IMPRESSIONS OF CHINESE COAL MINE GAS MONITORING TECHNOLOGY

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Summary

This paper details the current standard of coal mine gas monitoring currently undertaken by the small to medium coal mine sector in provincial China. The author was part of a four man team funded by Worksafe Australia to identify two coal mines which will be used as benchmarks to facilitate the introduction of Australian gas monitoring equipment and training expertise. Gas monitoring in China is still very basic and this limitation is a major contributing factor in the estimated 10,000 deaths from coal mine fires and explosions in China each year.

Australia gas monitoring expertise will be used to reduce the incidence of these events.

Introduction

China currently is the largest producer of coal in the world with production last year (1995) exceeding 1200 million tonnes and has identified coal resources of ten per cent of the global total. A minuscule amount of this coal is exported (20 million tonnes) with the bulk of the remainder consumed by power generation and industrial usage. China has in the order of 30,000 operating coal mines with in excess of 300 longwall mines currently working.

Under a Memorandum of Understanding between the Australian Government and the Chinese Ministry of Labour, the Chinese Coal Mining Safety Project was developed. The main thrust of this project is the provision of Australian technical assistance to improve the level and quality of mine gas monitoring conducted at small to medium coal mines in China.

To facilitate this outcome a team of Australian mining personnel was sent to China in May 1996 to select two sites to be used as benchmarks for this project. The team consisted of Mr Bill Flett - Senior Inspector of Mines NSW Department of Mineral Resources, Mr Ron Stothard - CFMEU District Check Inspector, Mr P Mason - Senior Technical Officer NSW Mines Rescue Service and the author.

The Australian delegation was in China for a period of 12 days and visited one large open cut coal mine and four small to medium underground coal mines all located near Shuozhou City in Shanxi Province. (Refer Appendix A - Map of Location in China).

Current Mining Techniques

The open cut coal mine visited was a large truck and shovel operation producing 15 million tonnes of coal per annum. The mine at Antaibou had been a joint Sino-American project but is now solely managed by the Chinese as a state mine. The mine employes over 3,000 people.

The four underground mines all produced coal in a similar manner up to a production rate of 800,000 tonnes per annum utilising a total workforce of 1,000 persons per mine. The coal is drilled, blasted and winch scraped on to floor conveyors. The floor conveyors transfer the coal to normal roadway conveyors then to a surge bin at the pit bottom. The coal is transported out of the mine by four tonne skips. The coal is hand picked, graded for size and transported by truck to its final destination.

All of the mines visited would be classified as gassy with methane production in excess of $10m^3$ per tonne per day. Mine ventilation was unreliable and poorly controlled. There was almost a total lack of basic personal safety equipment (excluding hard hats).

Gas Monitoring

Of the four underground coal mines visited, only one was equipped with a fixed mine gas monitoring system which was of the sensor type measuring methane at two points. The data was logged to a very basic mimic screen in the pit control room. No trending software was available with the system. The other three mines relied solely on methanometers and interferometers similar to equipment in use in Australia ten to fifteen years ago.

The calibration of the gas monitoring equipment and the training of mine officials in their use was not well developed. Equipment reliability was low and there seemed to be a basic lack of understanding of the mechanisms of coal mine fires and explosions. Mine fires and explosions are a fairly common occurrence in China and although accurate figures are difficult to verify indications are that at least 10,000 people are killed annually in coal mine fires and explosions. Indeed the delegation was told of several incidents where the rescue team trying to recover a mine after an initial explosion was killed by a second incubating explosion. Occurrences such as this can be substantially reduced by minimal levels of gas monitoring.

Another example of the lack of suitable monitoring procedures was evidenced during the delegation's visit underground at the Chaigou Coal Mine. Accompanied by Chinese officials equipped with methanometers two members of the team (including the author) tested the mine atmosphere at the edge of the goaf in a return roadway. Readings obtained were 18% oxygen, 20 parts pr million carbon monoxide and 8% methane. These readings were obtained using Minigas and Mentor units (Refer Appendix B). Levels of this nature are certain indicators of at least a spontaneous combustion (very high carbon monoxide make) and would be a major cause for concern in an Australian mine. Prior to the Australian visit the mine was unaware of the extent of the problem due to limited gas monitoring equipment.

