2016-17

वार्षिक प्रतिवेदन

ANNUAL REPORT

सीएसआईआर–केंद्रीय खनन एवं ईंधन अनुसंधान संस्थान

(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)

CSIR-Central Institute of Mining & Fuel Research

(Council of Scientific and Industrial Research)

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Published by: Dr. M.S. Alam, Sr. Principal Scientist & HOS, Science Communication & Publicity Department on behalf of CSIR-Central Institute of Mining & Fuel Research, Barwa Road, Dhanbad - 826015 (Jharkhand)

Printed at: Florence Offset Process Pvt. Ltd., Kolkata

वार्षिक प्रतिवेदन - Annual Report

2016 - 17

CSIR-CIMFR

सीएसआईआर–केंद्रीय खनन एवं ईंधन अनुसंधान संस्थान
CSIR-Central Institute of Mining & Fuel Research

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FROM DIRECTOR'S DESK

I feel privileged to share with you all our achievements for the year 2016-17. CSIR - CIMFR has made remarkable progress in gaining the confidence of the mining as well as fuel and allied industries by providing valuable R&D inputs. It was another eventful year.

During this period, CSIR - CIMFR dealt with 296 externally funded projects. Out of these, 142 were Sponsored Projects, 133 were Consultancy Projects, 19 were Service to Industry Projects and 2 Grant-in-Aid Projects. The external cash flow of the institute was Rs. 156.27 crore, out of which Government fund was Rs. 2.95 crore, Public Sector funded projects were worth Rs. 140.33 crore and fund from Private Sector was Rs. 12.99 crore. Reasonably good number of patents were filed and a few know-how were released by CSIR - CIMFR.

Like previous year, R&D dialogue, executive development programme, supervision of Ph. D. Theses and Masters Dissertations were continued with full dedication and devotion by my colleagues. Besides these, the institute has further improved and added new test facilities and analytical services of international standard for the benefit of the industries. Scientists of the institute were not only serving the nation but also have undertaken a number of international projects.

I am pleased to inform you that CSIR-CIMFR has organised an International Conference on NexGen Technologies for Mining and Fuel Industries (NxGnMiFu) at Vigyan Bhawan, New Delhi, India, during February 15-17, 2017. It was participated by about 900 delegates from India and abroad.

I sincerely acknowledge the support we have got from different ministries, organizations and industries. Finally, I would like to assure all our stakeholders that CSIR-CIMFR is poised to move with greater and faster strides in tune with the increased activities in mining and fuel sectors and growth of the nation.

PK Singh

(Dr. Pradeep K Singh)
Director, CSIR-CIMFR
Dhanbad

Dated : 21-02-2018

अनुसंधान परिषद की सूची / List of Research Council

अध्यक्ष / Chairman

प्रो. हर्ष कुमार गुप्ताः सदस्य, राष्ट्रीय आपदा प्रबंधन प्राधिकार, एनडीएमए भवन, ए-1 सफदरजंग एनक्लेव,नई दिल्ली-110029 / Prof. Harsh K. Gupta: Member, National Disaster Management Authority, NDMA Bhawan, A-I Safdarjung Enclave, New Delhi - 110029

बाहरी सदस्यगण / External Members

प्रो. आशीष भट्टाचार्जीः खनन विभाग, भारतीय प्रौद्योगिकी संस्थान, खड़गपुर-721302 Prof. Ashis Bhattacharjee: Department of Mining, Indian Institute of Technology, Kharagpur- 721302

श्री गोपाल सिंहः सी एम डी, बी सी सी एल, कोयला भवन, कोयला नगर, धनबाद-700001 / Shri Gopal Singh, CMD, BCCL Koyla Bhawan, Koyla Nagar, Dhanbad

प्रो. श्रीनिवास जयंतीः रसायन अभियांत्रिकी विभाग, भारतीय प्रौद्योगिकी संस्थान, मद्रास, चेन्नई-600036/ Prof. Sreenivas Jayanti: Department of Chemical Engineering, Indian Institute of Technology, Madras, Chennai - 600036

श्री अनिल कुमार झाः निदेशक (टी), एनटीपीसी लि0, एनटीपीसी भवन, कोर 7, स्कोप काम्प्लेक्स, 7 सांस्थानिक क्षेत्र, लोधी रोड, नई दिल्ली-110003 / Shri Anil K Jha: Director (T), NTPC Ltd., NTPC Bhawan, Core 7, Scope Complex, 7, Institutional Area, Lodi Road, New Delhi - 110003

श्री राहुल गुहाः महानिदेशक, खान सुरक्षा महानिदेशालय, धनबाद-826001 / Shri Rahul Guha: D.G., Directorate General of Mines Safety, Dhanbad - 826001

एजेंसी प्रतिनिधि / Agency Representative

श्री डी एन प्रसादः सलाहकार, प्रोजेक्ट्स, कोयला मंत्रालय, शास्त्री भवन, नयी दिल्ली-110 001 Shri D.N. Prasad : Advisor, Projects, Ministry of Coal, Shastri Bhawan, New Delhi - 110001

महानिदेशक द्वारा नामित **/ DG's Nominee**

डॉ. प्रदीप कुमार चटर्जीः मुख्य वैज्ञानिक व प्रधान, थर्मल अभियांत्रिकी प्रभाग, सीएसआईआर-सीएमईआरआई, दुर्गापुर-713209 / Dr. Pradip Kumar Chatterjee: Chief Scientist & Head, Thermal Engineering Division, CSIR-Central Mechanical Engineering Research Institute, Durgapur – 713209

सहोदर प्रयोगशाला **/ Sister Laboratory**

प्रो. एस के भट्टाचार्याः निदेशक, सीएसआईआर-केंद्रीय भवन अनुसंधान संस्थान, रूड़की-247667 / Prof. S.K. Bhattacharyya: Director, CSIR-Central Building Research Institute, Roorkee- 247667

क्लस्टर निदेशक **/ Cluster Director**

डॉ. एम ओ गर्गः निदेशक, सीएसआईआर-आईआईपी, पो0 आईआईपी, मोखमपुर, देहरादून -248005 / Dr. M.O. Garg: Director, CSIR- Indian Institute of Petroleum, PO-IIP, Mokhampur, Dehradun-248 005

स्थायी आमंत्रित सदस्य (प्रधान अथवा उनके नामित, योजना तथा निष्पादन प्रभाग, सीएसआईआर, नई दिल्ली) **/ Permanent Invitee (Head or his Nominee, Planning & Performance Division, CSIR, New Delhi)**

डॉ. सुदीप कुमारः प्रधान, योजना तथा निष्पादन प्रभाग, सीएसआईआर, अनुसंधान भवन, 2 रफी मार्ग, नई दिल्ली-110 001 / Dr. Sudeep Kumar: Head, Planning & Performance Division, Council of Scientific and Industrial Research, Anusandhan Bhawan, 2-Rafi Marg, New Delhi-110 001

निदेशक **/ Director**

डॉ. प्रदीप कुमार सिंह निदेषक, सीएसआईआर.केन्द्रीय खनन एवं ईंधन अनुसंधान संस्थान, धनबाद-826015 / Dr. Pradeep K Singh, Director, CSIR-Central Institute of Mining & Fuel Research, Dhanbad – 826 015

सदस्य सचिव **/ Member Secretary**

श्री डी कुम्भकारः प्रधान वैज्ञानिक, सीएसआईआर–केंद्रीय खनन एवं ईंधन अनुसंधान संस्थान, धनबाद-826015 / Mr. D. Kumbhakar: Principal Scientist, CSIR-Central Institute of Mining & Fuel Research, Dhanbad – 826 015

II. प्रबंधन परिषद की सूची / List of Management Council

1. Dr. Pradeep K Singh, Director, CSIR-CIMFR, Dhanbad (Chairman)
2. Director, CSIR-NML, Jamshedpur, Jharkhand (Member)
3. Director, NGRI, Hyderabad (Special invite ex- officio Member)
4. Dr. R.V. K Singh, Chief Sct. & Head, BDIL, CSIR-CIMFR, Dhanbad (Member)
5. Dr. C. N. Ghosh, Chief Sct., CSIR-CIMFR, Dhanbad (Member)
6. Dr. Sanjay Kr. Roy, Sr. Prin. Sct., CSIR-CIMFR, Dhanbad (Member)
7. Dr. M. P. Roy, Prin. Sct., CSIR-CIMFR, Dhanbad (Member)
8. Ms Mousami Mallick, Scientist, CSIR-CIMFR (Member)
9. Sri Suman Kiran, Principal Tech. Officer, CSIR-CIMFR (Member)
10. CoFA/FAO, CSIR-CIMFR, Dhanbad (Member)
11. CoA/AO, CSIR-CIMFR, Dhanbad (Member Secretary)

III. STRENGTH OF STAFF OF CSIR-CIMFR (AS ON 31.03.2017)

Group/Grade	SC	ST	OBC	PWD	General	Grand Total
Director	-	-	-		01	01
Group IV	19	10	23	01	96	149
Group III	14	06	21	00	45	86
Group II	10	05	00	00	40	55
Group I	17	09	01	00	73	100
Administrative	23	10	12	00	85	130
Total	**83**	**40**	**57**	**01**	**340**	**521**

IV. EXPENDITURE FOR THE YEAR 2016-17

Head	Amount (₹ in lakhs)
Capital	7949.323
Revenue	6843.275
Staff Quarters	100.000
Total	14892.598

A. MINING AND OTHER ALLIED SECTORS

1. Business Development & Industrial Liaison

1.1. BDIL

The following events were organized:

1. **Dr. Girish Sahni,** Director-General, CSIR & Secretary DSIR visited CSIR-Central Institute of Mining and Fuel Research, Dhanbad during 7th to 9th April 2016.

2. **Mr. Anil Swarup,** Secretary, Ministry of Coal, Govt. of India visited CSIR-Central Institute of Mining and Fuel Research, Dhanbad on 9th April 2016 and addressed to the Scientists & Staff members of CSIR-CIMFR.

3. **Dr. Harsh Vardhan,** Hon'ble Minister, Science & Technology and Earth Sciences, Govt. of India and Dr. Girish Sahni, Director-General, CSIR visited CSIR-Central Institute of Mining and Fuel Research, Dhanbad during 15th & 16th May 2016.

4. Brainstorming Session was organized in CSIR-CIMFR (Barwa Road) Campus on 08/06/2016 to discuss regarding R&D Activities to be taken up by the Institute for the benefit of Society and Nation.

5. **Dr. R. A. Mashelkar,** former Director General, CSIR, New Delhi visited CSIR-Central Institute of Mining and Fuel Research, Dhanbad on 20th June 2016 and delivered lecture on New directions of R&D Areas to the employees of CSIR-CIMFR.

6. **Prof. E. S. Dwarakadasa,** FNAE, Chairman, Karnataka Hybrid Micro Devices Ltd., Bangaluru visited CSIR-Central Institute of Mining and Fuel Research, Dhanbad as Chief Guest on CSIR Foundation Day which was celebrated on 14th October 2016. On this occasion, felicitation of retirees and presentation of mementoes to the staff who completed 25 years of service besides honouring wards of staff for various events organized.

7. Seminar for the Masses organized by Vijnana Bharati at CSIR-Central Institute of Mining and Fuel Research, Barwa Road, Dhanbad on 10/11/2016 & Digwadih Campus on 11/11/2016 under 2nd India International Science Festival (IISF-2016). Sri Sarju Rai, Minister, Govt. of Jharkhand, Ranchi was the Chief Guest in the function.

8. **Prof. Runa Sarkar,** Prof. of Economics, IIM, Kolkata delivered lecture on "Sustainability, Coal and CIMFR's Role" in National Science Day 2017 on 28/02/2017 at CSIR-Central Institute of Mining and Fuel Research, Dhanbad.

1.2. HRD

Following are the HRD Activities :

1. During the said period following Executive Training Programmes were conducted by HRD, CSIR-CIMFR, Dhanbad for knowledge dissemination

Sl. No.	Name of Course	Duration	Participating Organisation
1.	Executive Development Programme on “FLP Equipment	28 March-1 April, 2016	ONGC Executives from Mehsana, Gujerat, Ahmedabad, Assam, Mumbai, Sivasagar
2.	Executive Development Progamme on Coal Combustion	25-29 April, 2016	Executives from DVC, Andal, DVC Bokaro, CESC Ltd., W.B., DVC,Chandrapura, Sasan Power, Singrauli, WBPDCL, HPGCL Panipat & Hisar, NTPC, Netra, Jata Power, Jamshedpur, CMPDIL, Ranchi, GSECL Baroda, NTPC Sail, Durgapur
3.	Executive Development Programme on Coal Preparation	20-24 June, 2016	Executives from SCCL
4.	Executive Development Programme on Coal Preparation and Coke Making	2-6 October, 2016	Executives from EDRC Kolkata (West Bengal),, MMH HQ Kolkata, SAIL Guhati, RSP--HSM Rourkela,Bhilasi Steel Plant BF8
5.	Executive Development Progamme on Coal Sampling & Coal Analysis	18-20 November, 2016	Executives from WBPCB, CPCB Bhopal, Kolkata,& Delhi, MPCB Nagpur, Mumbai
6.	Executive Development Program on Environmental Management for Power Plants, Use and Disposal of Fly ash – New Avenues, Opportunities, Constraints and Challenges	5-7 January, 2017	Executives from Karnatka SPC Board, PPCB, CPCB, Lucknow, SPC Board, Odisha, MPC Board, PCB Meghalya State, HSPC, WBPCB Kolkata, Durgapur, HPSPCB Bilaspur
7.	Coal Combustion and Environmental Impact	10-11 January, 2017	Executives from Durgapur Steel Thermal Power, Andal
8.	Executive Development Programme on Best practices in Coalbed Methane Exploration and Production	9-13 January, 2017	Executives from NIT, Rourkela, IIT Madras, CMPDIL, Sikkim University, IIT Guwahati, Tirpura University, GSI, IIT Kanpur, Dibrugarh University, ONGC, IIT ISM, IIT BHU, CDNU
9.	Executive Development Programme on “FLP Equipment	27-31 March 2017	Executives from ONGC, Mehsana

2. **Vocational/Project Training** for the PG & UG Engineering and Science students were arranged according to their academic session. 47 PG Science/Engineering and 92 UG Science/Engineering of different streams like Computer Science, EEE, Mechanical Engineering, Applied Geology, etc. were benefited from the Vocational/Project Training during the said period. Students from different Colleges/Universities namely IIT (ISM),

Dhanbad, BIT Sindri, BHU, IIT, NIT, BITS Pilani, Central University, Patna University, etc., come to get their project training/internship as per their academic requirement.

3. Facilitation Provided for CSIR-CIMFR personnel to attend in organised Seminar, Symposium, Workshop: 320 S&T personnel of the institute attended in various National & International Conferences/ Seminars/ Workshops at national & international platform as a part of knowledge sharing & knowledge management.

4. Indo-Australian Joint Workshop on "Recent Developments on Highwall Mining in India" (27th July, 2016) was organised by Dr. P.Pal Roy, Outstanding Scientist at CSIR-CIMFR. – 58 persons participated in the Workshop.

5. Workshop on Emerging Mining Technologies and Low-Carbon Footprints with Waste Management was organised by Dr. S.K. Chaulya, Scientist during 13-14 February, 2017 at Vigyan Bhawan, New Delhi.

6. Two Day Workshop on Challenges and Opportunities of Underground Coal Gasification in India was organised by, Dr. Ajay K Singh, Scientist of this institute.

7. Visit of students from different Colleges/Universities like IIT(ISM), Dhanbad, Central University of Jharkhand and BSIP, Lucknow visited different labs of CSIR-CIMFR, Dhanbad to get acquainted with the knowhow and enhance their knowledge in engineering science - 12

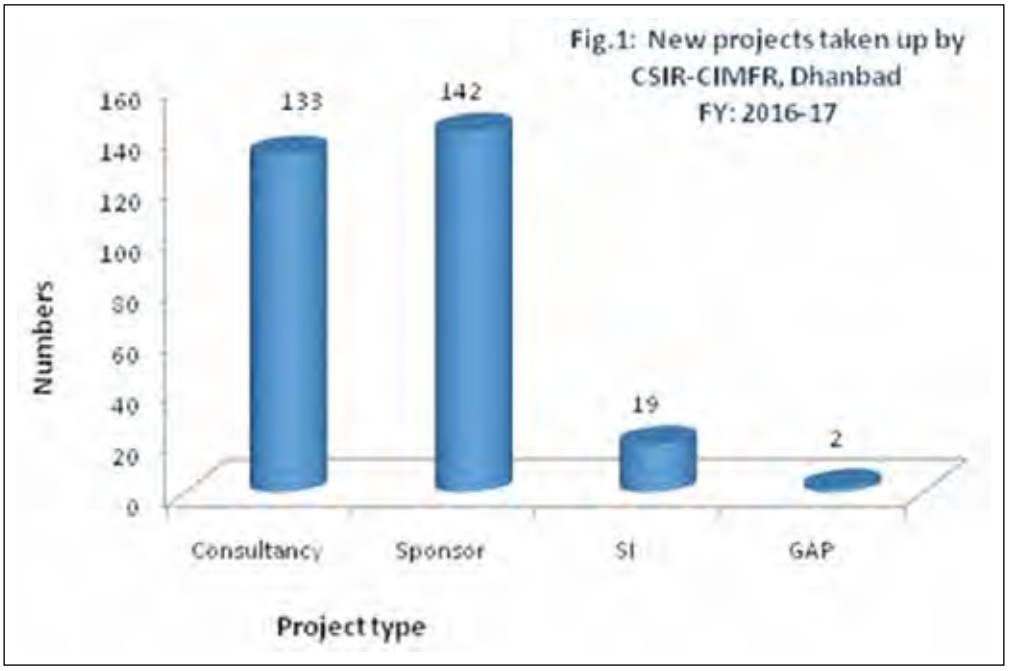
8. Lectures organised on Technical Topics from CSIR-CIMFR Personal and delegates from industries - 38

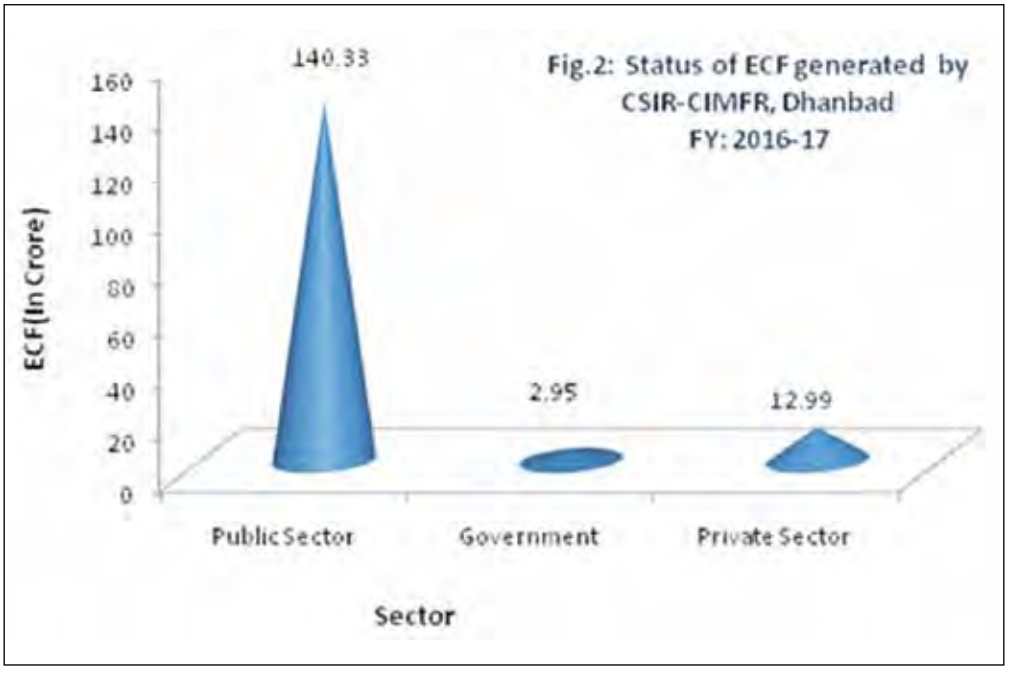
1.3 Project Monitoring & Evaluation Cell (PME)

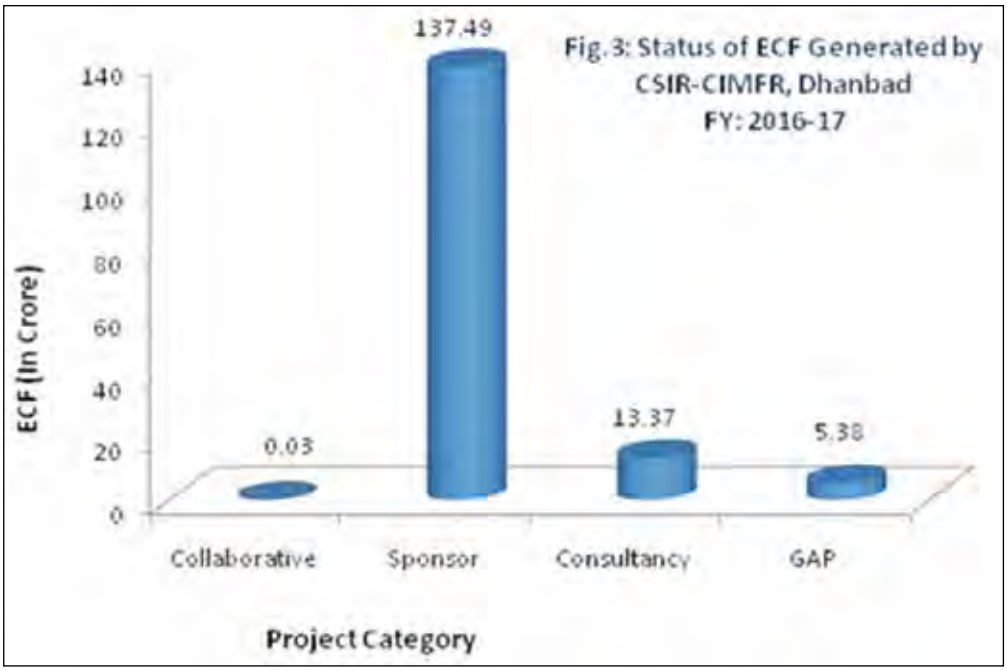
PME Cell of the institute, by virtue of its scope and jurisdiction, has a very onerous task and handling various projects covering the mining and its allied industries. The main activities of PME Cell during the period:

- Comprehensive development and maintenance of project related data base of all the information concerning projects in such way that any information about a particular project is available readily:
- Preparation of quarterly and annual performance reports of all the ongoing projects;
- Periodical review of performance of all the ongoing R&D projects;
- Preparation of Annual Budget in consultation with the scientists.
- To help in the preparation of MC documents by way of providing necessary inputs such as number of consultancy projects taken up; intellectual fee distribution details of completed sponsored/consultancy projects for etc.
- To help in the preparation of RC documents by way of providing necessary inputs such as number of consultancy / sponsor / collaborative / GAP / Inhouse projects are ongoing, completed and taken-up; ECF generation; whether projects are running as per schedule in the given time frame or lagging behind; and status of budget of the projects.
- Reply to Audit para raised by CAG Audit team if any in respect of different projects, equipment etc.
- Reply to Audit para raised by Service Tax Audit team if any in respect of different projects, equipment etc.

As regards the details of projects handled during year 2016-17, it is informed that total 296 externally funded projects were undertaken and executed. Out of which, 142 were Sponsored projects, 133 were Consultancy projects, 19 were Service to Industry Projects and 2 Grant-in-Aid projects which are depicted in Fig.-1. CSIR-CIMFR, Dhanbad received external cash flow of Rs. 156.27 crore, of which is Government fund is Rs. 2.95 crore, public sector Rs. 140.33 crore and private sector Rs. 12.99 crore as depicted in Fig.-2. Project category wise external cash flow of the institute is shown in the Fig.-3.







1.4. Knowledge Resource Centre (Barwa Road)

CIMFR KRC is actively engaged in acquisition of technical processing and updating the collection and providing the platform for E-access of information sources to expand the horizon of information base to the scientific community.

KRC is playing a coordinating role between users and the literature, providing personal information service through current Awareness (CAS) and Selective Dissemination of Information (SDI) using modern information technology. Besides the day to day circulation, reference and reprographic service, KRC is also rendering the following service.

Documentation, List of latest addition, Bibliographic service, OPAC search, CD-ROM search, In-house database, Internet Facility & Access to E-journals. Wi-Fi system facility is also available.

EM Security system at KRC was done successfully.

As per the instructions of the official language implementation KRC has been developing a variety of collection in Hindi language.

User awareness training program has been arranged on E Resource to maximize its utilization.

Institutional repository (IR) has been established using open source software with an aim to provide online access to CSIR-CIMFR research articles.

KOHA library management software has been successfully installed and union catalogue of CSIR (KNOWGATE) was implemented.

CIMFR KRC also provides press clippings of CIMFR activities and abstracting service of CIMFR publications.

Collection Strength

Books, Reports, Standards, Specifications and Bound Volumes	32798
CD Collection	896
Current Journals subscription	62
Translation of Foreign Language Articles	495
Photocopies of Technical Articles	34

1.5. Science Communication & Publication Department (SCPD)

Annual Report: Reports related to the activities like R&D work, supporting services, etc, for the year 2015 - 16 were collected from all the departments of the institute, edited, compiled and published in the form of CSIR - CIMFR Annual Report.

R&D Roadmap and Highlights: A booklet on R&D Roadmap and Highlights covering important research activities and significant achievements of the institute including R&D Roadmap was published during the year.

Technical Notes and Write-ups: Write-ups and technical notes on various R&D work and other useful activities of the institute were prepared and issued to different organizations and individuals when asked for.

CSIR Annual Report: An abridged report on important R&D work and other technical services of CSIR - CIMFR for the year 2016-17 was prepared and sent for inclusion in CSIR Annual Report.

Display Advertisement: A number of display advertisements were prepared and released to various newspapers, souvenirs and journals of mining and fuel sciences with a view to giving wide publicity of R&D work, design & developments and different test facilities available at the institute and thereby creating and keeping up good image of the institute.

Distribution of Publications: Different reports brought out during the year by the laboratory were distributed to various mining and other technical institutions, educational organizations and different R&D laboratories in India and abroad on exchange and complimentary basis.

Technical Enquiry: During the year 2016-17, a large number of scientific and technical enquiries sent by various organizations in India and abroad were attended.

Mailing List: The mailing list covering addresses of different organizations as well as distinguished persons connected with activities on mining, fuel and allied subjects in India and abroad was updated regularly for distribution of CSIR-CIMFR publications and selection of expert panels as well as referees.

CSIR-CIMFR Project and Work Record Book : CSIR-CIMFR Project and Work Record Book for the year 2017 was published and distributed amongst all the scientists, officers and other staff members of the institute.

CSIR-CIMFR Pocket Address Book: CSIR-CIMFR Pocket Address Book for the year 2017 was published and distributed amongst all the scientists, officers and other staff members of the institute.

Exhibition: During the reporting year the institute was participated a few exhibitions outside

Dhanbad. In these exhibitions, Science Communication and Publicity Department (SCPD) of this institute hired stalls and exhibited different design and developments of the CSIR-CIMFR and highlighted its other activities and achievements through photographs and posters. Queries of several of visitors to the stall were attended to their full satisfaction.

1.6. Standards Technology Management & ISTAG

(A) ON ISO 9001:2008 Certification Program:

(i) External Auditing Successfully Completed by DNV, Kolkata on December 06, 2016.

(ii) One round of Internal Auditing Completed at CIMFR during the period.

(iii) Management Review Meeting Conducted at Director level on March 08, 2017.

(B). Twelve scientists sent on deputation abroad for attending Seminar, Symposia, Conference, Business Development, Bilateral Exchange Program & Fellowship.

(C) Premium and Royalty received during 2016-17 is: 2,59,275=00

(D). New Agreements / MoU signed:

Sl. No.	Title of the Agreement	Party Name and Address	Date
1.	Agreement for Calibration of Instantel Inc, Canada Seismographs	M/s. Ultra Enviro-Systems Pvt. Ltd., HS-6, Kailash Colony, New Delhi – 110 048	06.04.2016
2.	MoU Bet' CSIR-CIMFR, Dhanbad and HZL, Udaipur	Hindustan Zinc Limited, Udaipur, Rajasthan	11.04.2016
3.	Deep Seated Potash Mine in Northwest Rajasthan, India	M/s. Indic Geo Resources Pvt. Ltd., Chandralok-A, Napeansea Road, Mumbai -400 006	06.05.2016
4.	Underground Mine of Non-Radioactive Rare Earth Elements (REE Minerals) in District Barmer, Rajasthan	M/s. Chandan Steel Ltd., 504, Sukh Sagar, N.S. Patkar Marg, Mumbai-400 007	06.05.2016
5.	Quality Evaluation of coal cores explored from different regions of India	Central Mine Planning & Design Institute Limited, Ranchi	07.06.2016
6.	Tripartite MoU for Third party sampling for coal quality monitoring at loading end of CIL subsidiaries and SCCL for dispatch to power utilities	Coal India Limited, Kolkata; National Thermal Power Corporation, New Delhi and CSIR-CIMFR, Dhanbad	28.06.2016
7.	Tripartite MoU for Third party sampling for coal quality monitoring at loading end of CIL subsidiaries and SCCL for dispatch to power utilities	Coal India Limited, Kolkata; Association of Power Producers, New Delhi and CSIR-CIMFR, Dhanbad	28.06.2016

8.	Bipartite MoU for Third party sampling for coal quality monitoring at loading end of CIL subsidiaries and SCCL for dispatch to power utilities	National Thermal Power Corporation, New Delhi and CSIR-CIMFR, Dhanbad	28.06.2016
9.	Bipartite MoU for Third party sampling for coal quality monitoring at loading end of CIL subsidiaries and SCCL for dispatch to power utilities	Association of Power Producers, New Delhi and CSIR-CIMFR, Dhanbad	28.06.2016
10.	Agreement for Integrated Strata, Gas and Environment Monitoring System	M. P. Enterprises, P.O: Mohalbani, Bhowra, Dhanbad - 828302	12.07.2016
11.	Agreement for Local Methane Detector	-DO-	12.07.2016
12.	MoU for Development of a Selection Methodology for Road Header and Tunnel Boring Machine in different geological conditions for rapid tunneling	Tripartite MoU between Central Power Research Institute, Bangalore; Central Mining & Fuel Research Institute, Dhanbad and Indian School of Mines, Dhanbad	19.07.2016
13.	MoU for Scientific Studies and Implementation of Control, Monitoring and Surveillance Systems at Mines, Pellet plant & OCSL Plants of NMDC Ltd.	NMDC Limited, Khanij Bhavan, Castle Hills, Masab tank, Hyderabad	17.09.2016
14.	MoU for joint academic and Scientific Studies	Technische Universitat Bergakademie Freiberg, Germany	07.10.2016
15.	Agreement for Third party sampling for coal quality monitoring at loading/ unloading end of CIL subsidiaries and SCCL for dispatch to different power utilities of Central Govt., State Govt. and Private power producing companies	CSIR-CIMFR, Dhanbad; Different Subsidiaries of Coal India Limited and different Power producing companies	More than 150 agreement signed on different date(s).
16.	Memorandum of Agreement bet' CSIR-CIMFR, Dhanbad and NRDC, New Delhi for marketing of CIMFR technologies	National Research Development Corporation, 20-22, Zamroodpur Community Centre, Kailash Colony Extension, New Delhi	19.12.2016

1.7. Testing Cell

Testing Cell of CSIR-CIMFR, Barwa Road Campus, Dhanbad is a single focal cell which provides ready assistances to the Mining and Allied Industries and the manufacturers of different equipment/ component/materials in getting the required items tested, evaluated, calibrated and certified. The cell also co-ordinates and monitors the testing, analysis and calibration related activities

of eleven testing laboratories of CIMFR, Barwa Road Campus, Dhanbad and the concerned customers, and releases the relevant test certificates for both indigenous and foreign make equipment/components.

The various activities of the cell and the concerned testing laboratories of CIMFR, Barwa Road Campus, Dhanbad are covered under ISO 9001:2008 for satisfying customers need in getting systematic and quality oriented services in respect to the testing and certification of equipment.

Total 637 numbers (Six hundred and thirty seven) of testing and evaluation reports of various samples including equipment/components were issued by the cell during the year 2016-2017 and an amount of revenue of Rs. 1,88,51,980.00 (Rupees One crore eighty eight lakh fifty one thousand nine hundred eighty) only were generated through the same. This amount includes the foreign currency of US $ 64,725 (Sixty four thousand seven hundred twenty five U.S. Dollar).

2. Electrical Design

During April, 2016 to March, 2017, Electrical Design Section has undertaken various assignments on in-situ study and advice on the condition of steel aerial ropes (track and haulage), winder ropes (cage and skip) besides the national level societal mission project on “Third Party Inspection and Monitoring of Projects under RGGVY in the state of Nagaland”, sponsored by Deptt. of Power, Govt. of Nagaland, Kohima, Nagaland.

The clients of this Section included: (1) M/s Timber Trail, Asia Resorts Limited, Parwanoo, HP, (2) M/s Damodar Ropeways & Infra Limited, Kolkata, (3) M/s Narwapahar Mines, (4) Uranium Corporation of India Limited (UCIL), Singhbhum (East), Jharkhand, (5) M/s The Singareni Collieries Company Limited, Kothagudem Collieries – 507101, Dist. Khammam, Telengana, (6) M/s Conveyor & Ropeways Services Pvt. Ltd., Kolkata, (7) M/s Kumaon Mandal Vikas Nigam Ltd., Nainital, Uttarakhand etc.

In situ studies were carried out in the following ropeways/winder installations:

1. One haulage rope of Digha Ropeway was studied using nondestructive method and condition of the rope was evaluated.
2. In Science city mono-cable passenger ropeway, Kolkata, present condition of the haulage rope was evaluated and recommended for further continuance in the installation.
3. One haulage rope and two track ropes of Gangtok Ropeway were studied and further continuation of the ropes were recommended.
4. Three cage ropes each in Main and IIIrd stage winder installations and four skip ropes each in Main and IIIrd stage winder installations in Jaduguda Mines of UCIL, Jharkhand were investigated for monitoring their suitability in the installation.
5. Two number of track ropes and two number of haulage ropes of Passenger Cable car Aerial Ropeway installation of M/s Kumaon Mandal Vikas Nigam Ltd., Nainital, Uttarakhand were scanned and extension of rope use was advised.
6. Four number of track ropes and two number of haulage ropes of Passenger Cable car Aerial Ropeway installation of M/s Timber Trail, Asia Resorts Limited, Parwanoo (H.P.), were scanned in situ and extension of rope use was recommended.

