Underground Coal Mining Ventilation

Introduction

It is well known that underground miners are exposed to one of the most dangerous working environments on earth. As miners delve deeper into the earth, the rock pressure and temperature rise, which in turn have an adverse effect on the environment and thus lead to higher operating costs. Furthermore, in coal mines where methane is also produced in coal beds, the combination of methane accumulation, oxygen and spark/heat can trigger explosions – which may cause fatal accidents.

The objective of this study is two-fold: (*i*) to develop mathematical model for total air-conditioning in mines; and (*ii*) to improve and optimize the design of underground mines to ensure miners safety and productivity whilst reducing the operating cost.

Mathematical model

The mathematical model comprises of conservation equations of mass, momentum, species and energy as well as scalar transport equations for turbulence model. Several turbulence models are tested and compared with experimental counterpart.

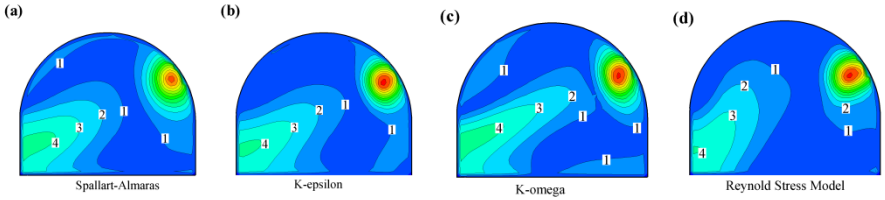

Fig. 1. Velocity contour at typical underground tunnel for various turbulence model at location 4 m from the dead zone area.

Design of Flow Stopping

One of the key factors that determine the performance of ventilation system is the velocity profiles inside the mines. In general, a higher velocities results in higher methane removal; more fresh air is also supplied in the mines for miners to breath.

Cross-cut region

Several ventilation scenarios in the cross-cut region are investigated with regard to the methane accumulation; they are (a) without additional equipment, (b) with blowing ventilation, (c) with exhausting ventilation, (d) with brattice, (e) with blowing-exhausting ventilation; and (f) with brattice-exhausting ventilation.

Mine development region

It is well-known that mining environments are dynamic and changing very rapidly as mining excavation continues using road header/continuous miner. In essence, changes in mine environment will also change the performance of ventilation system

Further study is underway to investigate various designs and parameters, e.g., ventilation in rapid mine development, gas and dust control as well as thermal management in underground mines

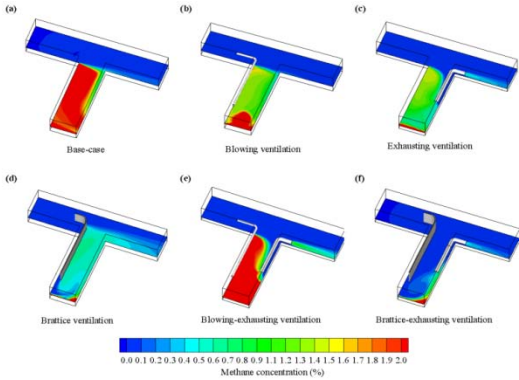

Fig. 2 Methane concentration (%) in the cross-cut region for several ventilation designs

Relevant publication:

A.P. Sasmito, E. Birgersson, H. Ly, K.W. Lum, A.S. Mujumdar, Improved ventilation system in underground coal mines - A computational study, *22nd World Mining Congress and EXPO 2011*, Istanbul, Turkey, 2011.

Contact:
Erik Birgersson, Assistant Professor, Department of Chemical and Bio-molecular Engineering, National University of Singapore. Email: **chebke@nus.edu.sg**
Arun S. Mujumdar, Professor and Director Centre, Department of Mechanical Engineering and Minerals, Metals and Material Technology Centre (M3TC), National University of Singapore. Email: **mpeasm@nus.edu.sg**