Hydrogeology of Indian Coalfields

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Hydrogeology of Indian Coalfields

- Coal occurrences in India are mainly confined to present day river Valleys
- Damodar Valley,
- Son Mahanadi Valley,
- Pench- Kanhan Valley,
- Wardha Godavari Valley.
- Bulk of coal reserves are confined to the south-eastern quadrant of the country in west Bengal, Bihar, Jharkhand Orissa, Chhatisgarh and eastern Madhya Pradesh
Hydrogeology of Indian Coalfields

PLATE - I

1. Raniganj coalfields
2. Rajmahal Group of coalfields
3. Jharia Coalfield
4. East & West Bokaro Coalfields
5. North & South Karanpura Coalfields
6. Singhrauli Coalfields
7. Talcher Coalfields
8. Ib Valley Coalfields
10. Sihagpur Coalfields
11. Sonhali Bhanrampur Coalfields
12. Waniha Valley Coalfield
13. kumpeti Coalfields
14. pench-Karanam-Tawa Valley
15. Pathibara Coalfields
16. Makum Coalfield

PLATE - I

COALFIELDS IN INDIA

Delhi
Mumbai
Chennai
CIL: COAL PRODUCING SUBSIDIARIES

1. EASTERN COALFIELDS LTD.
2. BHARAT COKING COAL LTD.
3. CENTRAL COALFIELDS LTD.
4. NORTHERN COALFIELDS LTD.
5. WESTERN COALFIELDS LTD.
6. SOUTH EASTERN COALFIELDS LTD.
7. MAHANADI COALFIELDS LTD.
8. NORTH EASTERN COALFIELDS. (A UNIT UNDER CIL(HQ))
9. SINGARENI COLLIERIES CO. LTD
10. NEYVELI LIGNITE CORPORATION

PLATE - II
Hydrogeology of Indian Coalfields

• **Ground Water Regime**
  - Based on geology, occurrence of Ground water may be divided into different provinces
  - Extra Peninsula,
  - Peninsula and
  - Indo-gangetic plain

• **Aquifer system**
  - the major Aquifer system of India based on different geological formation
ARABIAN SEA

Aquifer in hilly areas
Crystalline rocks
Limestone extensive
Alluvium, & Sandstone, extensive
Alluvium, extensive
discont, INDIAN OCEAN
basalt

Yield Potential (lps)
>40
10-40
5-25
1-40
1-25
<1

LEGEND

HYDROGEOLOGY OF INDIAN COALFIELDS

PLATE - III
Hydrogeology of Indian Coalfields

Legend:
- Alluvium extensive: >40
- Alluvium & Sandstone, discont.: 10-40
- Limestone extensive: 5-25
- Crystalline rocks: 1-40
- Basalt: 1-25
- Aquifer in hilly areas: <1

Key:
1. Raniganj coalfields
2. Rajmahal Group of coalfields
3. Jharia Coalfield
4. East & West Bokaro Coalfields
5. North & South Karanpura Coalfields
6. Singrauli Coalfields
7. Talcher Coalfields
8. Ib Valley Coalfields
9. Kolsa-Mandi/Baghmara Coalfields
10. Singhpor Coalfields
11. Sonnil-Bhimarpur Coalfields
12. Varuna Valley Coalfield
13. Jharkhand Coalfields
14. pench-Karanj-Tara Valley
15. Godavari Coalfields
16. Makum Coalfields

PLATE - IV
Hydrogeology of Indian Coalfields

- Occurrence of Ground water

1. Hard rock/consolidated formations
   - a) Volcanic rocks
   - b) Carbonate rocks
   - c) Non-carbonate non-volcanic crystalline rocks or Hard rock

2. Porous rock formations.
   - a) Unconsolidated formation and
   - b) Semi-consolidated formation.
## Hydrogeological units in Indian Coalfields

### 1. Consolidated formations

<table>
<thead>
<tr>
<th>Geological Age</th>
<th>Formation</th>
<th>States/hydrogeological character</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jurassic/Upper cretaceous to Ecocene</td>
<td>Rajmahal Traps, Deccan Traps</td>
<td>WB, Bihar, Jharkhand, Maharashtra. Well yield up to 5lps. K = 0.1-15m/d</td>
</tr>
<tr>
<td>Pre-cambrian</td>
<td>Vindhyan</td>
<td>UP, Bihar, Jharkhand, Chhattisgarh. K = 0.02-10m/d</td>
</tr>
</tbody>
</table>
### Hydrogeological units in Indian Coalfields