7. Wire ropes in 11 man riding chair car systems and 34 man riding chair lift systems of SCCL were subjected to nondestructive investigation for monitoring their suitability in the installation.

8. One haulage rope of Shri Naina Deviji Ropeway, HP was studied using nondestructive method and condition of the rope was evaluated.

9. One haulage rope of D.R.V. Passenger Ropeway at Darjeeling, West Bengal was studied using nondestructive method and recommendation for further continuance in the respective installation was made.

10. Two cage and two skip winding ropes in Narwapahar Mines of UCIL, Jharkhand were studied using nondestructive method and recommendation for further continuance in the respective installation was made.

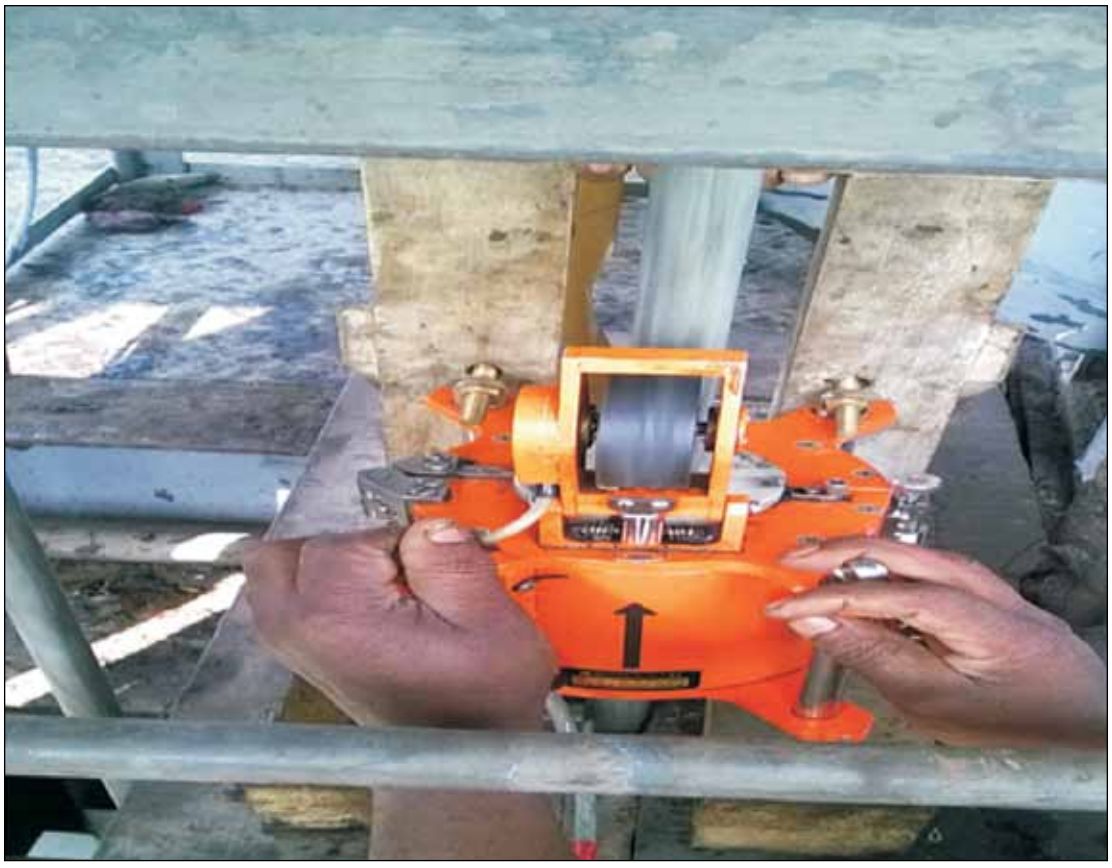
Besides above:

1. “Third Party Inspection and Monitoring of Projects under RGGVY in the state of Nagaland”, sponsored by Deptt. of Power, Govt. of Nagaland, Kohima, Nagaland was also undertaken. The cost of this project was Rs. 6.07 Crores and CSIR-CIMFR has completed the project as Third Party Inspection Agency (TPIA) under RGGVY. Dr. D. Basak and his team have carried out quality and quantity audit of rural electrification work in 9 (nine) districts (in 10 packages) in Nagaland. A total population of 16,76,294 (according to 2011 census) have been benefitted in Nagaland.

2. Calibration work of equipment like Digimatic Caliper, Universal Calibrator, Temperature Bath, Programmable DC Power supply, Ammeter, Voltmeter etc. of CIMFR HQ was carried out during 2016-17.

Photographs showing Layout of New-Longshen
33/11 KV Sub-Station Located in Block-Phomching, District-Mon, Nagaland

Nagaland project on RGGVY



Narwapahar Mines, UCIL, Jharkhand

Digha Ropeway, West Bengal

D.R.V. Ropeway, Darjeeling, West Bengal

SCCL Mines, Telengana

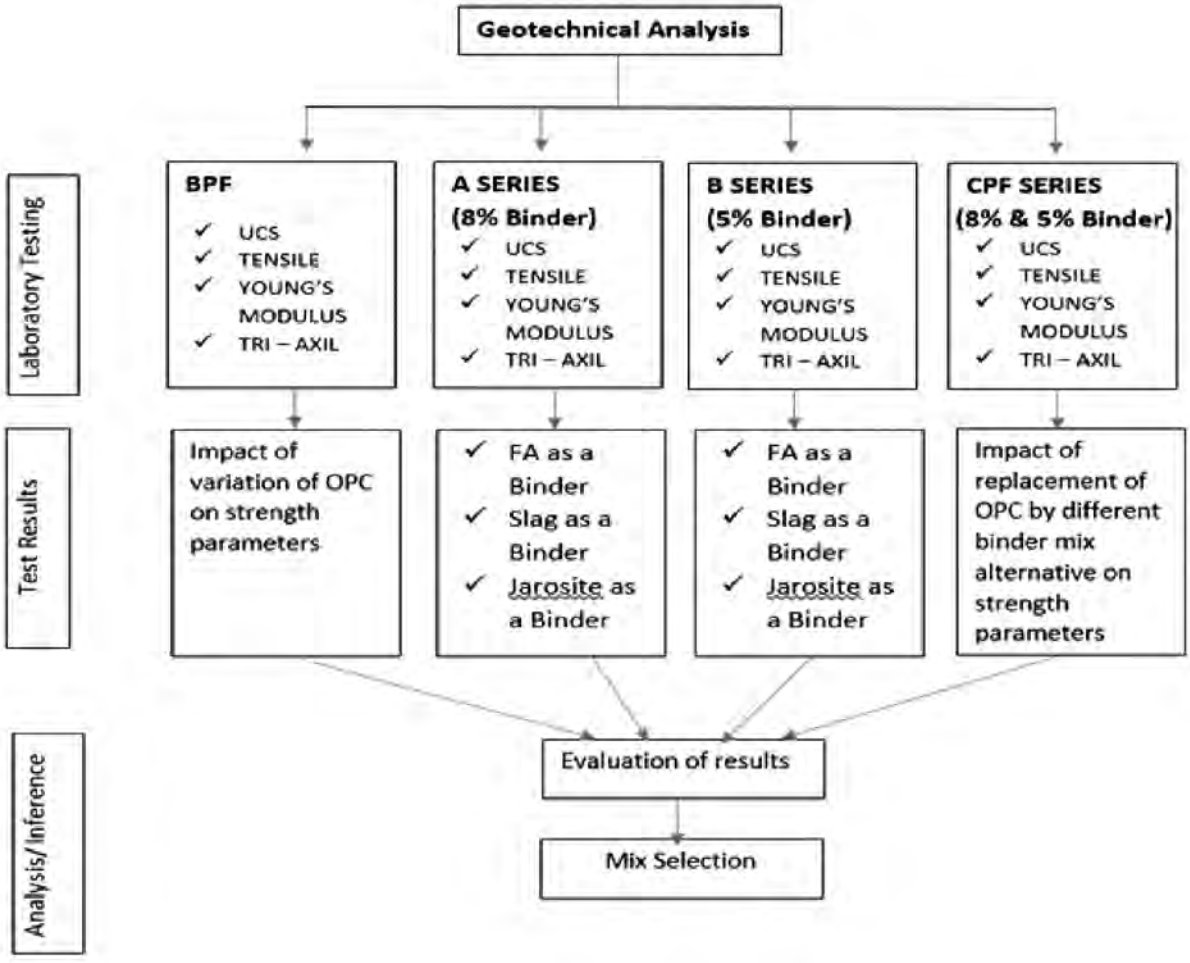
3. Geomechanics and Back Filling

3.1 Back Filling

1. Advice on the development of Paste Fill for mine backfilling at S. K. Mines, HZL

Binder cost contributes to about 75% of backfilling cost, in order to minimize this cost the management of HZL approached CSIR-CIMFR to find out binder alternatives without compromising on the strength parameters required for supporting backfilled stope. Accordingly, laboratory studies to optimize binder alternative viz, GGBS (Granulated slag), Jarosite (processed) and Fly ash to obtain the required strength of paste for a given stope dimension was carried out, elemental composition and backfill properties of the binders and different composition of paste was also carried out to access its backfilling properties.

Laboratory studies on paste mixes with different configuration of mill tailings, binder alternative for different curing period to evaluate its geotechnical properties and flow characteristics. Viz UCS, Shear strength and angle of internal friction, Poisson ratio, Youngs Modulus etc. These studies were carried out to maximize replacement of Ordinary Portland Cement (OPC) the conventional binder with binder alternatives mentioned earlier. Backfilling related parameters for all the Paste fill ingredients were also carried out to access its feasibility as a backfill material.



From the test results it was found that base paste mixes with binder of 8% can achieve the required strength after 14 days curing period for mixes with 6%, 7% and 8% OPC. Fly ash can replace OPC by 3% as it attains the desired after 14 days curing. Granulated slag didn't had much impact as a binder alternative. Jarosite can replace OPC by 2% for the required designed strength of the fill.

It is recommended that a long term monitoring plan of the backfill stope has to be adopted by mine management involving scientific research bodies to correlate the strength gained by the fill in the laboratory and field are the same or not. This is imperative to access the long term influence of backfill on ground control parameters.

Replacement of OPC with above mentioned binder alternative will not only reduce the overall backfilling and mining cost but will also help in utilizing these industrial waste in an environment friendly manner.

2. Advice on the replacement of cement with Flyash for filling the stopes of Rampura Agucha Mines HZL

The main objective of this project was to replace OPC with fly ash as a binder alternative to reduce the overall cost of backfilling. Accordingly, laboratory studies to maximize the use of flyash as binder alternative without compromising on its designed strength requirement was carried out. Laboratory studies included determination of geotechnical parameters (UCS and Tri-axial Test) and backfilling related parameters (settlement, physical and chemical characterisation, drainage behaviour, leaching and flow characteristics from the slump test etc.).

Laboratory studies on the above lines were carried out to determine the unconfined strength, shear strength, cohesion and angle of internal friction of paste mixes with different configuration of mill tailings, cement and fly ash for different curing period (7, 14, 28 and 56 days). These studies were carried out to maximize replacement of Ordinary Portland Cement (OPC) the conventional binder with fly ash as mentioned earlier.

Laboratory studies indicated that all the component of paste fill satisfies the backfilling related parameters. The geo-technical characterization of paste fill is under progress and part analysis of results are carried out.

Replacement of OPC with fly ash as binder alternative will not only reduce the overall backfilling and mining cost but will also help in utilizing fly ash in an environment friendly manner

3. Advice on the use of coal ash from DCPP with overburden at Gare Pelma IV/1 open cast mine

The Dongamahua Captive Power Plant, JSPL planned to dispose the ash generated in the plant at the nearby Gare pelma IV/1 open cast mine. Accordingly CIMFR had carried out extensive study in the field as well as in the laboratory to provide the detail design of the ash filling in opencast mine. Ash filling was started and is being implemented at a ratio of 1:3 ash and overburden. The ash filling is carried out at alternate layers with overburden. Regular monitoring is being carried out by CIMFR scientists to find the efficacy of coal ash filling in open cast coal mines. With this study it was possible for DCPP, JSPL to dispose the coal ash in environment friendly manner.

4. Feasibility study of ash filling in abandoned coal mines using ash from LANCO Power Limited

LANCO Amarkantak Power Limited (LANCO-APL) is operating one power generating units at Korba having a capacity of 600 MW (2 x 300 MW) from the coal supplied by SECL, Korba area. The Power Plant is situated at the Korba district of Chhattisgarh state. On the recommendation of Hon'ble National Green Tribunal and Govt. of Chhattisgarh, SECL allocated Rajgamar underground mine 8&9 Incline for ash filling to LANCO-APL. The mine was abandoned by SECL only after development considering the low grade of coal. CIMFR had carried out the study for suitability of ash generated from LANCO Power Plant for underground mine filling. It was observed that the ash is suitable for filling in underground mines. The detail design guidelines for ash filling in abandoned underground mines were also provided.

5. Advice on stabilization of G.P. Top seam working of Gopinathpur Colliery of Nirsa township

G.P. Top seam is worked below Nirsa township by ECL by keeping solid pillars at a shallow depth. But due to illegal mining the pillars were robbed heavily and only some stooks were left to support the surface structures. The surface is full of residential houses, roads, school and also NH-2 passes in the nearby area. CIMFR had carried out the stability of the surface structures using numerical modelling and it was found the area is highly unstable and may cause major subsidence in the area. In such case there is possibility of fatal accidents. CIMFR had given the design guidelines to stabilize the area so that subsidence can be avoided. Stabilization is presently being carried out by ECL based on CIMFR design guidelines.

6. Advice on the use of bottom ash from SGTPS Power Plant for underground stowing at Umaria UG mine of SECL.

Umaria colliery is an underground mine of Johila area of South Eastern Coalfield Limited. This is one of the oldest coal mine and probably the mine started in 1884 as has been reported by the mine management. There are three main workable seams namely; I, II and IV. IV seam is developed by Bord & Pillar method with pillar size of 20 x 20m and 22.5 x 22.5m. The width of the galleries is kept between 3.6m and 4.2 m. The height of extraction is 2.5 m. The maximum

depth of cover is 167m and minimum depth of cover is 22m. The mine management of Umaria has decided to depillar IV seam with bottom ash stowing as surface land is densely populated. Sand, the conventional stowing material is rare in that area so it is decided to use bottom ash for stowing purpose. There are number of thermal power plants in close vicinity of the mine, of which Sanjay Gandhi Thermal Power Station belonging to Madhya Pradesh government is nearest to the mine site. There are huge stock of bottom ash in the power plant. Accordingly it was decided to use bottom from SGTPS for depillaring of IV seam at Umaria mine. CIMFR had carried out extensive study to find the suitability of bottom ash for filling the voids in underground coal mines. The study indicated that the bottom ash from SGTPS is suitable for filling the voids in underground mines. The detail design guideline for ash stowing was also given.

7 Advice on the use of bottom ash for depillaring with stowing at Gare Palma IV/5 mine of Hindalco Industries Limited.

The Hindalco Industries Limited (HIL) is having two underground coal mines named as Gare Palma IV/5 and Gare Palma IV/4 at Milupara in the Raigarh district of Chhatisgarh. There are two workable seams with seam III as the upper seam and seam II as the lower seam. HIL proposes to depillar seam II. As there are some forest lands, some hutments and private cultivating land it is proposed to extract II seam with stowing to protect the upper seam as well as to avoid any subsidence at the surface. As there is no source of river sand in the vicinity of the mine so it was decided to use bottom ash from Dongamahua Captive Power Plant (DCPP) of JSPL for stowing purpose. Accordingly the management of Hindalco Industries Limited approached Central Institute of Mining and Fuel Research (CIMFR), Dhanbad for conducting studies to find the suitable location of the stowing plant, suitability of bottom ash from DCPP as a stowing material, underground pipe layout, advice during ash stowing etc. for depillaring with bottom ash stowing of II seam. CIMFR had carried out extensive study to find the suitability of bottom ash for underground stowing. It was found that bottom ash from DCPP is suitable for underground mine stowing. The optimum location of the stowing plant was also given. The method of work, the barricade design, the underground pipe layouts were also provided.

8. Advice on the use of coal ash from Korba Super Thermal Power Station, NTPC for underground stowing at SECL mines

The Korba Super Thermal Power Station is considered as one of the largest thermal power stations in India. The total capacity of the power plant is 2100 MW. The power plant belongs to NTPC and is situated in the Korba district of Chattisgarh State. There are a large number of underground and opencast mines of South Eastern Coalfields Limited (ECL) in close proximity to this power plant. A huge quantity of coal ash is generated everyday in this power plant and disposal of this coal ash in environment friendly manner has become a severe problem to this power plant. The management of Korba Super Thermal Power Station thus decided to dispose the ash for filling the voids in nearby underground coal mines of SECL. CIMFR had carried out extensive study to find the suitability of coal ash for filling the voids in underground coal mines. The study indicated that the coal ash from KSTPS is suitable for filling the voids in underground mines. The detail design guidelines for ash stowing was also given.

3.2 Geomechanics

During April 2016 to March 2017, the Geomechanics Section has undertaken various assignments on Rock Mass Characterization of roof rocks, Design of Support System for mine openings and other strata mechanics problem. The clients are M/s Jindal Power Ltd Raigarh, M/S Reliance Cement Company Pvt. Ltd. Raigarh, SCCL Kothagudem, SAIL, Western Coal Fields Ltd, Nagpur, Bharat Coking Coal Ltd, Dhanbad, Eastern Coal Field Ltd, Sanctoria etc.

At Gare Pelma, Jindal Power Ltd, Raigarh, CMRI-RMR have been determined & design of the suitable support system for drift, Seam II, III, IV of coal block IV/2 & IV/3 was done. The borehole data was analysed and feasibility report was submitted.

At Adriyala Longwall Project, Godavari Khani, SCCL, strata monitoring for stability evaluation of gate roadways during drivage and extraction of longwall block was carried out with the help of geotechnical instruments. The monitored data were collected and being analysed for the submission of final report.

Advice on monitoring of strata movement and efficacy of support system with the help of geotechnical instruments such as load cell, convergence indicators in block 14 & 15 and block 16 & 17 in XIV seam of Longwall face with stowing and gate roads at Jitpur Colliery, SAIL is continued for last two years. This would be help in assessment of roof behaviour during final extraction and take remedial measures, if required.

At Chanda Rayatwari Colliery, Chandrapur Area , WCL, design of suitable support system for 4th lift working is to be done on the basis of geotechnical studies. Extraction of coal in three lifts has been completed with stowing.

At Maheshpur Colliery, BCCL, in Sinidih section, design of support system of VIII A seam depillaring panels is formulated using empirical and numerical approaches. Overlying VIII 'B' seam is mined out with caving and the parting thickness is in between these two seams is from 9.5 m to 12 m. The stability of this parting was done using numerical modeling study and influence of overburden dump from adjacent opencast mine on surface and caved panel was included. The geotechnical study for the CMRI-RMR and Q value was also conducted.

The value of CMRI-RMR is 48.6 (fair) and the rock load for gallery/split and junction are 3.74 t/m2 & 4.83 t/m2 respectively. The Q values for slice and goafedge are 2.56 and 1.28 and the rock load in these two locations is 6.98 t/m2 and 8.79 t/m2 respectively. The maximum anticipated subsidence, slope, compressive and tensile strains at the surface are 4164.84 mm, 122.19 mm/m, 52.47 mm/m and 35.49 mm/m respectively.

During depillaring, local fall and main fall may occur after the creation of 25m and 35m (one and half pillar) wide span respectively and after that regular fall would occurred, that will fill the goaf to stabilize the working face by releasing the abutment stress. The factor of safety with designed support for split, slice and goaf edge is 2.55, 2.15 and 3.34 respectively. It is recommended to monitor the surface ground movement during depillaring operation to access the influence zone of subsidence for safety point view of surface features.

The planned mining activity in the developed panel is found safe with the study and the surface structure is also not found in the danger state during depillaring activity. Mine management would be able to extract the coal with better safety and productivity under the sustainable extraction of coal reserve located in this particular mine.

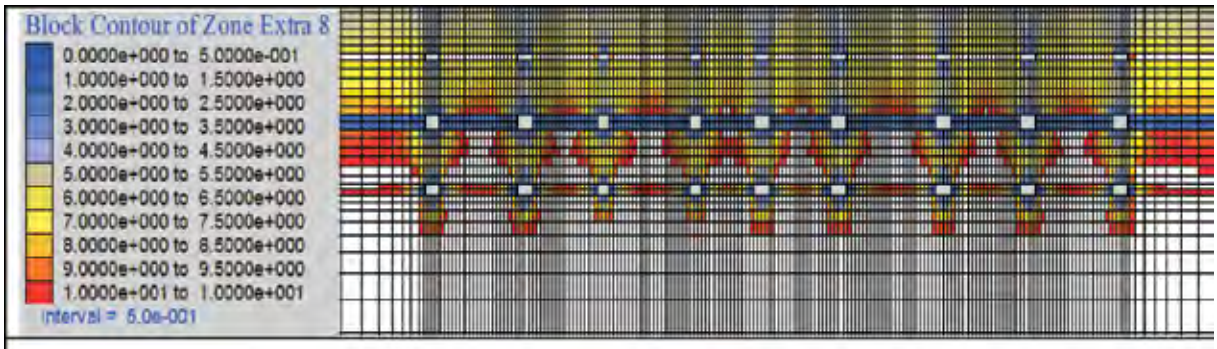


Fig. 1: Block contour of safety factors in and around the developed galleries (Mahespur Colliery)

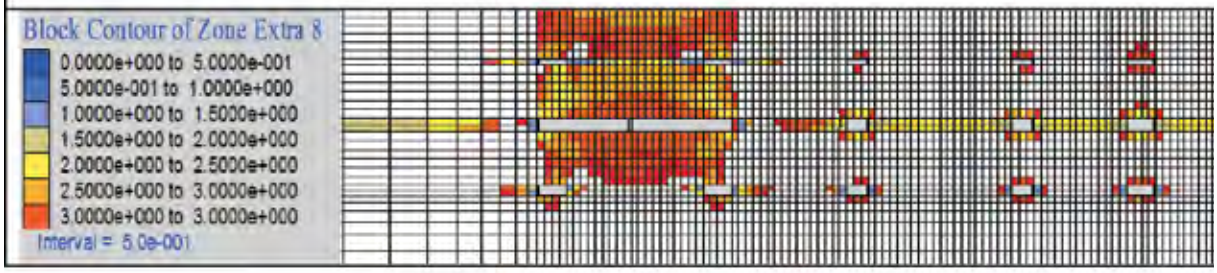


Fig. 2: Block contour of safety factors after 25m wide extracted span (Mahespur Colliery)

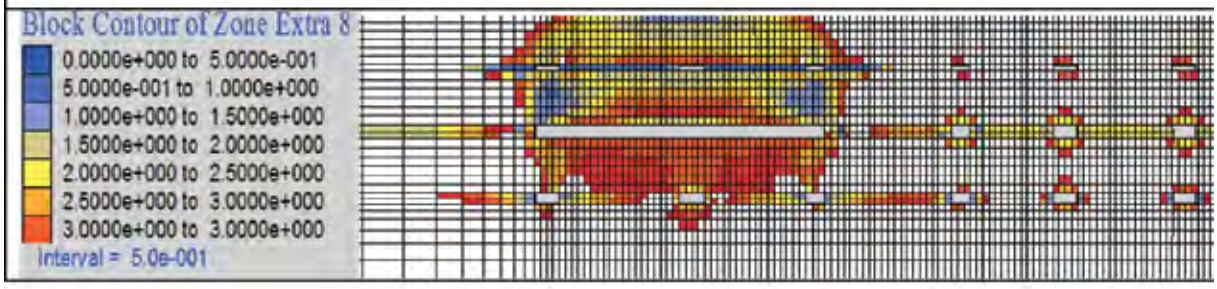


Fig. 3: Block contour of safety factors after 50m wide extracted span (Mahespur Colliery)

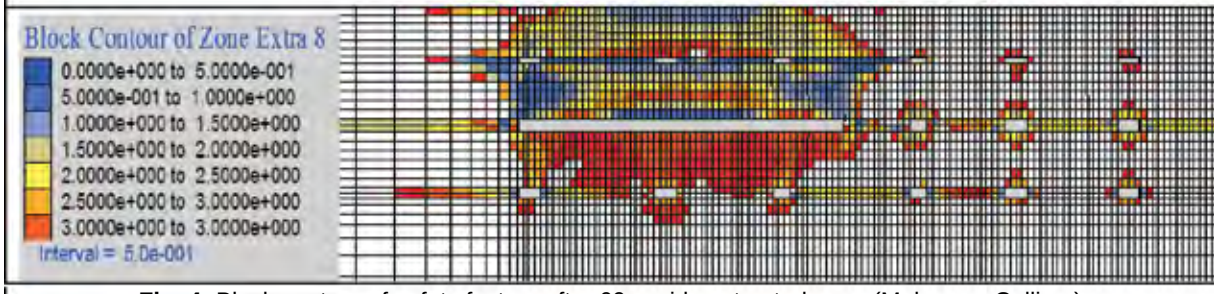


Fig. 4: Block contour of safety factors after 60m wide extracted span (Mahespur Colliery)

In Moonidih and Lohapatti collieries of WJ area , BCCL, the RMR has been evaluated on the basis of Geotechnical studies and rock samples tested by the CIMFR laboratory. The Moonidih Mine is developing IX seam in longwall method and the Lohapatti mine is developing XII seam by bord-&-pillar method of mining. This would be helped to mine management for formulation of SSR.

At Jhanjra Project of ECL, design of support system for prop free gate roadways of Longwall panel R-VI has been done on the basis of empirical and numerical simulation method. The value of CMRI-RMR is 47 (fair) and the rock load for main and tail gate are 3.86 t/m^2 & 3.70

t/m^2 respectively. The numerical simulation results indicate that during development of gate road no failure is anticipated and during extraction of longwall face main fall would be occurred after 65 m of advancement.

The designed support systems for 4.8 m wide main gate roads would be 3 resin bolts in a row at an interval of 1.5 m leaving 0.9 m space towards the pillar on both sides and the bolting rows would be spaced at 1.5 m. Two side bolts would be inclined at 600 towards pillar and the central bolt should be grouted vertical. In the portion, along the gate roads where the immediate roof is fractured due to multiple geological weaknesses, W-strap should be installed along with roof bolts.

At Kondapuram Colliery, Manuguru area of SCCL support design has been formulated on the basis of borehole data provided by the mine management and numerical simulation. The roof of mine is very weak and create problem during extraction. The final report is under progress.

At Adriyala Longwal Project, SCCL the immediate roof is in thin lamination of coal and shale. The two prominent clay layers are also major delamination plane. During drivage of 5.5 m width roadways with bolter miner thin layers has been started to negotiate the strength loss of immediate roof by blasting of solid and fast drivage of gate roads. Support design of roadways has been done on the basis RMR after rigorous geotechnical studies.

At Siyal Ghogri coal mine, Reliance Cement Company Ltd., Chhindwara (M.P.), strata monitoring of development roadways during drivage to assess the roof behaviour with the help of geotechnical instrumentation during extraction is in progress. The support design of this new mine for incline/ tunnel and in-seam was completed earlier. The shaly-coal roof is very weak and friable vulnerable to fall down even in development galleries due to blasting of solid. Mechanical means of coal extraction is advised. According to the monitoring data the support system is keep on updating.

4. Machine Health Monitoring

4.1. Metallurgy

The Metallurgical Laboratory of CSIR-CIMFR is known for its testing of various mine appliances for Mining and Allied Industries. The laboratory is also engaged in various researches. Beside that it also does various investigations for failure of mining equipment/ component.

The following works have been undertaken:

A. R&D Project, Testing & Analysis

1. Study and advice on suitability of wire ropes of mine hoisting system of Khetri Mine & Kolihan Mine of HCL for safe use in future by Metallurgical evaluation

Wire ropes of Hindustan Copper Limited of Khetri & Kolihan Copper Mines, Rajasthan were received to study whether it can be suitable for further use or not. The wire ropes and individual wires were subjected to different tests like visual examination, break load test, wear & corrosion test, lubrication test, tensile test, torsion test and reverse bend test. On the basis of different test results the wire ropes stood satisfactory as per relevant standards.

The study is in progress.

2. Development of corrosion protective chemical/ technique to prevent ferro-alloy specially mining equipment (wire rope)

The objectives of this project are as under:

I. Literature review on status of corrosion protective materials/ green inhibitor

II. Laboratory study on existing (two or three) corrosion protective green inhibitor /technique on ferro-alloy under different mine environment

III. Development of new chemical/green inhibitor/technique to protect ferro-alloy specially mining equipment (wire rope) from corrosion

IV. Study on various metallurgical parameter to quantify the corrosion during study

The study will help in safe operation of mines and allied industries. Further this will also enhance the life of mining equipment with proper safety consideration.

Achievements: We have studied corrosion behavior of wire rods under varying exposure to mine water and applied few organic as well as inorganic inhibitors on mild steel to know their property. The effect of corrosion on wires with different combination of green inhibitor has been studied.

3. Studies and investigation of physico- mechanical & Chemical properties for proto type steel cog (50T) and props (30 T) upto 3m height . (Joint project of metallurgy &RTL)

Steel cog and props are used in mine support system. The main objective of the project for this section is to study its chemical property and effect of corrosion on it. The study is in progress.

B. Infrastructure & Technical Services

Testing and evaluation of various mine appliances like, CS gear, Winding ropes, rope capple etc.:

18 reports send in 2016-17 amounting - ₹ 4, 03,877/

From sponsored project - ₹ 1, 25, 000/-

Total ECF amounting - ₹ 5, 28,877/

4.2. Material Testing Laboratory

1 R&D activities

1.1 Study on soundness of mechanical integrity of vital safety components used in Narwapahar Mines, through non-destructive evaluation

With reference to Work Order no. UCIL/NWP/MECH/19/15 dated January 22, 2015 the non-destructive examinations of vital components of cage & skip winding systems and other critical items used in mine operation were conducted at Narwapahar Mines, UCIL for assessment of their quality for further use in the installation. Cage suspension gear of cage & skip winders is used for safe hoisting of man, machine & material. A number of parameters play a vital role in deterioration of these items throughout their service lives. For surface and subsurface imperfections, Magnetic particle crack detection (MPCD) was conducted, whereas, Ultrasonic flaw detection (UFD) for assessment of internal flaws was also studied. Condition of most of vital components of cage & skip winding systems was found satisfactory except two D-links bearing IM No ATM 858 and ATM 957 revealed the presence of transverse cracks of 25mm and 30mm respectively which were replaced by new. Condition of sheave pulley shaft (cage/skip), tugger hoist, pick rose hoist, hooks with pin of crane of different capacities were found satisfactory, ventilation fan shafts. Thickness of Pressure vessels of different capacities (vertical/horizontal) at different location was found satisfactory.

Surface imperfection on D-link IM No ATM 858

Surface imperfection on D-link IM No ATM 957

On the basis of this study it is recommended that the materials in good condition may be safely used in the installation for next schedule date of examination after getting permission from competent authority.

1.2 Study on soundness of mechanical integrity of the vital components of winding systems of Jaduguda Mines through non-destructive evaluation

With reference to work order no. UCIL/MECH/J/135/1/14-15 dated September 4, 2014, Non-destructive examinations of vital components of cage/skip winding systems and other items except winding ropes of cage & skip winders were conducted at Jaduguda Mines, UCIL for assessment of their quality for further use in the installation. Cage suspension gear of cage & skip winders are used for safe hoisting of man, machine & material. A number of parameters play a vital role in deterioration of these items throughout their service lives. For surface and subsurface imperfections, Magnetic particle crack detection (MPCD) was conducted, whereas, Ultrasonic flaw detection (UFD) for assessment of internal flaws. Condition of most of vital components of these items (winder shaft drum, brake tie rods, bell crank plate, brake cylinder rods, brake post, fastener of brake path winders, head rope attachment of cage suspension gear components along with counter weights, head rope attachments of skip suspension gear components along with counter weights, frame of cage/skip, brake disc fastener and pins of guide rope pins were found satisfactory.

On the basis of this study it is recommended that the materials in good condition may be safely used in the installation for next schedule date of examination after getting permission from competent authority.

1.3 Study and advice on soundness of mechanical integrity of the vital components of winding systems of Loyabad Colliery, BCCL, Dhanbad through non-destructive evaluation

With reference to Letter no. Nil. Non-destructive examinations of vital components of winding system of Loyabad colliery, BCCL, Dhanbad for assessment of their quality. For surface and subsurface imperfections, Magnetic particle crack detection (MPCD) was conducted, whereas, Ultrasonic flaw detection (UFD) for assessment of internal flaws. Condition of most of vital components of these items (winder shaft drum, brake tie rods, brake post, fastener of brake path winders, pins, bucket, pully shaft etc. were found satisfactory except some items. Observations have been handed over the management for replacement of defective items.

1.4 Study on soundness of the vital components of shaft construction equipment at Moonidih, BCCL and advice for their safety thereafter

With reference to Letter no. Nil Dated: 31.01.2017, Non-destructive examinations of vital components of shaft construction equipment were conducted near to Moonidih mine, BCCL, Dhanbad, UCIL for assessment of their quality. For surface and subsurface imperfections, Magnetic particle crack detection (MPCD) was conducted, whereas, Ultrasonic flaw detection (UFD) for assessment of internal flaws. Condition of most of vital components of these items (winder shaft drum, brake tie rods, brake post, fastener of brake path winders, pins, bucket, pully shaft etc. were found satisfactory.

