Prospects of Coalbed Methane and Coal Mine Methane in India

Ajay Kumar Singh

CIMFR (CSIR), DHANBAD-826 015

National Research Conference on Climate Change

IIT Delhi

5 March 2010
INTRODUCTION
• India, third largest producer of coal.

• Fourth in coal resources.

• In two geological

✓ Gondwana Coal of drift origin

✓ Tertiary coal
Fracture system, cleats in coal
Butt cleats and face cleats
Microscopic view of the Micropores structure of coal

Macropores (>500 Å),
Mesopores (20 to 500 Å)
Micropores (8 to 20 Å)
Transport of Gas

Desorption from Internal Coal Surfaces

Diffusion Through the Matrix and Micropores

Fluid Flow in the Natural Fracture Network

Increasing Size
WHY CONSIDER CBM?
What about surface mines???
<table>
<thead>
<tr>
<th>Year</th>
<th>CH$_4$ Emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>0.650</td>
</tr>
<tr>
<td>1996</td>
<td>0.688</td>
</tr>
<tr>
<td>1998</td>
<td>0.703</td>
</tr>
<tr>
<td>2000</td>
<td>0.716</td>
</tr>
<tr>
<td>2010</td>
<td>??</td>
</tr>
</tbody>
</table>
Trend of CH$_4$ Emission
# Global CMM Emission

<table>
<thead>
<tr>
<th>Country</th>
<th>2000 Methane Released (M m³)</th>
<th>2000 CO2 Equivalent (MMT)</th>
<th>2010 Methane Released (M m³)</th>
<th>2010 CO2 Equivalent (MMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>10,000</td>
<td>142.7</td>
<td>15,753</td>
<td>224.7</td>
</tr>
<tr>
<td>US</td>
<td>5,461</td>
<td>77.0</td>
<td>5,748</td>
<td>82.0</td>
</tr>
<tr>
<td>Russia</td>
<td>2,236</td>
<td>31.9</td>
<td>2,138</td>
<td>30.5</td>
</tr>
<tr>
<td>Australia</td>
<td>1,381</td>
<td>19.7</td>
<td>2,004</td>
<td>28.6</td>
</tr>
<tr>
<td>Ukraine</td>
<td>1,970</td>
<td>28.1</td>
<td>1,689</td>
<td>24.1</td>
</tr>
<tr>
<td>India</td>
<td>683</td>
<td>9.7</td>
<td>1,319</td>
<td>18.8</td>
</tr>
<tr>
<td>Poland</td>
<td>1,037</td>
<td>14.8</td>
<td>939</td>
<td>13.4</td>
</tr>
<tr>
<td>Germany</td>
<td>1,030</td>
<td>14.7</td>
<td>764</td>
<td>10.9</td>
</tr>
<tr>
<td>South Africa</td>
<td>496</td>
<td>7.1</td>
<td>506</td>
<td>7.2</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>488</td>
<td>7.0</td>
<td>447</td>
<td>6.4</td>
</tr>
<tr>
<td>UK</td>
<td>365</td>
<td>5.2</td>
<td>343</td>
<td>4.9</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>351</td>
<td>5.0</td>
<td>266</td>
<td>3.8</td>
</tr>
<tr>
<td>Turkey</td>
<td>123</td>
<td>1.8</td>
<td>184</td>
<td>2.6</td>
</tr>
<tr>
<td>Japan</td>
<td>133</td>
<td>1.9</td>
<td>147</td>
<td>2.1</td>
</tr>
<tr>
<td>Canada</td>
<td>98</td>
<td>1.4</td>
<td>91</td>
<td>1.3</td>
</tr>
</tbody>
</table>
SOLUTION???
Tremendous Potential for CMM Emission Reduction

• One CMM Project at one mine may:
  - Reduce emissions by 100,000 -1,000,000+ tons/ year CO2 equivalent