#### 2. Semi-consolidated formations

<table>
<thead>
<tr>
<th>Geological Age</th>
<th>Formation</th>
<th>States/hydrogeological character</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Carboniferous to Jurassic</td>
<td>Gondwana</td>
<td>Sst, Shale, coal seams</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UP, Bihar, Jharkhand, Chhattisgarh, Maharastra, Orissa, Gujarat, Rajasthan &amp; TN. K = 0.5-50 m/d, well yield up to 14 lps</td>
</tr>
</tbody>
</table>
# Hydrogeological units in Indian Coalfields

## 3. Un-consolidated formations

<table>
<thead>
<tr>
<th>Geological Age</th>
<th>Formation</th>
<th>States/hydrogeological character</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent</td>
<td>Alluvial Plains</td>
<td>Clay, silt, gravel, sand, peat, coal &amp; organic matter. K=10-100, well yield=5 to 67 lps. Indo-Gangetic, Brahmaputras &amp; Godavari Alluvial Plains</td>
</tr>
</tbody>
</table>
Confined and Unconfined aquifers

- Non flowing well
- Water table well
- Flowing well

Unconfined or water table aquifer
Confining bed
Piezometric surface
Water table
Hydrogeology of Indian Coalfields

A Case Study

- **Underground Coal Gasification Project Merta Road Rajasthan**

- Analysis of the hydrogeological data of the experimental site, the following conclusions were drawn -

- The hydrogeological conditions of the experimental site has changed considerably due to extensive water pumping resulting in drawdown in aquifer 'A' (saturated thickness 4 m).

- No need of dewatering operation in Aquifer 'A'

- Aquifer 'B' below Lignite seam is multilayered thick system

- Advanced dewatering required for Aquifer 'B',
The hydraulic conductivity and storativity of Aquifer ‘B’ is 0.0008m/day & 0.002 respectively.

Environmental protection measures needed against water contamination.
LITHOLOGICAL CROSS SECTION OF MERTA ROAD AREA RAJASTHAN

INDEX
- Soil
- Clay
- Sandstone
- Lignite

FIG - 1
Ground water Modelling

- "Modelling and control of water systems in coal Mining Environment" done for Wardha Valley Coalfield.
- Hydraulic demarcation between Kamthis & Barakars intermingled
- Depletion of groundwater effect is confined to 500-1000m down dip
- In UG mine depletion is insignificant.
Hydrogeology of Indian Coalfields
CONCLUSIONS

- Coal India is the pioneer organization to establish ground water regime of Indian Coalfields.

- Indian Coalfields are normally bounded by crystalline rocks. The hydraulic conductivity of crystalline rocks varies from 0.1 to 1.5 m/day and yield ranges from 42 to 250 m$^3$/day.

- The aquifer in Indian Coal bearing formation is mostly constitutes Gondwana sandstone. The hydraulic conductivity ranges from 0.5 to 50m/day and yield ranges from 84 to 1176m$^3$/day.
CONCLUSIONS

- The Indian coal mostly acts as an aquitard having hydraulic conductivity ranging from 0.005 to 0.03 m/day.

- In underground mining, the estimation of mine water inflow under caving condition in Wardha valley, Sohagpur and Ib Valley Coalfields had been done in selected mines. The mine water inflow ranges from 550m3/day to 5000m3/day.
CONCLUSIONS

- In open pit mining the advance dewatering operation in selected mines of Indian Coalfields viz. Rajmahal (ECL), Wardha Valley (WCL) Singrauli (NCL) have been done. The advance pumping from the respective mines ranges from 5000 to 60000 m³/day.

- The problem related to environmental impact likely to be caused by ground water pumping during active mining is being addressed.
CONCLUSIONS

- To identify the problem of depletion of ground water due to mining, hydrographic monitoring stations have been established in Indian Coalfields and monitoring of water levels, four times in a year viz January, May, August, and November is being done as per guidelines of the Ministry of Environment and Forest (MoEF) Govt. of India.

- Problem of ground water depletion, once identified, measures are undertaken to augment water level by implementing artificial recharge systems such as rainwater harvesting, creation of water lagoons in mined-out regions, and recharge through abandoned tube wells.
CONCLUSIONS

- All efforts are being made to restore original water table by land reclamation and sand stowing after the closure of open pit and underground mine respectively to accelerate recharge of ground water system of the area.
Hydrogeology of Indian Coalfields

Thank You