Proceedings of the 5th World Congress on Mechanical, Chemical, and Material Engineering (MCM'19)
Lisbon, Portugal – August, 2019
Paper No. MMME 126
DOI: 10.11159/mmme19.126

Simulation of Gas Emission rate on Spontaneous Combustion Zone in Gob

Yang Ming
Henan Polytechnic University, State Key Laboratory Cultivation Base for Gas Geology and Gas Control
Jiaozuo, 454003, Henan P.R. China
yming@hpu.edu.cn

Extended Abstract

Safe production of the coal mine is severely threatened by the spontaneous combustion of residual coal in the gob resulted from the air leakage of the working interface toward the gob and the over-ranging gas at the upper corner of the working interface. For quite a long time, researchers from all over the world focus on the research on three spontaneous combustion zones of the gob. Liming Yuan and A.c.smith take the experimental data of the spontaneous combustion in small sizes and the conditions of spontaneous combustion of residual coal into consideration, which helps simulate the conditions of gas flow and heat transfer in the gob, and analyse the distribution law of its temperature field and oxygen concentration field[1]. Gao Jianliang and others assume that the porous media of the gob is isotropic and conforms to Darcy Law. Under this condition, they simulate the flow field of the air leakage of the gob under different permeability distribution forms of the gob and analyse the air leakage rate, distribution of leakage speed and the scope of three spontaneous combustion zones[2, 3,4]. Sun Yong, together with others, employs the testing method of comprehensive distribution along the fully mechanized working interface. In accordance with Darcy Law, a mathematical model is built up. With the method of numerical simulation, the distribution scope of the three spontaneous combustion zones of the fully mechanized working interface is fixed[5]. Zhang Xinhai and others assume that the concentration distribution and the air seepage of the gob are steady and conform to Darcy Law and Fick Law. The gob is considered as the average porous media. A steady-state model of the seepage in the gob of the fully mechanized working interface is built, to study the oxygen concentration, intensity distribution of air leakage and the scope of three spontaneous combustion zones of the gob[6]. Du Liming and Yang Yunliang employ the relevant theories of fluid mechanics of porous media, heat transfer and mass transfer to build mathematical models for 3D non-steady-state field of air flow and 3D non-steady-state temperature field of the gob. They develop the computational formula for thermodynamics wind pressure of the 3D gob for the first time[7]. Li Zongxiang and others employ finite element method of windward to define the gas seepage equation and the dissipation equation of the oxygen seepage in the gob. Besides, they employ the method of superposition between regions of heat accumulating and high oxygen concentration to define the scope of the spontaneous combustion zone of the gob[8]. Lan Zequan, Zhang Guoshu and other people employ the theory of filter stream and ventilation networks to simulate the distribution of the three spontaneous combustion zones with/without gas emission airway[9].

It can be seen from the analysis that the previous research on the range of three spontaneous combustion zones of the gob basically does not involve the impact of gas emission intensity of the gob on the scope of three spontaneous combustion zones; furthermore, discussion has not been made on length selection of the intake airway which was determined basically by experience[10,11]. Simulation is therefore given by this text on the ventilation flow field of the working interface when the length of the intake airway is respectively 10m, 15m, 20m, 30m and 40m by Fluent Software; analysis of the wind flow distribution at the inlet side on the working interface is made to determine the proper length of intake airway and study the scope of spontaneous combustion zones under different gas emission amount of the gob. The results indicate: the gas emission amount of the gob has a great influence on the scope of the spontaneous combustion zone. The decreasing of gas emission rate of the gob, the spontaneous combustion zone on the intake side of the gob is gradually penetrating into the gob, while, on the return side, it is gradually getting close to the working interface.

References

[1] Y. Liming, “Numerical study on effects of coal Properties on spontaneous heating in long wall gob areas,” *Fuel*, vol. 87, pp. 3409-3419, 2008.

[2] Chen Chao-Da Lv Zhi-Sheng, “Temperature Control in Agricultural Preservation Application Research,” *IJACT*, vol. 4, no. 1, pp. 470-476, 2012

[3] GAO Jian-liang, WANG Hai-sheng, “Influence of Permeability Distribution on Airflow Field of Leakage in Gob,” *China Safety Science Journal*, vol. 20, pp. 81-85, 2010.

[4] Liu Jiajia, “Research on Flow Field and Gas Distribution in Gob of Full-mechanized Mining Working Face,” Henan Polytechnic University China, 2011.

[5] SUN Yong, ZHANG Ren-wei, HE Xiao-gang, “Research on site measurement analysis of spontaneous combustion law for goaf of fully mechanized top coal caving mining face,” *Coal Science and Technology*, vol. 36, pp. 52-55, 2008.

[6] ZHANG Xinhai, XI Guang, XU Jingcai, “Partition of spontaneous combustion dangerous zone and prediction of spontaneous combustion based on numerically modeling the flow field at fully mechanized caving face,” *Journal of University of Science and Technology Beijing*, vol. 27, pp. 641-644, 2005.

[7] Du Liming, Yang Yunliang, “Mathematical Models of Unstable Air Pressure Field and Unstable Temperature Field and Heat Pressure Calculating of Three dimension in the Goaf,” *Journal Of Jiaozuo Institute Of Technology*, vol. 18, pp. 169-173, 1999.

[8] LI Zong-xiang, XU Duan-ping, LIU li-qun, “Study on numerical simulation about the division of spontaneous ignition “three bands”in operation goaf,” *Journal of Liaoning Technical University*, vol. 21, pp. 545-548, 2002.

[9] LAN Ze-quan, ZHANG Guo-shu, WANG Zhi-liang, “Research on Three Zones Distribution of Goaf with Gas Discharge Laneway,” *Safety in Coal Mines*, vol. 11, pp. 1-4, 2008.

[10] Ping Huang, Peng Yang, Jie Liu, Qi Meng, “Application of Surpac Vision Software in Arhada Lead and Zinc Mine,” *AISS*, vol. 4, no. 8, pp. 178-186, 2012

[11] ZHANG Yan, “Recognition System of Coal and Rock on Mechanized Coal Mining Face,” *AISS*, vol. 4, no. 8, pp. 101-107, 2012