

**Proceedings of The**

# **2<sup>nd</sup> International Conference on Mine Safety and Environment Protection**

**Edited by**

**Xintan CHANG**

**Shugang LI**

**Jerry C. TIEN**

**Jun DENG**

**October 10–12, 2011 Xi'an, China**



**国家自然科学基金委员会**  
National Natural Science Foundation of China



**陕西煤业化工集团有限责任公司**  
Shaanxi Coal and Chemical Industry Group Co., Ltd.



**神华宁夏煤业集团**  
SHENHUA NINGXIA COAL INDUSTRY GROUP

## Real-time DPM Ambient Monitoring in Underground Mines

Dr A. D. S. Gillies

(Union Pacific/Rocky Mountain Energy Professor of Mining Engineering, Missouri University  
of Science and Technology, Rolla, Missouri, USA    gilliesst@mst.edu)

**Abstract** A real-time Diesel Particulate Matter (DPM) monitor has been developed on the basis of the Personal Dust Monitor (PDM) unit designed by National Institute of Occupational Health and Safety (NIOSH). The objectives of a recently completed Australian Coal Association Research Program (ACARP) study was to modify the PDM to measure the submicrometre fraction of the aerosol in a real-time monitoring underground instrument. Mine testing focused on use of the monitor in engineering evaluations of Longwall (LW) moves demonstrated how DPM concentrations from vehicles fluctuate under varying ventilation and operational conditions. The strong influence of mine ventilation systems is reviewed. Correlation between the current SKC DPM measurement system and real-time DPM monitors was conducted and results from eight mines show a correlation between elemental carbon (EC) and the new monitor DPM mass ranging from 0.45 to 0.82 with  $R^2 > 0.86$  in all but two cases. These differences are suspected to be due to variations from mine to mine in aspects such as mine atmospheric contamination, vehicle fleet variations, fuel type, engine maintenance, engine combustion efficiency, engine behavior or interference from other submicrometre aerosol. Real-time monitoring clearly reflects the movement of individual diesel vehicles and allows pinpointing of high exposure zones such as those encountered where various vehicles engage in intense work in areas of constrained or difficult ventilation. DPM shift average monitoring approaches do not readily allow successful engineering evaluation exercises to determine acceptability of pollution levels. Identification of high DPM concentration zones allows efficient modification of mine ventilation, operator positioning and other work practices to reduce miners' exposures without waiting for laboratory analysis results.

**Keywords** longwall; realtime diesel particulate matter; total carbon; elemental carbon

	<i>ZHU Hai-long</i> <sup>1,2</sup> , <i>CHEN Jian-qiang</i> <sup>3</sup> .....	162
· 85	Key Issues on Emergency Refuge System Construction in Underground Mine	
	★ <i>SHENG Wu</i> <sup>1,2</sup> , <i>GAO Ming-Zhong</i> <sup>1</sup> , <i>YANG Li</i> <sup>2</sup> .....	163
· 86	Design and Related Parameters of Mobile Refuge Chamber for Coal Mines	
	★ <i>ZHANG An-yuan</i> <sup>1,2</sup> <i>QU Xiao-cheng</i> <sup>1</sup> .....	171