2 Testing, Evaluation and Calibration jobs undertaken

During the period April 2016 to March 2017 the under mentioned items have been tested and analyzed and reports have been sent to the concerned customers through proper channel. The following different types of items were tested for its quality evaluation:

Wire ropes – 22 nos, Safety Hooks- 21 nos., C. S. Gear – 1 no, Distribution Plate complete set – 35 nos.,1 no., Rope Cappel (FWRC) – 24 nos., Head and tail rope attachment – 33 nos., Bridle Chains – 126 nos., Cage shackle with pin – 148 nos., Pins- 76 nos., Swivel – 3 nos; Bow S Plate – 6 nos,, Chase block – 2 nos. White metal rope attachment – 12 nos,. Tub Couplings- (D link with pin) – 168 nos., C type coupling – 85 nos., Drawbar – 10 nos; Rod – 9 nos; Haulage rope cappel with pin – 108 nos,, Lashing chain – 10 nos., J-hook – 9 nos., Cage hanger – 12 nos. Coal channel beam – 1 no;, Steel bar – 9 nos and safety belts – 49 nos,

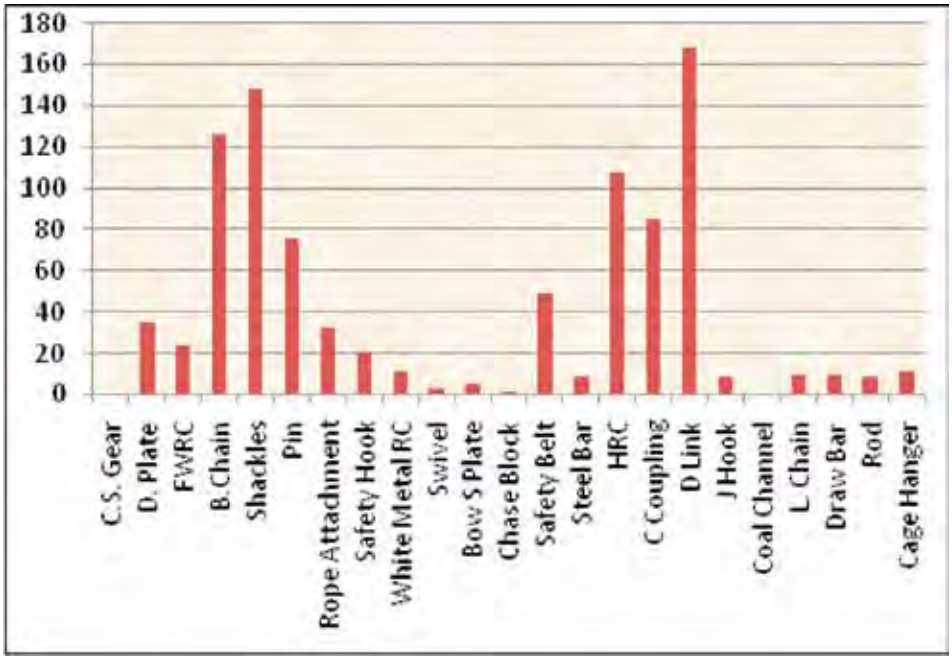
Total certificates issued to customers – 335nos.

Testing services rendered to small-scale industries have accrued considerable economic benefit. The items, which are being tested, were imported. These items have been developed as a measure of import substitution thereby saving the foreign exchange of several crores of rupees.

3 ECF catalyzed and budget handled (CSIR & other Agencies)

Total ECF during this period: Rs. 20,09491=50/- (Rs. Twenty Lakh Nine Thousand Four Hundred Ninety One and Fifty Paisa only).

BAR CHART TESTED SAMPLES FOR THE YEAR 2016-17



4.3. Roof Support Testing Laboratory

During April 2016 to March 2017 the Roof Support Testing Laboratory has undertaken various assignments on quality evaluation of mine support, R&D projects including design & development under Dehradun declaration.

GAP project

1. Design & development of truck mounted mobile coal sampler for instant coal ash & moisture at site from railway wagon / truck

Technology developed: A nuclear technique was developed to assess instantly the ash, moisture content and GCV of the coal including truck mounted mobile coal sampling under the project (sanctioned in two phases) sponsored by Ministry of Coal, Govt. of India.

Phase – I :The Project has been completed i.e feasibility of nuclear technique method with dual gamma-rays transmission for analysis of coal for ash and moisture content has been established and the Draft Project Report of Phase – 1 submitted in 48th SSRC meeting held on 18/12/2013.

Phase – II:Fabrication of various parts / units of the hydraulically operated Drilling Machine for the purpose of Coal sampling and the procurement of Auto Coal Analyzer, all other equipment's and instruments required in the project (i.e. truck and its body layout, eco-friendly generator, Crusher & mixer etc.) have been procured and installed. The field trial of this developed product has been satisfactorily conducted at SCCL, Kothagudem. Further, the draft report has already been sent to CMPDIL, Ranchi. Final report is being prepared.

2. Design & Development of Wheel Controlled Sewage Discharge System in Trains

This project has been sanctioned on Bharat Swachch Mission' launched by PM under Dehradun declaration. This project was sanctioned in in-house made to make the track/ platform as well as total environment more hygienic and healthy in Indian Railways. Conceptual design of the proposed technology to achieve the objective has been prepared. Procurement and fabrication of the prototype working model is in process.

3. Studies and investigations of physico-mechanical & chemical properties for prototype steel cog (50T) and props (30T) upto 3mtr. Height". By M/s Eastman Exports (P) Ltd. Ludhiana (Punjab)

It was investigated as per relevant standard. An interim report was issued to the manufacturer in his request. This project is continuing.

The division has also carried out Batch testing of 285 Nos. samples which included 76 Nos. of Steel Cog(50T), 30 Nos. of Steel Telescopic Prop / Adjustable Crossbar Support (30T) and 179 Nos. of Steel Hollow Section Props (30T) capacity from M/s. Bilaspur Mining Industries Private Limited, M/s. Burma Engineering Works, Dhanbad& M/s. Tubes &Structurals, Dhanbad for Axial testing, Eccentric testing & Over Load testing of Steel Cog, SHS Prop & Steel Telescopic Propwhich were tested as per DGMS circular.

5. Mine Fire, Ventilation and Miners' Safety

5.1. Mine Fire

1. Scientific investigation for extinguishing and containing fires at Gare Pelma-IV/ 2&3 OCM Raigarh, C.G.

Management of SECL (A Subsidiary of Coal India Ltd.) has requested the CSIR-Central Institute of Mining and Fuel Research, Dhanbad for carrying out an effective Fire Protecting strategy after ascertaining the details specific to mines after instructed by the Hon'ble NGT. The following problems were mentioned by the SECL authorities- thermal investigation to determine the status & extent of the fire in benches as well as loose coal, application of the fire fighting chemicals to suppress the fire, burnt mass should be removed after cool down its temperature, if fire occurs then possible control and combating measures should be applied under our supervision, provide the technology to prevent the further fire in the exposed mining area. On the basis of the ground reality and field study carried out on regular interval, the above areas were closely observed and technology were successfully applied in the field to prevent and control the further occurrence of fire.

2. Advice on determining the state and extent of the fire, its rate of progress at Sarubera(E) colliery, Kuju Area, CCL.

A problem for the determination of state and extent of fire (thermal mapping / contour) of the area under fire at Sarubera east colliery, kuju area was referred to CIMFR by the colliery management. Keeping in view of the above problem, the regular visit to the mine were made and thus the thermal images were taken to know the actual condition of the fire. Also the gas analysis of the underground mine were provided by the mine management for further analysis to our team. With the study and analysis of the thermal trend of the said area and the result of underground gas analysis, the final conclusion was made to advice the sarubera management regarding the solution of the problem.

3. Scientific investigation studies for advicing the incubation period of XIV coal seam of Jitpur colliery, SAIL-ISP. Chasnalla

A problem to determine the incubation period of coal seam XIV of Jitpur colliery, Dhanbad, was referred by the colliery manger. Accordingly, we collected the coal samples from the coal seam from two - three different locations. Coal samples have been analyzed through different tests and techniques for its thermal properties and tendency of coal to spontaneously fire. Extraneous mining and environmental conditions created due to or during mining operations were also considered. Topographic factors such as geological disturbance (faults and zones of weakness) and thermal in-homogeneity are the important contributory factors to impart the heating however in present situation their contribution is repellent. Scope of heat formation, dissipation and accumulation in the mine panel has been assessed to evaluate the incubation period. On this basis incubation period was determined.

5.2. Mine Ventilation

During the period the department has undertaken two R&D projects from CIL R&D Board, Government of India, various industry sponsored projects related with the problems of oppressive climatic condition at work places in underground mines, extent and rate of progress of fire in abandoned mines, requirement of air quantity in Continuous miners section etc. The section also deals with testing of brattice cloth and ventilation ducting and calibration of anemometer, velometer and manometer.

(A) R& D project

1. The project entitled “To find methodology of safe liquidation of thick coal seam of Raniganj coal fields, design, development and showcasing demonstrative trial at Khotadih colliery” has been successfully completed. In this project problem of spontaneous heating during liquidation of critically thick coal seam has been addressed by development and application of a comprehensive technology based on key parameters, viz. critical oxidation temperature (COT) of coal, Goaf frictional ignition temperature (GFIT) due to free falling of roof in goaf, design of panel ventilation system by computational fluid dynamics (CFD) modeling, fire ladder of the seam to minimize influence of external parameters on incubation period. This technology has been applied successfully in R-VI seam at Kottadih colliery, ECL. CPT, IPT, COT and frictional ignition temperature are of the order of 1160C, 1630C, 650C and 1570C respectively indicates that heating may take place just after the roof fall which corroborates the Actual field observation. Frictional ignition temperature is of the order of 1570C which greatly influence Crossing point and critical temperature. This influence can be minimized by providing a bed of sand/incombustible material having thickness 30 cm along the floor to reduce the frictional ignition temperature from 157 0C to 92 0C. Further wetting of the sand bed with water spraying arrangement in goaf are able to extract heat from goaf and maintain temperature below critical temperature (Figure 1 & 2).
2. The project entitled “Development of Guideline for Prevention & Mitigation of Explosion Hazard by Risk Assessment and Determination of Explosibility of Indian Coal Incorporating Risk Based Mine Emergency Evacuation and Re-entry Protocol” has been undertaken with an aim to create a national facility for testing of explosibility of coal dust for Indian coal mines. Finally guidelines would be framed for prevention and mitigation of explosion hazard in Indian coal mines. The project is in progress.

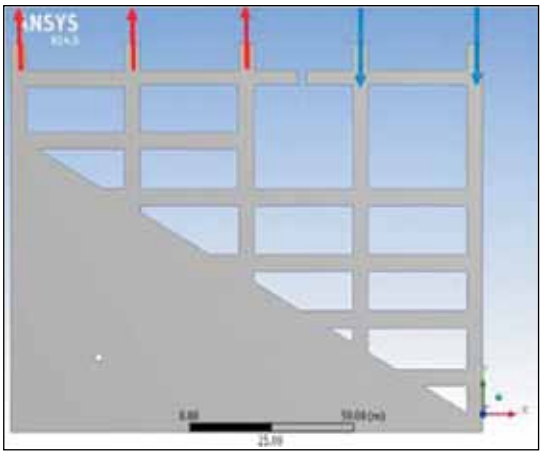


Fig. 1: Geometry of the Panel

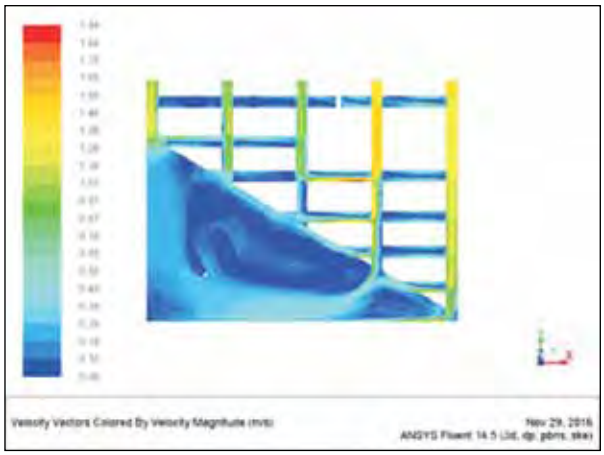


Fig. 2: Output showing air quantity distribution in goaf

(B) Industry Sponsored Project

I. The problem of oppressive workplace environment in three coal mines, viz. 6 & 7 Pit Jamadoba colliery, TATA STEEL and Mohan colliery, WCL, Moonidih Colliery, BCCL have been addressed by way of applying basic principles of fluid dynamics, carrying ventilation investigation, identifying the responsible parameters for deterioration in climatic condition and prediction of results after rectification/modifications by computer simulation studies.

II. Extent and rate of progress fire below sub surface at X Seam East Bhuggatdih colliery (BCCL) and X seam Sendra Bansjora colliery (BCCL) have been determined by development of logistic model of fire from the data obtained by probing method through boreholes at strategic locations measuring the fire parameters, viz. pressure, temperature, gas compositions of fire area fire diagnostic model and advised for its control.

III. Requirement of air quantity and ventilation layout at MIC Jhanjra Project Colliery, ECL has been designed by way of ventilation survey, computer simulation study followed by prediction of air quantity requirement using computational fluid dynamics (CFD) modeling. The air quantity of the order of 62.5 m3/s is predicted to be sufficient to meet ventilation requirement at different locations, viz. galleries, last ventilation connection (LVC) and coal face. etc. (Figure 3)

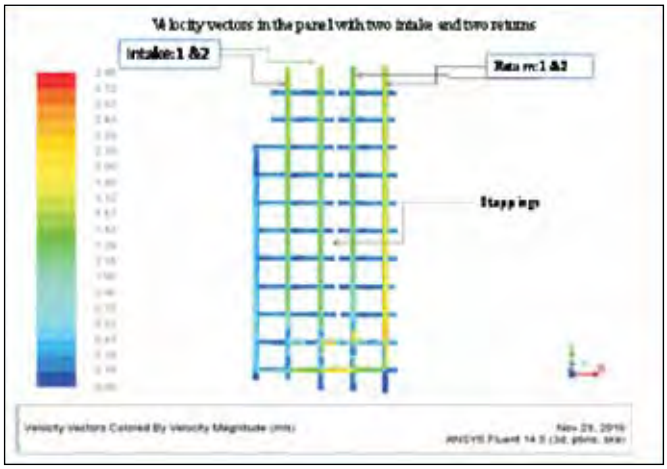


Fig. 3: Velocity profile inside the continuous miner panel

(C) Testing

During the reporting period 16 Anemometers were received from different subsidiaries of M/S Coal India Ltd. & private sectors and calibrated. One number of brattice cloth was tested.

6. Mine Mechanisation and Technology Development

1. Scientific study on strata and support monitoring of Jhanjra Longwall Panel of Sector-A, R-VI Seam, Jhanjra Project, ECL

M/s Gayatri Project Limited, Hyderabad entrusted CSIR-CIMFR, Dhanbad to conduct a scientific study of strata and support behaviour monitoring while extraction of retreating Longwall Panel 1 (LWP-1) of R VI seam at Jhanjra Longwall Project. The comprehensive study on strata and support monitoring of Longwall Panel, LWP-1 of RVI Seam Jhanjra Project Mine, ECL was conducted by CSIR-CIMFR and the findings are as follows:

- The main fall was observed on 25th September 2016 at face position of 65.30 m. The complete goaf got packed with caved rocks. Subsidence cracks of more than 1 inch width were observed on the surface.
- Total 31 falls of varying span and intensity were recorded up to 31st March 2017. The average span of periodic fall was 13m. During the periodic weighting numbers - 38, 50, 53, 54 and 56, the MLD exceeded 100 t/m^2. At these positions the overlying barrier in the RVIIA seam failed and transferred the load over the face. The maximum MLD of 119t/m^2 was observed on March 12, 2017 at 1018m face position, when the face was stopped for making the salvaging chamber.
- The supports which have a designed capacity of 134 t/m^2 have been found to be adequate for the existing geo-mining condition. Some of the periodic falls as observed in the mines have been correlated with the increase of the mean load density (MLD) at bottom zone, middle zone and top zone.
- The percentage of healthy leg circuits was always maintained at more than 90%.
- Also due to faster rate of extraction, the load cells and convergence points installed ahead of the face showed no significant increase in readings.
- The front and side abutment stresses did not cross 2 times the cover stress at any location.

2. Advice on Safe Crossing of Fault Zone by Numerical Modelling in Longwall Panel No. 1 of RVI Seam, Jhanjra Project Colliery, Jhanjra Area

R-VI seam at Jhanjra Project Colliery is presently being extracted using retreating caving longwall method. During extracting Longwall Panel-1 of R-VI seam at Jhanjra Project Colliery, a down throw fault zone was encountered at 1050 m from initial face position. To safely cross this fault zone, the mine management requested CSIR-CIMFR to conduct necessary scientific feasibility study. Based on the study the following conclusions were drawn:

1. The face should be stopped at the face stop line and it should be shifted to the installation chamber ahead of the fault zone.
2. The starting point of the salvaging chamber should be the longwall face position at which the last periodic fall is observed i.e. in between the face position of 996 m and 1009 m. The face stop line should be restricted within 5m from the next expected periodic fall considering

the average periodic fall span as 16 m as observed during extraction of this panel. This is to ensure a stable ground condition in the salvaging chamber.

3. The wire meshing should be started after the face has advanced 10m ahead of the positions at which the last periodic fall is observed before 996m face position. This will prevent flushing of caved materials from the goaf towards the salvaging chamber.
4. The face height should be reduced before the wire meshing work is initiated.
5. The health of the leg circuits, solenoid control valves, yield valves, including power pack shall be ensured in good operating conditions, which shall be kept maintained during the whole salvaging operation.
6. Leg pressure and convergence shall be measured and recorded in a bound page book kept for the purpose every day in order to monitor the impending strata pressure and conditions thereof. The loose muck, if formed, should be cleaned during the salvaging operation.

3. Scientific study on monitoring of SWP-4 shortwall panel at RKNT mine, SCCL

The study involved instrumentation and data collection regarding strata behaviour at the gate roads and the face, load on powered supports and positive supports in the advanced galleries.

The strata control observations were found to be within limits and there is no significant variation. This shows that the supports which have a designed capacity of 105 t/m^2 after cut is adequate for the existing geo-mining condition.

The pressure readings are compared between normal and weighting periods. The tale tales were installed at various locations to monitor the movement of the overlying strata. No roof separation was observed. This indicates that there is no significant roof separation taking place in the immediate roof within 4m.

4. Strata and support behaviour investigation at panel-1 in seam - 2, GDK 10A project, Ramagundam area II, S.C.C.L

The strata and support behaviour investigations were carried out by CSIR-CIMFR using various strata monitoring instruments like, tell-tale extensometers and convergence indicators. Pressure surveys were also carried out to monitor the support behaviour. The main fall was observed on 12th April 2014 at face position of 38.9m (main gate 54m and tail gate 23.8m) from barrier. Before the main fall two major local falls were observed in the goaf at the face position of 19.6m, and 33.1 m.

Thirty-one of periodic falls were observed in the goaf. The majority of periodic falls were taking place at an interval below 12 m with an average of 11.1 m with a median of 10.2 m. The average MLD in the bottom, middle & top zones are 62.7, 59.6 & 61.6 t/m2 with a maximum of 86.75, 89.3 & 89.9 t/m2 respectively. This shows that the supports which have a designed capacity of 94.4 t/m2 after cut is adequate for the existing geo-mining condition.

5. Scientific study for elimination of OC props in Gate Roadways of longwall panel No 1 of Adriyala Longwall Project up to 30 m from face

Based on our design, the first longwall face of Adriyala has been extracted with no OC props in the gate roads which causes hurdles in smooth advancing of longwall face. To facilitate easy installation of the powered support with the help of free steered vehicles, the vertical OC props in the widened face dip gallery, were removed and alternative support design with cable bolting

was recommended within 30 m from face. The elimination of OC props in the gate roads has resulted in faster liquidation and with enhanced production and productivity.

6. Guttering problem of longwall panel no 1 of Adriyala Longwall Project

Studied the problem of guttering due to high stress and stress anisotropy in deeper horizon during drivages of the face gallery and widening of the face gallery of Adriyala Longwall project and suggested support system to cope up and mitigate with guttering problems.

7. Procurement, installation and commissioning of HPC system

A High Performance Computing (HPC) system of 32 nodes, 512 processors with a computational power of 10.3 Terra FLOPS, has been installed in the lab for simulation and visualization of deep mining and geosciences problems. This HPC has been procured under the network project "DeepCoal" and the ongoing activities of HPC are as follows:

- **ANSYS software was installed in HPC, and it has been utilised for numerical simulation of longwall hydraulic powered supports and to predict the stresses developed due to different loading conditions including bending, torsion etc. Numerical modelling for realistic simulation of support-strata interaction will help in designing the critical components of the hydraulic powered supports.**
- Ventilation department of CSIR-CIMFR is using ANSYS fluent for CFD simulation
- Development of mathematical cum logical m-files in MATLAB environment for identification of caving layers from borehole lithologs and rock strength parameters.
- Application of artificial neural network in MATLAB environment for Geostatistical classification of roof rocks and estimation of rock load.
- Preparation of software for prediction of load and safety factor in design of barrier pillar.
- Developing the FEM based C++ program for the analysis of displacements and stresses around underground workings.

8. Development of Tele Robotic and Remote operation Technology for underground coal Mines

Development of remote operation technologies will technologically empower Indian coal industries for efficient exploitation of underground coal seams. The remote operation technology enables continuous and on-line monitoring of real time strata control parameters like stress on pillars/ stooks/ribs in underground openings including underground coal mines and tunnels wirelessly and communicates the data to a safer and remotely placed computing station. Design of wireless module for vibrating wire based sensor has been carried out. In addition, laboratory scale communication network has been developed for transmission of the sensed data from the various sensors based on potentiometer which are usually installed in underground coal mines. The project is sponsored by Ministry of Coal, Govt. of India, New Delhi and CMPDI, Ranchi. The project has been completed.

9. Development of a system for early detection of fire including real time monitoring of fire associated gases for underground coal mines

Underground mines are characterized by their tough working conditions and hazardous environment. Due to difficult working conditions, there are many hindrances come across during mining. Fire is one of the most alarming hazards in underground coal mines. Underground coal

mine fire mostly occurs due to self heating, thermal runaway and ignition. Underground mine fire has huge economic, social and ecological impacts. It not only affects the production cost of coal but also imposes impacts on the land and local residents. These can be controlled if the mine fire is reported at its earliest stage with the use of sophisticated sensors. Therefore, a system for early detection of fire including real time monitoring of fire associated gases for underground coal mines has been developed in which seven parameters can be obtained wirelessly using wireless sensor network (WSN) such as available concentration of CO, CO2, CH4, H2S, and O2 in underground coal mines including temperature and humidity. In addition, a roof mounted fixed traction system and sensory enclosure has also been designed for continuous monitoring of the said parameters. The project is a XII Five year plan project.The project work has been completed.

10. Development of a Technology for Optimal Extraction of Locked-up Coal from Underground Mines using Artificial Pillars (DeCoalArt) XII Five year plan project

Task Title: : Instrumentation and monitoring of various stability related parameters in the laboratory scale model.

Assessment of stability related parameters for the vital mining structures i.e. pillar and roof strata including applied support at different stages of an underground coal mining is important for optimization of safety and recovery. It goes without saying that, coal measure formations offer somewhat intricate rock mass for estimating the strength and stress. Therefore, performance assessment of different types of underground structures at various stages of the mining is required. Since the main aim of the project was to develop a suitable technological package for optimal extraction of locked-up coal from underground mines by replacing coal pillars locked up under different constraints with artificial pillars, therefore, instrumentation and monitoring of stability related parameters for the artificial pillars with respect to the coal pillars are parallely important. Keeping in view, stability related data of self compacting geopolymer (SCG) concrete designed by CSIR-CBRI to replace the locked-up standing coal pillars using geotechnical sensor have been generated.

11. Preparation of Mine Closure Plans for Two Coal Mines [Digwadih and 6&7 Pit]

TATA Steel, Jharia Division has assigned this project to CSIR-CIMFR to prepare mine closure plans as per the MoC guidlines. In this project efforts have been made to minimize mining footprint on surrounding flora and fauna. The baseline data has been collected for mine closure process such as geological, mining scheme, safety, and environmental control measures. A schedule for mine closure activities is proposed in sync with the mine life. Financial outlay for mine closure activities are estimated to ensure zero effect on socioeconomic and environment aspects after the mine closure. The final plan has been submitted to the Ministry of Coal for approval after two revisions.

12. Development of Ground Safety Analysis System

This project aims to bridge the gap between users need and current offline process. This system will assist mine management to manage safety of underground coal mine workings in real time basis using state-of-the-art sensors and communication devices. This project designs an innovative instrumentation topology and get necessary regulatory certificates for the use in hazardous places of underground coal mines. Till now, vibrating wire signal processing interface unit has been developed at lab scale, an underground topology for depillaring district has been formulated, a safety analysis algorithm has been developed, and an artificial neural

network based realtime sensor data analysis and safety alert software have been developed. All the hardware and software developed are being integrated into a prototype system for field demonstration

13. Development of standard methodology for performance evaluation of HEMMS in large opencast coal mine

This project uses Global Navigation Satellite system for monitoring the performance of the HEMMS in the opencast coal mines. The GNSS has been procured and tested in the field conditions of open cast coal mines. The data have been collected in two open cast coal mines.

14. Preparation of mining strategy/plan for Sinsar Limestone mine of ACL Gujarat

M/s Ambuja Cement Limited has entrusted CSIR-CIMFR for preparing a mining plan for a complex limestone deposit. Mining plan is to be prepared for the limestone mining with difficult geological conditions. The mining plan will be submitted to the IBM for approval. The approval will lead to the exploitation of limestone for the cement industry. The baseline data of geo-mining parameters have been collected from the mine site. The plates of different regulatory requirements are being prepared.

15. Development of Tracking System for Controlling Illegal Mining and Coal Transportation in North East Region of India

CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad has implemented the S&T project entitled “Development of Tracking System for Controlling Illegal Mining and Coal Transportation in North East Region of India”, which has been sponsored by Ministry of Electronics & Information Technology (MeitY), Government of India. Under this S&T project, ‘Mine transport surveillance system’ has been developed by CSIR-CIMFR.

Mine transport surveillance system is useful for checking overloading of minerals on trucks or dumpers and their efficient disposal from a mine site, improving safety and productivity in opencast mines as well as controlling illegal transportation of minerals through unauthorized routes. The system consists of 8 modules for performing various functions, namely (i) Weighbridge automation for fast and accurate weighing, (ii) Centralized billing and software solution for secure and transparent dispatch system, (iii) In-motion weighbridge for production monitoring, (iv) Virtual fencing for mine periphery surveillance, (v) GPS and RFID based tracking for optimum deployment of shovel-dumper combination, (vi) CCTV surveillance for on-line monitoring, (vii) Proximity warning for safety of heavy earth moving machinery, and (viii) Wireless networking for cost-effective deployment of the system.

Field trial of the developed system has been carried out in Tirap Opencast Coal Mine of North Eastern Coalfields, Margherita Area, Assam. A patent has been filed for the developed technology {Chaulya, S.K. and Prasad, G.M. (2015) “Mine transport surveillance system”, with patent application No. 2107/DEL/2015}. The patented technology has been transferred to M/s Dadhwal Weighing Instruments, Dhanbad for commercialization. The developed system is being implemented at opencast mines and pellet plant of M/s National Mineral Development Corporation Limited.

One book has been written on the subject by S. K. Chaulya and G.M. Prasad, entitled “Sensing and monitoring technologies for mines and hazardous areas”, which has been published by Elsevier, USA in 2016. Publications have also been made in the journals from the project output. Further, 6 manpower have been trained under the project and 1 Ph. D. degree is in progress.

Project works of 8 B. Tech. and M. Tech. students have been completed during implementation of the project.

16. Setting-up of Safety Testing Laboratory for Electronics and IT Products

Ministry of Communications and Information Technology (MeitY, erstwhile DeitY), Govt. of India has issued "Electronics and Information Technology Goods (Compulsory Registration) Order, 2012". This order has come into effect from July 2013 that all Electronics and IT products must be registered with BIS before they can be sold in the market. For grant of BIS registration number by BIS, it is necessary that all electronics products be tested by BIS recognized labs. MeitY has sponsored CSIR-CIMFR for setting-up of safety testing laboratory to test and certify electronics and IT products. CSIR-CIMR is in process of purchasing the test and measurement equipment as well as preparing rooms for the laboratory.

17. Completed Grants-in-Aid Projects

Development of tracking system for controlling illegal mining and coal transportation in North Eastern Coalfields, Assam.

Nodal Agency: CSIR-Central Institute of Mining and Fuel Research, Dhanbad.

Major Objectives:

- Development of coal transportation tracking and controlling system using RFID tags and PLC in authorized route.
- Development of vehicle detection system using anisotropic magneto-resistive sensors in unauthorized routes.
- Development of application software for controlling the systems.
- Deployment of developed systems in a coal mine.

Deliverables / Significant Contribution till now :

The system has been developed and installed at Tirap Open Cast Mines in NEC, Assam for improving safety and productivity of mines, and controlling illegal coal transportation from mines. The system consists of 8 modules:

i) Weighbridge automation ,

ii) Centralized billing and software solution,

iii) In-motion weighbridge,

iv) Mine periphery surveillance,

v) GPS and RFID based tracking,

vi) CCTV surveillance,

vii) Proximity warning system, and

viii) Wireless networking.

List of Technology Transfers: The technology has been transferred to M/s Dhadwal Weighbridge Instrument, Dhanbad. MoU has been signed between CSIR-CIMFR and NMDC Limited for implementation of the system in all the mines of NMDC. NMDC has already funded a sponsored

project for implementation of the system in Donimalai and Kumarswamy Mines, and Donimalai Pellet Plant.

18. ON-GOING GRANTS-IN-AID PROJECTS

Setting-up of Safety Testing Laboratory

Nodal Agency: CSIR- Central Institute of Mining and Fuel Research, Dhanbad

Major Objectives:

1. Setting-up of Safety Testing Laboratory to test 30 Electronics and IT products
2. Testing and certification as per the Indian Standards/IEC standards for the benefit of all stakeholders including domestic industry, exporters, importers, entrepreneur, small and medium enterprise, existing academic and research institutions, and electronic products standard setting bodies.

7. Mining Methods and Design Simulation

7.1. Mining Methods

(A) R&D PROJECT, TESTING & ANALYSIS

Khottadih colliery, Eastern Coalfields Limited (ECL), the R-VI seam of thickness 5.5m was developed along the floor and poised to be depillared. Till date in India, the continouns miner (CM) deployed has not have height of cutting not greater than 4.5m - 4.6m. Based on the numerical modeling and engineering judgements, it was suggested to go for deployment of CM of height of cutting (single-lift) up to 5.5m. As advised by this section, it is being implemented as also accepted by the Inspeoctorate to increase the height and width of gallery as well as of extraction to 5.5m and 6m respectively with recommended support design. Similar such approaches of mining methods designs with CM deployment were the part of the research works undertaken and completed by this section for the mines namely, Khairaha mine (Sohagpur Area, SECL), Hirakhand Bundiya (MCL). Also one S&T project was completed with a task to develop methodology of safe liquidation of thick seam of Raniganj coalfields, considering the ground control as well as the ventilation aspects in a tandem approach. Earlier only 6-8 nos. of pillars in a panel were being depillared, keeping in view the spontaneous heating occurrence due to the lower incubation period of R-VI seam. After the CSIR-CIMFR study outcomes, the nos. of pillars being depillared in a single panel raised to 12-16. Appreciation from the industry has been also received for the same.

In the deepest coal imine in India, Chinakuri Mine No. 1, Eastern Coalfields Limited (ECL) had fought with complex geotechnical problems so much so that the workings had to be disused, sterlising about 72MT of coal of very high grade. The Mining Methods section has to resort to an innovative initiative of method of working design, where Wongawilli method (established worldover) is tweaked to be ready to be implemented with stowing. The initiative is the first of its kind in the world as CM would be deployed with stowing. The problems of coal bump, very pronounced in Disergarh seam (R-IV), high stress regime and rock support interactions are suitably addressed in the comprehensive report prepared by this section and accepted by inspectorates and mine operators (Fig. 1).

Strata evaluation and management with a suite of geotechnical instruments were undertaken at Churcha colliery, South Eastern Coalfields Limited (SECL) and Sarpi project of Eastern Coalfields Limited (ECL), all locales of coal extractions are with CM deployment where the

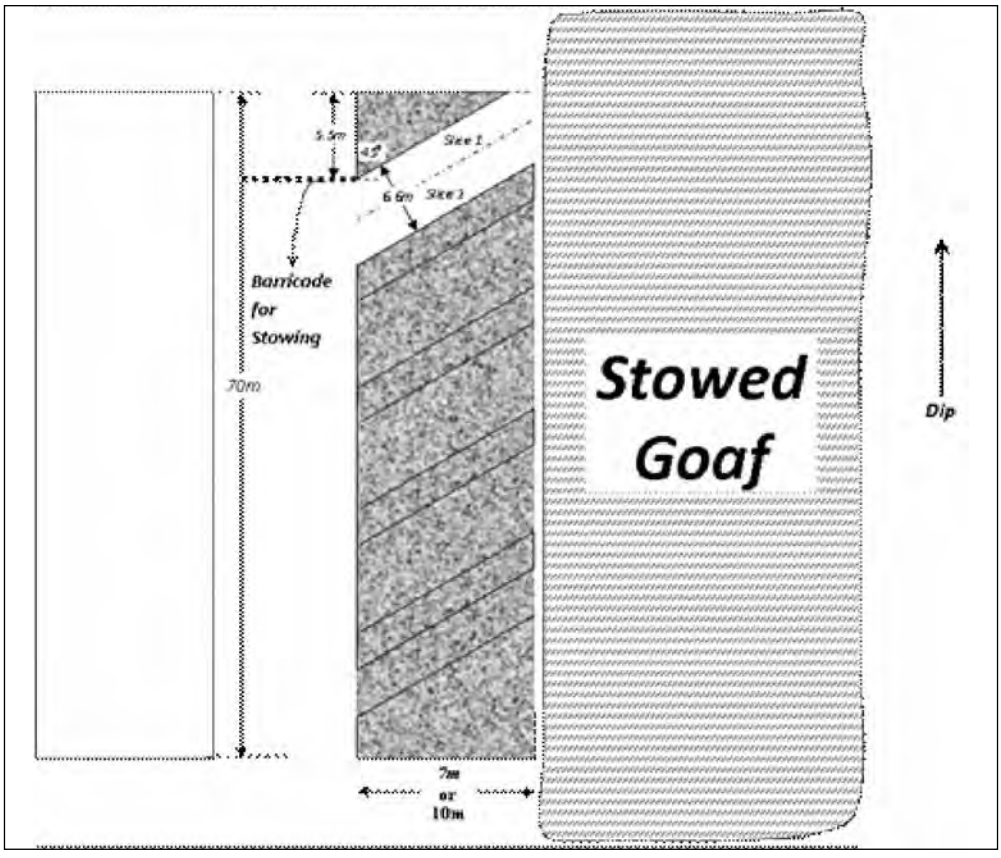


Fig. 1: Proposed stowing arrangements in the proposed Wongawilli panel of Chinakuri Mine No. 1

research advices as a part of feasibility study undertaken by this section are validated with “Design and Measurement”. Lohapatti colliery, Bharat Coking Coal Limited (BCCL) became the sole case where the development and depillaring in a virgin block of XIV seam (the Top Seam) and underlying XIII and XII seams are designed to be so extracted that there would not be any adverse subsidence impact on the importat surface properties – residential colonies, townships etc. The aspects of subsidence engineering and stability analysis by numerical modelling were suitably addressed.