Outcomes

The delegation made twelve recommendations to the Chinese Ministry of Labour:

1. Mines producing gas above 8-9 cubic metres of methane per tonne of coal should seriously consider some form of gas drainage.

2. a) Ventilation should be improved in relation to quantity and reliability required.
   b) Spontaneous combustion has to be considered in this regard as high pressure ventilation systems will cause problems across pillars and goaf areas unless the ventilation is carefully controlled.

3. Automatic power shut off should occur in all underground workings when the main ventilation systems fails.

4. a) Goaf areas should be sealed upon completion of extraction within the incubation period of the seam for spontaneous combustion.
   b) Where possible, balanced ventilation pressures should be maintained across goaf areas and old workings balanced ventilation pressures.
   c) Seals erected should be as airtight as possible and be strongly constructed.

5. Basic mine gas monitoring should be installed measuring methane, carbon monoxide and oxygen and should warn of spontaneous combustion problems or mine fires. Computer controlled systems with alarms at predetermined levels should be installed. As a minimum return roadways close to the working areas should be monitored. As well as the main return near the ventilation fan.

6. a) Small to medium mines should have at least three hand-held multi-gas detectors available at the mine, one for each shift and two spare for the gas inspectors or other officials. Larger mines would require more gas detectors. (One person should be responsible for safety in each area).

   b) Monitoring devices should be capable of measuring methane, carbon monoxide and oxygen. Where carbon dioxide or other gases may be a problem, appropriate detector tubes should be available.
   c) Means should be available for monitoring high roof areas with the hand-held monitors.

d) Technology is currently available to remotely monitor areas beyond the reach of hand held monitors and this type of monitoring should be considered.

7. Extensive specialised training should be carried out to ensure that all local mine inspectors and officials are competent in the use of safety equipment provided.

8. a) A suitable calibration system should be established at each mine for the purpose of carrying out a weekly test of the monitoring equipment.
   b) An independent testing authority should be set up to facilitate the calibration and testing of monitoring equipment at intervals of not greater than one month.
   c) At each mine a responsible person should be appointed to manage and audit the periodic testing and calibration of monitoring equipment.

9. a) The mine electrical supply should be made more reliable and equipped with redundancy provisions to stop interruption to the ventilation system.
   b) The underground power supply should be upgraded to incorporate safety devices such as overload protection, short circuit and earth leakage protection.

10. To prevent the propagation of a coal dust explosions, the treatment of all roadways with suitable inert limestone dust should be considered. The quantity applied should be sufficient to raise the incombustible content of the deposited dust to at least 75%.

11. Personal protection equipment should be made readily available to the workforce, especially dust masks in areas of high dust make. Provision of other personal protection equipment should also be considered.

12. Heating of mine intake air in winter should be addressed by professionally qualified ventilation engineers.

Of the twelve recommendations the Chinese nominated three as urgent matters to be dealt with under the current Memorandum of Understanding. They were as follows:

1. The purchase of suitable gas monitoring equipment.

2. The establishment of two gas monitoring/calibration centres. (One in Pinglu District and one in Huiren County in Shanxi Province).

3. The provision of education and training of mine officials in the use of modern gas monitoring equipment and calibration of this equipment.

Future Developments

The delegation has costed a proposal for an AIDAB aid project to equip two gas monitor calibration, servicing and training centres to look after a total of eight small to medium underground coal mines in Shanxi Province. Under the proposal Australia will supply 60 triple gas monitors and all associated calibration, maintenance and training equipment. Australian technical experts will train the Chinese coal mine officials at the two centres which will then be used as benchmarks for the rest of the Chinese coal industry.

The thrust of this exercise will be to increase the range and reliability of gas monitoring which will contribute to a diminution of the number of coal mine explosions. Mine gas monitoring is not the complete answer to the problem as indicated by the recommendations but it is a major factor in the level of current mine accidents relating to explosive gas.

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APPENDIX A - MAP OF LOCATION IN CHINA