Application of Remote Sensing Satellite Data in Coal Exploration & Mining

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Remote Sensing in CMPDI/Coal India

• Remote Sensing Cell was set up in CMPDI way back in 1989
• Remote Sensing started in Coal Industry with IRS 1A data
• Today we have grown to a well equipped Geomatics Division comprising about 40 scientists of multidisciplinary group
  • Geologists
  • Mining Engineer
  • Civil Engineer
  • Environmental Engineers
  • Surveyors
  • Computer Engineers
  • Excavation Engineers
• All the scientists are imparted basic training in NRSC
• Specialized training are imparted in IIRS, GSI, Survey of India and USA under Indo-US programme.
• Equipped with ERDAS, Geomatica, Arc-info, LPS
• Using following satellite data ranging from visible to microwave
  • LISS-III
  • LISS IV
  • Carto I & II
  • IKONOS
  • WorldView-2
  • ASTER
  • Landsat 8
  • RISAT
Today Geospatial technology has made in road in all the stages of mining viz. Pre-mining, syn-mining and Post-mining.

CMPDI is using almost all the satellite data ranging from visible to Microwave spectrum in different application in mining.

CMPDI has also been bestowed Geospatial World Excellence Award -2012 and Best Enterprise using Geospatial Technology-2013 in recognition of its excellent work carried out in the field of Geospatial Technology.
✔ **Topographical Survey**

Updated Topographical survey of all the major coalfields on 1:5000 scale with 2 m contour interval has been taken up in collaboration with Survey of India based on Remote Sensing data. Topo sheets will be prepared on GIS platform and will be used for detail coal exploration, mine planning and infrastructure development.
✓ **Coal Exploration**

High resolution satellite data are used for regional geological mapping as well as for locating the potential coal bearing area for detail exploration.
✓ Hydrogeomorphic mapping

Coalfiel wise hydrogeomorphic mapping for locating the potential ground ground zone are carried out based on geospatial technology for water supply
Land use/Vegetation Cover Monitoring in Coalfield

Geo-environmental data base for all the coalfields are created using geospatial technology and monitored at regular interval of three years to assess the impact of coal mining on land use/vegetation cover in the coalfield.

Year 2000
VEGETATION COVER MAP OF SINGRAULI COALFIELD BASED RESOURCES
ESAR/LIII DATA OF THE YEAR 2008

Vegetation Cover
- 1991: 168.38
- 1998: 163.39
- 2000: 175.33
- 2005: 177.64
- 2008: 178.94
- 2011: 168.70

Plantation
- 1991: 17.78
- 1998: 32.08
- 2000: 57.25
- 2005: 69.3
- 2008: 70.85
- 2011: 72.74

Mining Area
- 1991: 38.42
- 1998: 38.57
- 2000: 31.42
- 2005: 36.6
- 2008: 39.95
- 2011: 48.94
Land Reclamation Monitoring of OC Projects

- Land reclamation monitoring of all the 168 opencast are taken up by CMPDI at regular basis using high resolution satellite data and GIS from Year 2009.
- Mines which are producing more than 5 million cubic m. (coal +OB) are monitored on annual basis and less than 5mcm mines at interval of three years.
- Such monitoring helps in assessing the progressive status of mined land reclamation and mine closure and also to take up remedial measures, if any, required for environmental protection.
- Land reclamation monitoring of 50 mines (>5mcm capacity) carried out during year 2013 indicates that about 50% excavated area are biologically reclaimed by plantation carried out on backfilled and OB dump. 30% excavated area is under backfilling and balance 20% area is under active mining. After completion of backfilling, area will be planted.
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Land Reclamation Monitoring in Piparwar & Ashoka OC, CCL
## Land Reclamation Status in 50 OC projects  Year-2012

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Coal Company (No. of OC Projects)</th>
<th>Leasehold</th>
<th>Area in Sq. Kms. (% calculated in respect of total excavated area)</th>
<th>Plantation</th>
<th>Under Backfilling</th>
<th>Area under Active Mining</th>
<th>Total Excavated Area</th>
<th>Total Reclaimed Area</th>
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<tbody>
<tr>
<td>(i)</td>
<td></td>
<td>(ii)</td>
<td>(iii)</td>
<td>(iv)</td>
<td></td>
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<tr>
<td>1</td>
<td>WCL (10)</td>
<td>77.94</td>
<td>26.82 27.44 22.10 23.43 8.19 7.95 57.11 58.82</td>
<td>46.96 46.65 38.70 39.83 14.34 13.52</td>
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<td></td>
<td>48.92 50.87</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>SECL (10)</td>
<td>159.48</td>
<td>42.90 42.66 21.10 22.21 17.08 18.74 81.08 83.61</td>
<td>52.91 51.02 26.03 26.55 21.07 22.41</td>
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<td></td>
<td>64.00 64.87</td>
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<tr>
<td>3</td>
<td>NCL (10)</td>
<td>179.40</td>
<td>59.94 61.70 29.89 28.52 15.90 17.61 105.73 107.83</td>
<td>56.69 57.22 28.27 26.45 15.04 16.33</td>
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<td></td>
<td>89.83 90.22</td>
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<tr>
<td>4</td>
<td>MCL (11)</td>
<td>86.36</td>
<td>14.37 14.41 11.56 12.63 14.55 14.58 40.48 41.62</td>
<td>35.50 34.62 28.56 30.35 35.94 35.03</td>
<td></td>
<td></td>
<td>25.93 27.04</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>CCL (05)</td>
<td>47.14</td>
<td>15.95 16.33 4.56 4.30 4.60 4.70 25.11 25.33</td>
<td>63.53 64.47 18.17 16.98 18.31 18.55</td>
<td></td>
<td></td>
<td>20.51 20.63</td>
<td></td>
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<tr>
<td>6</td>
<td>BCCL (02)</td>
<td>14.06</td>
<td>1.32 1.34 4.20 4.63 1.33 1.24 6.85 7.21</td>
<td>19.27 18.59 61.31 64.22 19.42 17.20</td>
<td></td>
<td></td>
<td>5.52 5.97</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>ECL (02)</td>
<td>39.44</td>
<td>3.82 3.83 4.40 4.77 3.37 3.59 11.59 12.19</td>
<td>32.96 31.42 37.96 39.13 29.08 29.45</td>
<td></td>
<td></td>
<td>8.22 8.60</td>
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</tr>
<tr>
<td>TOTAL CIL (50)</td>
<td>603.82</td>
<td>165.12 167.71 97.81 100.49 65.02 68.41 327.95 336.61</td>
<td>50.35 49.82 29.82 29.85 19.83 20.32</td>
<td>54.31 55.75 80.17 79.68</td>
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Company wise Land Reclamation Status in the Year 2012
COMPARISION OF LAND RECLAMATION STATUS BETWEEN THE YEARS 2010 TO 2012 IN DIFFRENT SUBSIDIARIES OF COAL INDIA LIMITED