Innovative approach by this section by way of suitably designed staggered panels of coal extraction in Seam I of thickness 6m could provide a reprieve to Mauri Incline, Mohan Colliery, Western Coalfields Limited (WCL), where competent and non-cavable basalt rock of Deccan trap exists above the insufficient vertical extent of immediate roof (primarily cavable sandstone, shales etc). This mine was experiencing “chase-out”, huge loss of coal and high abutments, sometimes unsurmountable. The research report was accepted by mine operators as well as Inspectorates and now ready for implementation under R&D trial study, to be conducted by CSIR-CIMFR.

7.2. Mine Design Simulation

This department provides solutions to underground coal and metalliferous mining problems related to method of mining, numerical modelling, rock mechanics and ground control and strata behavior study. During the period April 2016 to March 2017 the department undertook various R&D and industry sponsored projects and completed previous year’s projects. One new R&D

project has been submitted to the Ministry of Coal, Govt. of India. During the period, the clients of Industries included SCCL, HZL, Tata Steel, IMFA, BCCL, ECL, and MCL.

Apart from the project relative activities the department impacted training to students (under the HRD banner of CSIR-CIMFR) to engineering colleges. Scientists of the department are also associated, as project member in other departments of CSIR-CIMFR projects.

During the year 2016-17, the department conducted different laboratory (numerical models) and field investigations for several R&D, industry sponsor projects.

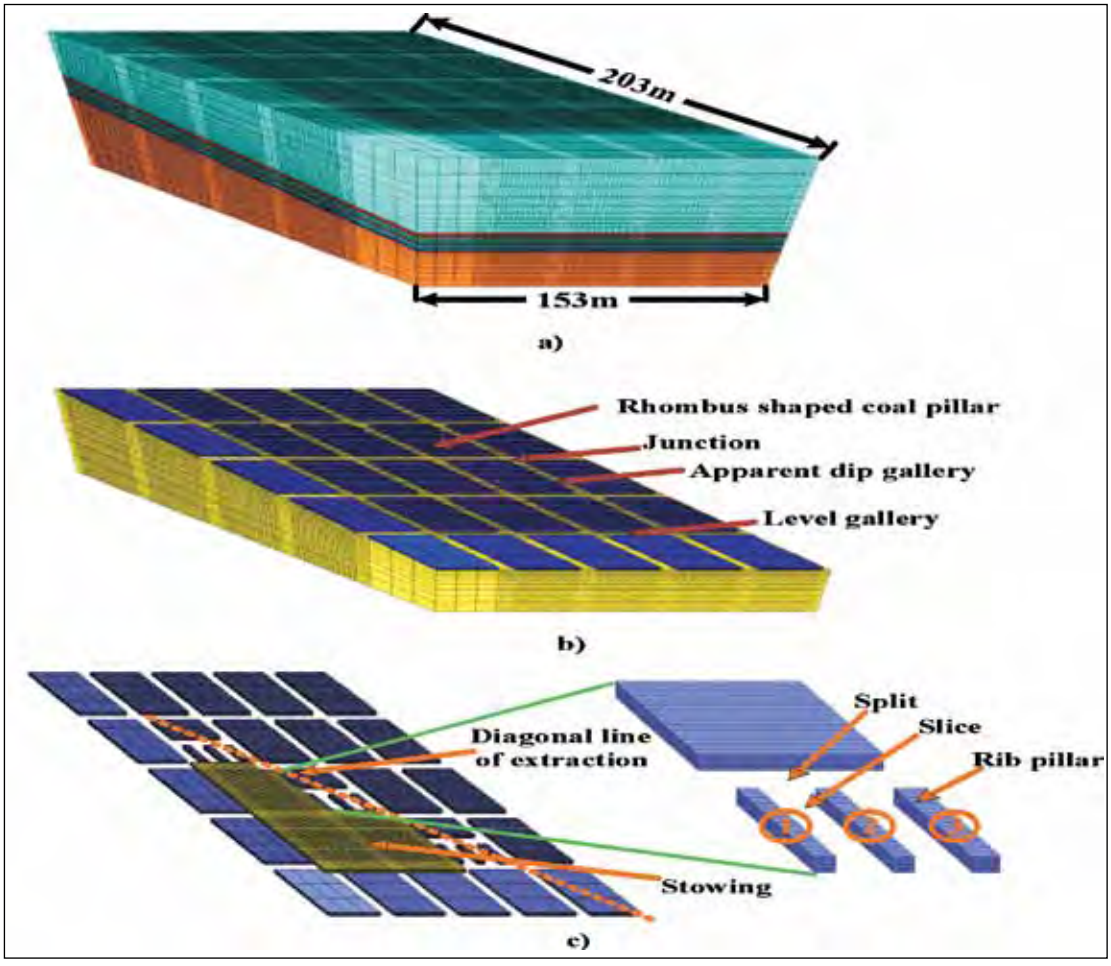


Fig. 1: Flac3d grid of the development and depillaring of inclined coal seam.

R&D PROJECTS

1. Development of a Technology for Optimal Extraction of Locked-up Coal from Underground Mines using Artificial Pillars, (Acronym: DeCoalArt),

Task Title: Numerical modelling and stability analysis, method of work, laboratory scale demonstration.

It is a 12th Five Year Plan CSIR Network Project. CSIR-CIMFR, Dhanbad is the nodal laboratory and CSIR-CBRI, Roorkee and CSIR-CMERI, Durgupur are the participating laboratories for execution of the project. In most of the coalfields in India, there are many mines where the seams are only developed by extracting 15-20% of coal but the pillars could not be extracted

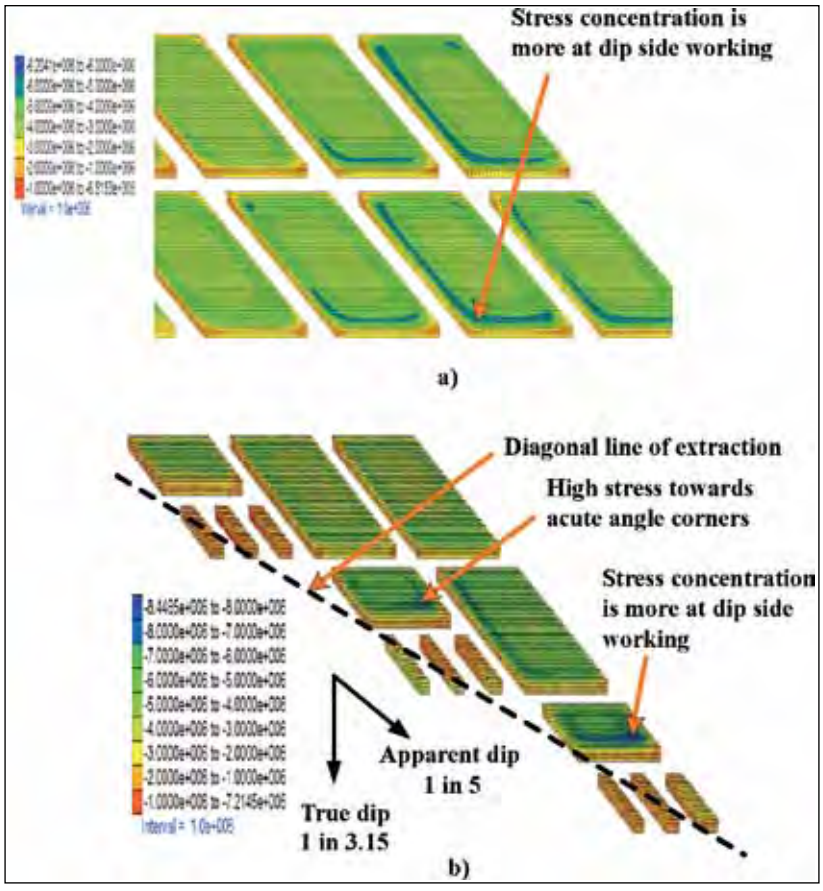


Fig. 2: Stress distribution during development and depillaring of inclined coal seam

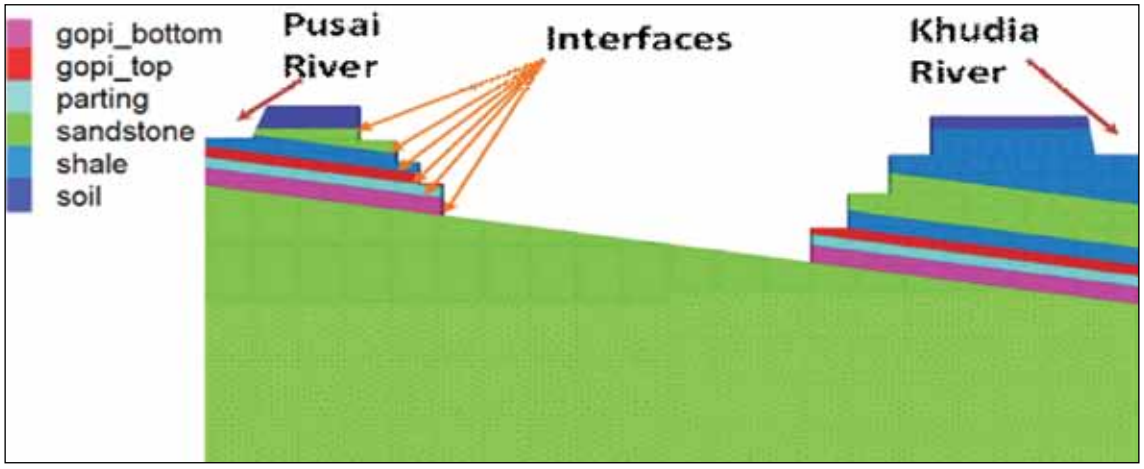


Fig. 3: 3DEC modelling for barrier stability of opencast mine

due to different constraints like presence of surface/subsurface features, forest area, danger of subsidence, lack of proper methodology, scarcity of suitable filling material, environmental issues, etc. As a result, a huge quantity of good quality coal (around 3200 million tones) is locked-up in pillars for many years. Under this project, efforts has been made to develop a technology for optimal extraction of locked-up coal from underground mines using artificial pillars, A material has been developed in collaboration with CSIR-CBRI, Roorkee to construct the artificial pillar. Based

on numerical modelling, a number of extraction methodologies are designed and analysed, and a suitable extraction methodology is selected for particular geo-mining condition. The laboratory scale demonstration of the project has been conducted. All objectives of the project have been achieved and the project has been successfully completed.

2. Development of suitable design methodology for extraction of coal at depth (>300m) for Indian Geomining condition (DeepCoal), Project No. ESC 303 Task No. 5.2: Numerical Simulation of coal pillar extraction using CM technology for deep coal

It is a part of 12th Five Year Plan CSIR Network Project involving four CSIR laboratories i.e., CSIR-NGRI, CSIR-CMERI and CSIR-CMMCS as participating laboratories and CSIR-CIMFR as a nodal laboratory. In this particular task, application of Continuous Miner Technology has been studied for extraction of deep-seated coal seams though numerical modelling and filed studies. Field study and numerical modelling of VK7 underground mines having depth of cover > 350m have been designed for depillaring of developed pillars using CM technology. Extraction and monitoring of the designed panel is completed. Similarly, design of development and depillaring for virgin patches with CM technology for Shantikhani mine has been completed where depth is > 350m. This project has been completed.

3. Robotics & Micro-machines

Task Title: Development of a system for early detection of fire including real time monitoring of fire associated gases.

It is a part of the 12th Five Year Plan CSIR Network Project tilted “Robotics and Micromachines” consisting nine CSIR laboratories including. CSIR-CMERI, Durgapur as a nodal laboratory. Proximate analysis of coal samples collected from fiery seams of different underground coal mines has been completed. Lab scale model of remote monitoring device for underground coal mine gases has been developed. The assembly of dual rail traction system and self-propelled sensory enclosures equipped with sensors and electronic module for data transmission. Development of remote monitoring device for underground coal mine gases using roof based traction system is being developed. The assembly of the electronic modules and sensors in sensory enclosure for detecting the impending mine fire and data transmission. Design of wireless sensor networking integrating the sensors for the fire impending parameters is done. The project is completed.

4. Development of Tele Robotic and Remote operation Technology for underground coal Mines

This project is being jointly carried with CSIR-CMERI, Durgapur. Design of compatible wireless module for vibrating wire based geotechnical sensors such as stress meter has been completed and laboratory trial and fine tuning is being carried out. In addition, a laboratory scale wireless sensor network (WSN) has been developed for transmission of the sensed data from the various potentiometer and thermistor based sensors. Integration of electronic module developed for vibrating wire based geotechnical sensors with WSN is done. Limited scale field demonstration of the system has also been done. The project is completed.

Industry Sponsored Projects

1.0 At VK7 incline, SCCL, strata monitoring and investigation were conducted during the extraction by continuous miner. Based on field monitoring study, necessary advice was given during the extraction of the coal seam.

2.0 At Orient mine No.3, Lajkura seam, Orient area, MCL, a scientific study was conducted

for designing a suitable method for systematic liquidation of already developed contiguous workings and further development of the virgin patch of the seam. Based on field study and numerical modeling a suitable design of depillaring of Lajkura seam has been recommended.

3.0 At Shantikhani Mine, Mandamarri Area, SCCL, a scientific study was conducted for liquidate (Development & Depillaring) the Salarjung seam in identified patches (Area 1 & 1A). Based on the field study, discussion with mine management and numerical modeling, a suitable design of development & depillaring by continuous miner technology was suggested.

4.0 At Sendra Bansjora colliery, Sijua area, BCCL a monitoring study was conducted using six numbers of Bore Hole Extensometer to monitor the subsidence of different rock strata above the fire affected X seam along the DC Railway line near the Bansjora railway station. Necessary advice was given time to time based on monitoring study.

5.0 At Digwadih colliery, Tata Steel, a scientific study was carried out for depillaring of panel with hydraulic sand stowing in XVI seam at Digwadih colliery. Based on field study, discussion of mine management and numerical study, a suitable design was suggested.

6.0 At Gopinathpur colliery, ECL, the barrier against Pusai River has been designed to avoid chances of sliding down of barrier along interface with Gopinathpur seam.

7.0 At 21 Incline mine, Yellandu area, SCCL a strata monitoring investigation is conducted to extract the thick seam by Blasting Gallery method in panel BG U-S in Queen Seam. Geotechnical instrumentation and monitoring study was taken up for safe extraction of the seam.

8.0 A scientific study was conducted for review of the ground control management plan of RAM and Kayad mines of M/s HZL.

9.0 At Mahagiri Mines (Chromite) in Sukinda Valley of M/s IMFA, the thickness of crown pillars has been designed below 85mRL to -395mRL at different levels with stop height of 50m.

8. Nagpur Research Centre (Rock Excavation, Fragmentation, Geotechnique & Mine Modelling)

R&D work in rock excavation engineering/fragmentation, numerical modelling (mine geotechnics), mine slopes, and geo-hydrological problems of mines are being undertaken by the scientists of the Nagpur centre (Unit-1). Mining technology group of Nagpur centre initiated 25 new externally funded projects from industry and enrolled 21 projects in the financial year. Thus, department earned external cash flow (ECF) of Rs. 277.302 lakhs (as per PME data). With an objective to provide technical R&D support for the industry and various mines, the basic objective of research was aimed towards the work place safety with improved productivity. The benefits of R&D studies are availed by the sponsoring agencies for both long term gains and immediate in terms of statuary compliance. The centres activities have strengthened CIMFR industrial liaison with Indian mineral industry thereby generating new clientele.

Some ongoing projects enrolled during previous year 2015-16 were completed successfully in 2016-17 and new in-house projects were initiated for enhancing the mining research status. Other supportive academic activities namely training of students (HRD related) were also undertaken for mining engineering students of nearby colleges and interaction held with polytechnic institutes which is engaged in mining discipline teaching. Division's R&D endeavour has brought laurels for the group scientists of CIMFR unit-1 too in the form of honours/awards and publication

of technical papers in various international and national events i.e. conferences /workshops/ seminars. Promotion to do technical work and day to day official work in Hindi was an additional effort taken up by the centre.

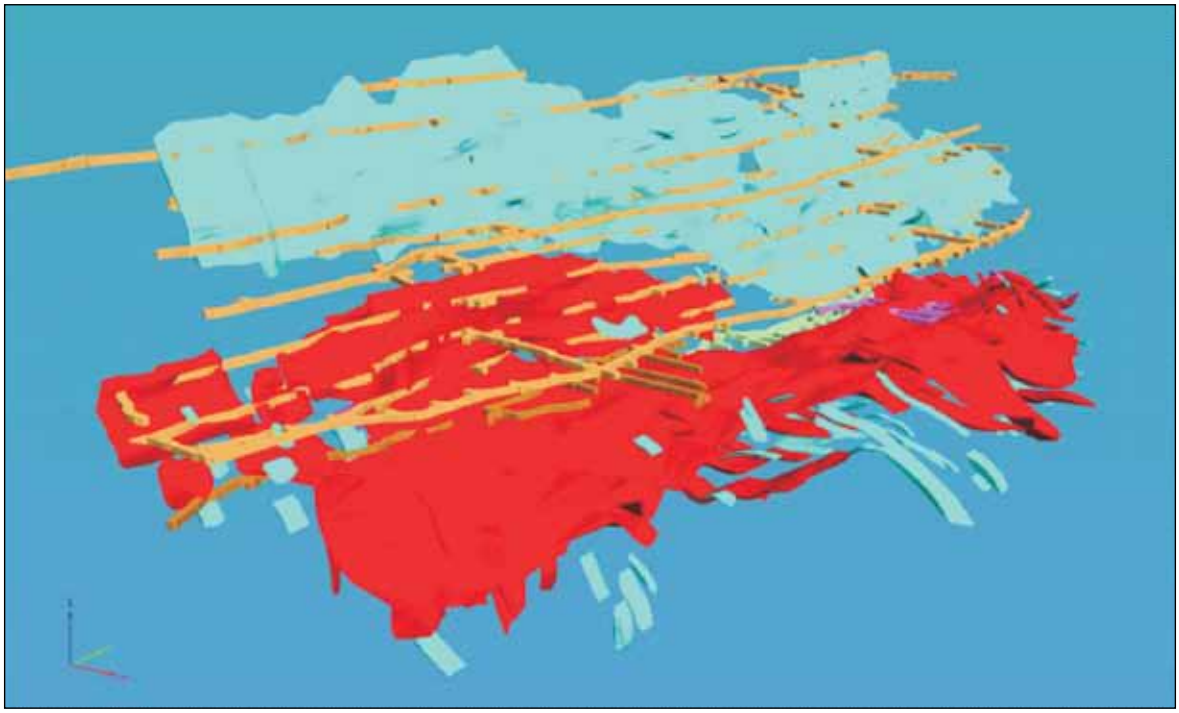
In the new and changing scenario of national level research and development, priorities have been fixed for socially relevant R&D work. With an aim to achieve 'green and less polluted environment' in the mines and mineral bearing areas, practical approach and proper management techniques of mineral extraction were recommended to industry/sponsorer. This has ensured 'environmental friendly mineral extraction techniques at less and competitive cost of production/ ton of mineral.

Furthermore, various organisations of civic sector has shown keen interest and utilized the knowledge of CIMFR in the 'underground construction' and 'sub-surface sciences' e.g. tunnelling, underground space, cavern excavation, etc., railways, highways and metro projects can be mentioned in this context.

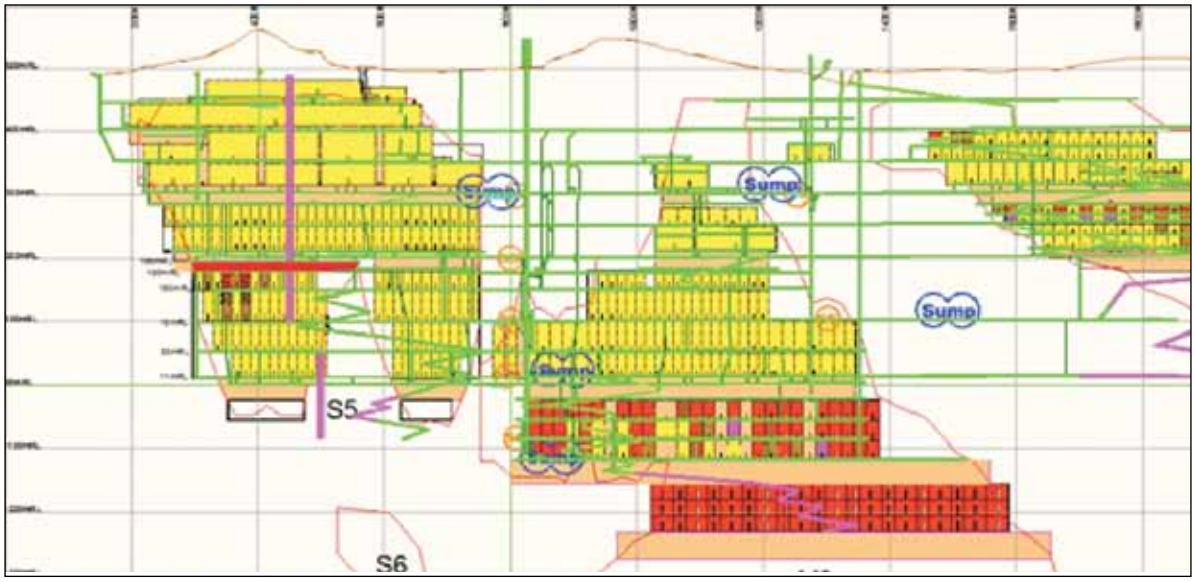
Technical briefs of selected R&D projects (metal mining sector) are as given hereunder.

1. Numerical modelling and advice for optimization of stoping parameters and sequence of mining for BLOCK-III deposit between 200mL to 50mRL at Kayad mine, HZL

M/S Hindustan Zinc Limited operates one of the richest Lead Zinc deposit found at Kayad Mine using 'underground stoping method of mining with cemented rock fill'. Currently, the central portion of block - III, which is mostly flatter in dip, is proposed to be mined. From 3D numerical modelling a feasible extraction sequence with maximum ore recovery has been formulated. The designed method will ensure safety during extraction and also surface stability on long-term (Pl see Fig. below)



2. Review of Ground control practices and support system for 1 year at Rajpura Dariba Mine, HZL

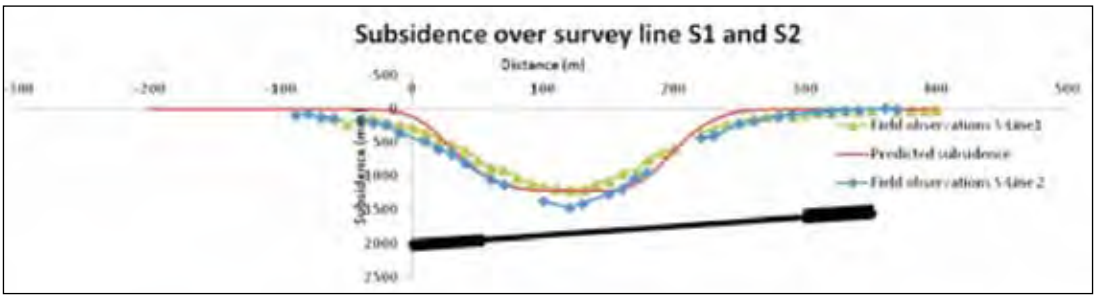


A comprehensive Ground Control Monitoring Plan (GCMP) has been formulated by the mine management, which has been refined and vetted by CSIR-CIMFR. Audit of the same has been done by CSIR-CIMFR for its implementation in the mine. This resulted in safer mining operations from ground control point of view (Pl see Fig. above).

3. Design of stoping geometry and the crown pillar thickness at Kayad mines, Hindustan Zinc Ltd.

At Kayad Mine of M/S Hindustan Zinc Limited two studies have been done for optimization of ore recovery. Firstly the crown pillar between 300 m RL and 325 m RL is optimized to ensure long- term stability and maximum ore recovery. Further, an optimum and stable length of stopes is designed for stopes below 325 m RL. About 1,20,000 tonnes of locked ore, amounting to ≈ Rs. 200 Crore has been recovered through this study (Fig. below).

4. Subsidence prediction studies and field validation over Panel-LW1 of Seam-I at Adriyala Longwall Project, SCCL



The Singareni Collieries Company Limited (SCCL) envisaged Adriyala shaft project, a deep shaft mine with fully mechanized Longwall technology with the target production of 2.5 MTPA. Currently, the rise side panel LW1 in Seam-I is being extracted. A village exists at the dip side of the LW1 panel. The effect of surface subsidence due to caving in LW1 panel on the structures existing in the village premises and the SRSP irrigation canal has been studied using an innovative inclined seam influence function method and field validation using subsidence monitoring data. This enabled smooth extraction of the Longwall panel without any significant damage to the village and other surface features.

Other Projects :

1. This year a new grants-in aid project entitled “Development of a selection methodology for road header and tunnel boring machine in different geological conditions for rapid tunnelling” sponsored by Ministry of Power (through CPRI, Bangalore) is added in the list and initial project work has just begun.
2. CIMFR technical advice was imparted on controlled blast pattern design ,execution and monitoring of rock excavation sites of HRT & surge shaft, vertical and horizontal pressure shaft for the Rammam H.E project, Darjeeling, West Bengal being built by NTPC.
3. Studies on safe vibration limits for ‘reservoir bund’ at package 12 of Pranhitha-Chevella Lift Irrigation Project, Karimnagar, A.P. was conducted based on field results derived periodically.
4. ‘Salinity Ingress Study’ with special reference to hydro-geological regime in and around Narmada Cement-Jafarabad Works (NCJW), Village-Babarkot, Taluka-Jafarabad, District-Amreli (Gujarat) was done in collaboration with CSIR-NEERI Nagpur at the centre. This project was sponsored by UltraTech Cement Limited Narmada Cement- Jafarabad Works (NCJW) ,Gujarat.
5. Private sector mines namely Pericherala Quarry, District Guntur, Andhra Pradesh were provided with CIMFR know-how & advice in the rock blasting area. Technical discussions for troubleshooting in tunnel and mines was held with Simplex, AFCONS and other large agencies.
6. During the period final report is prepared for the project entitled “Geotechnical study for advice on the stability of tailing dam at Codli Mine”. The study is sponsored by M/s Vedanta Ltd. and report is submitted to the sponsorer.
7. CIMFR advice is being imparted for the India’s largest marble excavator M/s R K Marbles

Pvt. Ltd. Geotechnical studies, both field study and laboratory study, is currently going on for the 'ultimate pit slope designs of the Morwad & Dharmeta marble mines (slope stability analysis work).

8. Development of advanced infrastructural facilities for R&D in the fields of Slope Stability & Survey applications (for Mines & Civil Sector Projects) is ongoing as in-house activity.

9. On 27th July 2016, CSIR-CIMFR HQ and Nagpur regional centre in collaboration, organised an "Indo-Australian Joint Workshop on Recent Developments on Highwall Mining in India" at CSIR-CIMFR, Dhanbad. Dr. P. Palroy and Dr. John Loui Porathur were Convenors of this workshop and it was held at Barwa Road Campus, Dhanbad.

Summarily, organisations of mining industry that included mainly coal companies (WCL) and Singareni Collieries Company Ltd.(SCCL), Hindustan Zinc Ltd.(HZL) / Vedanta Resources, Manganese Ore India Ltd.(MOIL), Cement producing companies (Ambuja, ACC, Ultratech) were the beneficiaries of our advise during this year. Subsidiaries of Indian Railways namely Central Railway(CR), West- Central Railway(WCR), South-Eastern Railways (SER) and Southern Railways (SR) took advantage of CIMFR expertise /advice for their rail tunnels, being excavated in different rock formations en-route the different rail divisions.

This research group constitutes interdisciplinary and versatile experts with diverse experiences in the area of mining environmental sciences, instrumentation, remote sensing, environmental biology, ecology, geology, geophysics, environmental chemistry and soil sciences. This group has wide experience in dealing with the environmental problems and providing right solutions from underground to surface mining associated industries, thermal power plants, coal washeries, etc., through R&D and consultancy services. It has capability for handling complex environmental problems in mining and non-mining areas. Our infrastructure boasts of highly sophisticated equipment for monitoring and analysis coupled with latest computer backup both in terms of hardware and software for environmental modelling as well as GIS based application. NREM is dedicated to sustainable development of mining and allied industries and specialized in monitoring of environmental parameters, environmental Impact Assessment through Computer Modelling & simulation technique, Subsidence Prediction by Numerical Modelling, risk hazard assessment, bio-reclamation, environmental remote sensing & GIS analysis and preservation of bio-diversity.

Environmental Impact Assessment (EIA) of the running Jitpur and Chasnalla Colliery and washery of SAIL has been carried out to suggest suitable Management Plan (EMP), so that coal mining can be carried out with eco-friendly and sustainable manner.

The scope of the study includes detailed characterization of exiting status of environment in the study area with respect to various environmental components, viz. air, noise, water, land, biological and socio-economic components and other parameters of human interest. The envisaged scope of EIA is as follows:

- To assess the present status of air, noise, water, land, biological and socio-economic components of the environment.
- Identification and quantification of significant impact of mining operations on various components of the environment.
- Preparation of Environmental Management Plan (EMP) outlining additional control measures to be adopted for mitigation of adverse impacts during mining.

Baseline data have been generated for pre-monsoon season for different components of environment. Various secondary data have also been collected from different government offices. On the basis of collected data and information, environmental impact assessment (EIA) has been evaluated through computer simulation and modelling of different environmental parameters. From the base line data and EIA result, management plan has been prepared for implementation in the respective area for eco-friendly coal mining. The measures to be applied are sprinkling of water around dust generating sources, green belt development around active pollution source, use of coagulant in mine effluent water, construction and maintenance of settling tank etc., reclamation and other eco-friendly measures along with community development program. The identification of risks and mitigative measures to avoid accidents, a disaster management plan has also been formulated.

Mining and related activities cause large scale air pollution in and around the mining areas. The study has been undertaken as in-house R&D project. A study of particulate matter (PM10 and PM 2.5) and the dust deposition in selected tree species was carried out to estimate the menace of dust pollution and also understand the dust attenuation capacity of the plants. Based on the findings from the study a management plan was put forth to reduce the health risk prevailing in mining and adjoining areas. Results indicated that the dust concentration of PM10 ranged from 173.23 to 129.07, 174.37 to 161.56 and 59.59 to 53.98 $\mu g/m^3$ in mine, transportation and control sites respectively. The concentration of PM 2.5 values ranged from 76.21 to 46.3, 78.34 to 69.14 and 33.82 to 28.93 $\mu g/m^3$ in mine, transportation and control sites respectively. The maximum values of PM10 and PM 2.5 were found at site BR1 (transportation) and BR2 (transportation) respectively. The values for both PM10 and PM 2.5 were found to be beyond permissible limits in both transportation sector and mining areas except in Aamtal mining site for PM 2.5. Daily dust attenuation capacity results indicated that Tectona grandis captured maximum dust (21.50 g/m^2) followed by Ficus glomerata (20.45 g/m^2) and minimum values were found in Peltophorum enermi (1.54 g/m^2) and preceded by Albizia lebbeck (1.72 g/m^2) among the growing trees in the surrounding areas. The plants can act as bio filters with respect to PM10 and PM 2.5 hence a greenbelt design has been suggested to improve the air quality of the mining and transportation area.

The environmental study of Kathautia Open Cast Coal Mine, a captive mine of M/s Hindalco Industries Ltd., situated at Daltonganj district of Jharkhand was carried out to know the effects of mining activities on surrounding area. The detailed study with respect to air, water, noise, soil and Flora & Fauna has been carried out in the year 2016-17. Total five sampling stations have been selected for air quality monitoring on the basis of wind direction and other meteorological parameters. All the measured parameters like PM10, PM 2.5 , SO2 and NO2 are well below the threshold level prescribed by National Ambient Air Quality Standards at all the monitoring sites. To assess the impact of mining on water quality, seven water samples have been collected from different locations. This comprises of four grounds, one mine effluent, one effluent from settling tank and two river water samples. Noise level study has been done for monitoring the ambient noise level in the leasehold area. To assess the mining impact on soil in and around Kathautia Open Cast Coal Mine, the effect on agricultural field, soil quality of the area has been evaluated with respect to physical and chemical parameters. The physical properties of soil, which are important for plant growth and agricultural productivity is: texture, bulk density, moisture content and water holding capacity. The chemical properties, which govern growth performance of crops and plant, are pH, EC, N, P, K and organic carbon. Based on analytical evaluation of data preventive measures were suggested like use of sprinkling system on haul

and transport road, regular maintenance of the heavy earth moving machines and wetting of active OB dumps to avoid wind erosion. Reclamation and re-vegetation of overburden dumps should be done to control soil erosion, denudation of agricultural land and nearby riverine system, wetlands and to improves the aesthetics of the area.

Environmental parameters were monitored at Tenughat and Patratu thermal power stations. Effluent samples were collected from different discharge points. Analyses of some physico-chemical parameters as well as heavy metals are carried out. Recommendations of remedial measures are provided at the end of each project duration .

Environmental impact of fly ash filling in sarisatoli coal mines indicated that the discharge of mine water from Sarisatoli mines should be treated to remove hardness , dissolved solids, sulphate, and manganese before discharge into Ajay river. This will help in flourishing the aquatic life in the downstream of Ajay River. The leachates obtained from fly ash and pond ash at present did not show any harmful chemicals in it but proper precautions should be taken and time to time pond ash should be characterised for any harmful component present in it.

A study for evaluation of rain water harvesting scheme at Turamdih Mine of Uranium Corporation of India Limited (UCIL) has been done to prepare technical feasibility report of rain water harvesting Scheme. Water level of nearby wells were monitored in pre-monsoon and post-monsoon seasons in and around the mine along with water quality of the well water. Resistivity survey has also been done at two sites for designing of the rain water harvesting scheme.

Wenner- Schlumberger (WS) electrode configuration is considered for prospecting purpose. ERT data have been acquired along profiles AA and BB with total profile length of 235 m and 141 m at electrode spacing of 5 m and 3 m respectively. Then data sets have been inverted based on regularized least square optimization technique using RES2DINV (Loke and Barker 1996). The inverted geo-electrical sections have been interpreted based on the variation of anomalous high and low resistivity values. The 2D ERT sections of WS array along the profiles AA is shown in Figs 1.

