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A comprehensive investigation on the ventilation and gas management systems of Parvadeh_1 Mine in Iran – a case study

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ABSTRACT

Mine ventilation is an essential part of underground operations used to provide fresh and cool air, and to dilute and remove contaminants from mine workings. This paper presents a comprehensive investigation on the ventilation and gas management systems of a leading underground coal mines in Iran. Parvadeh_1 mine, located in Tabas coalfield in south Khorasan province, is the only fully mechanised mine in Iran utilising the longwall retreat technique, and produces 1.1 to 1.3 million tonnes of coking coal, annually. The mine ventilation system currently utilises two 630Kw suction surface fans introducing 250 m³/s fresh air into the mine. The advanced gas management system utilised in the mine includes surface-to-inseam pre-drainage boreholes. The underground mine is equipped with a gas reticulation pipeline for the production of methane gas. The paper concludes with an analysis of the ventilation and gas management characteristics of the mine in comparison with the standards used in Australian mines.
Diesel to electric – creating a positive paradigm in underground ventilation and cooling

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ABSTRACT

Mining deep ore bodies is increasingly becoming the norm as the “easy” ore bodies are depleted. Deep ore mining requires significant ventilation and cooling infrastructure to not only meet regulatory requirements for air quality but also to achieve acceptable workplace temperatures with the higher strata rock temperatures and increased autocompression. At the same time, advances in battery equipment technology are turning the possibility of a battery powered fleet into reality. The switch from a diesel fleet to a battery powered fleet offers several positive opportunities for the design and operation of a deep mine. The potential to reduce ventilation and cooling requirements due to battery powered equipment results in significant cost savings for mine development and infrastructure. At the low ventilation volumes possible with a battery powered fleet, surface refrigeration plants are limited with respect to the amount of cooling that can be delivered to the workplace. Considerations for calculating the optimum air flow and cooling requirements are presented. Considerations for locating the refrigeration plant are also discussed. This paper presents these opportunities and considerations, including a case study comparing the ventilation and cooling system design with a diesel fleet versus battery fleet for a planned mine in Northern Ontario, Canada.
Analysis of the ventilation system efficiency for features of the oil shale mine

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ABSTRACT
Analysis of the ventilation system efficiency has been produced in the working oil shale mine which is in production from the early seventies of the last century. At this mine room-and-pillar with drill-and-blast methods is used. The mine has a complicated ventilation system to supply fresh air for the eight mining production areas on the radius of about 12 km. The main purpose of the experimental testworks was to obtain data for estimation of an optimum cross-section area for a new ventilation shaft. Experimental testworks included measurements of air volume and fan pressure using five different modes of intake air through the ventilation shafts system. Measurements of airway friction factors were obtained during the ventilation surveys to determine characteristic friction factors for the intake airway. The results of the measurements will be used for further air flows simulation processes required for design of new additional ventilation shafts in the oil shale mine. Results of the study can be useful in estimation of frictional pressure drop in oil shale mines conditions.
Establish, implement and maintain longwall ventilation system Grosvenor Mine case study

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ABSTRACT

The Grosvenor metallurgical coal project is located in the Bowen Basin of Queensland, Australia. It was approved for development in late 2011 after extensive resource evaluation and feasibility study. Longwall operations were successfully commissioned in May 2016; seven months ahead of schedule and US$100 million below budget. The Grosvenor Longwall system is capable of producing 7.5 million saleable tonnes of high quality metallurgical coal per year. The Grosvenor ventilation system was established and implemented to realise safe and efficient world-class production of coal.

Ventilation circuits that were considered to be implemented for Longwall block 101 at Grosvenor included:
- Homotropal maingate with intake tailgate
- Homotropal maingate with tailgate twin return
- Antitropal maingate with tailgate twin return
- Antitropal maingate with intake tailgate

Design criteria were established to determine what a successful ventilation system should provide to achieve world-class safe production of coal. The design criteria included:
- Main fan collar pressure
- Production face ventilation quantities (Longwall and development)
- Ventilation control device leakage
- High intake road velocities
- Emergency response to a fire events in the belt road, travel roads or tailgate return
- Heat stress management
- Management of gas
- Removal of dust and minimising pickup of dust in high velocities
- Exposure to diesel emissions
- Limiting goaf pressure differentials
- Limiting intake air passing over goaf seals
An antitropical maingate circuit was implemented as the preferred option when critiqued against the set of design criteria. This arrangement provided for an intake road adjacent to the tailgate return and a low main fan collar pressure. The ventilation circuit was initially very successful; however, as the Longwall ramped up production we started to generate excessive heat from the conveyor system, mainly the three tripper drives installed along the 2.6 km gate road to manage the steep dip. Cut coal emissions were also higher than initially considered in the feasibility stage.

Performance monitoring of the antitropical ventilation system identified that the heat load and cut coal emissions reporting to the Longwall face from the conveyor system were impacting on production. The system was no longer succeeding against the design criteria. A homotropical conveyor system was required to remove the dust, heat and gas generated along the conveyor system.

The ventilation model needed to be reconciled against empirical data which was gathered during the Longwall production ramp up period. The reconciliation of the ventilation model provided the platform to revisit the original ventilation circuit options and design criteria. A ventilation change was undertaken to provide a homotropical maingate conveyor road. This successfully managed the heat, dust and gas issues previously experienced from the antitropical maingate. Furthermore, a risk management process was conducted to identify the limitations of the homotropical system, implement corrective actions to manage the limitations and establish system performance alarms for further monitoring.