Spring 2017 SME Presentations

Saturday, February 18, 1:45 pm

Where are the people? Including social sustainability in the circular economy

J. Smith, N. Smith, L. Battalora, and C. McClelland

Tuesday, February 21, 9:25 am, Room 104

Corporate social responsibility as an engineering competency for the mining industry

N. Smith and J. Smith

Divisions between the “technical” and “social” dimensions of mining and engineering can cast Corporate Social Responsibility (CSR) as the domain of social scientists and community relations experts. Drawing on ethnographic research with practicing engineers in the mining industry, we illustrate how CSR is inherent to their work as engineers. We examine the ways in which social concerns shape their work throughout the life cycle of a mine, and how their work blurs the lines between the social and technical aspects of natural resource development. This work suggests that CSR is not peripheral to engineering, but is a key competency required for careers in the global mining industry.

Tuesday, February 21, Room 106

Design of site layout for tunneling projects

O. Frough and J. Rostami

Tuesday, February 21, 9 am, Room

Effects of skew angle on cutting tool temperature increment, wear, and performance

E. Kim, K. Hirro, D. Oliveira, and A. Kim

Monday February 20, 2:45 pm, Room 612

Research of the Injury Rates in Selected Mining Sectors and the Economic Benefits of Mine Safety Improvements

C. Fuellenbach [1], J. Brune[2] and H. Mischo [1];

[1]Technical University Bergakademie Freiberg, Freiberg, Germany and [2]Colorado School of Mines, Golden, CO

Occupational safety and health plays an important role in the mining industry. An example for a safety improvement program in Germany is the “Vision Zero” program developed by the German professional association for the raw materials and chemical industries (BG RCI). Researchers at the Colorado School of Mines have investigated the correlation between safety performance and profitability in several mining companies. The goal of this research was to use engineering and economic methods to determine whether mines with lower accident frequencies and severity rates are also more productive and profitable operations. The research aims to quantify economic benefits of safety improvements in the German mining industry, with special regards to salt and potash and aggregates mining. The research focuses on the evaluation of incident rates across the last decades and its correlation to business numbers like profit and productivity. Another aspect studied is the comparison of incidence rates between the western and eastern States of Germany as well as the dependence of the injury rates from the enterprise size.

Monday February 20, 3:05 pm, Room 612

Accidents of the Past Compared with Accidents of Today

C. Enright and J. Brune; Mining Engineering, Colorado School of Mines, Golden, CO

While mining has evolved in technology, techniques, equipment and design, have accidents changed? The authors present a detailed comparison for accidents at a single metal mine in 1973 with accident and injury statistics from a comparable mine in 2013. The authors compare and contrast different mechanisms of injury, locations and types of accidents, and other pertinent details to determine if and how accidents have changed in 40 years.

Tuesday February 21, Room 501, 3:05 pm

Improving Modern Mining Methods for Moderately Inclined Tabular Deposits

T. Rockley [1], L. Rattmann[2] and J. Brune [1];

[1]Mining Engineering, Colorado School of Mines, Golden, CO and [2]THGA, Bochum, Germany

The mining of tabular deposits accounts for a significant portion of modern production in both underground hard rock and soft rock mining, but especially in the latter. There is a large discrepancy between the availability of tabular reserves and the amount of development of these deposits, particularly when the deposit has a dip of around 25-50 degrees. This project studied the technical and practical barriers to the mining of these deposits through modern and historical case studies. The primary technical barriers to the development of these deposits are material movement and roof support. The study of historical attempts overcome these barriers and why they failed allowed us to research implementing modern technology on previously unsuccessful methods, allowing for these methods to be reapplied successfully. If some common mining methods are slightly altered these deposits can be mined at only a marginal increase in cost and using readily available equipment. These modified methods could allow for previously underdeveloped deposits to become viable.