Two sites have been selected for making rain water recharging scheme on the basis of resistivity survey conducted in the Turamdih mining lease area. At site 1 aquifer level is found between 3 to 12 meter. It is proposed to make a surface water collecting pond of size 50mx30mx2m in which three individual recharge wells will be constructed for recharging the ground water up to aquifer level i.e. up to depth of 12m. The detail structure is shown in Figure 2. The rain water collected in the tank will be sipped into ground through three recharge wells made in the tank. In individual well the rain water will also pass through the layers of coarse sand, stone boulders & gravels through 6'' dia pipe. Single recharge well has been proposed at site 2 as there is no space for constructing pond at this site. The detail design is shown in the figure 3 This single recharge well will be useful in passing through the runoff water to the ground water level after passing through the screening layers of soil gravel and sand.

Findings of the study are as follows:

- The water level in the post- monsoon seasons varies in the range of 1.75 m to 10.2 mbgl and pre-monsoon seasons varies in the range of 2.35 m to 10.9 mbgl. Variation in general ground water level is only due to the ground surface slope. The ground surface is sloping towards South and South-East.
- In post-monsoon season, pH level of well water varies from 6.54 to 7.22 showing neutral in nature and TDS varies from 132 to 384.0 mg/l. Most of the water is found soft except

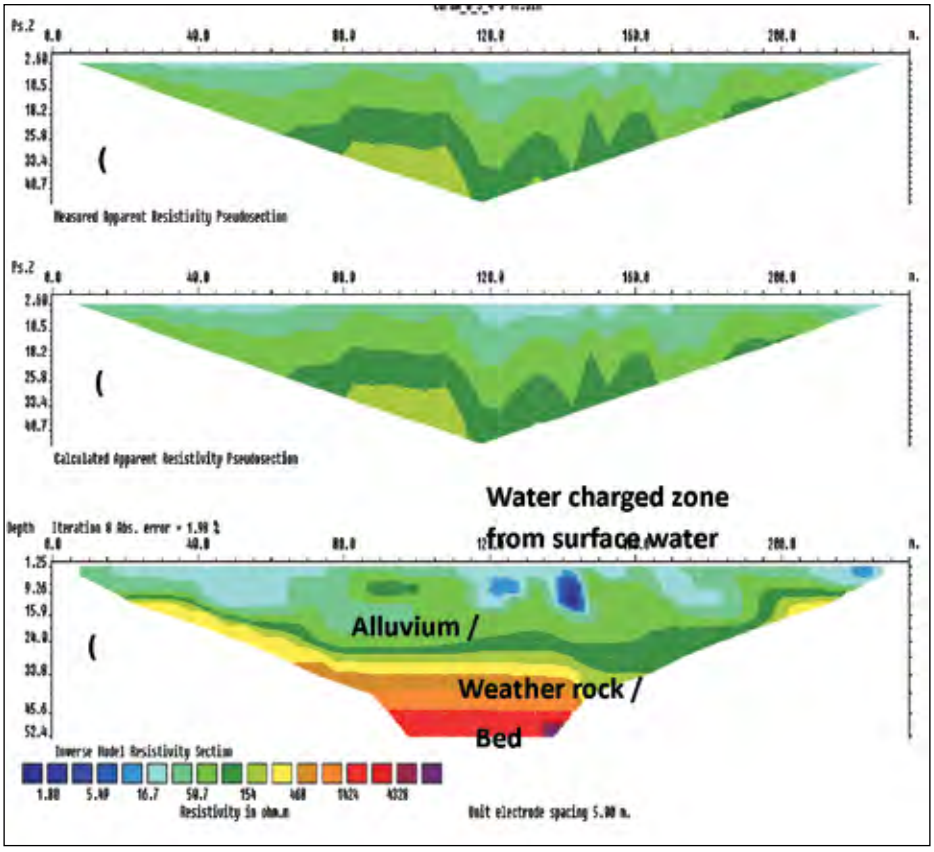


Fig. 1: 2D ERT section along profile AA/ using Wenner – Schlumberger over lower ground near Basti (a) Measure apparent resistivity pseudo section (b) Calculated apparent resistivity pseudo section and (c) Inverse model resistivity section with quality factor 5.

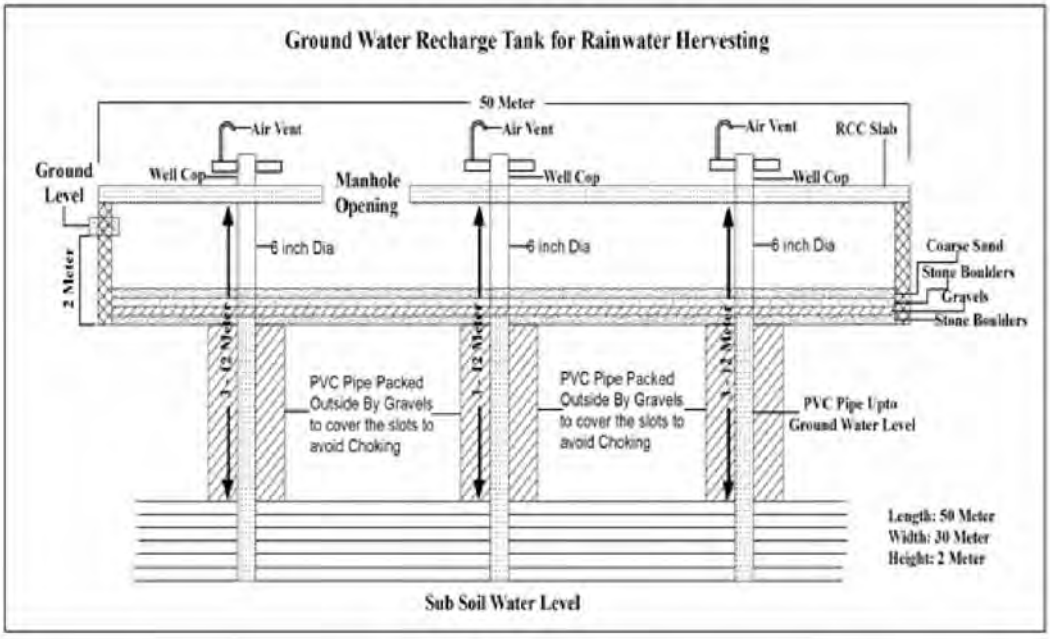


Fig. 2: Proposed Recharge Tank for Rainwater Harvesting at Site No.1

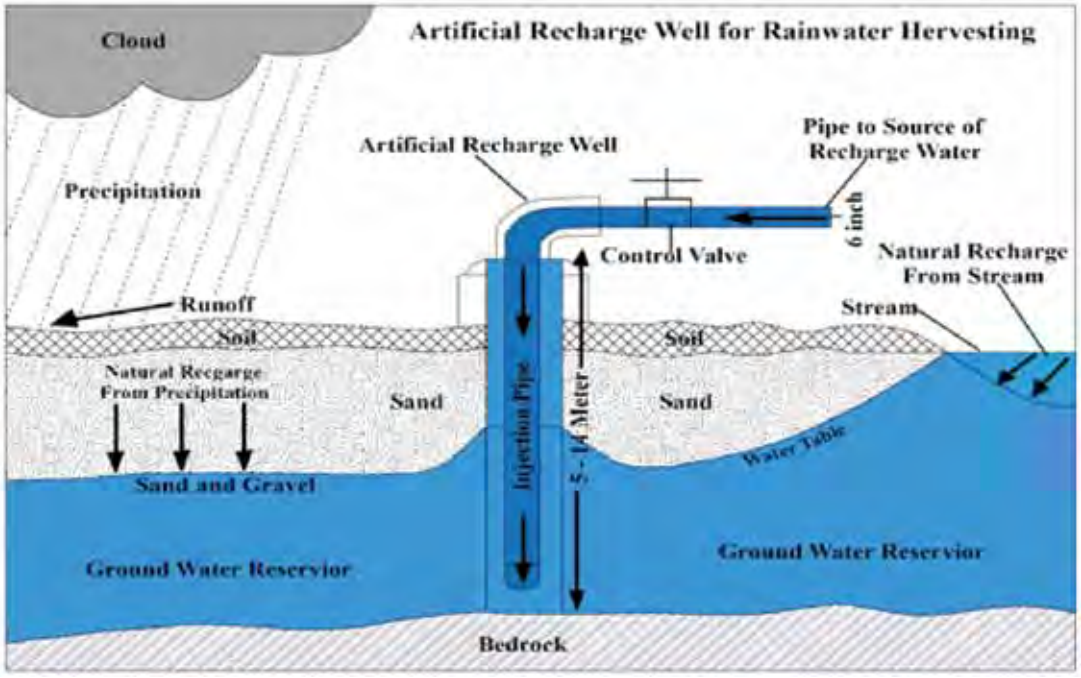


Fig. 3: Proposed Recharge well at site No. 2

at locations GW3 & GW12. Level of Fe content in well water varies from 0.24 to 1.99mg/l which is higher than its threshold value of 0.3 mg/l. Other parameters are found well within the limit.

- In pre-monsoon season, water quality assessment of the same wells were repeated to see the variations in the quality of water. No significant changes occurred. TDS varied from 192 to 397 and hardness varied from 84.0 to 350.0 mg/l. Level of Chloride found increased and varied from 44.0 to 276.0 mg/l.
- It seems to be bed rock at the depth of about 45 m to 53 m. The RD (reduced distance) of about 22 m to 75 m with relatively low resistivity zone around the resistivity of about 17 Ωm to 50 Ωm, it seems to be aquifer zone at the depth of about 3 m to 12 m.
- The possible moist alluvium/aquifer zone has been observed at the RD (reduced distance) of about 7 m to 43 m with relatively low resistivity zone having the resistivity around 30 Ωm to 80 Ωm at the depth of about 3 m to 14 m and another possible moist alluvium / aquifer zone has been observed the RD (reduced distance) of about 76 m to 130 m with relatively low resistivity zone having the resistivity around 30 Ωm to 80 Ωm at the depth of about 5 m to 14 m.
- The average annual replenishable recharge is 9.06 million m3/year.
- The net annual ground water availability is 6.848 million m3/year.
- The stage of ground water development is 24.16%.
- The radius of influence is 627m.
- Two sites have been selected for making rain water recharging schemes on the basis of resistivity survey conducted in the Turamdih mining lease area.

- At site 1, aquifer level is found between 3m to 12 m depth. It is proposed to make a surface water collecting pond of size 50mx30mx2m in which three individual recharge well will be constructed for recharging ground water up to aquifer level i.e. up to depth of 12m. The rain water collected in the tank will be shipped into ground through three recharge wells made in the tank. In each individual well the rain water will also pass through the layers of coarse sand, stone boulders & gravels through 6'' diameter pipe.
- Single recharge well has been proposed at site 2 as there is no space for constructing pond at this site. This single recharge well will be useful in passing through the runoff water to the ground water level through the screening layers of soil gravel and sand.
- Extra rain water of amount 0.0005 MCM/annum will be recharged in the mining area through rain water harvesting scheme.

A study has been conducted on environmental impact of Mugma mines of Eastern Coal Field on preparing site specific wild life conservation plan for cluster 1 &2.Field investigations have been carried out to study the environmental impact of underground and opencast coal mine at local level following the terms of reference approved by the Ministry of Environment, Forest and Climate Change, Govt. of India. Ambient air quality, noise, water quality, soil and hydro geological studies have been made. Observations were made to identify the impact on ecology and biodiversity of the core and buffer zone and species as per schedule I to VI of Wildlife Protection Act, 1972. Socio-economic status of the study area has also been investigated. Based on the aforesaid environmental impact investigations a project specific wild life conservation plan has been prepared for mining projects.

In the Greenfield project, Kasta of West Bengal Power Development Corporation Ltd. field survey has been completed for components of environmental parameters to furnish the data for the Pre-Feasibility Report which is a requisite for the submission of Form I. Contacts has been developed with villagers to generate local support during the field investigation. The study is in its very initial phase and the project proponent will be able to submit Form-I after the completion of lease boundary survey with DGPS and demarcation. The DGPS survey is expected to be completed by the post monsoon season.

During the pre-nationalisation period due to unscientific mining large number of old workings exist below important structures at various coal fields in India. Mostly these old workings exist below National Highways and Railway track. These workings are generally at shallow depth. It has been observed that subsidence and pot holing are common in those areas. As a result the safety of vehicles and passenger trains plying over these areas endangered. Since the old workings are more than 60 years old in most of the cases the proper plan and survey documents are not available. So it is extremely difficult to exactly locate the underground voids from the surface such that precautionary measures can be initiated for stabilisation. Eastern Coalfields Limited (ECL) has entrusted this challenging task to CIMFR for delineation of old workings below the National Highway (NH–2) Road near Dalmia colliery of Salanpur Area of ECL. The workings were completed about 60-70 years back in the pre-nationalisation period and since then the area had been unapproachable. Considering these facts, MineVue Radar (Fig.4) was used for the investigation of old mine workings below NH-2. In addition to that, Direct drilling method was also used for physical verification of the old workings.The MineVue radar survey was conducted along the profile (AB) at NH-2 near Dalmia, colliery of Slanpur area, W.B. After interpreting MineVue radar section along the GPR survey profile (Line AB, Fig.5), two voids were found at the depth of 40 m (height of void/gallery of 1.8 m & surface position of 155 m,

Fig.6) and another at the depth of 33.5 m (height of void/gallery of 1.35 m & surface position of 175 m, Fig.7). These voids were confirmed by Core Borehole Drilling by ECL Management. Afterr that, CIMFR has given advice to ECL management to fill-up the mine galleries by Blind-back filling for the safety of NH-2.

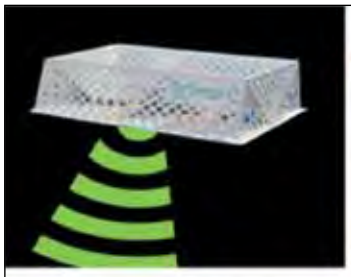


Fig. 4: MineVue Radar for delineation of underground mine galleries along NH-2 near Dalmia colliery

Fig.5: Part Plan Showing locations of GPR Survey Line, Pits, incline, borehole locations & Surface Structures Along NH-2 Near Dalmia Colliery

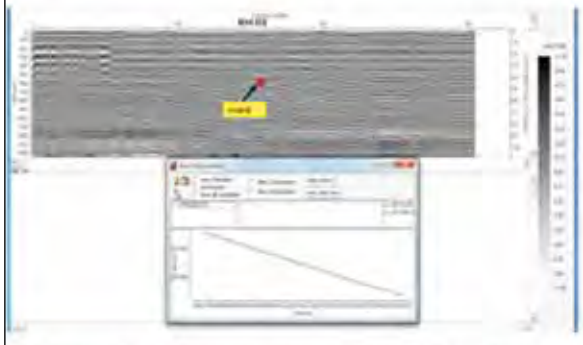


Fig.6: MineVue Radar Signatures showing Underground Mine Gallery at the depth of 40 m at surface position of 155 m below NH-2

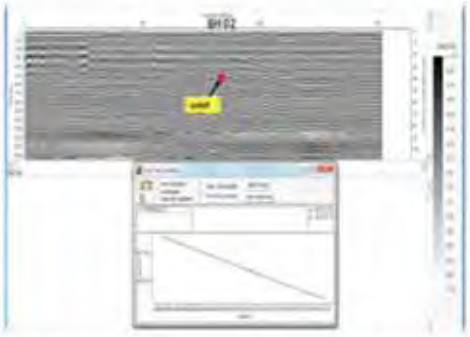


Fig. 7: MineVue Radar Signatures showing Underground Mine Gallery at the depth of 33.5 m at surface position of 175 m. Below NH-2

9. Natural Resources & Environment Management

9.1. Environmental Assessment and Remediation

This research group constitutes interdisciplinary and versatile experts with diverse experiences in the area of mining environmental sciences, instrumentation, remote sensing, environmental biology, ecology, geology, geophysics, environmental chemistry and soil sciences. This group has wide experience in dealing with the environmental problems and providing right solutions from underground to surface mining associated industries, thermal power plants, coal washeries, etc., through R&D and consultancy services. It has capability for handling complex environmental problems in mining and non-mining areas. Our infrastructure boasts of highly sophisticated equipment for monitoring and analysis coupled with latest computer backup both in terms of hardware and software for environmental modelling as well as GIS based application. NREM is dedicated to sustainable development of mining and allied industries and specialized in monitoring of environmental parameters, environmental Impact Assessment through Computer Modelling & simulation technique, Subsidence Prediction by Numerical Modelling, risk hazard assessment, bio-reclamation, environmental remote sensing & GIS analysis and preservation of bio-diversity.

Environmental Impact Assessment (EIA) of the running Jitpur and Chasnalla Colliery and washery of SAIL has been carried out to suggest suitable Management Plan (EMP), so that coal mining can be carried out with eco-friendly and sustainable manner.

The scope of the study includes detailed characterization of exiting status of environment in the study area with respect to various environmental components, viz. air, noise, water, land, biological and socio-economic components and other parameters of human interest. The envisaged scope of EIA is as follows:

- To assess the present status of air, noise, water, land, biological and socio-economic components of the environment.
- Identification and quantification of significant impact of mining operations on various components of the environment.
- Preparation of Environmental Management Plan (EMP) outlining additional control measures to be adopted for mitigation of adverse impacts during mining.

Baseline data have been generated for pre-monsoon season for different components of environment. Various secondary data have also been collected from different government offices. On the basis of collected data and information, environmental impact assessment (EIA) has been evaluated through computer simulation and modelling of different environmental parameters. From the base line data and EIA result, management plan has been prepared for implementation in the respective area for eco-friendly coal mining. The measures to be applied are sprinkling of water around dust generating sources, green belt development around active pollution source, use of coagulant in mine effluent water, construction and maintenance of settling tank etc., reclamation and other eco-friendly measures along with community development program. The identification of risks and mitigative measures to avoid accidents, a disaster management plan has also been formulated.

Mining and related activities cause large scale air pollution in and around the mining areas. The study has been undertaken as in-house R&D project. A study of particulate matter (PM10 and PM 2.5) and the dust deposition in selected tree species was carried out to estimate the menace of dust pollution and also understand the dust attenuation capacity of the plants. Based on the findings from the study a management plan was put forth to reduce the health risk prevailing in mining and adjoining areas. Results indicated that the dust concentration of PM10 ranged from 173.23 to 129.07, 174.37 to 161.56 and 59.59 to 53.98 µg/m3 in mine, transportation and control sites respectively. The concentration of PM 2.5 values ranged from 76.21 to 46.3, 78.34 to 69.14 and 33.82 to 28.93 µg/m3 in mine, transportation and control sites respectively. The maximum values of PM10 and PM 2.5 were found at site BR1 (transportation) and BR2 (transportation) respectively. The values for both PM10 and PM 2.5 were found to be beyond permissible limits in both transportation sector and mining areas except in Aamtal mining site for PM 2.5. Daily dust attenuation capacity results indicated that Tectona grandis captured maximum dust (21.50 g/m2) followed by Ficus glomerata (20.45 g/m2) and minimum values were found in Peltophorum enermi (1.54 g/m2) and preceded by Albizia lebbeck (1.72 g/m2) among the growing trees in the surrounding areas. The plants can act as bio filters with respect to PM10 and PM 2.5 hence a greenbelt design has been suggested to improve the air quality of the mining and transportation area.

The environmental study of Kathautia Open Cast Coal Mine, a captive mine of M/s Hindalco Industries Ltd., situated at Daltonganj district of Jharkhand was carried out to know the effects

of mining activities on surrounding area. The detailed study with respect to air, water, noise, soil and Flora & Fauna has been carried out in the year 2016-17. Total five sampling stations have been selected for air quality monitoring on the basis of wind direction and other meteorological parameters. All the measured parameters like PM10, PM 2.5 , SO2 and NO2 are well below the threshold level prescribed by National Ambient Air Quality Standards at all the monitoring sites. To assess the impact of mining on water quality, seven water samples have been collected from different locations. This comprises of four grounds, one mine effluent, one effluent from settling tank and two river water samples. Noise level study has been done for monitoring the ambient noise level in the leasehold area. To assess the mining impact on soil in and around Kathautia Open Cast Coal Mine, the effect on agricultural field, soil quality of the area has been evaluated with respect to physical and chemical parameters. The physical properties of soil, which are important for plant growth and agricultural productivity is: texture, bulk density, moisture content and water holding capacity. The chemical properties, which govern growth performance of crops and plant, are pH, EC, N, P, K and organic carbon. Based on analytical evaluation of data preventive measures were suggested like use of sprinkling system on haul and transport road, regular maintenance of the heavy earth moving machines and wetting of active OB dumps to avoid wind erosion. Reclamation and re-vegetation of overburden dumps should be done to control soil erosion, denudation of agricultural land and nearby riverine system, wetlands and to improves the aesthetics of the area.

Environmental parameters were monitored at Tenughat and Patratu thermal power stations. Effluent samples were collected from different discharge points. Analysis of some physico-chemical parameters as well as heavy metals are carried out. Recommendations of remedial measures are provided at the end of each project duration .

Environmental impact of fly ash filling in sarisatoli coal mines indicated that the discharge of mine water from Sarisatoli mines should be treated to remove hardness , dissolved solids, sulphate, and manganese before discharge into Ajay river. This will help in flourishing the aquatic life in the downstream of Ajay River. The leachates obtained from fly ash and pond ash at present did not show any harmful chemicals in it but proper precautions should be taken and time to time pond ash should be characterised for any harmful component present in it.

A study for evaluation of rain water harvesting scheme at Turamdih Mine of Uranium Corporation of India Limited (UCIL) has been done to prepare technical feasibility report of rain water harvesting Scheme. Water level of nearby wells were monitored in pre-monsoon and post-monsoon seasons in and around the mine along with water quality of the well water. Resistivity survey has also been done at two sites for designing of the rain water harvesting scheme.

Wenner- Schlumberger (WS) electrode configuration is considered for prospecting purpose. ERT data have been acquired along profiles AA and BB with total profile length of 235 m and 141 m at electrode spacing of 5 m and 3 m respectively. Then data sets have been inverted based on regularized least square optimization technique using RES2DINV (Loke and Barker 1996). The inverted geo-electrical sections have been interpreted based on the variation of anomalous high and low resistivity values. The 2D ERT sections of WS array along the profiles AA is shown in Figs 1.

Two sites have been selected for making rain water recharging scheme on the basis of resistivity survey conducted in the Turamdih mining lease area. At site 1 aquifer level is found between 3 to 12 meter. It is proposed to make a surface water collecting pond of size 50mx30mx2m in which three individual recharge wells will be constructed for recharging the ground water up to

aquifer level i.e. up to depth of 12m. The detail structure is shown in Figure 2. The rain water collected in the tank will be sipped into ground through three recharge wells made in the tank. In individual well the rain water will also pass through the layers of coarse sand, stone boulders & gravels through 6'' dia pipe. Single recharge well has been proposed at site 2 as there is no space for constructing pond at this site. The detail design is shown in the figure 3 This single recharge well will be useful in passing through the runoff water to the ground water level after passing through the screening layers of soil gravel and sand.

Findings of the study are as follows:

- The water level in the post- monsoon seasons varies in the range of 1.75 m to 10.2 mbgl and pre-monsoon seasons varies in the range of 2.35 m to 10.9 mbgl. Variation in general ground water level is only due to the ground surface slope. The ground surface is sloping towards South and South-East.
- In post-monsoon season, pH level of well water varies from 6.54 to 7.22 showing neutral in nature and TDS varies from 132 to 384.0 mg/l. Most of the water is found soft except at locations GW3 & GW12. Level of Fe content in well water varies from 0.24 to 1.99mg/l which is higher than its threshold value of 0.3 mg/l. Other parameters are found well within the limit.
- In pre-monsoon season, water quality assessment of the same wells were repeated to see the variations in the quality of water. No significant changes occurred. TDS varied from 192 to 397 and hardness varied from 84.0 to 350.0 mg/l. Level of Chloride found increased and varied from 44.0 to 276.0 mg/l.
- It seems to be bed rock at the depth of about 45 m to 53 m. The RD (reduced distance) of about 22 m to 75 m with relatively low resistivity zone around the resistivity of about 17 Ωm to 50 Ωm, it seems to be aquifer zone at the depth of about 3 m to 12 m.
- The possible moist alluvium/aquifer zone has been observed at the RD (reduced distance) of about 7 m to 43 m with relatively low resistivity zone having the resistivity around 30 Ωm to 80 Ωm at the depth of about 3 m to 14 m and another possible moist alluvium / aquifer zone has been observed the RD (reduced distance) of about 76 m to 130 m with relatively low resistivity zone having the resistivity around 30 Ωm to 80 Ωm at the depth of about 5 m to 14 m.
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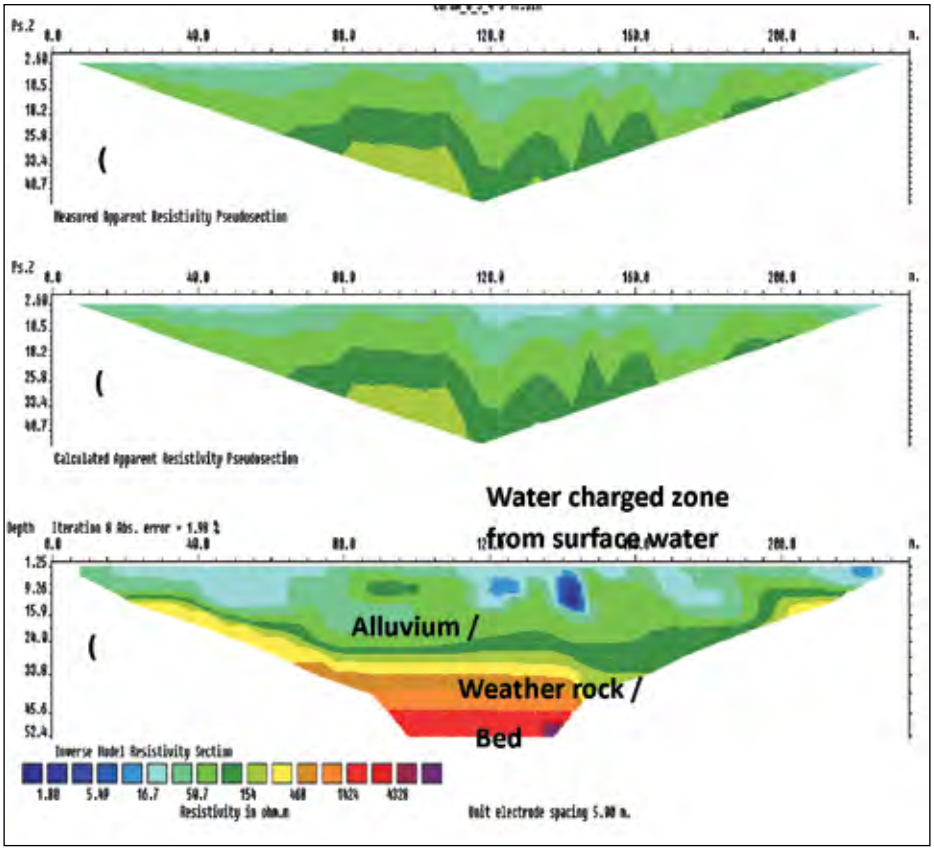

Fig. 1: 2D ERT section along profile AA/ using Wenner – Schlumberger over lower ground near Basti (a) Measure apparent resistivity pseudo section (b) Calculated apparent resistivity pseudo section and (c) Inverse model resistivity section with quality factor 5.

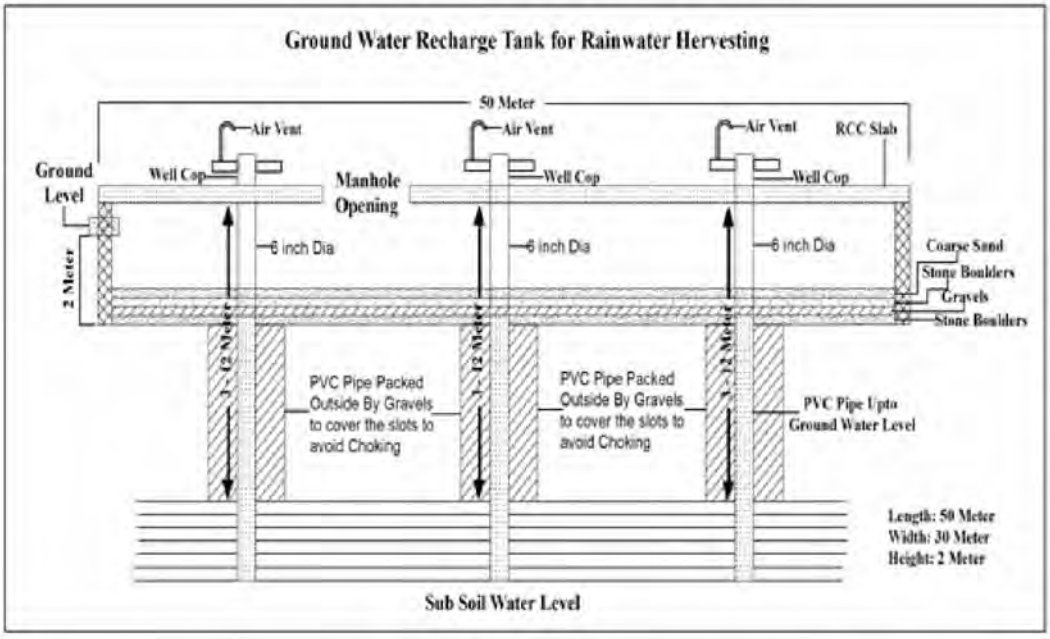

Fig. 2: Proposed Recharge Tank for Rainwater Harvesting at Site No.1

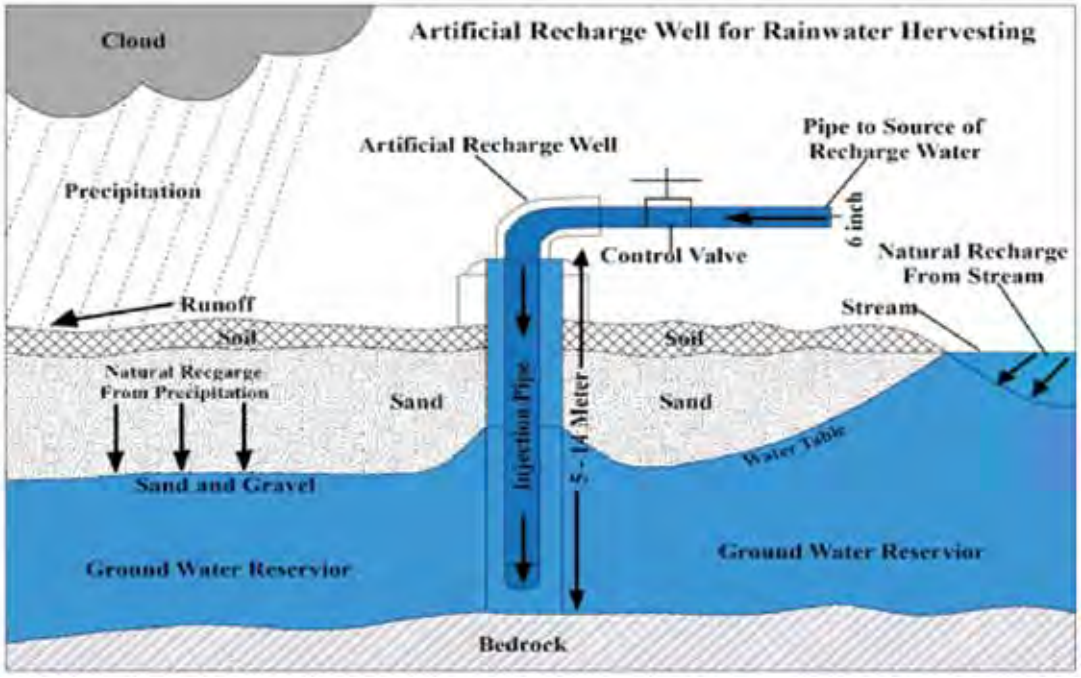

Fig. 3: Proposed Recharge well at site No. 2

- Single recharge well has been proposed at site 2 as there is no space for constructing pond at this site. This single recharge well will be useful in passing through the runoff water to the ground water level through the screening layers of soil gravel and sand.
- Extra rain water of amount 0.0005 MCM/annum will be recharged in the mining area through rain water harvesting scheme.

A study has been conducted on environmental impact of Mugma mines of Eastern Coal Field on preparing site specific wild life conservation plan for cluster 1 &2.Field investigations have been carried out to study the environmental impact of underground and opencast coal mine at local level following the terms of reference approved by the Ministry of Environment, Forest and Climate Change, Govt. of India. Ambient air quality, noise, water quality, soil and hydro geological studies have been made. Observations were made to identify the impact on ecology and biodiversity of the core and buffer zone and species as per schedule I to VI of Wildlife Protection Act, 1972. Socio-economic status of the study area has also been investigated. Based on the aforesaid environmental impact investigations a project specific wild life conservation plan has been prepared for mining projects.

