The Australian Mine Ventilation Conference 2017

Paper Number: 02

The use of mid-panel ventilation shafts to improve positional cooling efficiency in a Bowen Basin longwall mine - a case study

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ABSTRACT

Due to steep geo-thermal gradient in Bowen Basin area, as underground coal mines reach increased depths of extraction, the bulk air cooling (BAC) requirements will increase as opposed to cool the workplace using the ventilation means. One such mine has already been using a 4MW surface BAC plant for the last six years to manage the working temperatures with reduced cooling efficiency with the mine expansion. Due to the horizontal nature of the longwall mine layout, distances from the working face to intake shafts are rapidly expanding over 6 km as opposed to the vertical mine layout of a hard rock mine. To improve the positional cooling efficiency, reduced panel pressure differentials, improved rib emission gas management, small diameter intake shafts were located on the in bye end of production panels and halfway up the development panels with localized and mobile small BAC plants.

This paper summarizes the results of extensive underground data analysis of this innovative cooling concept with regard to positional cooling efficiency for development and retreating longwall face compared to a larger remote BAC plant. In addition, the influence of the nature of the longwall tailgate goaf stream formation over the longwall face area is analysed using the underground data as a result of changes made to the longwall tailgate layout. A relationship between the nature of incomplete goaf stream formation over the longwall face temperature and its positive impact on face temperature is established and the benefits of correct tailgate layout are discussed.

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Paper Number: 56

Reducing the heat load in hot working areas of Nevada’s underground precious metal mines

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ABSTRACT

Nevada’s underground precious metal mines are becoming gradually deeper while employing large diesel powered mining equipment to increase the production rates. The ability of ventilation systems to assure appropriate climatic conditions for the underground workers will decrease as a function of increasing mining depth and an ever rising level of mechanization. Most of Nevada’s underground metal mines are not considered to be hot mines due to the fact these mines do not have an extensive spread-out heat problem. However, there are several localized areas where temperature and humidity can exceed the threshold limit values during development and production operations. Consequently, heat may rather be considered a contaminant, which must be reduced by means of redesigning the mines’ ventilation system, and as a last resort by employing localized spot cooling systems.

This paper aims to discuss the methods and technologies which can be used to reduce the heat which is transferred to the ventilating air from strata, mining equipment, auto-compression and other sources. In this paper, we will highlight and demonstrate the importance of selecting/developing an appropriate heat stress index which can protect the underground workforce in deep and hot underground metal mines. Furthermore, we will also summarize and discuss the advantages and challenges of different approaches that underground mines have taken to reduce exposure to heat and minimize heat related illnesses for their underground workforce.

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Paper Number: 16

The contribution of conveyed broken rock on mine heat load

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ABSTRACT

The dominant heat loads in a deep underground mine are the surrounding rock mass, autocompression and machinery. In addition heat can be contributed by other sources. Many block cave, sub-level cave operations and coal mines utilise conveyors to transport broken rock out of mine, in some cases completely, in others in combination with other forms of transport. This broken rock can be loaded onto the conveyor at virgin rock temperature and can represent a major heat input to the ventilation airflow as it is transported out of the mine. The purpose of this paper is to review established knowledge regarding heat flow from conveyed rock, to determine the main factors influencing the heat flow and to develop a methodology for predicting heat flow from caved rock. The paper concludes with suggestions for further research in the area of conveyed rock heat transfer.

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Paper Number: 49

Heat load assessment and mine cooling strategies for a longwall coal mine

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ABSTRACT

Bowen Basin coal mines suffer from hot and humid ambient conditions during the summer period. The ambient conditions combined with high VRT's, increasing depth of working and significant equipment heat loads results in heat issues underground. Coal mines operate under heat stress management plans as required by legislation with associated trigger action response plans [TARP's]. Some mines also employ refrigeration as part of their heat management strategy.

Kestrel produces about 4.5Mt/y from their longwall and experiences summer ambient temperatures of about 23.5ºCwb. The expected virgin rock temperature will be 46ºC at 300m depth. The mine currently introduces a modest amount of surface cooling at the portal using 'off-the-shelf' air conditioning units. This system does not effectively manage face temperature primarily due to positional inefficiency.

Underground conditions remain hot in summer and work is typically undertaken in accordance with the Heat TARP. This has a direct impact on the productivity of crews, worker comfort and also negatively impacts the workforce morale. The mine commissioned a study to determine a refrigeration strategy aimed at maintaining underground conditions below TARP levels 90% of the time.

The ventilation network model was calibrated against actual temperature data to simulate the heat loads including longwall, conveyor system, strata and auxiliary diesel fleet. This model was then used to determine the cooling requirements for bulk surface cooling, bulk underground cooling, surface district cooling and underground district cooling strategies. These estimates were used to undertake a total owning cost trade-off for the different strategies. The study concluded that a chilled air shaft has a lowest technical risk but highest total owning cost due to shaft development needs. Introducing chilled water to an underground cooler via bore holes offered the lowest total owning cost and was recommended.