The Australian Mine Ventilation Conference 2017

Paper Number: 48

Addressing the deficiencies of current spontaneous combustion index parameters

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ABSTRACT

Current spontaneous combustion index parameters such as SHT, CPT/RIT and R_{70} all have deficiencies that need clarifying from a risk management perspective. In some instances they can produce a false positive evaluation and in others they can produce a false negative evaluation. These tests all use a relative rating scheme that does not provide any indication of the time it takes for a spontaneous combustion event to develop, nor do they consider the moderating influence of moisture present in the coal. This is viewed as a major deficiency since the true self-heating behaviour of broken coal is primarily a function of time that is governed by the initial boundary conditions such as initial ambient temperature and moisture state. This paper will present examples of the current index parameter deficiencies and demonstrates a more practical method to overcome them using incubation testing. This new test also provides information on the stages of a heating for individuals coals, which is important in developing an appropriate Principal Mining Hazard Management Plan for spontaneous combustion.

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Paper Number: 11

Using liquid nitrogen for the inertisation of goafs

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ABSTRACT

During the response to the Moura No. 4 disaster, use was made of the New South Wales Mines Rescue Service's "Mineshield" inertisation equipment. The equipment had to be transported from Newcastle, approximately 1400kms, and the liquid nitrogen a similar distance. The time taken and therefore availability of the liquid nitrogen became a significant problem. Operational issues were also experienced during use. Typically the liquid nitrogen is converted to a gas (vaporised) before being injected into the mine. However as the propane gas tanker used for the vaporising unit was delayed, an attempt was made to inject the liquid nitrogen directly down uncased boreholes. This proved unsuccessful.

Following the Moura No. 4 disaster and the Moura No. 2 disaster, recommendations were made relating to having inertisation capacity for the Queensland coal mining industry. Today the Queensland industry has multiple options available for inertisation, including the high volume GAG and smaller volume units such as boilers and membrane separation units. Although it ultimately aided re-entry into Moura No. 4, most likely due to the issues associated with supply to Central Queensland, liquid nitrogen has not found favour within the Queensland industry as an inertisation tool.

Coregas has commissioned an air separation plant in Mackay, improving the availability of liquid nitrogen to Central Queensland. Based on the availability of this nitrogen, recent sealing operations at Kestrel have trialled using liquid nitrogen and associated vaporising units. This paper details the practical application and findings of using liquid nitrogen during routine longwall panel sealing.

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Paper Number: 25

Tube bundle integrity testing methodologies

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ABSTRACT

The tube bundle system is an integral part of an underground coal mines gas monitoring system. The maintenance of these systems is vital to ensure the quality of the data produced. Integrity testing of the tube bundle lines is required monthly, as specified in AS/NZ2290.3 (1990). The various forms of integrity testing will be reviewed, including pressure testing and introduction of a known gas. This paper will provide a recommended, standardised methodology for those techniques where none currently exist. A strengths, weaknesses, opportunities, threats (SWOT) analysis will be performed. The parameters considered for the SWOT will include resourcing required by the mines, time for the testing to be performed and quality of the result produced. The suitability of such integrity testing protocols to be used in a mine emergency situation will also be evaluated.

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Paper Number: 75

Experimental study on the effect of high ground temperature environment on spontaneous combustion danger of coal

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ABSTRACT

In order to understand the effect rule of high ground temperature environment on coal spontaneous combustion, characteristic parameters of spontaneous combustion of the two coal samples that one was dealt with 40 ℃ constant temperature, the other was rose temperature from normal temperature were tested and analyzed based on the temperature programmed experiment, and a calculation model of apparent activation energy of coal was established using the relationship between CO concentration and temperature changes to compare and analyze the change rule of the apparent activation energy of the two coal samples in different temperature phases. The experiment results showed that, The oxygen consumption rate, CO and CO_2 generation rate, extreme heat release intensity of the coal sample that was dealt with high temperature were higher than the coal sample that was rose temperature from normal temperature, and this trend was more and more obvious as the temperature rose, and its apparent activation energy was lower than the coal sample that was rose temperature from normal temperature, especially in low temperature stage, its apparent activation energy was lower, which demonstrated high temperature environment led to the oxidation exothermicity of coal enhanced, oxidation reaction required less energy, under the same condition, the speed of oxidation reaction was faster, it was easier to oxidize and happen spontaneous combustion, the spontaneous combustion danger increased.