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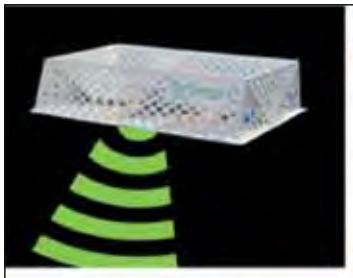


Fig. 4: MineVue Radar for delineation of underground mine galleries along NH-2 near Dalmia colliery

Fig.5 Part Plan Showing locations of GPR Survey Line, Pits, incline, borehole locations & Surface Structures Along NH-2 Near Dalmia Colliery

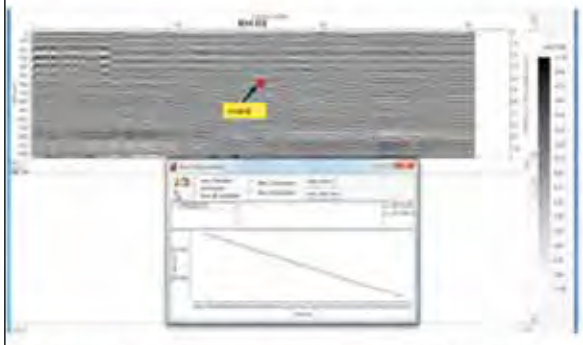


Fig.6: MineVue Radar Signatures showing Underground Mine Gallery at the depth of 40 m at surface position of 155 m below NH-2

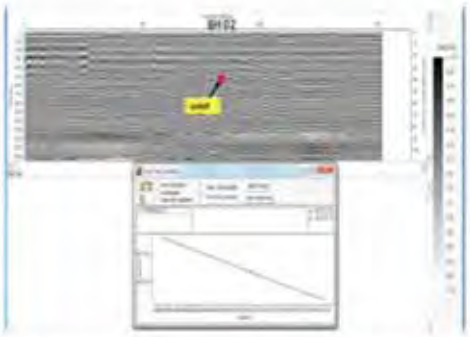


Fig. 7: MineVue Radar Signatures showing Underground Mine Gallery at the depth of 33.5 m at surface position of 175 m. Below NH-2

9.2. Mine Subsidence & Surveying

Mine Subsidence and Surveying Section conducted subsidence investigations over different depillaring panels under complex (multi-seam) mining conditions in Jharia Coalfield for safety evaluation of surface structures and features. Three dimensional prediction of subsidence, compressive strain, tensile strain and slope were also conducted for proposed panels of Jharia and Raniganj Coalfields sponsored by various industries. Projects carried out during the period from April, 2016 to March, 2017 are briefed below:

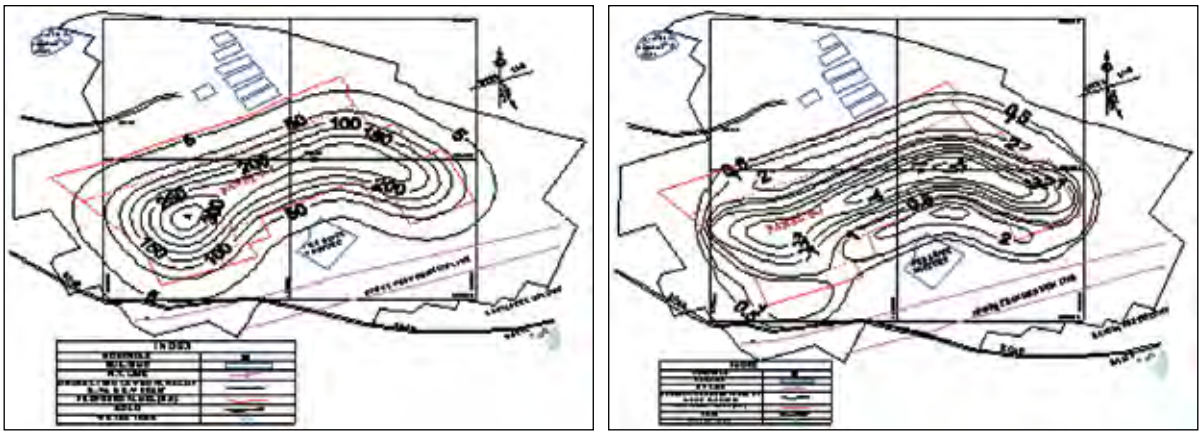
Jamadoba colliery management of M/s Tata Steel Limited proposed to extract 3-S panel in XI seam with hydraulic sand stowing. It is proposed to extract 4.50 m height along roof of the seam having a gradient of 1 in 7. Depillaring is proposed by bord and pillar method with 70 percent of extraction. The minimum depth of cover over 3S panel is 581 m. The important surface features over the proposed panel are road, Dungri jore with RCC floor, a drain connecting to Dungri jore, road and magazines. These panels were extracted before 1982 and it is assumed that these panels must have been settled. Therefore, subsidence prediction was done using modified influence function method for the proposed 3S panel in XI seam, F1 and F2 panels in XIV seam and E1 panel in XVA seam individually which were extracted from 1996 onwards.

The maximum subsidence, slope, compressive and tensile strains at the surface are 81.94 mm, 0.60 mm/m, 0.18 mm/m and 0.10 mm/m respectively. The cumulative values of maximum subsidence, maximum slope, maximum compressive strain and maximum tensile strain due to extraction of proposed 3S panel along with overlying old depillared F1, F2 and E1 panels on the surface are 276.98 mm, 1.3 mm/m, 1.62 mm/m and 0.84 mm/m respectively. These values are well within safe limits and not likely to cause any damage to surface structures. It is recommended to depillar 4.5 m height of extraction in 3-S panel of XI seam with 70 percent extraction in conjunction with hydraulic sand stowing.

Bejdih colliery management of Eastern Coalfields Limited proposed to extract S-1 panel in Sripur (R-VI) seam with caving below agricultural land. It is proposed to extract 1.70 m height which is having a gradient of 1 in 6. Depillaring is proposed by bord and pillar method with 68 percent of extraction. The minimum depth of cover over S-1 panel is 96 m. The important surface features over and around the proposed panel are agricultural land, fire brick factory, high tension power transmission line, jore (located beyond the zone of influence of subsidence), Ranisayer colony and basty, tank, road and cluster magazine house. There is an old depillared working in RB & BD (R-VA & R-V) seams located vertically below the proposed panel.

The subsidence prediction done using modified influence function method due to extraction of proposed S-1 panel of Sripur (R-VI) seam has maximum subsidence, slope, compressive and tensile strains at the surface of 745.1 mm, 10.47 mm/m, 9.30 mm/m and 5.10 mm/m respectively, thus exceeding the permissible limit. The values of maximum subsidence, maximum slope, maximum compressive strain and maximum tensile strain due to extraction of modified S-1 panel on the surface are 361.5 mm, 5.40 mm/m, 5.20 mm/m and 2.70 mm/m respectively. These values close to safe limits for agricultural land. It is recommended to depillar 1.40 m height with 50 percent extraction with caving in the modified S-1 panel.

The 6 &7 Pits Bhutgoria amalgamated colliery management proposed to extract 6-S panel in



(a) Anticipated subsidence contour (b) Anticipated strain contour

IX seam with hydraulic sand stowing. The height of extraction is 3.06 m having dip of seam 1 in 7.2. The proposed mining method is bord and pillar with 70 percent of extraction. The variation depth of extraction is 390 to 420 m. The important surface structures and features over and around the proposed panel are 11 kV Tata Steel line, boundary of Central hospital, road to Bhowrah, drain and railway acquired land (abandoned and dismantled JBO loop). Influence of each panel over the floor of every overlying seams and at surface were calculated by modified Influence Function method. Finally, the cumulative subsidence movements were also modeled up to surface.

The subsidence prediction done using modified influence function method showed maximum subsidence, slope, compressive and tensile strains of 56.21 mm, 0.35 mm/m, 0.35 mm/m and 0.21 mm/m respectively at the surface. The maximum subsidence, slope, compressive and tensile strains on the floor of 11 seam due to extraction of 6-S panel are 208.51 mm, 5.26 mm/m, 1.08 mm/m and 0.92 mm/m whereas they are 177.85 mm, 2.33 mm/m, 1.23 mm/m and 1.12 mm/m along the floor of 14 seam respectively. The cumulative subsidence, slope compressive and tensile strains on the surface are 143.23 mm, 1.71 mm/m, 1.93 mm/m and 1.01 mm/m respectively which are well within safe limits. It is recommended to depillar 3.06 m thick coal with 70 percent extraction from proposed 6-S panel of IX seam with hydraulic sand stowing.

Anticipated ground movements on surface due to extraction of S-1 panel at Bejdih Subsidence investigations were conducted over 12 stowed panels during April, 2015 to March, 2016 at Jamadoba 2 Pit, 6&7 Pit Bhutgoria Amalgamated Jamadoba, Digwadih and Sijua collieries of Tata Steel in Jharia Coalfield for the safety evaluation of different surface features and structures. All the panels were extracted by bord and pillar method of mining with 70-80 percent of coal extraction in conjunction with hydraulic sand stowing. Depillaring operations were carried out at depths varying from 83.50 m to 560.79 m. The width-depth ratio of the panels varied between 0.27 and 1.20, i.e., all the panels were under sub-critical width. All these panels were extracted under multi-seam mining condition with overlying old stowed and caved goaves. Three panels namely IX/8S of 6&7 Pit Bhutgoria Amalgamated Jamadoba, IX/2S of Digwadih colliery and XI/10S of Sijua colliery were extracted completed during the study period. The important surface features over most of the panels include company quarters, private roads, ponds, filter plant, tank, high tension lines and private buildings. This study conducted during the above period

led to the Maximum subsidence movement was 6.0% of extraction thicknesses over the 10S panel in X seam at Sijua colliery. Maximum slope, compressive and tensile strains observed over measured panels were 7.0 mm/m, 1.51 mm/m and 1.34 mm/m respectively. Subsidence, slope and strains profiles were influenced by overlying old goaves, position of goaf edges, inclination of the seam, topography of the surface profiles as well as left out stooks/ribs in the overlying seams worked by bord and pillar method of mining. Subsidence movements did not cause any adverse impact on surface features and structures. It is recommended to erect subsidence monitoring stations at least one month before the commencement of depillaring over new panels. It is also recommended to extend subsidence monitoring stations equal to panel depth outside the panel boundary.

10. Rock Excavation Engineering

10.1. Explosive & Explosion Laboratory

During April 2016 to March 2017, Explosive and Explosion Laboratory undertook various assignments related to development and advice on safety, quality and performance of explosives and accessories which were aimed at either development of improved products or enhancement in productivity in underground and opencast coal mines of SCCL. Moreover, EEL undertook investigations into the accidental samples of explosives and accessories to assist statutory agencies in revealing the probable causes of accidents.

Under two continued and two new projects sponsored by M/s SCCL, total 490 samples of permitted and non-permitted explosives and accessories, comprising of 5 SMS/SME explosives, 24 LD explosives, 70 detonating fuse, 22 cast boosters, 26 cord relays, 275 nonels, 20 permitted explosives, 36 permitted detonators, 6BG explosive and 6 permitted detonating fuse samples, were evaluated for their different quality parameters at SCCL sites to advice on their quality, safety and performance parameters. Evaluation of these explosive and accessories samples of various manufacturers collected from different areas by SCCL management revealed useful information on their conformity or deviation from declared / expected values. Moreover, twelve samples of permitted explosives and two sample of explosive-cord system were also evaluated for concentration of toxic gases in the post detonation fumes after five minutes of blasting at the face. Analysis of results revealed that quality of all samples of SME explosives, SMS of SCCL own plants, detonating fuse, cast boosters, explosive - cord system for BG panel were found to be satisfactory. Moreover, all samples of permitted detonators met the quality requirement of resistance, drop, snatch, series firing current, no fire current and strength parameters. Similarly, all samples of cord relays found to have satisfactory initiation characteristics. All samples of permitted explosives met the statutory requirement of toxic gases in post detonation fumes under their actual usage conditions in underground coal mines.

Out of 24 samples of LD explosives, numbers of samples which failed to meet the density and VOD parameters are three and ten respectively. Out of 20 samples checked during 2016-16 only 6 samples of permitted explosives were meeting all the statutory requirements but 4 samples failed to meet the statutory requirement of either AGS or VOD parameter and thus failed to meet the overall quality requirements. 27 out of 260 cord relays from 26 samples of cord relays (i.e. 10.39%) were found to have their delay timings within their expected range. Other 233 cord relays were found to have their delay timings outside the expected range and hence were not

meeting the quality requirements of delay timings. Similarly, 258 out of 275 (i.e. 93.82%) of nonel samples and 15 out of 24 (i.e. 62.5%) permitted delay detonators samples failed to meet the quality requirement of delay timings as at least one nonel /detonator of those batches was having its delay timing outside the expected range. Surprisingly, some nonels with nominal delay timing of 0 ms were found to have delay timings upto 30 ms and some nonels and cord relays with predefined nominal delay timings (≥ 17ms) fired almost instantaneously. A few samples of nonels misfired also because during the trails we observed that detonation wave travelled upto full length of shock tube but detonator attached at the end failed to detonate.

Under a collaborative project with M/S gulf Oil Corporation Limited, Hyderabad an improved emulsion explosive formulation meeting all statutory requirements of group P5 permitted explosive including shelf life of six months was developed and its field trials were successfully completed. DGMS have given permission for use in underground coal mines. In the same project, emulsion explosive formulations meeting requirements of P1 and P3 group of permitted explosives have already been successfully developed during previous financial years.

M/s Solar Industries India Limited, Nagpur sponsored a project on assistance in the development of P5 emulsion permitted explosive, which was successfully completed and a new emulsion P5 explosive was developed under this project.

M/s A.P. Explosives Pvt. Limited, Secunderabad has recently funded projects related to advice on suitability of their copper coated steel permitted delay detonators APSPDD (0-6 delays) for use in underground coal mines.

10.2. Rock Excavation Engineering

During April 2016 to March 2017, the Rock Excavation Engineering Division (Erstwhile Blasting Department) has undertaken various assignments on blast optimization and safety related problems for mining, quarrying, construction, demolition and tunneling.

During this period, designing of blasting methodology, planning of controlled blasting operations, blast optimization and safety studies have been undertaken for various organizations and companies viz. National Mineral Development Corporation Limited, UltraTech Cement Limited, National Thermal Power Corporation limited, Tata Steel Limited, Indian Railways, Ambuja Cement Limited, Lafarge India Limited, Essar Steel India Limited, Damodar Valley Corporation, Department of Mines & Geology, Government of Bihar, etc. wherein at 2 x 660 MW STPP Khargone Project of NTPC, Madhya Pradesh, controlled blasting were carried out in close proximity of various sensitive structures of the plant, viz. foundations of Main Power House Building, Boiler Unit, Turbine Generators, Reservoirs, MUW Pipe Line, Outer Drain near 32 KV LT Line, etc. The demolition of two Rail-Over-Bridges (ROB Nos. 149 & 99), one near Bhagalpur Airport and other near Lakshmipur station between Bhagalpur and Pirpainti section of Eastern Railways, Malda Division, was carried out successfully with total safety of the nearby structures as well as railway track within the given block period. The demolition as well as clearance of debris from the track was completed within the block period of 6 hrs. assigned by the Railway Board. Other than that the clients included M/s Moher & Moher-Amlohri extension opencast project of Sasan Power Limited, Noamundi, Katamati, Joda East and Khondbond Iron Mines of OMQ division of Tata Steel Ltd., Sukinda Chromite mine of Tata Steel Limited, Kayad Underground

Mine, Rampura Agucha open pit as well as underground mine, Sindesar Khurd Mine of M/s Hindustan Zinc Limited, Injapalli Limestone mine of M/s Vasavdatta cement works, Banduhurang mine of M/s UCIL, Dhdhichua, Khadia, Jayant and Nigahi projects of M/s NCL, Mahabir colliery, Mohanpur colliery, SP mines and Kajora Area of M/s ECL, Bera colliery of M/s BCCL, Wani Area of M/s WCL Hinuti/Sijata and Mendhi Limestone mine of M/s Prism Cement Limited, M/s IEPL, M/s Black Diamond Explosive Limited, M/s IDL, M/s IOCL IBP division, IIEST Shibpur, ISM Dhanbad, DGMS Dhanbad, etc.

Due to excessive rain in the first week of September 2016, a very large sized boulder dislodged from its position from the Brahmayoni Hill in Gaya, Bihar thereby causing threat to the lives and properties of the people residing downhill. The safe dismantling work of the unstable boulder was carried out by this Department in three different stages using controlled blasting techniques with complete safety to the men and properties residing close-by. At Bailadila Iron Ore Mines of NMDC in Dantewada District, Chhatishgarh, the designing and planning of controlled blasting work for hard rock excavation for construction of a new Screening Plant-III were carried out assuring complete safety to the various nearby structures, viz. residential hutments, LPG Gas Godown, Petrol Pump, etc. At Kumarswamy Iron Ore Mine, NMDC, Donimalai, Karnataka, the blast design methodology were suggested for safe excavation work for construction of approach road to the crushing plant ensuring safety of the newly installed conveyor belts passing very close to the existing road. At Bokaro Thermal Power Station, DVC, Bokaro Thermal, Jharkhand controlled blasting techniques were used in the blasting works very close to the existing and old structures of the running plant for safe excavation work in the track hopper area in the running plant. In the Kashlog Opencast limestone mine of M/s Ambuja Cement Limited, Darlaghat, Himachal Pradesh, and Arniya Joshi Limestone Mines of Chittor Cement Plant of M/s Lafarge India Limited, Chittorgarh, Rajasthan, deep-hole controlled blasting were carried out and their impact on the safety and stability of the various nearby structures were assessed. This Department is also involved continuously for the last six years in establishing the controlled blast design patterns at Aditya Limestone Mine, Shambhupura, Chittorgarh of M/s UltraTech Cement Limited as a support organisation wherein ground vibration, noise/air overpressure, flyrock, fragmentation assessment and training of mine officials are being undertaken at regular interval at a place which is politically and environmentally very sensitive. This Department has also experimented and developed safe blast design patterns of solid blasting operations for improved production productivity and better safety to the men and machineries in Jamadoba Colliery, 6&7 Pit Bhutgoria Colliery and Digwadih Colliery, all are degree-III underground coal mines of M/s Tata Steel Limited.

The study at M/s Moher & Moher-Amlohri extension opencast project of Sasan Power Limited involved trials with varying blast designs and charging patterns, monitoring of ground vibration, air over-pressure/noise in and around the mine premises and at nearby villages. Thirty nine blasts Experimental blast were performed (for shovel and dragline benches) successfully producing muck pile with high degree of looseness and consistent fragmentation with throw to the final void position of 36 to 42 % in case of 55-60 m bench, while in case of 45 m Dragline bench, the casting percentage was recorded upto 56 %. The recorded magnitudes of vibration due to shovel and dragline blasting were lower than those recorded by conventional blasting at respective scaled distances. The optimised drilling & blasting patterns and placement of explosives in the holes

helped enable to achieve the desired fragmentation and throw of the overburden in de-coaled area while controlling vibration within safe limit at the structures concerned. The study at Injepalli Limestone mine of M/s Kesoram Industries Ltd. (Unit-Vasavdatta Cement) involves optimisation of blast design parameters to control ground vibration, air overpressure/noise and flyrock within safe limit for the safety of houses/dwelling with improved production and productivity. The study involved experimental trials with varying blast designs and charging patterns, monitoring of ground vibration, air over-pressure/noise at various locations in the periphery of the mine as well as in the Injepalli village. The study at Mendhi, Hinauti/Sijhata Limestone Mine of M/s Prism Cement Limited, Satna involves the optimization of blast design parameters at to control ground vibration within safe limits for the safety of structures in the periphery of the mine with improved production and productivity.

REE division of CSIR-CIMFR designed various blasting techniques at Gagal Limestone Mine of M/s ACC Limited, Bilashpur District, Himachal Pradesh since 2012 using Nonel system of initiation and electronic detonators for assuring complete safety to the various nearby structures situated beyond 150 m distance which led to enhanced productivity with assured safety. At NTPC Kaniha, Talcher, Odisha, controlled blasting techniques were used to excavate the hard rock for Wagon Tippler & conveyor tunnels in close proximity of Petrol Pump, Railway Line, Switch Yard and Fuel Storage Tank. Also studied were carried out on the safety of public structures due to tunnel blasting of Shongtong-Karchham and Sawra-Kuddu Hydro-electric Projects of M/s Himachal Pradesh Power Corporation Limited, Shimla. At Budawada Limestone mine of M/s Balaji Cement, blast economics was improved significantly using CSIR-CIMFR's blasting techniques.

Controlled blasting in outer drain at the project site of 2 x 660 MW STPP Khargone, NTPC, MP


Demolition of ROB-99 near Lakshmipur station between Bhagalpur – Pirpainti Railway Line of Eastern Railway


Safe dismantling of unstable rock boulder in densely populated area, at Brahmayoni Hills, Gaya, Bihar


Controlled blasting operation for excavation of hard rock in Track Hopper Area of
Bokaro Thermal Power Station, DVC, Bokaro Thermal

An Overview of the Moher and Moher Amlori Ext. OCP of M/s Sasan Power Limited

A view of strata condition in different benches of Injepalli Limestone mine

The overview of Mendhi and Prism Cement Limestone Mine of M/s Prism Cement Limited

Electronic Blasting (EB) at Gagal Mine

Smooth bench face obtained using EB

11. Rock Slope and Equipment Safety

11.1. Rock Slope

1. Optimum slope design of external dump at Moher & Moher Amlohri Extension opencast coal mine, M/s Sasan Power Ltd. 150m high external dump has been designed.

2. Advice on slope stability of pits and external dumps of Ghorhaburhani - Sagasahi iron ore block, Barbil, Odisha, Essar Steel India Limited. The final pit was designed with following parameters.

Geo-mining conditions	Bench Parameters for Pits		
	Bench height (m)	Bench width (m)	Angle (deg.)
Top Soil	10	12	70
Weathered laterite, soft laminated ore/ friable ore, blue dust/ powdery ore, weathered shale	10	12	80
Dump mass	15	15	37

11.2. Flame Proof & Equipment Safety

When installing electrical circuits in hazardous locations, some form of explosion protection must be used in the industries. This department attempted to utilize the basic principles to maintain or enhance the safety of men and materials in hazardous industries. In order to facilitate the safety in industries, this department has carried our various projects such as Assessment & Advice for suitability of Heater Treater Transformers installed in Oil and Gas Facilities of ONGC assets.M/s ONGC, Corporation-HSE, Delhi offered different certified flameproof, Intrinsically Safe and increased safety electrical equipment for their suitability to use in hazardous explosive atmosphere. Based upon the physical assessment and visual inspection of different certified electrical equipment to maintain the integrity of their type of protection as flameproof/intrinsically safe/increased safety, the installed equipments are suitable for safe use in Gas Group IIA/IIB and IIC and Zone 1 & 2 hazardous atmosphere only of CBM-MBA of ONGC asset.

Different studies were carried out on Assessment & Advice for suitability of Electrical equipment installed in Zone 1 & 2 hazardous areas of Ravva Oil and Gas field in PKGM-1 offshore block, located in Krishna-Godavari Basin, Bay of Bengal off the coast of Andhra Pradesh as per different relevant standards. M/s Cairn India Limited, Gurgaon offered different certified and approved flameproof, intrinsic safety and increased safety electrical equipment for their suitability to use in hazardous explosive atmosphere. Based upon the physical assessment and visual inspections of different certified electrical equipments to maintain the integrity of their type of protection as flameproof/increased safety/intrinsic safety, the installed equipments are found suitable for safe use in Gas Group IIA/IIB and IIC and Zone 1 & 2 hazardous atmosphere of Ravva Oil and Gas Field PKG-1 offshore block.

The studies related to assessment of electrical safety parameters and advice on Pressurized (Ex ‘p’) DC Motor Rated at 746 kW, 4Pole, 750V in Frame Size OM4903CX as per IS/IEC 60079-2:2007 for use in Zone- 1 & 2, Gas Group IIA/IIB hazardous areas as per relevant Indian Standard were carried out at BHEL.M/s BHEL, Bhopal offered one no. of aforesaid squirrel cage induction motor with design drawings and necessary assessment of electrical safety parameters

and advice at their workshop. On the basis of assessment of electrical parameter and advice as per IS/IEC 60079-7:2006 and IS/IEC 60079-15:2005, the motor under reference confirms to the applicable requirements of type of protection Ex 'e' and Ex 'n' respectively for use in Zone 2 hazardous area as defined in IS: 5572. The stator winding temperature rise is determined and found well below that of the insulation class 'B'. However, the class of insulation of the stator winding is above class-II. The rotor temperature in locked rotor condition is calculated as per standard equation and is limited to temperature class T3 at an ambient temperature of max. 450C and the time tE for aforesaid motor is 31.91sec. Therefore the safe time tE to switch off the motor under abnormal or locked rotor condition is below/within 31.91.sec.

The various categorised service to industry projects were carried out in the area of inspection of factory as required for the first time manufacturing of flameproof equipment for use in hazardous areas at Ex-technologies, Gujarat, Global brass & alloy (India), Jamnagar and Bigapple arcade, secunderabad etc. The various projects on assessment of flameproof system design for EOT crane of 2T capacity span pendent operated 14 (fourteen) nos., 5T monorail 02 nos. and 5T EOT cranes 04 nos. for use in hazardous area were sponsored by Indian industries. Other projects related to Assessment and Technical Advice on temperature rise classification and Hydraulic witness of flameproof Motor in Frame size: 315 L/LX, Rating 334A, 415V, 50Hz, 4Pole as per relevant Indian Standard were also completed successfully.

12. Roorkee Research Centre

Geo-technical Engineering & Underground Space Utilisation Group

During April 2016 to March 2017, the CSIR-CIMFR Research Centre, Roorkee has undertaken assignments on design of highway tunnels, railway tunnels, slopes, rock mass characterization, tunnel instrumentation and monitoring, blast optimization and safety related problems for tunnelling sectors.

The clients included M/s Larsen & Toubro Construction; ITNL (IL&FS), Mumbai; Consulting Engineers Group Ltd. (CEG), Udaipur; Rail Vikas Nigam Ltd., Kolkata, THDC India Ltd., Tehri; Rithwik Power Projects Ltd., Vizag, Indic Geo Resources Ltd. (Chandan Steel Ltd.), Mumbai and M/s UTM Engineering Pvt. Ltd., Gurgaon.

Chenani-Nashri highway tunnel (the Asia's longest bidirectional highway tunnel with 9.0km in India), J&K state was completed in all aspects and inaugurated by Hon'ble Prime Minister of India, Shri Narendra Modi. CSIR-CIMFR was associated with this tunnel as the proof design check consultant from 2011.

The main tunnel measuring 13.3m in diameter will be utilized for traffic and the parallel escape tunnel of 6m diameter is intended to be used as escape route for persons, smoke clearance in the case of any accident/ fire in the main tunnel and for other emergency services. Both the tunnels are interconnected at every 300m by 27 cross passages. In addition to this, the traffic tunnel has a fully-integrated control system providing facilities like radio frequency, communication, ventilation, power supply, SOS call box, fire-fighting and incident detection.

Following benefits would be there for the society:

- Travel route of 41km along the surface highway between Chenani and Nashri has been reduced to 9.0 km through newly constructed tunnel.
- The tunnel will reduce the travel time from 2 hours to 11min.

- It will save fuel of about ₹ 27 lakh every day and will also reduce the carbon emission, which would be a contribution towards “Swachh Bhaarat” upto a certain extent.
- Neither the lithology of the ground surface has been disturbed nor deforestation was carried out while construction of the tunnels, and hence it preserves ecological balance all along the tunnel route.
- It will be a safe, all-weather road protected from avalanche and landslides as it bypasses snow- and landslide-prone Kud, Patnitop and Batote areas.
- It will boost economy and tourism in J&K state.

In Kiratpur-Ner Chowk Highway tunnelling project on NH-21 in Bilaspur, H.P, there was a problem with regard to the stability of barrier between the escape and main tunnels at Kaichi Mod (Tunnel No.1). CIMFR suggested diversion of escape tunnel to increase width of the rockmass barrier from 11m to about 17m. In addition to this, lay-byes were also suggested to shift from poor rock mass to comparatively good rock mass in order to increase the stability of barrier under high induced stresses due to large excavated tunnel size. According to the previous design, lay-bye were planned with the pedestrian cross passage in the barrier pillar at Ch. 13+350m. With this design, the barrier pillar of 11m would have been further reduced to 7m. Therefore, the lay-bye has been suggested to shift from Ch 13+350m to Ch 13+440m. The work is in progress.

Ladakh region of Jammu and Kashmir (J&K) is linked with rest of the country through two routes Leh-Srinagar and Leh-Manali which remain closed in the months of November to March every year due to heavy snow fall and avalanch. To overcome this isolation of Ladakh region, Ministry of Road Transport and Highways (MORTH) has undertaken construction, operation and maintenance of Z-Morh tunnel including approaches on National Highway 1 (NH-1) in the state of J&K on design, build, finance, operate and transfer (DBFOT) annuity basis. ITNL is the concessionaire for development of 6.5km long Z-Morh tunnel section of NH-1 in J&K on BOT basis. ITNL entrusted the work of proof checking of detailed design and drawings of tunnels and slope protection work to CSIR-CIMFR Research Centre, Roorkee. CSIR-CIMFR Research Centre carried out the tunnel design check and given its first report to ITNL containing the observations/comments/suggestions on Geotechnical Report, Tunnel Design Reports, West Portal Design Report and Ventilation Tunnel Portal Design. The work is in progress.

As an integral part of Tehri Hydro Power Complex (HPC) located in the State of Uttarakhand in Northern India; an underground 4 x 250 MW Tehri Pumped Storage Plant (PSP) proposed to be constructed parallel and close to the existing 1000 MW Tehri Hydro Power Plant (HPP) by the Tehri Hydro Development Corporation (THDC). The major underground components to be constructed are a machine hall, upstream surge shafts, butterfly valve chamber (BVC) and upper & lower penstock assembly chamber (PAC), downstream surge shafts, busbar cavern, busbar tunnels, a pair of tail race tunnels (TRTs) and outlet structures. CIMFR Roorkee Centre is providing technical advice to THDC in order to interpret the deformation behavior of the surrounding rock mass and assess complex engineering behaviour of the HPP and PSP underground structures by evaluation of instrumentation data provided by THDC. The closely excavated openings are instrumented by bi-reflex targets, MPBXs and load cells at different monitoring sections. The work has just been started and shall remain continue in next year.

CIMFR Roorkee is providing technical assistance for critical rock mass excavation in Pump Storage Power Project of THDC Ltd., Rishikesh at Tehri, Uttarakhand state. Controlled blast design for excavation of Butterfly Valve Chamber (BVC), Penstock Assembly Chamber (PAC)

and Transformer Hall and Power House caverns and large number of inter connecting galleries/ tunnels are carried out in close proximity (less than 5.0 m) of first phase HPP project housing very sensitive electro-mechanical equipments. CIMFR Roorkee has also carried out detailed field investigations at Tapovan Vishnugaad HEP Project, Joshimath, Vishnugaad-Pipaloti HEP Project, Pipalkoti and Singoli-Bhatwari HEP Project, Rudraprayag and provided optimised blast design for various rock mass classes for safe and productive rock excavation.

An inhouse R&D project for three years duration entitled 'Studies on Impact of Construction Blast Vibrations on Hill Slopes and Domestic Houses along the Tunnel Alignment' has been undertaken. Successful completion of the project work would help in formulating R&R policy guidelines for compensation to affected villagers and will also help in increasing acceptability of controlled blasting technique amongst the villagers residing in the close proximity of the construction project sites.

PHOTOGRAPHS

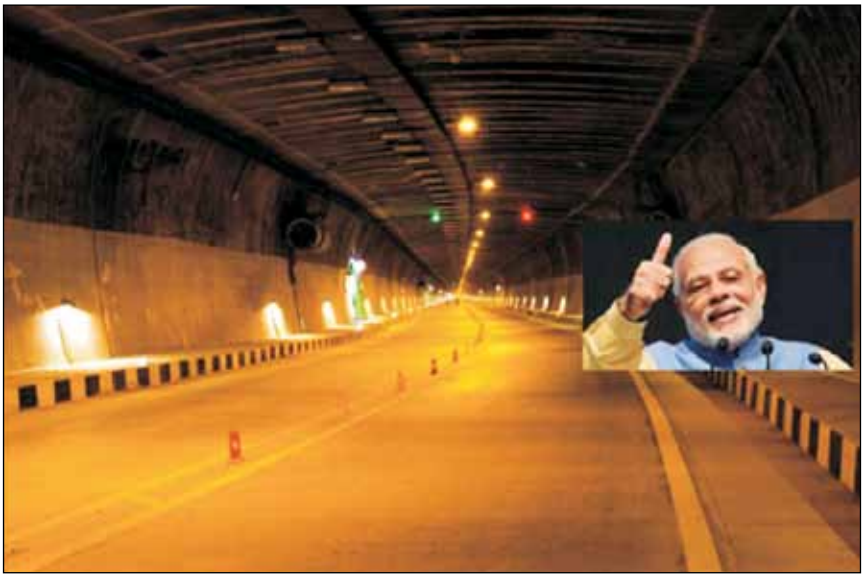


Photo 1: Interior view of finished Chenani-Nashri highway tunnel inaugurated by Hon'ble Sh. Narendra Modi ji, Prime Minsiter of India (Source:jummulinksnews.com)

Photo 2: Entrance of the main tunnel at Chenani end (Source:jummulinksnews.com)

Photo 3: Work on the portal of intermediate access tunnel for the Z-Morh tunnel project, J&K state

Photo 4: MPBX installed in butterfly valve chamber (BVC) in Tehri PSP project

13. Strata Mechanics and Nonconventional Gases

13.1. Strata Mechanics

An engineering effort for efficient underground mining of coal seams needs to be matched with thickness and characteristics of the seam, surrounding rock-mass and stress conditions. Bord and pillar (B&P) route of underground coal mining is popular in Indian coalfields. Under favourable geo-technical conditions of the coalfields, a large number of coal seams in the country have been left developed by Bord & Pillar (B&P) method of mining. Depillaring of these developed coal seams is challenging but important because they have locked a considerable amount of coal and blocked mining scope to the coal seams below it. Continuous miner (CM) based mass production approach is being adopted for a normal thickness of the developed coal seam, while single lift depillaring of total thickness (SLDTT) is preferred over the conventional multi-section depillaring of a developed thick coal seam. CM based mechanised depillaring (MD) adopts high capacity, stiff, resin grouted and pre-tensioned roof bolts as support system and are applied at goaf edge too. Strata Mechanics section undertook various industry sponsored and in-house assignments related to the design of roof bolt based breaker-line design (RBBLS) for MD and efficient operation of SLDTT on the basis of extensive field and laboratory investigations during the period April 2016 to March 2017.

Goaf edge of a depillaring panel inherits a number of openings, which provides least resistance path for the caving roof strata to encroach the working areas (Fig. 1). Influence of strata caving, inside the goaf, make it difficult to apply conventional roof bolt support norms in these openings at the goaf edge. Basic rock mechanics considerations find that the mining induced stress development improves the efficacy of roof bolt at the goaf edge. Application of, relatively, high density of bolts as roof bolts-based breaker line support (RBBLS) in the existing openings at the goaf edge to arrest the goaf encroachment is found to be working satisfactorily only if the surrounding natural supports are stable. The stability of a natural support, in and around the goaf edge, is found to be diluted due to side spalling/loosening caused by the mining induced stress. Different field experiences found that a high value of the stress causes side spalling/ loosening in natural supports, standing in and around the goaf edge. Simulation studies for these investigations were carried out in laboratory, mainly, using Flac 2D & 3D (Fig. 2) and field studies were done for safe and efficient extraction of developed coal seams at GDK-11 Incline Mine of SCCL and Pinoura Mine of SECL. Under the existing geo-mining conditions of some of the recent MD operations in Indian coalfields, the extent of spalling varied from 0.5m to 2m only (Fig. 3). Considering an acceptable dimension of the rib/snook for these site conditions, the position of RBBLS is shifted out-bye from the goaf line as per the extent of spalling, which performed satisfactorily in the field.

