management Systems (VMS) equipment. The available equipment on the market through mainstream suppliers was not suitable for the unique solution required due to the insitu installation of the surface fans "where she be, there she be". So a solution was sought in the realm of the oil and gas industry through collaborative and innovative thinking on both sides of the fence. This paper describes both the Innovation and operational sustainability approaches followed in the implementation of the monitoring equipment at the site.

The Australian Mine Ventilation Conference 2017

Paper Number: 23

Application of venting technology in deceleration of explosion and flame deflagration in ventilation air methane

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ABSTRACT

Application of thermal oxidation is considered a promising technique in reducing fugitive methane gas from the ventilation air methane (VAM). A typical thermal oxidizer combusts the diluted methane and convert it to less potent greenhouse gases. However, having a thermal oxidiser in vicinity of the coal mine exhaust shaft is a major safety concern as its high operation temperature increases the likelihood of accidental fire and explosion. The aim of this study is to investigate the application and effectiveness of side venting technique in deflagration reduction caused by methane gas. To address this importance a series of experimental work conducted on a detonation tube designed and fabricated as part of larger scale VAM safety project. The experimental work carried out into two stages; investigate the flame and explosion properties under some given conditions, and then examine the effectiveness and performance of the venting (venting coefficient Kv= 37) in deceleration of flame deflagration velocity and explosion pressure.

The Australian Mine Ventilation Conference 2017

Paper Number 20

Incorporation of research data in addressing methane and coal dust fire and explosion hazards in coal mines

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ABSTRACT

The concentrations of methane and coal dust vary from one location to other in underground coal mines. In the presence of an ignition source, such as static electricity, these mixtures can initiate explosions and consequently cause massive destruction. Research data can help in understanding the level of hazards and associated risk which these flammable mixtures can produce. For instance, the level of peak explosion pressure and flame travel speed can be well understood from experimental and numerical research data. With this aim, methane-air mixtures and hybrid methane-coal dust-air mixtures were employed in a ducted spherical vessel. According to literature, the maximum value of peak explosion pressure can be obtained in vessels of spherical geometry when compared to vessels of other geometries. Thus the values of explosion parameters generated from spherical vessels can be incorporated in hazard analysis and understood at the highest level.

In this study the duct integrated with the vessel resembles any channel or pathway connected to a methane and/or coal dust rich area in the mine. Experimental investigations emphasise that the severity of explosion in the explosion zone transmits to the channel or pathway. The length of the channel or pathway also plays an important role on the values of explosion parameters. The higher the length of the channel or pathway, the higher the explosion pressure is and therefore the higher the destruction is. Ignition energy and concentrations of methane and coal dust were varied in collecting experimental pressure and flame speed data. The data of explosion parameters thus obtained can be employed in addressing hazard mitigation strategies in coal mines.