ASSESSMENT OF SEALED OFF AREAS AT MOONIDIH MINE, INDIA

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Outline of Presentation

• Coal mining/CMM in India
• Objective and scope of the study
• Study site/Moonidih Mine
• Sampling plan
• Results
• Proposed CMM recovery scheme
• Barriers
• Summary
Coal Mining in India

- Coal accounts for ~55% commercial energy
- Total coal reserve 246 BT
- India: 3rd largest coal producer in world
- Annual coal production 538 MT (2010-11)
- 85% from surface operations and 15% from underground mining
- 384 underground mines
- Degree I, II and III mines in order of gasiness
- 19 degree III gassy mines (> 10 m³/t of coal)
CMM Scenario in India

- No apparent CMM recovery activity in India
- U/g production decreasing
- Low priority
- Future demand to be met from u/g mining due to social problems with surface operations
- CMM will be important for deep coal mines
- One reason why CMM extraction has not started is the lack of scientific data on CMM resource and feasibility of extraction
Objectives

- Create scientific data base for possible CMM extraction scheme at a prospective Indian mine
- Evaluate a prospective Indian mine for potential CMM recovery and utilization
- Moonidh Mine was selected for the study – it is one of the gassiest in India
- Study was conducted between June 2010 and June 2011
Study Site/Moonidih Mine

• Very old mine (started in 1965)
• Deep (>600 m)
• Degree III gassy mine
• Longwall operation with caving
• Extensive gob area (67 sealed off areas)

Other advantages:
• CBM drilling from virgin seams
• Production of electricity using gas engines
Location of Moonidih Mine

Jharkhand State

Moonidih Mine
Borehole log of Moonidih Mine

**A series panels**
- **4.49 m**
  - XVIII Seam
  - Depth: 300.13 m
  - Depth: 304.62 m

- **1.16 m**
  - XVII (T) Seam
  - Depth: 378.54 m
  - Depth: 379.70 m

- **1.02 m**
  - XVII (B) Seam
  - Depth: 387.48 m
  - Depth: 388.50 m

**D series panels**
- **2.54 m**
  - XVI (T) Seam
  - Depth: 417.12 m
  - Depth: 419.66 m

- **2.23 m**
  - XVI (B) Seam
  - Depth: 493.98 m
  - Depth: 496.21 m

- **3.02 m**
  - XV (T) Seam
  - Depth: 594.10 m
  - Depth: 597.12 m

- **3.47 m**
  - XV (B) Seam
  - Depth: 600.88 m
  - Depth: 674.32 m

- **10.36 m**
  - XIV Seam
  - Jhama+MP
  - Depth: 684.68 m

- **6.74 m**
  - XIII Seam
  - Jhama+MP
  - Depth: 687.35 m
  - Depth: 694.09 m

**Ground Surface**
- Borehole closes at 872.00 m
## Seam-wise Coal Reserve

<table>
<thead>
<tr>
<th>Name of the Seam</th>
<th>Geological Reserve (Mt)</th>
<th>Mineable Reserve (Mt)</th>
<th>Present Status of the Seam</th>
</tr>
</thead>
<tbody>
<tr>
<td>XVIII</td>
<td>13.40</td>
<td>7.9</td>
<td>Major part blocked within multiple faults. Sizeable area contains Jhama.</td>
</tr>
<tr>
<td>XVII (T)</td>
<td>12.60</td>
<td>5.3</td>
<td>Worked and exhausted</td>
</tr>
<tr>
<td>XVII (B)</td>
<td>18.90</td>
<td>4.85</td>
<td>Non-workable - thin seam</td>
</tr>
<tr>
<td>XVI (T)</td>
<td>21.30</td>
<td>9.06</td>
<td>Major part exhausted</td>
</tr>
<tr>
<td>XVI (C)</td>
<td>3.60</td>
<td></td>
<td>Jhama and stone intrusion</td>
</tr>
<tr>
<td>XVI (B)</td>
<td>22.10</td>
<td>7.72</td>
<td>Minor part workable; Dip side thinned; Nearly virgin; Development work started.</td>
</tr>
<tr>
<td>XV (T)</td>
<td>48.20</td>
<td></td>
<td>Totally virgin</td>
</tr>
<tr>
<td>XV (B)</td>
<td>58.70</td>
<td>11.80</td>
<td>Totally virgin</td>
</tr>
<tr>
<td>XV(C)</td>
<td>9.00</td>
<td></td>
<td>Totally virgin</td>
</tr>
</tbody>
</table>
## Sealed Areas Studied