Deterioration in the competency of a natural support is an observed fact of different strata control studies conduted during single lift depillaring of total thickness (SLDTT) of a thick coal seam. This dilution is, mainly, due to an increase in extraction height by underwinning of roof coal band of the thick coal seam, developed along its floor horizon on room and pillar. These studies also noticed that the presence of competent roof strata over the extraction caused delayed caving after a large overhang, which varied from 6000 m2 to 10000 m2 in the studied panels. Most of the depillaring under above mentioned conditions experienced uncontrolled roof-pillar interaction during their roof caving, which adversely affected the mining operation. There ia a significant drop in w/h ratio of natural support (pillars/stooks) resulting in the reduction of pillar strength during depillaring and the nature of pillar changes from sqat to slender. Strata control

problems like junction failure, pillar/stook failure, side spalling of pillars, failure of barrier pillars were observed in the panels of GDK 8 and GDK 10 incline mines of Ramagudem area, SCCL. These strata control problems are mainly due to competent strata over thick coal seams which results in delayed caving in the panel. A simple idea to dilute the competency of overlying strata by fracturing is, first, experimented on simulated models to achieve controlled caving in the depillaring operation. An analysis of the stress redistributions in and around the depillaring for different horizons of fracturing in simulated models is used to derive a suitable horizon of fracturing (Fig. 4). The idea of competency dilution and obtained horizon of fracturing are validated by a field investigations during a SLDTT below a fractured overlying strata.

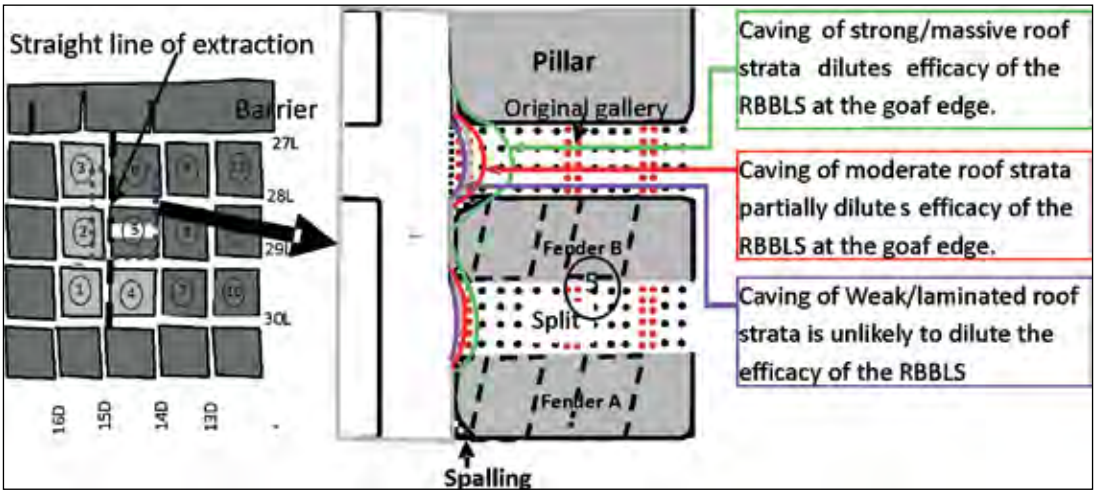
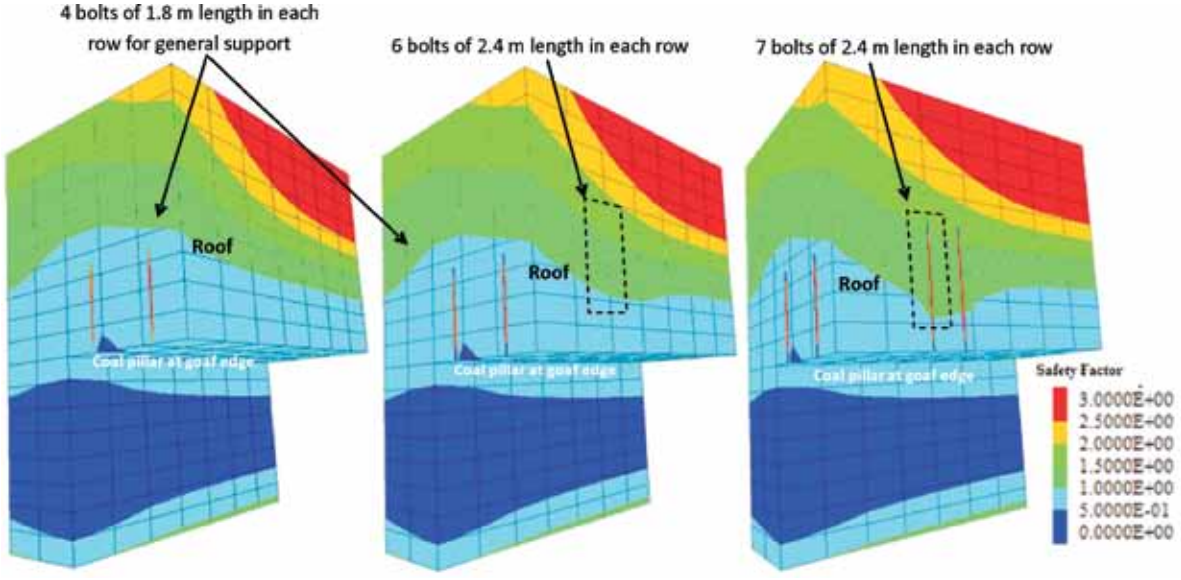


Fig. 1: Possibilities of goaf encroachment during caving of different types of roof strata (plan view)



(a) Without RBBLS (b) 1 m grid of RBBLS (c) 0.75 m grid of RBBLS

Fig. 2: Influence of RBBLS over the safety factor contour at 2 m distance from the goaf edge

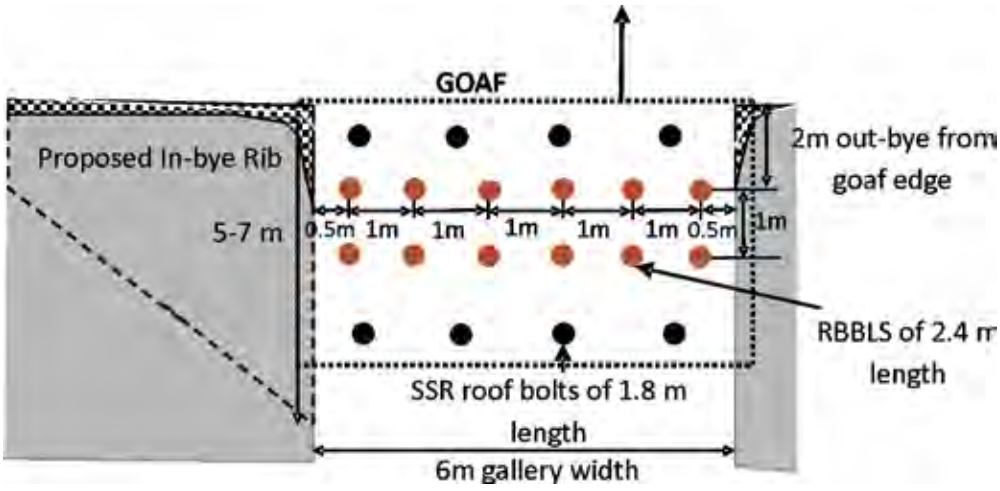


Fig. 3: Control of the goaf encroachment beyond the RBBLS position in a MD panel

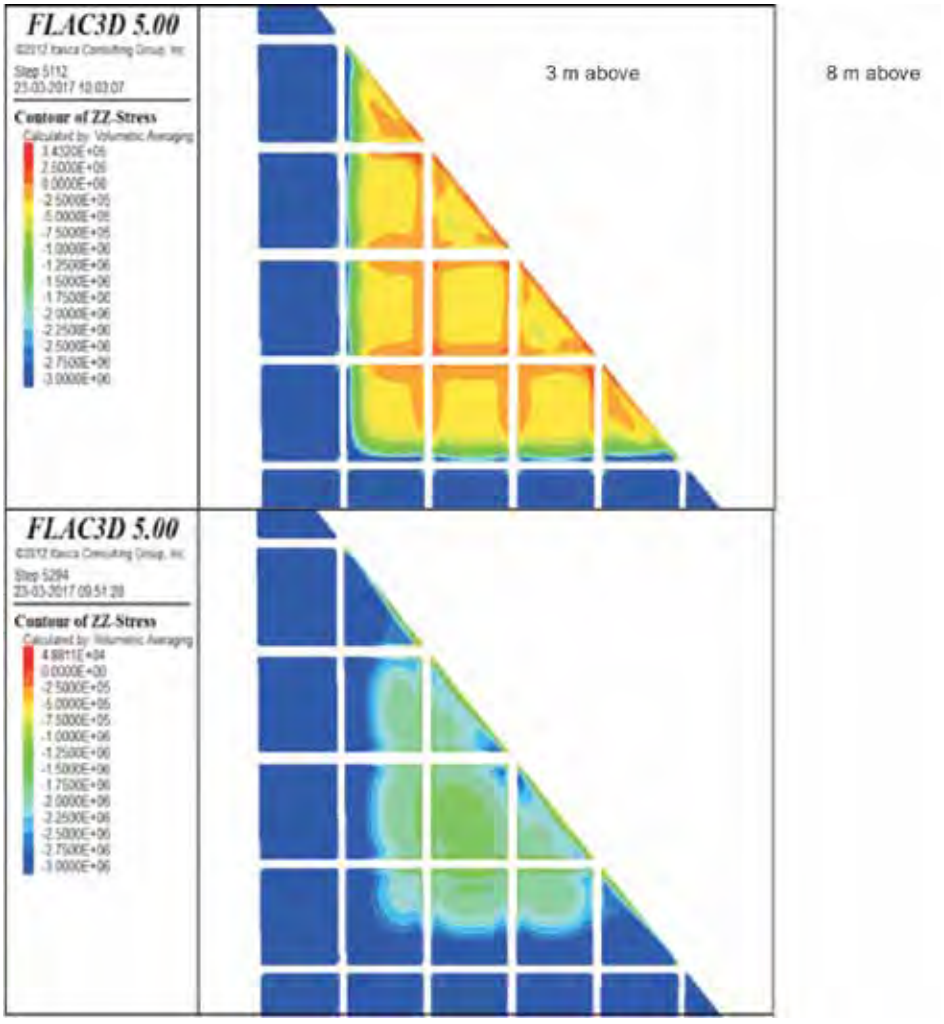


Fig. 4: Vertical stress contour in the panel at the maximum exposed span of goaf for different horizons (3m and 18 m from roof) of fracturing inside the overlying roof strata

13.2. Nonconventional Gases

This section is working to harness energy from various non-conventional sources ensure such as coalbed methane, coal mine methane, ventilation air methane and underground coal gasification. The group undertakes investigations on safety in underground coal mines from gas hazard. Estimates of greenhouse gas emission from coal mining and handling activities, and oil and natural gas systems are also prepared by the same group.

S & T Research Projects

1. Role of coal composition and maturity on the sorption behaviour of Indian Coals for the Gas Storage Estimation

Sorption isotherm of coal seam is critical for CBM reservoir studies as it provides information about storage capacity of coal, recoverable resource, techno-economic feasibility, and helps in simulating and designing the operational conditions. The state-of-art adsorption isotherm setup designed and developed under this project is in active use for adsorption isotherm construction for some of the companies working on CBM. A total of 190 samples including 70 coal samples were studied on adsorption behaviour of Indian coals. It has been observed that chemical and petrological properties of coal affect the sorption behaviour of the coal samples. The work is completed.

2. Shale Gas Potentiality Evaluation of Damodar Basin of India

The major objective of this research project is to evaluate different sedimentary basins of India for their shale gas potentiality through integrated geophysical, geological, geochemical and petrophysical investigations. A total of 220 shale samples have been investigated for detailed Megascopic properties like colour, hardness, fracture, sp. gravity, homogeneity, banding, etc. Rock eval pyrolysis and TOC of 130 shale core sample were carried out to assess shale gas potentiality in Jharia and Raniganj coalfields. 3D//2D seismic studies have been completed by National Geophysical Laboratory, Hyderabad at Rangatmati B in the East of Jhanjhra, Raniganj coalfield. All these properties are to be investigated in Jharia Coalfield. The work is in progress.

Industry sponsored Projects

1. Adsorption Isotherm Studies of Carbonaceous Shale/Coal Samples for Characterization of Shale Horizons with Respect to shale Gas Potentiality and Quantitative Estimation of Shale Gas Resources by Direct Method in Mohuda sub-basin of Jharia Coalfield during XII Plan period.
2. Investigation on Methane Emission at R-IV and R-V Coal Seams of Pandaveswar Colliery for the Categorization of Degree of Gassiness and Advice on Associated Gas Hazards.

B. FUEL SCIENCE SECTOR

1. Combustion Science and Technology

1. Energy Sector Inventory: Biennial Update Report (BUR-2, BUR-3) and Third National Communication (TNC)

Work done: Prepared National GHG inventory for energy and manufacturing industries for the year 2011-2013.

2. Clean coal technology tap coal (csc-0102)

Work done: Different experimental parameters for oxy-fuel combustion studies in Fuel Evaluation Test Facility are optimized. Cold model set up successfully worked with Ilmenite sample for CLC application. Combustion behaviour of coal/biomass blends are studied in different scale.

2. Coal Preparation and Carbonization

1. Coal Preparation section has undertaken various projects on washability, sampling of indigenous and imported coals, Dry beneficiation etc.

The clients included TATA R & D Centre, Jamshedpur, Karnataka Power Corporation Limited, Bengaluru, TATA West Bokaro, SAIL, Kolkata, Singareni Collieries Company Ltd., Hyderabad and Adani Pvt. Ltd., Gurgaon.

Washability studies on the samples supplied by KPCL, Begnaluru from PKPK, Talcher were carried out and the results indicated that it is possible to achieve a yield of 73.0% at 31% ash content and 82% at 34% ash content.

TATA West Bokaro washability studies were carried out on the coarse fraction and flotation of the coal fines for calculation of total recovery of clean coal, middlings and rejects.

Sampling and Analysis of imported coal unloaded at Port ends-CIMFR had characterize the imported coals after collecting the representative samples during unloading at the port ends and preparation of samples for characterization as per the standard procedure. During the period 2016-17 sampling from four vessels was carried out at unloading ports of Vizag, Paradeep and Haldia and the analytical report was submitted.

2. Washability and Characterization of coal samples supplied by Singareni Collieries Company Limited

Study of the cleaning potentialities of the coal supplied from different mines of SCCL to RKP Washery. The work is in progress.

3. Washability and characterization of seam IV, V and VI borehole coals from Parsea Block supplied by Adani

Study of the bore-hole washability followed by different characterization tests of raw and products from three different seams, supplied by Adani. The work is in Progress.

4. Development of Zero Waste Technology for Processing and Utilization of Thermal Coal (ZWT-CUP)

The detailed studies carried out using the dry beneficiation route showed that it is possible to remove hard stones/shales through rotary breaker and further by passing the crushed coal through ore sorter it is possible to reduce the ash content by 6 to 8 units.

5. Development of an On-line Washability analyzer

The laboratory model of the analyzer was installed and initial tests were carried out by the sub-implementing agency. The building for installation of the on-line washability analyzer was completed and the online analyzer was erected at the coarse coal washing pilot plant.

Online Coal Washability Analyzer installed at Coal Washing Pilot Plant

6. Study on the preparation of reactive coke from lignite for ferro-alloy production

In this project Lignite sample was collected from Naively Lignite Corporation, Tamilnadu. The lignite samples were characterized with respect to its physical and chemical properties with special reference to proximate analysis, ultimate analysis and thermal rheological parameters. Lignite sample was collected and characterized with respect to its properties. The sample has been carbonized at different temperature from600°C to 800°C to get desired quality of char. The char was also characterized with respect to different chemical parameters. Fine char samples were agglomerated in the form of briquette. The briquettes were also characterized with respect to their physical properties. Effort was also initiated to repair/ renovation the existing high pressure briquette machine.

7. Study on the preparation of formed coke from low rank coal for metallurgical use

The objective of the project is to study the preparation of form coke using different low rank coal and petroleum based binders, including the study of various properties of the formed coke for use in metallurgical industries. The project is under progress.

3. Industrial Biotechnology and Waste Utilisation

1. Potassic (K) fertilizer Technology to Empower the Nation (K-TEN): CIMFR Activity: Development of biomass ash/ biochar based slow release potassium fertilizer (SRKF)

Ash samples were collected from > 20 biomass based power plants across the country. Total potassium content in the ash varied from 0.5- 14%. Potassium content was higher in the fly ash than bed ash. Several experiments were conducted for extraction of potassium from the ash using different acids, chemicals, surfactants and at different temperature and agitation time. It was found that water extraction at ambient condition is good enough for extraction of 80 – 90

% of the potassium present in the ash. The extracted potassium solution was evaporated and the resultant salts were mixed with suitable binders and pelletized into slow release fertilizer. A lab scale reactor (1 kg/ batch) was designed and installed. The process was optimized in the lab scale reactor. Based on the data from lab scale reactor a pilot scale reactor (100 kg/ batch) was installed. The process is further simplified in the pilot scale reactor by adopting decanting process instead of vacuum filtration; and solar evaporation instead of forced evaporation. The extraction process was optimized in the pilot scale reactor. The residue ash obtained after extraction of potassium was used for brick making.

2. Inventory of poly aromatic hydrocarbon (PAH) emissions from thermal power plants of India, ESC 305

Polycyclic aromatic hydrocarbon (PAH) contents were analysed in 39 coal samples collected from different coallieries. Total PAHs content was higher for coal samples from Rajmahal collieries (151.0 mg/kg) and the lowest value of 33.79 mg/kg was observed in Jharia coal samples. Phenanthrene and high molecular weight PAHs were found to be more prominent among total PAHs. The emission of PAHs during co-combustion of coal and biomass (corn cob) was studied in a drop tube furnace. The total PAHs content was always higher in the gas phase (12.7 – 41.7 µg/m3) than particulate phase (0.25 – 6.7 µg/m3). The total PAH emission increased with biomass addition. Stack sampling and analysis of PAH emission from four NTPC thermal power plants have been completed. PAHs emission was higher in the gas phase than the particulate phase. In the gas phase, low and medium molecular weight PAHs were dominant, whereas high molecular weight PAHs in particulates.

3. Carbon storage and its stabilization in the coal mine overburden dumps of Jharia Coal Field (JCF) through plantation and soil amendments

Above ground and below ground organic carbon stocks for reclaimed coal mine spoils have been assessed. With increase in age of reclamation the soil organic carbon increased linearly, whereas plant C stock followed a curvilinear trend. CO2 emission study carried out by adding different amendments with fresh overburden. The short term trend in C mineralization rate was modelled assuming SOC decomposition occurred in two pools. Mean residence time (MRT) was found higher in case of biochar addition, and addition of fly ash decreased the C mineralization rate. A 5 feet column experiments involving mine spoil amended with different combination of fly ash (FA), farmyard manure (FYM), poultry manure (PM), and biochar (BC) has been studied to understand the below ground carbon accumulation pattern.

4. Bio-treatment of coal based industrial effluents (CBE) using aquatic photoautotrophs and recovery of coal-fines: A step towards the National Mission ‘Clean Ganga’

Innovative process developed for treatment of coal based industrial effluent (CBE)using aquatic phototrophs. The outcome of the project will serve an eco-friendly way to treat the coal based industrial effluent and lead to clean Damodar and full fill the National Mission Clean Ganga.

5. Screening and characterization of extremophiles methanogenic bacterial consortium in coal bed methane reservoir and study on its application for recovery of methane

Highly efficient and novel strains methanogenic bacteria for coal bio-processing were isolated from CBM sites underground coal mines and isolated organisms were under characterization study for patenting under IBT (International Budapest Treaty). Methanogenic organisms were tested for coal to bio-methane production.

6. CSIR Network (CSC 102) TAP COAL Activity 1: CO2 sequestration through Biological Route, CO2 mitigation, bio-H2 production &recovery of novel bio-products from coal combustion flue gas using coal industrial effluent through micro algae

Eighty nine (89) species of new filamentous and single cell algae (Chlorella, Oscillatoria, Spirogyra, Nostoc, Anaebaena, Hydrodactyonetc) have been isolated and identified from coal mining areas and process for CO2 to capture using flue gas from thermal power plants (13-17%CO2) was developed. Designed and patented the "Fibrous matrix photo bioreactor for branched and filamentous micro algae cultivation".

7. CSIR Network (CSC 102) TAP COAL, Activity 2: Bio-gasification of Coal

Developed the process for bio gasification of coal and designed "coal/biomass based domestic movable biogas reactor" (CSIR copyright and Design act). The process developed for biomethanation of coal leads to collaboration with NTPC, Netra for bio-methanation of coal mill rejects. Process for de-ashing of high ash Indian coals by bacterial route and Co-biomethanation of low rank Indian coal with 17 different biomass substrates were developed.Highly efficient and novel strains of white rot fungi and methanogenic bacteria for coal bio-processing were isolated from underground coal mines and isolated organisms were patented under IBT (International Budapest Treaty).

8. Evaluation of coal mill rejects for its suitability for bio methanation

Process developed for biomethane production from coal mill reject.

9. Process for synthesis of PHA (polyhydroxyalkanoic acids)- A biodegradable plastics from biodepolymerized lower rank coal

Developed the process for synthesis of Polyhydroxyalkanoates PHAs (bio plastics) from bio-depolymerized low grade coal using Pseuodomonus and Bacillusstrains. PHAs has numerous applications in medicine (surgery, transplantation, tissue engineering) and for making plastic kitchenware, packaging film, other disposable items, etc.

4. Resource Quality Assessment

1. Testing and Analysis (Chemical)

Several thousands of coal, coke & other carbonaceous samples were analyzed as aid to industry & basic research in addition to earning the ECF of around Rs. 125lakh.

2. Chemical and Petrographic characterization of coal from virgin areas of different coalfields as aid to power and steel industry in India

The present work is aim to analyze the coal samples of Damodar valley and various other coalfield for Proximate, GCV, Ultimate analysis, Petrographic and other tests like HGI, AI etc. This data bank will serve as national asset as for as coal quality of these coalfields are concerned. In the past the compiled data on various coalfields in eight volumes by CSIR-CIMFR was used for planning several Indian Steel plants & Power plants. CSIR-CIMFR supplied especially complied data bank to Directorate General of Hydrocarbons, New Delhi to plan for CBM exploration in Indian coal basins. These reports may be used even as a sellable product in printed/electronic version. The work will also update the old analytical results after 2001.

3. Consultancy on collection and quality monitoring of coking coal samples dispatched to SAIL integrated Steel plants from CCL washeries and ROM coal

The samples of washed and raw coals being dispatched to different SAIL plants from different

loading points of CCL mines such as: Dhori, Karo, Swang, Kathara, Rajrappa & Kedla are being sampled on daily basis and after preparation their qualitative analysis is being done for total moisture, moisture on Air Dried (AD) basis and ash contents. The parties are satisfied with our performance.

4. Testing and Analysis (Petrography)

During the above mentioned period micro petrographic analysis of about 200 number of samples has been carried out.

5. Evaluation of coal quality at unloading point of NTPC, Vindhyachal Super Thermal Power Project (VSTPPS), Singrauli, M.P.

Progress: Round the clock sampling & sub-sampling job at site are going on. As per defined modalities the results were sent to them.

6. Validation of GCV of coals at unloading point of NTPC Vindhyachal super thermal power project (VSTPPS), Singrauli, M.P. (Third Phase)

Round the clock sampling & sub-sampling job at site are going on. As per defined modalities the results were sent to them.

7. Characterisation of coals from different coalfields explored by CMPDIL RI-I, through borehole coal Core study- Phase I (For coal cores received between September 2013 to March 2014)

Band by band analyses of Dharma block, Narankuri, and Bishtupur blocks have been carried out and the results were sent to RI-I. The Overall samples analysed after getting the advice.

8. Characterisation of coals from different coalfields explored by CMPDIL RI-II, through borehole coal core study- Phase I (For coal cores received between September 2013 to March 2014)

Band by band analyses of Singra and Kapuria block have been carried out and the results were sent to RI-II.

9. Coal quality assessment of borehole coal core samples received from Tete Province of Mozambique for industrial application– Phase– II

After logging of ~1512 meter of coal core sent by CIAL, band by band around 3500 samples were analyzed for moisture and ash content. Preparation and analyses of overall samples have been done.

10. Characterisation of coals from different coalfields explored by CMPDIL RI-III, through borehole coal core study – Phase I (For coal cores received between August'13 – March 2014)

Band by band analyses of Religarh and Patratu block have been carried out and the results were sent to RI-III. After getting the advice for overall samples, different analyses will be carried out.

11. Quality monitoring of coal at loading point (ECL mines) for NTPC, Kahalgaon, Bihar

Sampling and sub-sampling jobs at site round the clock were completed. During this period the samples collected at NTPC end were brought to CIMFR for different analyses viz. Moisture on 60% RH at 40oC, Ash and Gross Calorific value to fix the received grade.

12. Quality monitoring of coal at loading point (ECL mines) for NTPC, Farakka, W. B.

Sampling and sub-sampling jobs at site round the clock were completed. During this period the samples collected at NTPC end were brought to CIMFR for different analyses viz. Moisture on 60% RH at 40oC, Ash & Gross Calorific value to fix the received grade.

13. Coal quality monitoring at loading end (NCL mines) for NTPC, Rihand Thermal Power Station, U.P.

Sampling and sub-sampling jobs at site round the clock were completed. During this period the samples collected at NTPC end were brought to CIMFR for different analyses viz. Moisture on 60% RH at 40oC, Ash & Gross Calorific value to fix the received grade.

14. Monitoring of coal quality at loading points (NCL mines) for NTPC, Singrauli Thermal Power Station

Sampling & sub-sampling jobs at site round the clock were completed. During this period the samples collected at NTPC end were brought to CIMFR for different analyses viz. Moisture on 60% RH at 40oC, Ash & Gross Calorific value to fix the received grade.

15. Monitoring of coal quality at loading points (NCL mines) for NTPC, Vindhyachal Thermal Power Station, M.P.

Sampling and sub-sampling jobs at site round the clock were completed. During this period the samples collected at NTPC end were brought to CIMFR for different analyses viz. Moisture on 60% RH at 40oC, Ash and Gross Calorific value to fix the received grade.

16. Technical advice for efficient combustion behavior of coal at NTPC, Badarpur, New Delhi

Collection of coal samples from individual rake from selected wagons as per mutually agreed modalities. Five sampling points such as (i) Unloading points, (ii) Pre-crusher, (iii) Post-crusher, (iv) Pre-bunker and (v) Coal as fired (Mill fines) were chosen for collection of representative samples. This exercise was repeated for seven successive days i.e. seven rakes. Sub-sampling was done at unloading point near the laboratory of NTPC, Badarpur and reduction of samples as per requirement. Characterisation of coal samples through their facility with NTPC, Badarpur was done and technical advice on plant performance was provided. This includes Moisture As-received Basis, Equilibrated moisture at 60% RH and at 40oC, Proximate Analysis and GCV.

17. Technical advice for efficient combustion behavior of coal at NTPC, Jhajjar, Harayana

Five sampling points, viz. (i) Unloading points, (ii) Pre-crusher, (iii) Post- crusher, (iv) Pre-bunker and (v) Coal as fired (Mill fines) were chosen for collection of representative coal samples. This exercise was repeated for seven successive days i.e. seven rakes. Sub-sampling was done at unloading point near the laboratory of NTPC, Jhajjar and reduction of samples as per requirement. Characterisation of coal samples through their facility with NTPC, Jhajjar was done and technical advice on plant performance was provided. This includes Moisture As-received Basis, Equilibrated moisture at 60% RH and at 40oC, Proximate Analysis and GCV.

18. Technical advice for efficient combustion behavior of coal at NTPC, Dadri, U. P.

Five sampling points, viz. (i) Unloading points, (ii) Pre-crusher, (iii) Post- crusher, (iv) Pre-bunker and (v) Coal as fired (Mill fines) were chosen for collection of representative coal samples. This exercise was repeated for seven successive days i.e. seven rakes. Sub-sampling was done at unloading point near the laboratory of NTPC, Dadri and reduction of samples as per

requirement. Characterisation of coal samples through their facility with NTPC, Dadri was done and technical advice on plant performance was provided. This includes Moisture As-received Basis, Equilibrated moisture at 60% RH and at 40oC, Proximate Analysis and GCV.

19. Validation of Gross calorific value of coals at loading point for NTPC, Singrauli, U.P. (Second Phase)

Sampling & sub-sampling jobs at site round the clock were completed. During this period the samples collected at NTPC end were brought to CIMFR for different analyses viz. Moisture on 60% RH at 40oC, Ash & Gross Calorific value to fix the received grade.

5. Gasification and Liquefaction

1. Tap Coal: Co-gasification of High Ash Indian Coal and Biomass

Characterization of selected biomass and coal samples for physical and chemical properties has been completed. Gasification reactivity of two biomass (Rice Husk, Ground nut) and coal at different temperatures in TGA has been completed. Fluidization behavior of different biomass and coal samples in fluidized bed test facility at cold condition has been studied. Installation and commissioning of Thermo gravimetric Reactor (TGR) and online gas analyzer have been completed. Co-gasification of selected coal and biomass was conducted in pilot scale fluidized bed gasifier.

2. Catalytic petcoke gasification study

Characterization of feeds has been completed. Suitable catalyst has been selected. Pure Petcoke gasification in the temperature range of 900 – 1300 0C is completed. Co-gasification of petcoke (70% and 80%) and biomass (30% and 20%) blends is completed. Co-gasification of petcoke ((70% and 80%) – coal (30% and 20%) blends is completed. Catalytic petcoke gasification is also completed.

3. Development of Indigenous Catalyst through Pilot scale studies of Coal-to-Liquid (CTL) conversion technology

An integrated CTL Pilot Plant has been installed and commissioned with the fund provided by the Ministry of Coal (MoC), Govt. of India. This project aimed for the development of indigenous CTL catalyst and process without the knowhow from foreign collaborators. The Pilot Plant consists of a Fixed Bed Air blown updraft Gasifier (Coal capacity: 50 – 100 kg/h), Gas Cleaning System and Fischer – Tropsch Reactor (Catalyst Capacity: 10 L) in an integrated way for testing of CTL catalysts. Two alumina supported cobalt catalysts have been tested and CTL crude has been synthesized. In this project, high ash Indian coal has been used for testing the activity of the FT catalysts. The CTL crude is having very high calorific value of more than 10899 Kcal/kg which is more than that of diesel produced from petroleum crude and it has also very high Cetane number (>74.8) and low RON (<40) which shows its suitability as diesel fuel.

4 Development of iron and cobalt based mesoporous and macroporous catalysts for conversion of syngas to liquid hydrocarbon through Fischer-Tropsch route

Cobalt-Ruthenium incorporated mesoporous silica doped alumina (SDA) catalysts were prepared by non-hydrothermal sol-gel method and thoroughly characterized by different techniques e.g. N2 adsorption desorption isotherm, XRD, HRTEM with elemental mapping, H2-TPR. Catalyst activity is tested in10 mL fixed bed reactor at 220 °C temperature and 30 bar pressure. The synthesis gas used for reaction is equivalent composition obtained from coal gasification. To evaluate catalyst

activity and long term stability, each experimental run was carried out in continuous mode for ~ 280 h at a GHSV of 500 h-1. Online GC analysis is carried out to monitor CO consumption and hydrocarbon production by TCD and FID detectors. Seven cobalt based catalysts (SDA and Al2O3 support) have studied and maximum conversion up to ~58% is achieved with 85 % C5+ selectivity. Three iron-copper based mesoporous silica-carbon nanocomposite supported catalysts were prepared by non-hydrothermal sol-gel method. Catalytic activity was tested in a 10 mL reactor and reaction was performed at 260 °C temperature and 30 bar pressure by using H2 deficient synthesis gas which is equivalent to coal gasification. The catalytic activity of three iron based catalyst have already been checked on-stream for 300 h (each catalyst). Evaluation of the activity of iron based catalysts is in progress.

5. Prevention of asphaltene aggregation towards improving real term process viability of coal liquefaction

By fluorescence spectroscopy we have been able to establish that coal derived asphaltene (CDA) forms aggregates in CCl4 medium. The molecular weight of the asphaltenes derived from various sources such as Barari and Lodna coke plant and coal to liquid plant has been determined successfully by VPO (Vapour Pressure Osmometer) technique. To ascertain the real term feasibility, the molecular weight of the asphaltenes derived from samples/emulsions obtained from the 2L continuous stirred tank reactor has also been determined by VPO. Studies leading to formation of asphaltene aggregates with time in toluene solvent have been carried out by VPO. Further, steady state fluorescence spectroscopic technique has been used to investigate the aggregation of coal derived asphaltene (CDA) sourced from Lodna Coke Plant situated at Dhanbad, India. The emission spectra of CDA provide information regarding the various stages of onset of aggregation in carbon tetrachloride medium. Almost similar results have also been inferred from the analysis of corresponding excitation spectra. It has been observed that the onset of aggregation of CDA occurs at concentration beyond a concentration of 10 mgL-1. Studies indicate the formation of a trimer at this concentration range. The association constant (K) for the trimer formation has also been evaluated from the spectroscopic data. Thus, our experimental result in fluorescence studies indicates nanoaggregation of CDA with a trimer in this concentration range (5-20 mgL-1).

6. CIMFR-DC: Regional Centre, Nagpur

1. Study of quality of coal for power generation, dispatched from loading ends of WCL to Nasik thermal power stations of MAHAGENCO from loading ends of WCL

A total of 923806.97 MT of coal dispatched for Nasik power plant from various sidings of WCL has been analysed at both at mine end as well as power plant end.

2. Study of quality of coal for power generation, dispatched from loading ends of WCL to Koradi thermal power stations of MAHAGENCO from loading ends of WCL

A total of 904101.95 MT of coal dispatched for Koradi power plant from various sidings of WCL has been analysed at both at mine end as well as power plant end.

3. Study of quality of coal for power generation, dispatched from loading ends of WCL to Satpura thermal stations, Sarni of MPPGCL from loading ends of WCL

A total of 850739.42 MT of coal dispatched for Satpura thermal stations, Sarni of M/s MPPGCL from various sidings of WCL has been analysed at both at mine end as well as power plant end.