Wednesday February 22, Room 704, 9:45 am

CFD Modeling of Longwall Tailgate Ventilation Condition

Juganda [1], J. Brune [1], G. Bogin[2], J. Grubb [1] and S. Lolon [1];

[1]*Mining Engineering, Colorado School of Mines, Golden, CO and* [2]*Mechanical Engineering, Colorado School of Mines, Golden, CO*

Ignitions of accumulated methane gas at longwall faces are well known to be some of the major causes of methane explosions in underground coal longwall mining operations. As a preventive measure, MSHA requires all underground coal operators in the United States to install methane monitoring devices on longwall shearing machines and at the tailgate end of the longwall face. Despite these effort, there are still regular occurrences of face ignitions. Some of these ignitions can lead to major mine explosions, such as the Upper Big Branch mine disaster in 2010, in which migrated methane from the gob to the shearer cutting drum where it was ignited, resulting in a major mine disaster. This methane had not been detected by any of the methane sensors installed near the longwall face. With the use of Computational Fluid Dynamics (CFD), a more detailed interaction between the intake air flow and various methane inflows at the longwall face can be modeled and visualized. The resulting airflow profiles will provide a better understanding of tailgate ventilation conditions that may lead to an accumulation of methane at the tailgate corner.

Wednesday February 22, Room 704, 10:05 am

Evaluation of Explosive Methane-Air Mixture Leakage from the Gob Due to Atmospheric Pressure Changes

S. Lolon [1], *J. Brune* [1], *G. Bogin*[2], *J. Grubb* [1], *A. Juganda* [1] *and S. Saki* [1]*;*

[1]*Mining Engineering, Colorado School of Mines, Golden, CO and* [2]*Mechanical Engineering, Colorado School of Mines, Golden, CO*

Gob “breathing” has long been acknowledged to occur during underground longwall mining. Gob breathing occurs when the pressure conditions across the gob are disturbed due to barometric pressure swings. These swings may cause the gob to breathe in fresh air and breathe out gob air containing methane and other contaminants. This condition can create explosive methane-air mixtures that can migrate into the longwall face and other active areas of the mine. Researchers at the Colorado School of Mines have developed a series of Computational Fluid Dynamics models to investigate and characterize the explosion hazards caused by gob breathing. This research is beneficial to determine the tolerable limits of barometric pressure variations, the time span before outgassing is expected, the most effective location for methane monitoring system and the recommended frequency and locations to monitor mine atmospheric readings. These findings are also important to plan appropriate actions to mitigate the potential explosion risks.

Wednesday February 22, Room 704, 10:45 am

The Effect of Environmental Factors on the Propagation of Methane Flames in the Longwall Gob *M. Fig* [1], *G. Bogin* [1], *J. Brune*[2] *and J. Grubb*[2]*;*

[1]*Mechanical Engineering, Colorado School of Mines, Littleton, CO and* [2]*Mining Engineering, Colorado School of Mines, Golden, CO*

Several recent mine explosions, such as the disaster at the Upper Big Branch mine in 2010 that caused 29 fatalities, have demonstrated that explosive gases can accumulate and ignite within and near longwall coal mine gobs. Prevention and mitigation of explosions of this kind require a fundamental understanding of flame propagation in enclosures and through rock features under varied environmental conditions. A combustion model was produced to examine the impact of water vapor concentration, temperature and surface wetting of simulated gob on the progress of CH_4 explosions. The CFD modeling of CH_4 combustion and flame propagation in humidified cylindrical vessels of various diameters with simulated gob is detailed, along with corresponding experimental results. The combustion model was developed in ANSYS for easy coupling to available ventilation models. Significant results include: 1) The CH_4 combustion model captures the effect of physical scale on explosions; 2) Humidity acts to retard the progress of the flame; 3) Water wetting on the simulated gob also acts to cool the flame and aids in quenching; and 4) increasing atmospheric and gob temperature increase burning velocity.

Wednesday February 22, Room 702, 10:05 am

Advanced Life Support in the Underground Environment

C. Enright, C. Harman and J. Brune; Mining Engineering, Colorado School of Mines, Golden, CO

The mining environment presents one of the most challenging and complex situations where medical care may be required. The combination of remote locations, dangerous work, difficult access and long response times create a perfect storm that we believe creates an increase in morbidity and mortality in the event of serious accidents. Initial responders at mine sites generally are trained no better than the Emergency Medical Technician Level (EMT), with MSHA only requiring that mine rescue teams are trained at the Emergency Medical Responder (EMR) level, and the training and scope of practice for these providers is not sufficient for response to a complex or critically injured patient. We believe that the introduction of advanced life support (ALS) capable providers and equipment, (paramedic-level) can reduce morbidity and mortality from serious accidents and critical medical emergencies dramatically.