#### IV. DPM, SMOKE AND DUST

	Real-time DPM Ambient Monitoring in Underground Mines ★ <i>Dr A. D. S. Gillies</i> .....	183
	DPM Dissipation Experiment at MST's Experimental Mine and Comparison with CFD Simulation	
· 89	★ <i>ZHENG Yi</i> , <i>LAN Hai</i> , <i>THIRUVENGADAM Magesh</i> , <i>TIEN Jerry C.</i> .....	184
	Simulation on Dissolute and Dust Dispersion in Comprehensive Mechanized Heading Face with	
· 90	Forced-exhaust Ventilation ★ <i>NIE Wen</i> <sup>1</sup> , <i>CHENG Wei-min</i> <sup>1</sup> , <i>HAN Li</i> <sup>2</sup> , <i>ZHOU Sheng-ju</i> <sup>2,3</sup> ,	
	<i>YU Yan-bin</i> <sup>1</sup> , <i>ZHAO Shan-shan</i> <sup>1</sup> .....	185
· 91	Optimizing of Coal Dust Prevention Project Based on Dust Properties ★ <i>ZHANG Jiang-shi</i> <sup>1,2</sup> ,	
lines	<i>ZHAO Yong-guang</i> <sup>1</sup> , <i>LI Tian-yang</i> <sup>1</sup> , <i>LI Hai-peng</i> <sup>1</sup> .....	186
· 92	Theoretical Research on Temperature Distribution and Smoke Flow in Region Close to Fire Source	
	★ <i>NIU Hui-yong</i> <sup>1,2</sup> <i>WANG Hai-qiao</i> <sup>1,2</sup> , <i>TIAN Zhao-Jun</i> <sup>1,2</sup> , <i>DENG Jun</i> <sup>3</sup> .....	192

#### V. GAS DRAINAGE AND OUTBURST

104	Integrated Outburst Detector Sensor-model Tests ★ <i>DZIURZYNSKI Wacław</i> <sup>1</sup> ,	
Mine	<i>WASILEWSKI Stanisław</i> <sup>1,2</sup> .....	198
112	A Study of the Mixed Coal Simulation Soft Layer on Adsorption of Gas ★ <i>LI Shu-gang</i> ,	
118	<i>ZHAO Peng-xiang</i> , <i>PAN Hong-yu</i> , <i>HUANG Jin-xing</i> .....	199
125	High-low-blasting Technology and Its Application in Methane Dynamic Disaster Prevention	
	★ <i>LI Xian-zhong</i> <sup>1,2</sup> , <i>LIN Bai-quan</i> <sup>1,2</sup> , <i>YANG Wei</i> <sup>1,2</sup> , <i>NI Guan-hua</i> <sup>1,2</sup> , <i>LI Quan-gui</i> <sup>1,2</sup> .....	200
131	Research on Time Structure Characteristic of Gas Concentration Sequence in the Working Face	
	★ <i>HE Li-wen</i> <sup>1,2</sup> , <i>SONG Yi</i> <sup>3</sup> , <i>SHI Shi-liang</i> <sup>3</sup> , <i>LI Xi-bin</i> <sup>2</sup> .....	201
137	Stochastic Prediction and Control of Methane in Coal Mine ★ <i>WU Wen-zhong</i> .....	202
143	Gas and Coal Outbursts in Polish Mines — Causes and Assessing Methods	
	★ <i>WIERZBICKI Mirosław</i> .....	203
150	Experimental Study on Influence of Coal Structural Anisotropy to Gas Permeation	
	★ <i>QIAO Yan-zhen</i> <sup>1,2</sup> .....	210
157	Research and Application of Directional Hydraulic Fracturing Technology ★ <i>Li Quan-gui</i> <sup>1,2</sup> ,	
	<i>Zhai Cheng</i> <sup>1,2</sup> , <i>Lin Bai-quan</i> <sup>1,2</sup> , <i>Li Zi-wen</i> <sup>1,2</sup> , <i>Li Xian-zhong</i> <sup>1,2</sup> .....	216
161	Prediction for Gas Emission of the Mine Coalface Based on Grey Theory ★ <i>ZHAO Jian-hui</i> ,	
	<i>SUN Rong-hong</i> .....	224
	Research on Gas Emission of Mining and Tunneling Faces Based on GIS ★ <i>LI Shi-lin</i> <sup>1,2</sup> ,	
	<i>FENG Tao</i> <sup>1</sup> , <i>WANG Peng-fei</i> <sup>1,2</sup> , <i>ZHU Zhuo-hui</i> <sup>1,2</sup> .....	228
	Research on Damage Dynamical Evolution Mechanism of Coal and Gas Outburst	
	★ <i>WU Yu-liang</i> <sup>1,2</sup> , <i>YANG Fu-he</i> <sup>2</sup> .....	234