• Significant Global Potential:
  - Total Global: 475-500 million tons Emissions CO2 equivalent/year
  - Short term: 85-150 million tons/year Reductions
  - Long term: 150-300 million tons/year Reductions
Production of CBM, What really happens?
DIFFERENT CATEGORIES OF CBM

• VCBM
• CMM
• AMM
• VAM
Typical VCBM Well in Production
Coal Mine Methane
Types of gas drainage and capture techniques in coal mining
Underground Horizontal and Cross–Measure wells

- Horizontal wells drilled typically 200 to 400m
- Several hundred drilled and connected to a surface based vacuum pump
- Wells can be left on suction during and after mining though with significant damage due to goafing
Methane from Goaf

Figure 2. A gob well, used to extract CMM from post-mining collapsed coal seams.
Types of gas drainage and capture techniques in coal mining
Vertical Pre-Mining gob wells and Underground Horizontal wells

• Gob wells drilled from the surface to about 20m above the coal
• Fracture and gob formation increases permeability of the gas bearing strata
• Gas is brought to surface under vacuum (-40KPA)
• CH4 % varies during the life of a gob well
• Pre-mining gas drainage wells can have permeability increased via fracing or enhanced drilling technology such as Medium Radius Drilling
VAM Utilisation

Primary fuels:
- CMM (in-scan and gob gas)
- Natural gas (when necessary)

Ventilation air
0.7% CH,

Exhaust fan

Ventilation shaft

IC Engine-Generator
Opportunities in India
Coal occurs in two stratigraphic horizons

Permian sediments (c. 290Ma) mostly deposited in Intracratonic Gondwana basins.

Early Tertiary (c. 60Ma) near-shore peri-cratonic basins and shelves.
EMERGING POSSIBILITIES OF EXPLOITING CBM/CMM & ECBM requires

1. Characterisation of resource on chemical, petrographic and gas desorption parameters at exploration stage.
2. Reservoir Modelling/Production Testing.

for Optimal utilisation of resource both at short and long term perspective
POSSIBLE AREAS FOR DEEPER (>300M) LEVEL COAL RESOURCE

- South Eastern part of Jharia Coalfield
- Eastern part of Raniganj Coalfield
- Western part of Ib-River & Talcher Coalfield
- Westcentral part of Mand-Raigarh Coalfield
- Central part of main basin, Singrauli Coalfield
- Eastern part of Birbhum-Rajmahal Coalfield
- Eastern part of Pench-Kanhan Coalfield
- Central part of north Godavari Coalfield
JHARIA COALFIELD

Salient features

<table>
<thead>
<tr>
<th>FORMATION</th>
<th>THICKNESS</th>
<th>COAL SEAMS</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intrusives</td>
<td></td>
<td>No</td>
<td>Thickness</td>
</tr>
<tr>
<td>Raniganj</td>
<td>725m</td>
<td>22</td>
<td>(0.1m-4.7m)</td>
</tr>
<tr>
<td>Barren Measures</td>
<td>850m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barakar</td>
<td>1130m</td>
<td>46</td>
<td>(0.3m-33.0m)</td>
</tr>
<tr>
<td>Talchir</td>
<td>225m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basement</td>
<td>--</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COAL RESOURCE

0-600m -- 14.2 bt
600m-1200m -- 5.2 bt
0 – 1200m – 19.4 bt
EAST BOKARO COALFIELD

Salient features

<table>
<thead>
<tr>
<th>FORMATION</th>
<th>THICKNESS</th>
<th>COAL SEAMS</th>
<th>No</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mahadeva</td>
<td>500m</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panchet</td>
<td>600m</td>
<td>7</td>
<td>(0.4m-3.0m)</td>
<td></td>
</tr>
<tr>
<td>Raniganj</td>
<td>600m</td>
<td></td>
<td></td>
<td>(0.4m-63.9m)</td>
</tr>
<tr>
<td>Barren Measures</td>
<td>500m</td>
<td>26</td>
<td>(0.4m-63.9m)</td>
<td></td>
</tr>
<tr>
<td>Barakar</td>
<td>1000m</td>
<td></td>
<td></td>
<td>(0.4m-63.9m)</td>
</tr>
<tr>
<td>Talchir</td>
<td>80m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COAL RESOURCE

