CMM Drainage Methods and their Implication on Optimization of Safety, Economic Benefit from Coal Production and Beneficial Use of Methane, with Complimentary Reduction of Greenhouse Gas
Why do we drain methane?

<table>
<thead>
<tr>
<th>Coal Mined per Face/Annun</th>
<th>1,000,000 tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Market Price per Tonne</td>
<td>40 $</td>
</tr>
<tr>
<td>Low Turnover of Face</td>
<td>40,000,000 $/annum</td>
</tr>
<tr>
<td>High Market Price per Tonne</td>
<td>70 $</td>
</tr>
<tr>
<td>High Turnover of Face</td>
<td>70,000,000 $/annum</td>
</tr>
<tr>
<td>Drainage</td>
<td>30 m3/min</td>
</tr>
<tr>
<td>Power Generation Capacity</td>
<td>7,000 kW</td>
</tr>
<tr>
<td>Hours</td>
<td>6,570 Hrs/annum</td>
</tr>
<tr>
<td>Low Market Price of Electricity</td>
<td>0.05 $/kWhr</td>
</tr>
<tr>
<td>Low Revenue from Electricity</td>
<td>2,299,500 $</td>
</tr>
<tr>
<td>% of Low Market Face Turnover</td>
<td>6 %</td>
</tr>
<tr>
<td>% of High Market Face Turnover</td>
<td>3 %</td>
</tr>
<tr>
<td>High Market Price of Electricity</td>
<td>0.20 $/kWhr</td>
</tr>
<tr>
<td>High Revenue from Electricity</td>
<td>9,198,000 $</td>
</tr>
<tr>
<td>% of Low Market Face Turnover</td>
<td>23 %</td>
</tr>
<tr>
<td>% of High Market Face Turnover</td>
<td>13 %</td>
</tr>
</tbody>
</table>

Cost of safe drainage

Opportunity cost of not utilizing gas for heat or power

Cost of loss of production

($1 million dollars per week?)

Cost of loss of life

(human cost + reputational loss + cost for each life)
Gas explosions often cause dust explosions
Drainage Techniques – geology/depth dependent

- Mine Ventilation – Use of suction or pressure mine air fan
- Surface vertical or guided horizontal in seam pre-drainage
- Surface guided horizontal fracked in seam pre-drainage
- Underground in seam pre-drainage
- Surface gob well post-drainage
- Underground roadway post-drainage
- Underground cross measures post drainage
How do we optimize gas drainage?

1. Do what you do already, but do it better!
   - Improve physical installation of pipework (find leaks and fix them)
   - Improve sealing at points of connection
   - Measure suction and concentration at each point of drainage and reduce suction where drainage is effective*
   - Review mine management

2. Your engineers know their mine’s geology and their drainage technique better than anyone – widen their breadth of experience!
   - Take your internal expertise and allow them to travel and see how other mines using similar techniques control their gas
   - Take experience from other parts of the world, with incremental improvements to your existing arrangements

3. Systematic fundamental review of gas drainage
   - New Project
   - Internal Review team
   - Change Management
   - National Academia
   - Government Regulation
   - International Experience
   - Manufacturers/Drillers
   - How to Fund?

*including sealed waste areas
Control Suction on all Suction Points

• All connections should be tightly sealed, but in practice this is not always possible

• Where gas extraction points connect to the mine, if they are poorly sealed, they will draw air into the pipework system

• Typical 60m³/min extraction pump will cost $80,000 in electricity to run, at 25% CH₄, you will be spending $60,000 per year on air leaks

• Reducing suction on poorly connected holes increases suction/flow available to good holes
Sealed Areas as a Gas Reservoir Source

- Gas not being drained from a sealed area enters the mine roadways and makes the mine less safe.
- Gas being drained from a sealed area is kept out of the mine roadways, makes the mine safer, and raises the concentration of CH4, making transportation safer.
- Can be done either from underground or from the surface.
- Automatic control is straightforward – CH4 concentration can be used to control an air actuated control valve.
How do we make a better business case for CMM development?

• It is clear that turning CMM drainage from a cost centre to a revenue centre increases mine focus on drainage
• Increased attention to capture improves the safety of the mine
• Revenue generation enables investment in new safety/drainage infrastructure
• Need for more quantitative methods of coal mining business improvement analysis

QUALITATIVE
Reduction in Greenhouse gas Emissions
25% reduction in methane stoppages could be worth $2 million per year
Reduction of methane in mine reduces likelihood of catastrophe, reduces risk of high cost incident
Changing CMM from a safety cost into a revenue opportunity

QUANTIFIABLE
15% IRR from Utilization or Destruction

Reduction of methane in mine reduces likelihood of catastrophe, reduces risk of high cost incident
Gas Optimization Results – Linear Improvement in Gas Safety, Financial Performance and Reduction in Greenhouse Gases

Gas Capture UK Coal Mines

- Thoresby Colliery
- Welbeck Colliery
- Maltby Colliery
- Stillingfleet Mine
- Kellingley Colliery
- Harworth Colliery
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