Integrated gas management tools for improving gas control and reducing explosion risk in coal mines

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Reducing explosion risk – a combination of two tools

The tools are:

❑ The RA method which uses the “3T risk matrix” to evaluate effectiveness of controls, thus avoiding the complexity of probability.

❑ The impact of RA on the workplace is assessed using a safety performance monitoring system (Elmeri) which yields a comparative index.
The “3T” risk assessment matrix

<table>
<thead>
<tr>
<th>Current level of prevention and control</th>
<th>Potential severity of injuries &amp; diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Slight</td>
</tr>
<tr>
<td>Control is sufficient and no problems apparent</td>
<td>1: Risk is insignificant.</td>
</tr>
<tr>
<td>Some controls need improvement and problems are apparent</td>
<td>2: A small risk. Keep observing the situation and carry out the easy measures.</td>
</tr>
<tr>
<td>Considerable need for improvement and problems occur often</td>
<td>3: An average risk. Plan and carry out suitable measures.</td>
</tr>
</tbody>
</table>

Control is sufficient, when:
- a) machines, tools and structures comply with law and standards
- b) work is designed and organised to be safe and healthy
- c) employees are trained, and they actually use correct (safe) working practices
Example: 3T Risk Assessment check list - controlling gas emission hazards and mitigating explosion risk

<table>
<thead>
<tr>
<th>Item number</th>
<th>Hazard</th>
<th>Details of hazard</th>
<th>Control method</th>
<th>Remarks</th>
<th>3T risk score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total gas emissions</td>
<td>Gas is released into the mine airways from all coal seams disturbed by mining activity and from worked out areas</td>
<td>Dilution to permissible concentration by main ventilation. Monitored methane concentrations should not have exceeded maximum permissible limits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Gas not captured by methane drainage</td>
<td>Gas not captured by pre or post drainage is emitted into the mine airways during production</td>
<td>Gas drainage capture sufficient to allow planned production. Monitored methane concentrations should not have exceeded maximum permissible limits in the longwall return airway</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Explosive gas mixture in gas drainage pipes</td>
<td>Explosive mixtures arise when too much air is drawn into the methane drainage system</td>
<td>Design and regulate the gas capture and drainage system to ensure methane concentration &gt;30%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OSH performance monitoring – need and method

• Need to know if application of RA is leading to continuing improvement in safety
• Accident statistics are a poor indicator and often incomplete
• Near-miss data are better but not sufficient
• The “Elmeri” system developed in Finland provides a suitable tool
  ➢ Proved in industry in the EU
  ➢ Adapted for mining and tested in a EU-China project on occupational health and safety in high risk sectors (EUCOSH)
  ➢ Modified by UNECE for application to gas control and evaluated in a UNECE/GMI study in Shanxi
Standard observation is a valid indicator of the accident rate

Accident rate = lost time accident per million working hours


UNECE Documentation

1. Manual

2. Interactive training courses
   ❖ Risk Assessment - 6 modules
   ❖ Performance Monitoring – 7 modules
   ❖ Data analysis
Part 1: Risk Assessment Course content

• 1.1 Introductions
• 1.2 The RA and OSH tools and why they are needed
• 1.3 Basics of risk assessment
• 1.4 Best practice gas control and strategic risk assessment
• 1.5 Using the gas hazard work sheet
• 1.6 Risk assessment refresher
Part 2: OSH performance monitoring course content

- 2.1 Occupational Safety and Health indicators
- 2.2 Basics of the Elmeri observation system
- 2.3 Observation criteria for Elmeri
- 2.4 Observation sheet template for mines
- 2.5 Elmeri field exercise
- 2.6 Elmeri data analysis spreadsheet
- 2.7 Revision exercise
Trial application of the tools UNECE/GMI

3T Risk Assessment – Tenghui coal mine, Shanxi
1. Trainees worked in groups with a mine representative in each
2. Reasonably consistent results
3. Low concentration methane identified as high risk by most groups
4. 3T considered a useful tool and RA processes easily understood

Elmeri Performance Monitoring – Duerping CMM plant, Shanxi
1. First experience for trainees, inconsistent results and not well understood by all
2. Most correct - noise, air quality, ergonomics, safe access
3. Least correct - floor tidiness, electrical systems, gas control, first aid

Conclusion: Training in the understanding and application of both tools requires a minimum of 4 days, and later refreshers