Wednesday February 22, Room 706, 2:25 pm

CSM Mine Rescue – Going Beyond the Contest *C. Enright, M. Wrona, C. Smith and J. Brune; Mining Engineering, Colorado School of Mines, Golden, CO*

Mine rescue teams have held a particular regard for contests, as they provide both a training opportunity and an opportunity to participate in friendly rivalry with other mines (and now universities). While the CSM Mine Rescue team was initially founded to participate in these contests, a request for emergency assistance was received in 2011 that led to a significant shift in the goals and overall training for our team. We will present how our organization now trains and responds to emergency calls in addition to contests, as part of our comprehensive and all-hazards emergency response approach.

Wednesday February 22, Room 702, 3:05 pm

Subsurface Mine Ventilation Research *J. Lee [1], H. Mischo[2], J. Brune [1] and J. Weyer[2];*

[1]Colorado School of Mines, Greeley, CO and [2]TU Bergakademie Freiberg, Freiberg, Germany

Optimization of ventilation systems plays a huge role in saving a company valuable time, money, and energy. At the experimental mine at TU Bergakademie Freiberg in Germany, a full scale, ductwork ventilation lab was constructed to analyze the impact that different types and sizes of ducts have on ventilation systems. The lab consists of over 300 meters of duct work. Each 50-meter segment consists of flat or spiral ducts that differ in size ranging from 400-600mm. 150 meters of the system is comprised of properly installed new ducts, and the other 150-meters are poorly installed, and old. Both ducts are attached to a forcing radial fan that has the ability to direct the airflow into either portion of ducting. Ports are installed to record airflow velocities and pressures for each segment. Testing included measurements of static, dynamic, and total pressure at twelve points along the system. A pitot tube and manometer were used to take these measurements. Calculations were made to determine flow velocity, volume flow, duct resistance, leakage, and the shock loss effects around bends and elbows. Information from these tests will be useful in optimizing ventilation systems.

Wednesday February 22, Room 711, 2:05 pm

Prevention of Gob Ignitions and Explosions in Longwall Mining Using Dynamic Seals

J. Brune and S. Saki; Colorado School of Mines, Golden, CO

Most, if not all longwall gob areas accumulate explosive methane-air mixtures that pose a deadly hazard to miners. Numerous mine explosions have originated from explosive gas zones (EGZs) in the longwall gob, including the 2010 explosion at the Upper Big Branch mine in the US State of West Virginia that fatally injured 29 miners. Research at the Colorado School of Mines (CSM) have studied EGZ formation under projects funded by the National Institute for Occupational Safety and Health. They found that EGZs form along the fringe areas between the methane-rich atmospheres deep within the gob and the fresh air ventilated areas along the working face. Researchers found that, for progressively sealed gobs, a targeted injection of nitrogen from the headgate and tailgate, along with a back return ventilation arrangement, will create a dynamic seal of nitrogen that effectively separates the methane zone from the face air and eliminates the EGZs.

Wednesday February 22, Room 711, 3:45 pm

Effect of Simulated Longwall Coal Mine Gob Conditions on the Burning Velocity of Premixed Methane-Air Combustion

C. Strebinger [1], M. Fig [1], K. Blackketter[2], A. Walz[2], G. Bogin [1], J. Brune [1] and J. Grubb [1];

[1]Colorado School of Mines, Golden, CO and [2]Red Rocks Community College, Lakewood, CO

Longwall coal mine explosions can be disastrous as evidenced by the Upper Big Branch Mine explosion in 2010 which resulted in 29 casualties. Methane explosions in the gob are not well understood and thus there is a need to fundamentally understand flame dynamics in rock rubble. The impact of simulated gob conditions on methane gas ignition and flame propagation was investigated in horizontal cylindrical tubes packed with rock rubble. Experiments show burning velocity is sensitive to ignition location and simulated gob conditions (e.g. packing orientation and density, and thermal properties). More densely packed gob areas reduce burning velocities when placed upstream of the ignition source, but increase burning velocities if located downstream of the ignition source due to the increase in exhaust pressure accelerating the flame. In contrast, a loosely packed gob area results in the opposite effect on the burning velocities for the same orientation of the ignition source. These results demonstrate that methane gas explosions in a longwall gob require a fundamental understanding of the complex interaction of fluid dynamics, heat transfer, and flame dynamics.