Year wise comparision of Land Reclamation in CIL Subsidiaries
 ✓ **Erosion and Siltation Assessment**

- Assessment of siltation in Govind Ballabh Pant reservoir near Singrauli Coalfield are carried out by CMPDI using satellite data.
- Study indicates that contribution of coal mining area in siltation in GBP sagar is 0.73% only. Balance contribution (99.27%) is from catchment area (12865 Sq.KM.) due to natural erosion.
- 15.50% capacity of GBPS reservoir has been reduced due to siltation in last 50 years.
Satellite Data Year 2005
Catchment Erosion Area
<table>
<thead>
<tr>
<th>Agency</th>
<th>Year</th>
<th>Period since commissioning</th>
<th>GBPS capacity mcm</th>
<th>Total Loss in GBPS Capacity mcm</th>
<th>Average Loss per year mcm</th>
<th>Total thickness of sediments in metre</th>
<th>Average Thickness per year in cm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Design</td>
<td>1962</td>
<td>0</td>
<td>10608.32</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Dorris Survey</td>
<td>1990</td>
<td>28</td>
<td>9865.00</td>
<td>743.32</td>
<td>26.55</td>
<td>2.49</td>
<td>8.91</td>
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<tr>
<td>IRI Roorkee</td>
<td>1995</td>
<td>33</td>
<td>9324.81</td>
<td>1283.51 (12.10%)</td>
<td>38.89</td>
<td>4.31</td>
<td>13.05</td>
</tr>
<tr>
<td>CMPDI</td>
<td>2005</td>
<td>43</td>
<td>9033.00</td>
<td>1575.32 (14.85%)</td>
<td>36.64</td>
<td>5.29</td>
<td>12.29</td>
</tr>
<tr>
<td>CMPDI</td>
<td>2011</td>
<td>49</td>
<td>8963.00</td>
<td>1645.32 (15.51%)</td>
<td>33.58</td>
<td>5.52</td>
<td>11.27</td>
</tr>
</tbody>
</table>
Overburden Measurement using LiDAR/Satellite data

CMPDI is using Terrestrial LiDAR for rapid and accurate measurement of OB in large capacity OC mines on regular basis.
• CMPDI has initiated the Satellite based Thermal Infrared (TIR) survey for mapping the extent of fire

• *Mine Fire Information System (MFIS)* has also been developed to monitor the latest status of coal mine fire in Jharia, Raniganj, Karanpura and Bokaro coalfields and direction of fire front movement to formulate the remedial measures.

• Mine fire monitoring being carried out by CMPDI regularly on annual basis in the above coalfields based on Thermal Satellite Data (ASTER/Landsat-8).

• Result of the study carried out based on 2013 satellite data reveals that area of fire has been reduced from **9.73 sq. km (2009) to 6.17 sq.km. (2013)** in Jharia coalfield due to number of mitigative fire control measures taken by BCCL.
Status of Coal Mine Fire in Jharia CF based on ASTER Satellite Data of Year 2012
CMPDI has identified potential TPS sites using Geospatial technology for Central Electricity Authority, Govt. of India.

More than 120 TPS & UMMPs sites are located including pitheads, load centers and coastal areas. Most of the UMMPs are coming on the sites selected by CMPDI.
Georeferencing of Mining lease over Carto-II +LIV Data

- IBM has issued guidelines for overlaying mining leases on satellite data (CartoII+LIV) for monitoring of illegal mining.
Geospatial technology in R&R

• After notification, resident of the area start new construction for compensation

• To identify the construction after notification, high resolution satellite data of two cut off Dates (during notification and compensation) analysed for identifying the illegal construction

• Satellite data are also used for locating the rehabilitation site around the mining projects.
Constraints for high resolution satellite data

- Limited availability of Carto-II
- Carto-II data billing should be as per AOI
- DG data delivery to be expedited.
- All LISS-III data allowed for free downloading like Landsat 8
- Sensor should be developed for air and water quality monitoring
Future satellite data requirement in mining sector

✔ High resolution stereo satellite data for excavation measurement

✔ Air and Water quality monitoring sensor

✔ High resolution thermal sensor
R&D In Coal Mining Sector

✓ Proposal are invited for Geospatial technology applications in coal mining sector under R&D

✓ Funding will be done by Coal India
Thanks!