<table>
<thead>
<tr>
<th>Name of Panel</th>
<th>Name of the Seam</th>
<th>Depth of Working (m)</th>
<th>Panel Dimensions (m×m)</th>
<th>Date of Abandonment of Panel</th>
<th>Height of Working (m)</th>
<th>Volume of Worked Out Area (x 1000 m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>XVIII</td>
<td>320-400</td>
<td>212 × 144</td>
<td>27.05.1996</td>
<td>2.4</td>
<td>73</td>
</tr>
<tr>
<td>A2</td>
<td>XVIII</td>
<td></td>
<td>344 × 92</td>
<td>03.06.1999</td>
<td>2.4</td>
<td>76</td>
</tr>
<tr>
<td>A3</td>
<td>XVIII</td>
<td></td>
<td>520 × 92</td>
<td>26.02.2001</td>
<td>2.4</td>
<td>115</td>
</tr>
<tr>
<td>A6</td>
<td>XVIII</td>
<td></td>
<td>144 × 100</td>
<td>-</td>
<td>2.4</td>
<td>35</td>
</tr>
<tr>
<td>A7</td>
<td>XVIII</td>
<td></td>
<td>204 × 60</td>
<td>06.11.1996</td>
<td>2.4</td>
<td>29</td>
</tr>
<tr>
<td>D8</td>
<td>XVI (Top)</td>
<td>430-530</td>
<td>680 × 140</td>
<td>10.07.1998</td>
<td>2.4</td>
<td>228</td>
</tr>
<tr>
<td>D9</td>
<td>XVI (Top)</td>
<td></td>
<td>640 × 132</td>
<td>30.10.2001</td>
<td>2.4</td>
<td>203</td>
</tr>
<tr>
<td>D10</td>
<td>XVI (Top)</td>
<td></td>
<td>660 × 104</td>
<td>20.02.2002</td>
<td>2.4</td>
<td>165</td>
</tr>
<tr>
<td>D11</td>
<td>XVI (Top)</td>
<td></td>
<td>680 × 140</td>
<td>31.05.2004</td>
<td>2.4</td>
<td>228</td>
</tr>
</tbody>
</table>

Panels selected based on size, methane concentration, accessibility.
Surface Plan
Spot samples were collected at 15-day intervals.
Methane Concentration
Max-/ Min- Methane Concentration

The graph illustrates the maximum and minimum methane concentrations in different sealed off areas. The x-axis represents the sealed off areas (A1, A2, A3, A6, A7, D8, D9, D10, D11), and the y-axis represents the CH₄ concentration (%).
## Classification of Sealed Areas

<table>
<thead>
<tr>
<th>Category</th>
<th>Methane Concentration</th>
<th>Sealed off Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>High methane concentration</td>
<td>&gt; 70 %</td>
<td>A1, A3, A7</td>
</tr>
<tr>
<td>Medium methane concentration</td>
<td>25 - 70%</td>
<td>A2, A6, D8,</td>
</tr>
<tr>
<td>Low methane concentration</td>
<td>5 - 25%</td>
<td>D11</td>
</tr>
<tr>
<td>Very low methane concentration</td>
<td>&lt; 5%</td>
<td>D9, D10</td>
</tr>
</tbody>
</table>
## Estimated Methane in Sealed Areas

<table>
<thead>
<tr>
<th>Panel Name</th>
<th>Sealed off Panel Volume (m³)</th>
<th>Methane Emission (Min) (m³)</th>
<th>Methane Emission (Max) (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>73,267</td>
<td>249,592</td>
<td>436,786</td>
</tr>
<tr>
<td>A2</td>
<td>75,955</td>
<td>258,749</td>
<td>452,811</td>
</tr>
<tr>
<td>A3</td>
<td>114,816</td>
<td>391,132</td>
<td>684,481</td>
</tr>
<tr>
<td>A6</td>
<td>34,560</td>
<td>117,732</td>
<td>206,031</td>
</tr>
<tr>
<td>A7</td>
<td>29,376</td>
<td>100,072</td>
<td>175,126</td>
</tr>
<tr>
<td>D8</td>
<td>228,480</td>
<td>1,795,996</td>
<td>3,142,993</td>
</tr>
<tr>
<td>D11</td>
<td>228,480</td>
<td>1,795,996</td>
<td>3,142,993</td>
</tr>
</tbody>
</table>
## CMM Recovery Potential of Sealed Areas

<table>
<thead>
<tr>
<th>Panel Name</th>
<th>Minimum Methane Volume (m³)</th>
<th>Minimum Methane Concentration (%)</th>
<th>CMM Recovery Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>249592</td>
<td>95</td>
<td>Good</td>
</tr>
<tr>
<td>A2</td>
<td>258749</td>
<td>66</td>
<td>Moderate</td>
</tr>
<tr>
<td>A3</td>
<td>391132</td>
<td>97</td>
<td>Good</td>
</tr>
<tr>
<td>A6</td>
<td>117732</td>
<td>49</td>
<td>Moderate</td>
</tr>
<tr>
<td>A7</td>
<td>100072</td>
<td>78</td>
<td>Good</td>
</tr>
<tr>
<td>D8</td>
<td>1795996</td>
<td>43</td>
<td>Moderate</td>
</tr>
<tr>
<td>D11</td>
<td>1795996</td>
<td>21</td>
<td>Low</td>
</tr>
</tbody>
</table>
Proposed CMM Recovery Scheme

- Seven panels are divided into two groups and CMM from two groups extracted alternatively until concentration reduces to 25%
- Group I: A1, A2, A7, and D11. Total CMM quantity: 2.4- 4.1 MMm³ with initial average concentration of ~ 50%
- Group II: A3, A6, and D8. Total CMM quantity: 2.3 - 4.0 MMm³ with an average concentration of ~62%
- Continuous and cyclic production of CMM from Group I and Group II panels
CMM Recovery and Barriers

- Most prospective utilization alternative is power generation by on-site combustion using IC engine

Barriers

- Priority (mining vs. methane extraction)
- Permission from DGMS: may not be easy, simple or quick
- Accessibility: some panels may be flooded and can not be accessed from underground
- Technical expertise lacking (in-seam drilling, deep drilling, well completion)
- Lack of pipeline infrastructure
Summary

• Study was carried out for 9 panels.
• 7 panels have good to moderate potential
• CMM recovery scheme was proposed with cyclic production from two groups of panels
• Barriers to CMM recovery were identified
• IC engine recommended as the most suitable option
THANK YOU!!!!

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