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Paper Number: 18

Kinetic characteristics of spontaneous combustion of the huge thickness coal seam in the Eastern Junggar coalfield, Xinjiang, China

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ABSTRACT

The Eastern Junggar coal field comprises coal seams of the huge thickness going up to 100 meter, which is unique for whole China. The mining of this coal seam poses a challenge in particular with respect to the spontaneous combustion associated with mining activities. To study the oxidation processes of the major coal seam of the eastern Junggar coalfield, the authors conducted experiments where coal samples of different particle sizes were oxidized at electronically controlled temperatures. Some characteristic quantities, like the critical spontaneous combustion temperature Tc, which is the initial temperature for producing CO, the Graham indexes, the change of CO and O2 concentration with increasing temperature, and the concentrations of other CnHm gases, are determined and discussed in the present paper. Results show that the initial temperature of CO TCO increases with reduction of particle sizes. The average initial CO temperature is about 66.37℃, and it can be concluded that the reaction rate of the samples is not dependent on the particle size. It is also shown that the critical temperature TC increases with reduction of particle sizes, and the average critical temperature is about 154.73℃. Between ambient temperature Ta and TCO, the average oxygen-consumption rate is about 0.2454 ml/min/℃, and between the TCO and the temperature of self-sustained burning Tb, the rate is about 4.0049 ml/min/℃. With the progress of oxidation, the oxygen-consumption rate of the sample with particle sizes between 150 □m and 180 □m is higher than that of the 109□□ m-120 □m size and that of the 80 □m-96 □m size, which indicates that the sample with largest particle sizes has a much higher reactivity than the others within above particle size range. In the temperature range from 70℃ to 100℃, the Graham index R3 has higher significance to indicate spontaneous coal combustion than R1 and R2. From this research, it is recommended to choose the CO concentration, temperature, O2 concentration, Graham index R3, as well as C2H4, C2H6, and C3H8 concentration to indicate the spontaneous coal combustion in a coal mine. In order to know the influence of particle size on the kinetic parameters of coal oxidation, the authors also conducted thermogravimetric analysis measurements of these samples. The results reveal some effect of the size of particles on the kinetic parameters.

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Paper Number: 53

Risk evaluation of the spontaneous combustion of coal for underground coal mining

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ABSTRACT

In underground coal mining, one of the biggest challenges is spontaneous combustion, which can often present huge economic losses, serious environmental problems, safety hazards and even fatalities sometimes. The occurrence of spontaneous combustion depends on many factors, primarily including coal properties, mining methods, the advance rate of working face, ventilation, and surrounding geological conditions as well. Consequently, a comprehensive evaluation to systematically assess all these factors is necessary during mining planning to control spontaneous combustion hazard. The main factors for the spontaneous combustion of coal were collected, optimized, and then categorized into four groups, which were further subdivided into thirty eight subfactors.

Analytic Hierarchy Process (AHP) was utilized to evaluate all contributing factors and help build the comprehensive evaluating system. The factors in hierarchy structure were then weighed and integrated with the help of ten experts in spontaneous combustion. The results indicate that coal rank plays the most significant role in the risk of spontaneous combustion, followed by the inhibiting agent injection and the monitoring system. The risk of spontaneous combustion for a mine was classified according to the comprehensive evaluation index proposed in this study. Four coal mines were then selected to illustrate the application of this evaluation system. These results indicate that a mine with low-rank coal may still have a low risk of spontaneous combustion, if effective precautions are utilized.