- 0-300m -- 3.2 bt
- 300m-600m -- 1.5 bt
- 600m-1200m -- 2.3 bt
- 0 – 1200m -- 7.0 bt
NORTH KARANPURA COALFIELD

Salient features

<table>
<thead>
<tr>
<th>FORMATION</th>
<th>THICKNESS</th>
<th>COAL SEAMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mahadeva</td>
<td>165m</td>
<td>No</td>
</tr>
<tr>
<td>Panchet</td>
<td>225m</td>
<td>Thickness</td>
</tr>
<tr>
<td>Raniganj</td>
<td>400m</td>
<td>5 (0.5m-35.2m)</td>
</tr>
<tr>
<td>Barren Measures</td>
<td>385m</td>
<td></td>
</tr>
<tr>
<td>Barakar</td>
<td>500m</td>
<td>1 (0.5m-10.5m)</td>
</tr>
<tr>
<td>Karharbari</td>
<td>200m</td>
<td></td>
</tr>
<tr>
<td>Talchir</td>
<td>180m</td>
<td></td>
</tr>
<tr>
<td>Basement</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

COAL RESOURCE

- 0-300m -- 10.3 bt
- 300m-600m -- 4.3 bt
- 0 – 1200m – 14.6 bt
SOUTH KARANPURA COALFIELD

**Thicknes**
- Raniganj: 360m
- Barren Measures: 385m
- Barakar: 1050m
- Talchir: 180m
- Basement: --

**Coal Seams**
- Raniganj: 7 (0.8m-3.3m)
- Barren Measures: --
- Barakar: 42 (0.5m-54.2m)
- Talchir: --

**Coal Resource**
- 0-300m: -- 3.3 bt
- 300m-600m: -- 1.8 bt
- 600m-1200m: -- 0.9 bt
- 0 – 1200m: -- 6.0 bt

**Salient Features**
- Deeper level
<table>
<thead>
<tr>
<th>Category</th>
<th>Gondwana Coals</th>
<th>Jharia, Bokaro, Raniganj and North Karanpura Coalfields.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>ranking high volatile bituminous A and above.</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>ranking high volatile bituminous A and below.</td>
<td>South Karanpura, Raniganj, Pench-Kanhan and Sohagpur Coalfields.</td>
</tr>
<tr>
<td>III</td>
<td>Low rank Gondwana Coals.</td>
<td>Talchir, Ib, Pranhita-Godavari Valley and Wardha Valley Coal field.</td>
</tr>
<tr>
<td>IV</td>
<td>Tertiary Coals / Lignite resources.</td>
<td>Cambay, Bikaneer-Nagaaur, Barmer, Assam-Arakan, Cauvery and Himalayan Foot Hills Basins.</td>
</tr>
</tbody>
</table>
Chronology of CBM Development in India
• CBM policy formulated in 1997
• First offer of CBM blocks announced in May 2001.
• One block awarded on nomination basis.
• Contract signed for 5 blocks awarded under Round – I in 2002. Two more blocks awarded under nomination basis.
• Contract signed for 8 blocks awarded under Round- II in 2004.
• Contract signed for 10 blocks offered under Round – III in 2006.
PRESENT STATUS OF CBM BLOCKS

• Blocks awarded till date – 26
• Area awarded – 13,600 sq. km.
• Total CB Resources – 1374 BCM.
• Expected Production Potential – 38 MMSCMD.
• Present Gas production from 3 blocks:
  RG (S), SP (E), SP (W) – 0.18 MMSCMD.
• Expected CBM production from 3 blocks by 2013 – 7.4 MMSCMD.
THANK YOU

ajayabha@yahoo.com
For Our Beautiful Planet