4. Study of quality of coal for power generation, dispatched from loading ends of WCL to Paras thermal stations of MAHAGENCO from loading ends of WCL

A total of 863967.01 MT of coal dispatched for Paras power plant from various sidings of WCL has been analysed at both at mine end as well as power plant end.

5. Study of quality of coal for power generation, dispatched from loading ends of WCL to Bhusawal thermal stations of MAHAGENCO from loading ends of WCL

A total of 2037541.75 MT of coal dispatched for Bhusawal power plant from various sidings of WCL has been analysed at both at mine end as well as power plant end.

6. Study of quality of coal for power generation, dispatched from loading ends of WCL to Khaparkheda thermal stations of MAHAGENCO from loading ends of WCL

A total of 2086279.47 MT of coal dispatched for Khaparkheda power plant from various sidings of WCL has been analysed at both at mine end as well as power plant end.

7. Study of quality of coal for power generation, dispatched from loading ends of WCL to Chandrapur Super Thermal Stations of MAHAGENCO from loading ends of WCL

A total of 5803619.12 MT of coal dispatched for Chandrapur power plant from various sidings of WCL has been analysed at both at mine end as well as power plant end.

8. Study of quality of coal for power generation, dispatched from loading ends of WCL to Parli Thermal Stations of MAHAGENCO from loading ends of WCL

A total of 426280.55 MT of coal dispatched for Parli power plant from various sidings of WCL has been analysed at both at mine end as well as power plant end.

9. Study of quality of coal for power generation, dispatched from loading ends of WCL to Thermal Power Stations of KPCL, Karnataka from loading ends of WCL

A total of 749787.71 MT of coal dispatched for TPS of KPCL, Karnataka power plant from various sidings of WCL has been analysed at both at mine end as well as power plant end.

10. Study of quality of coal for power generation, dispatched from loading ends of WCL to NTPC Ramagundam from loading ends of WCL

A total of 8960688.52 MT of coal dispatched NTPC Ramagundam power plant from various sidings of WCL has been analysed at both at mine end as well as power plant end.

11. Study of quality of coal for power generation, dispatched from loading ends of WCL to NTPC MOUDA WCL from loading ends of WCL

A total of 1864055.07 MT of coal dispatched NTPC MOUDA WCL power plant from various sidings of WCL has been analysed at both at mine end as well as power plant end.

12. Study of quality of coal for power generation, dispatched from loading ends of WCL to HPGCL from loading ends of WCL

A total of 54816.88 MT of coal dispatched HPGCL power plant from various sidings of WCL has been analysed at both at mine end as well as power plant end.

13. Electrical energy audit and benchmarking of electrical power consumption of AKWM colliery of Katras area including colony and offices of Bharat Coking Coal Limited, Dhanbad

The proposed study would aim at setting specific power consumption norms for mine and estimate energy saving potential in opencast mine. The study will result in cost-effective recommendations to reduce electrical consumption of the mine including colony and offices. The study also aims to aware management and technical personnel of BCCL regarding the importance of energy efficiency, energy conservation and benchmarking in electrical machinery of the mine. The specific power consumption norm for mine is useful to compare the energy performance of other similar mines. Draft report submitted and accepted after technical discussions.

14. Study of Specific Diesel Consumption (SDC) of Kusmunda Opencast Mine, South Eastern Coalfields Ltd., Bilaspur

The proposed study would aim at setting specific diesel consumption norms for HEMMs and estimate diesel saving potential in Kusmunda opencast mine. The study would aware management and technical personnel of SECL regarding the importance of fuel efficiency and benchmarking in HEMMs at present operating conditions. The outcome of the study is beneficial to SECL for establishing the specific diesel consumption norms for HEMMs as well as mine and to compare the SDC of other similar mines. Field visits completed. Draft report submitted and accepted after technical discussions. Final report to be submitted

15. Benchmarking Specific Diesel Consumption (SDC) of Gevra Opencast Mine South Eastern Coalfields Ltd., Bilaspur

The proposed study would aim at setting specific diesel consumption norms for HEMMs and estimate diesel saving potential in Gevra opencast mine. The study would aware management and technical personnel of SECL regarding the importance of fuel efficiency and benchmarking in HEMMs at present operating conditions. The outcome of the study is beneficial to SECL for establishing the specific diesel consumption norms for HEMMs as well as mine and to compare the SDC of other similar mines. Draft report submitted and accepted after technical discussions. Final report is to be submitted

16. Optimisation of various parameters of lab scale winnowing system (phase II)

Winnowing experiments have been conducted with 100-50 mm, 100-75 mm and 75-50 mm size fraction coal samples of New Shasti siding (NSS)& Hindustan Lalpeth (HLSG) sidings of Ballarpur area of WCL. For 100-50 mm, 100-75 mm and 75-50 mm coals of NSS there were ash percentage reduction of 13.5,18.8 and 12.9 units has been obtained respectively. The corresponding yield of clean coal was 60%, 48.17% and 70.68 %. Similarly, for 100-75 mm and 75-50 mm coals of HLSG there were ash percentage reduction of 9.0, 9.4 and 3.7 units has been obtained respectively. The corresponding yield of clean coal was 71.67%, 62.46% and 71.67 %.

17. To study the effect of blending of Imported coal and Indian coals on coal quality parameters

Imported coal sample and Indigenous ROM coal sample were collected. Laboratory samples in ratios of 5 to25% of Indian coal to Indigenous coal were prepared.

18. To study the suitability of various non-toxic inorganic liquids and saccharides for float sink test of coal

Three (3)-Coal samples from WCL mine viz, New Sasti, Umrer & HLC mines have been collected. Crushing & Screening in various size fractions like 100-50 mm, 50-25 mm, 25-13 mm, 13-6mm, 6-3 mm & 3-0.5 mm have been carried out. Float & Sink tests in organic liquid (As per current practice & IS) has been conducted in the lab. Washability curves have been drawn.

19. Systematic compilation of coal quality, coal property and coal ash quality for preparation of databank of virgin coalfields of Maharashtra, Madhya Pradesh, A.P, Odisha, Chhattisgarh and lignite fields of Tamil Nadu, Gujarat and Rajasthan

During the period coal quality and property data for broholes from blocks Mathra Deep, Konda Hardola and Rajura Manikgarh (one seam) of Wardha Valley coalfield and Pathakuri Pipariya and Tedi Imli block of Pench valley coalfield were compiled.

7. CIMFR-DC: Regional Centre, Ranchi

1. Characterisation, Testing and Analysis of Coal

Around 10647 meters coal core processed and about 21425 nos. samples were prepared & 494 nos. samples analyzed during the period. The data generated helped the drilling agencies to know the quality of coal, mine planning, designing & exploitation of coals for proper utilization for industrial purposes. Industrial Interference with different Private, PHs of NTPC, CCO, CCL & MCL through the testing and analysis of referee and quality coal samples. Nos. of samples- 431.

2. Characterisation of coals from different coal fields explored by CMPDIL RI-III, through borehole coal core study– hase I (For coal cores received between 05.12.2011 to 30.06.2012)

Received total 3023.04mts of borehole coal from Ramgarh East block (474.01 mts), Bhurkunda block, (119.49 mts), Patratu block (2259.79 mts.) and Raham block (497.92 mts) of Ramgarh, South Karanpura and North Karanpura coalfield respectively. Approx 9312nos. of coal samples have been generated and send the results of (A+M) % test, Proximate (at 60%RH and 400C) and special test to the sponsor, CMPDIL, RI-III. Coal of Bhurkunda, Patratu & Raham blocks are high moisture and moderated to high ash content and non-caking in nature whereas coal of Ramgarh are low moisture but high ash content coal and shows the semi to weakly coking propensities.

3. Characterisation of coals from different coal fields explored by CMPDIL RI-III, through borehole coal core study–Phase II (For coal cores received between 01.07.2012 to 31.03.2013)

Approx. 9944 nos. coal samples have generated through the processing of approx. 3789 meters borehole coal cores which belongs to Patratu block (nos.- 21,1601.30 mts.), Raham block (nos.- 45,2063.61 mts.) and Gonda block (nos.– 3, 124.08 mts). Ten nos. of coal seams encountered in Patratu Block, South Karanpura coalfield where seam II to IV are spilted. The coal of this block has high moisture and low to medium ash content. The deep seated coal seams show the coking prosperities which are very weekly in nature. Five coal seams; from V to I in descending order have encountered in Raham block, North Karanpura coalfield. The bottom most coal seam – I has spilted into three parts viz; IB, IM & IT whereas seam – II has spilted into two parts viz; IIB & II T. Coking prosperities have developed in the seam – IB with weekly to semi coking in nature which observed by formation of bead.

4. Characterisation studies of coal seams encountered in Borehole No.-CMMJ-73, 78, 80, 89, 90, 91, 93, 94, 98, 99 & 100 Porda Block, Mand Raigarh Coal Fields

Received 11 (eleven) borehole coal cores and processed for sectional seam overall samples (around–1081nos:) and detail analysis/tests/(viz; Proximate, Gross Calorific Value, Ultimate analysis, Ash Fusion temp range and Hard grindibility Index have been done and dispatched the results to concerned sponsor. Maximum Eleven (11) nos. of coal seams encountered and

co-related as seam no.- II to XII. Thickest seam is seam VI, (approx. 10mts.) which meet in borehole no.- CMMJ – 94. Seam no.- II,IV & V splits into three to four parts. The coal of this block, have moisture (>5%) and ash content ranges from 14-45%. The gross calorific value of this block ranges from 3200 – 6990 Kcal/Kg. The sulphur content is very low (<1%) and refractory in nature as the ash fusion temp range is above 14000C. The good quality coals have been observed in the bottom seam nos. – II, III & IV which may be use as power grade coal without any beneficiation as ash content is very low (<25%) and gross calorific value is range; 5500-6900 Kcal/Kg.

5. Potentiality Study of Banhardi coal Block, Latehar, Auranga Coalfield through Characterisation, Testing and Analysis of Bore Hole Coal Core

39 BH coal core received during the period and around 8780 band by band samples and 1117 seam overall samples were prepared and analysed during the period. The analytical results (A+M)%, proximate analysis (on 60% RH & 400C) Gross calorific value, Ultimate analysis, Ash Fusion Temp range and Hard Grindibility Index were sent to drilling agencies. Approx. forty two (42) nos. of un-corrected coal seams countered in Banhardih block. The moisture and ash content ranges from 6-8% and 15.6%- 37.8% respectively. The deep seated coal seams (>800 mts) shows comparatively less moisture and ash content which ranges 3-5% and 22-31% respectively. The thickest coal seams encountered in borehole no.- S1, having thickness of 34.00 mts and ash content of <25%.

6. Potentiality Study of Lajkura, Rampur & IB Seam at Samleswari Block, IB-Valley Coalfield through characterisation, Testing & Analysis of Bore Hole Coal core

Received, eight (08) nos. of borehole coal cores from Samaleshwari block, IB-Valley coalfield 1891 nos. of band by band samples and 218 nos. of seam overall samples prepared by processing of 674 mts. (approx) of borehole coal cores and dispatched to the concerned sponsored,–CMPDIL, RI-VII, Bhubaneswar, Orissa.

Three (03) nos. of seams encountered which correlated as Lajkura, Rampur & IB in descending order. Rampur and Lajkura seams spilts into twelve (12) parts and seven (07) parts respectively. The coals of both seams have high moisture and ash content which ranges from 5.0-9.0% and 22.0-47.0% respectively. The good quality coal; observed in seam IB which belongs to Karharbari formation. .

7. Characterisation of coals from different coal fields explored by CMPDIL RI-III, through borehole coal core study–Phase II (For coal cores received between 01.04.2013 to 31.03.2014)

The coal of Patratu block is high moisture and moderate to high ash and non-caking coal whereas the coal of Raham and Rautpara block is medium to semi coking coal. The coal of Patratu Block may be use in Power Sector and the coal of Raham and Rautpara may be use as blendable coal after proper beneficiation.

8. Characterisation Studies of coal seams encountered in Borehole no.- CSNB-12,13,16,18,19 & CMTBL-34,40,41of Brahmanbil Block, Talcher Coalfield, Orissa

Around 149 samples were received during the period and was analysed. The analytical results viz. proximate and 60% RH & 400C and GCV were sent to the sponsor the coal of this block is high moisture and high ash non-caking coal which may be use in Thermal Power Station.

9. Characterization of coals from different coal fields explored by CMPDIL RI-III, through borehole coal core study-phase IV (For coal cores received between 01.04.2014 to 31.03.2015)

Approx. 6300 nos. of B/B samples prepared from123 nos. of borehole coal are which received from Patratu, Raham, Mahuwamilon, Hendigir, West Karkatta, KD-Hesalong & Bhurkunda block of South Karanpura and North Karanpura coalfield. The analyised result of (Ash +Mosture)% test results have dispatched to the concerned sponsor, CMPDIL,RI-III, Ranchi. The coal of Mahuwamilon, West Karkatta and KD-Hesalong block are low to medium moisture & ash content which ranges 3-4% & 13.0-42.0% respectively six to ten nos. of coal seams including local seams have encountered in this three blocks. Coals of hendigir block have low to moderate, moisture & ash content and approx twenty (20) nos. of coal seams encountered in this block.

10. Potentiality Study of Lajkura, Rampur & IB Seams at Lajkura Dip Sside and Burapahar Block, Ib-Valley Coalfield through Characterisation, Testing & Analysis of Bore Hole Coal Core

Received; (20) nos. of borehole coal cores from Lajkura Dip side and Burapahar block of IB-Valley coalfield. Generated nos. of B/B and national seam overall samples through the processing of approx. 1144 mts samples of borehole coal cores. Two coal seams, Lajkura and Rampur including twelve (12) nos. of local seams have encountered in this block. The coal has high moisture and high ash which rouges from 4-7% & 32-47% respectively the coal seams are inter bounded and non-caking in nature.

11. Quality Assessment of Coking and Non-Coking coal of North & South Karanpura, East & West Bokaro Coalfields for Seam/Steam/Channel samples

One hundred (100) samples have been analysed for determination of moisture (at 60% RH and 400C) and GCV.

12. Characterization study of the borehole coal core of Burapahar and Lajkura Dipside blocks of Ib Valley coalfield

Coals of Birapahar and Lajkura dip side blocks of Ib valley, are good power grade coal which will help to power plant for efficient generation of power energy.

13. Characterization of coals from different coal fields explored by CMPDIL RI-III, through borehole coal core study–Phase V (For coal cores received between 01.04.2015 to 31.03.2016)

Detailed analyses/tests (viz. Proximate, GCV, Ultimate on 60%RH & 40oC moisture basis and AFT and HGI) will be conducted for the sectional overall samples based on the seam disposition and overall characteristics of the seams encountered.

14. Washability studies of borehole coal core of eight coal seams of Banhardi coal block, Latehar, Department of Mines and Geology, Govt. of Jharkhand

After proper beneficiation of coals of Banhardih may be used in power plant directionally.

15. Characterisation of coals from different coal fields explored by CMPDIL RI-III, through borehole coal core study-Phase VI (For coal cores received between 01.04.2016 to 31.03.2017)

This study provided a scientific & technical data to the customer which helped in proper utilization of this coal.

16. **Quality Assessment of coal at Salanpur-B and Barul Bagdih Blocks, Ranigunj Coalfield through characterization Testing and Analysis of Bore Hole Coal Core)**

This study provided a scientific & technical data to the customer which helped in the proper utilization of this coal.

17. **Technical advice on quality monitoring of coal (loading area-Bharatpur, Jagannath and Basundhara area of MCL) for Durgapur STPS**

Approx. 1.413 million tons of coal will be taken over under this project for analysis of representative samples in equilibrated moisture, ash content and GCV on equilibrated basis.

18. **Technical advice on Quality monitoring of coal at Un-Loading Area of NTPC-TSTPS, Talcher**

Approx. 8320000 tons of coal will be taken over under this project for analysis of representative samples in equilibrated moisture, ash content and GCV on equilibrated basis.

19. **Technical advice on quality monitoring of coal (Loading Area- Bharatpur, Jaganath, IB, Lakhanpur and Basundhara Area) for NTPC-TSTPS**

The job of quality monitoring of coal will be executed for two years. The deliverables will be assessment of coal quality being dispatched for payment to supplying coal company/mines.

20. **Quality Assessment of Coal from saunda B. Siding. Urimari Project, Barka Sayal area of CCL for Utilization in thermal power plant**

Approx. 100 percent of the samples will be tested for proximate and GCV under standard condition (at 60% RH &400C).

21. **Technical advice on quality monitoring of coal (Loading Area- Bharatpur, Jaganath, IB, Lakhanpur and Basundhara Area) for NTPC-JAJJAR**

The job of quality monitoring of coal will be executed for two years. The deliverables will be assessment of coal quality being dispatched for payment to supplying coal company/mines.

22. **Technical advice on quality monitoring of coal (Loading Area- Bharatpur, Jaganath, IB, Lakhanpur and Basundhara Area) for NTPC - Simhadri**

The job of quality monitoring of coal will be executed for two years. The deliverables will be assessment of coal quality being dispatched for payment to supplying coal company/mines

23. **Technical advice on quality monitoring of coal (Loading Area-Bharatpur, Jaganath, IB, Lakhanpur and Basundhara Area) for NTPC-HPGCL**

The job of quality monitoring of coal will be executed for two years. The deliverables will be assessment of coal quality being dispatched for payment to supplying coal company/mines.

24. **Technical advice on quality monitoring of coal (Loading Area-Bharatpur, Jaganath, IB, Lakhanpur and Basundhara Area) for NTPC- TTPS**

The job of quality monitoring of coal will be executed for two years. The deliverables will be assessment of coal quality being dispatched for payment to supplying coal company/mines.

25. **Technical advice on quality monitoring of coal (Loading Area- Bharatpur, Jaganath, IB, Lakhanpur and Basundhara Area) for Jindal Power Limited**

The job of quality monitoring of coal will be executed for two years. The deliverables will be assessment of coal quality being dispatched for payment to supplying coal company/mines.

26. Technical advice on qulitay monitoring of coal (Loading Area- Bharatpur, Jaganath, IB, Lakhanpur and Basundhara Area) for NTPC-NTECL

The job of quality monitoring of coal will be executed for two years. The deliverables will be assessment of coal quality being dispatched for payment to supplying coal company/mines.

27. Technical advice on quality monitoring of coal (Loading Area- Bharatpur, Jaganath, IB, Lakhanpur and Basundhara Area) for NTPC-Simhadri

The job of quality monitoring of coal will be executed for two years. The deliverables will be assessment of coal quality being dispatched for payment to supplying coal company/mines.

28. Technical advice on quality monitoring of coal (Loading Area- NK, Piparwar, Barka Sayal, Kuju and Argada Area) for Reliance Rosa Power, Navi Mumbai

The job of quality monitoring of coal will be executed for one year. The deliverables will be assessment of coal quality being dispatched for payment to supplying coal company/mines.

29. Technical advice on quality monitoring of coal (Loading Area- NK, Piparwar, Barka Sayal, Kuju & Argada Area) for Indira Gandhi Super Thermal Power Project, Jhajjar

The job of quality monitoring of coal will be executed for one year. The deliverables will be assessment of coal quality being dispatched for payment to supplying coal company/mines.

30. Technical advice on quality monitoring of coal (Loading Area- NK, Piparwar, Barka Sayal, Kuju and Argada Area) for FGUTPS, Uchahar, NTPC

The job of quality monitoring of coal will be executed for one year. The deliverables will be assessment of coal quality being dispatched for payment to supplying coal company/mines.

31. Technical advice on quality monitoring of coal (Loading Area- NK, Piparwar, Barka Sayal, Kuju and Argada Area) for Barh Super Thermal Power Plant, Bihar

The job of quality monitoring of coal will be executed for one year. The deliverables will be assessment of coal quality being dispatched for payment to supplying coal company/mines.

8. CIMFR-DC: Regional Centre, Bilaspur

Resource quality assessment of virgin coal resources of Chhattisgarh, Madhyapradesh, Odisha and Uttar Pradesh. During this period coal core of 15974.75 meter received. Around 8500 meters coal core processed and about 28904 nos. samples were prepared and analyzed. The data generated helped the exploration agencies to know the quality of coal, mine plan, design & utilization for industrial purposes.

During this period 40914 samples were prepared and analyzed for different sponsoring agencies viz. SECL, NTPC, DB Power, JK Cement , Lafarge Cement, GMR, CCO, MCL, MPPGCL, R V Briggs, Adani Power etc. as aid to industry & basic research in addition to earning the ECF of around Rs. 102 Lakh.

Testing and Evaluation Facilities Available

The laboratory is well equipped with adequate infrastructure for testing and analysis of coal and providing services to various Industries. Different types of activities performed here are as follows, Coal Sampling, Proximate Analysis (Conventional and Instrumental), Ultimate Analysis (Instrumental), Determination of Bulk Density and Specific Gravity, HGI of coal, Ash Fusion

Characteristics (AFT), Different forms of Moisture, Gross Calorific Value (GCV), Screen analysis of coal, lab-scale coal washability studies of ROM and borehole coal cores

Sophisticated Instrument Analysis

TGA	: Leco-701 and Navas-1000D,
Bomb Calorimete	: PARR-6200 and IKA-C 2000
CHN Analyzer	: Elementar Vario Macro, CHN-100
Sulphur Analyser	: CS-580, S-144 DR
AFT Determinator	: 5E-AF-4000
WD XRF	: Rigaku ZSX Primus

Sponsored Projects

a) Characterization of coals from different coalfields explored by CMPDIL, RI-V through borehole coal core study, Phase- V

Characterization of 182 number borehole coal cores generated from the detailed exploratory drilling in 10 blocks from 4 coalfields done by CMPDIL RI-V. The study includes visual lithological logging of boreholes coal cores of around 5860 metres, testing of ash and moisture percentage (on AD basis) of band by band samples (around 1300 nos.) and preparation and testing of sectional overall samples (around 1900 nos.) as per the advice of sponsor/CIMFR BU. Detailed analyses/ tests (viz. Proximate , GCV , Ultimate on 60% RH and 40oC moisture basis and AFT and HGI) will be conducted for the sectional overall samples based on the seam disposition and overall characteristics of the seams encountered. However, 100% of overall samples will be tested for proximate and GCV under equilibrated moisture condition while 10-15% (tentative) samples will be taken up for special tests like ultimate analysis , AFT, TS etc. HGI will be taken up according to data requirement to find out the range. For this study 10,300 band by band samples have been analysed and results submitted to sponsor. Apart from this, 1900 PO samples have been analysed for Proximate and GCV respectively. Besides, 170 samples have been analysed for Ultimate, 180 for AFT, 100 for Total Sulphur and HGI each.

b) Quality monitoring of coal at loading points supplied to MPPGCL from different SECL sidings and their characterization (Phase-I)

Total 1421 rake samples were collected and analyzed for Proximate, TM, and GCV for around 1 year from different SECL sidings viz. Bhatgaon, Jainagar, Bishrampur WHARFWALL, Kumda, Katora, Churcha, Dumanhill, NCPH-Chirmiri, Bijuri, Rajnagar, Govinda, Burhar, Nowrozabad, Surakachhar, New Kusmunda, Gevra, Junadih, Dipka and Robertson. The cost of the project was of Rs.13.35 crore.

c) Characterization of coals from different coalfields explored by CMPDIL, RI-V through borehole coal core study Phase- VI

Characterisation of 415 numbers borehole coal cores generated from the detailed exploratory drilling in 13 blocks from 4 coalfields done by CMPDIL RI-V.The study includes visual lithological logging of borehole coal cores of around 10942 mts. , testing of ash and moisture percentage (on AD basis) of band by band samples (around 18290 nos.) and preparation and testing of sectional overall samples (around 3500 nos.) as per the advice of sponsor/CIMFRBU following borehole samples like CMSI 7-10; CMRU 103-125; ASAE 7-52 ; CKBI 86-95 ; CMBP 6-17 ;

CSSN 44-50 ;CSDA 11-16 ;CDBB 50-62 ; CMSI 01-06 and SMPB 36-45 were analyzed for Proximate, TM and GCV and the results were sent to the sponsor.

d) Quality monitoring of coal at loading points supplied to MPPGCL from different SECL sidings and their characterization (Phase-II)

Total 200 rake samples were collected and analyzed for Proximate, TM, and GCV for around 3 months from different SECL sidings viz. Bhatgaon, Jainagar, Bishrampur WHARFWALL, Kumda, Katora, Churcha, Dumanhill, NCPH-Chirmiri, Bijuri, Rajnagar, Govinda, Burhar, Nowrozabad, Surakachhar, New Kusmunda, Gevra, Junadih, Dipka and Robertson. The cost of the project was of Rs.154 Lakh.

e) Characterization of coals from different coalfields explored by CMPDIL, RI-V through borehole coal core study Phase- VII

Characterisation of 743 number of borehole coal core generated from the detailed exploratory drilling in 19 blocks from 6 coal fields explored by CMPDIL RI-V. The study includes visual lithological logging of boreholes coal cores of around 23826.67 metres, testing of ash and moisture percentage (on AD basis) of band by band samples (around 58044 samples)

f) Study of quality of coal received at Sipat super thermal power station (NTPC) from SECL for power generation (Phase-I & II)

Quality monitoring of coal dispatched from different sidings of SECL to Sipat Super Thermal Power Station (NTPC). During this period 589 rakes were analyzed for TM, Moisture, Ash and GCV.

g) Study of quality of coal received at NSPCL, Bhilai from SECL for power generation

Quality monitoring of coal dispatched from different sidings of SECL to NTPC-SAIL Power Corporation Private Limited, Bhilai. During this period 315 rakes were analyzed for TM, Moisture, Ash and GCV.

h) Study of quality of coal received at GMR-Warora from SECL for power generation

Quality monitoring of coal dispatched from different sidings of SECL to M/s GMR-Warora. During this period 171 rakes were analyzed for TM, Moisture, Ash and GCV.

i) Quality monitoring of coal at loading points supplied to NTPC-Mouda from different SECL sidings and their characterization.

Quality monitoring of coal dispatched from different sidings of SECL to M/s NTPC-Mouda. During this period 180 rakes were analyzed for TM, Moisture, Ash and GCV.

j) Study of quality of coal received at Torrent power limited from SECL for power generation

Quality monitoring of coal dispatched from different sidings of SECL to M/s Torrent Power, Ahmedabad. During this period 120 rakes were analyzed for TM, Moisture, Ash and GCV.

k) Study of quality of coal received at Shri Singaji Khandwa thermal power station from SECL for power generation

Quality monitoring of coal dispatched from different sidings of SECL to MPPGCL-SSTPS, Khandwa. During this 27 rakes were analyzed for TM, Moisture, Ash and GCV.

l) Study of quality of coal received at Jindal Power Limited-Tamnar from SECL for power generation

Quality monitoring of coal dispatched from different sidings of SECL to JPL-Tamnar, Raigarh. During this 115 samples were analyzed for TM, Moisture, Ash and GCV.

m) Study of quality of coal received at MPPGCL Amarkantak thermal power station (ATPS) from SECL for power generation

Quality monitoring of coal dispatched from different sidings of SECL to MPPGCL-ATPS, Chachai. During this 186 samples were analyzed for TM, Moisture, Ash and GCV.

n) Study of quality of coal received at Korba super thermal power station (NTPC) from SECL for power generation (Phase-I & II)

Quality monitoring of coal dispatched from different sidings of SECL to Korba Super Thermal Power Station (NTPC). During this period 422 rakes were analyzed for TM, Moisture, Ash and GCV.

o) Study of quality of coal received at Sanjay Gandhi thermal power station (MPPGCL-SGTPS) from SECL for power generation.

Quality monitoring of coal dispatched from different sidings of SECL to Korba Super Thermal Power Station (NTPC). During this period 1124 rakes were analyzed for TM, Moisture, Ash and GCV.

9. Technical Information and Industrial Liaison

9.1 Knowledge Resource Centre, Digwadih Campus

CSIR- CIMFR, KRC (DC) is actively engaged in acquisition, updating the collection and providing the platform for E-access of information sources to expand the horizon of information base to the scientific and technical community. KRC is playing a coordinating role between users and the literature, providing personal information service through Current Awareness Service (CAS) and Selective Dissemination of Information (SDI) using modern information technology. Besides the day to day circulation, reference and reprographic services KRC is also rending the services like Documentation, List of latest addition, Bibliographic service, OPAC search, CD-ROM search, In- house database, Internet Facility & Access to E-journals. As per the guide line and instructions of the official language implementation authority , KRC (DC) is developing a variety of collection in Hindi language. User have been guided to maximize utilization of E Resource as well as Institutional repository (IR) with an aim to provide online access to CSIR-CIMFR research articles. KOHA library management software has been successfully installed and union catalogue of CSIR (KNOWGATE) was implemented.

Collection Strength at a glance:

1. Books (including reference books), Reports, thesis, Standards, specifications and bound volumes of Journals : 24639
2. CD & DVD Collection : 107
3. Current Journals subscribed : 22

9.2. Project Monitering and Evaluation and Industry Interface

Sixty seven sponsored projects and six consultancy projects were processed. Total 3407 numbers

of samples were received for testing and analysis. As an income Rupees 1,68,95,856.00 have been received.

9.3. Technology Transfer and Patents

Patents Filed in India:

1. Process for sequestration of CO2 and traces of hydrocarbon from natural gas processing industry by micro algae, Vetrivel Anguselvi, Lal Chand Ram, Reginald Ebhinmasto, Parivesh Chugh, Raj Kumar Kashyap, Renu Sinha, 26/Oct/2016, 0019NF2016/India, 201611036660
2. A process for the preparation of slow release potassium fertilizer from combustion wastes of biomass based power plants, Masto Reginald Ebhin, Ram Lal Chand, Dutta Pashupati, Thakur Sanjay Kumar, George Joshy, Das Tarit Baran, Mukherjee Ashis, Anguselvi Vetrivel, 01.12.2016, 0197nf2016/india, 201611041058

10.00 Right to Information Cell

This cell handled nine cases of RTI requests during the year. Information/reply was sent to the requestor in time.

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Aansari Iqbal, Sharma, S.N., Sundararajan, M., Kumar, R. and Pandey, B. K. (2016): Medicinal plant in Jharkhand state: an overview of current scenario, Global Journal of Engineering Science and Researches, ISSN 2348 – 8034, pp.1-6.

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Giri Soma and Singh, Abhay Kumar (2017): Ecological and human health risk assessment of agricultural soils based on heavy metals in mining areas of Singhbhum copper belt, India. Human and Ecological Risk Assessment: An International Journal, 23:1008-1027, DOI: 10.1080/10807039.2017.1295224.

Giri Soma and Singh, Abhay Kumar (2016): Spatial distribution of metal (loid)s in groundwater of a mining dominated area: recognizing metal (loid) sources and assessing carcinogenic and non-carcinogenic human health risk. International Journal of Environmental Analytical Chemistry. V. 96, 1313-1330, DOI:10.1080/03067319.2016.1255735.

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Deputation

- Dr. Ashok K. Singh, Scientist visited Houston, Australia on September 2016.
- Dr. Prabhat Kumar Mandal, Scientist visited West Virginia, USA from July 23-31, 2016, for presenting a technical paper titled “Development of a Technology for Optimal Extraction of Locked-up Coal from Underground Mines using Artificial Pillars” in the 35th International Conference on Ground Control in Mining (ICGCM) on July 26-28 in Morgantown, West Virginia, USA.
- Dr. Sahendra Ram visited and presented a technical paper at 35th International Conference on Ground Control in Mining (ICGCM), West Virginia, USA, 25-29 July, 2016.
- Dr.R. Ebhin Masto,Scientist deputed to Pacific Northwest National Laboratory, Richland, WA, USA to carryout research work on ‘Nitride-based slow-release fertilizer from fly ash: surface reactions and nitrogen-use-efficiency studies.

Awards

1. Dr. Santosh Kumar Ray, Principal Scientist received National Geoscience Award 2016 instituted by Ministry of Mines, Government of India under Mining Technology Group.
2. Dr. Santosh Kumar Ray, Principal Scientist received Dr. Rajendra Prasad Memorial Prize from The Institution of Engineers (India) for publication of paper entitled “Recent Development in Determining Spontaneous Heating Susceptibility of Indian Coals and Its Correlation with Intrinsic Parameters of Coal” in Journal of The Institution of Engineers (India) Series D, Vol 96, Issue 2.
3. Dr. R. Ebhin Masto, received National Geo-science Award (Sustainable Mineral Development), from Ministry of Mines, GOI, New Delhi.
4. Dr. V.A. Selvi,Scientist has been received the Aparajitha Award 2016

Attainment of Qualification

1. Dr. D.K. Sakhre,Scientist received Ph.D.degree in Mechanical Engineering on the subject-Design and Development of catalytic converter for reducing NOx from Diesel engine exhaust gases.

Courses and workshop Organized

1. Executive Training Programme on ‘Best Practices in Coalbed Methane Exploration and Production’ (ETP: CBM E&P 2017)

Excutive training programme imparted thorough understanding of climate change consequences of coal extraction and utilization, energy mix, geology of CBM reservoirs, reservoir characterization, reservoir simulation, data collations and interpretation and, designing and execution of commercial CBM projects while addressing the environmental impacts of CBM projects. Distinguished domain experts from academia, R&D institutions and Industry including CSIR-CIMFR, IIT Bombay,

Indian Institute of Management, Ahmedabad (IIMA), ONGC, IIT Kharagpur, IIT ISM, Dhanbad etc., provided a holistic approach on CBM exploration & production strategies to foster research and commercialization of CBM in India.

2. A two-day workshop on the 'Challenges and Opportunities of Underground Coal Gasification (UCG-2017)

The workshop was a part of the CSIR Network Project Coal Gas Urja and received additional financial support from ONGC, JCB India, ONGC Energy Centre, SAIL, SCCL and NLC India. In addition, many other governmental, industrial, research and academic organizations (DGH, NTPC, CCL, CMPDI, MECON, Ergo Exergy, Tata Steel, JSPL, SWP, MAPL, CSIR-IICT, IIM Ahmedbad and IIT(ISM) Dhanbad) supported this event by nominating their senior and mid-level delegates to attend this event. More than 80 delegates participated in this event hosted at the Vighyan Bhavan, New Delhi. The workshop received quite a positive response from the audience. Many officials from different companies suggested that routinely organizing such events could lead to better exchange 2338659079e of ideas between industry and academia.

Facility Inaugurated:

The national facility for high pressure adsorption isotherm construction (HPAIC) for research on nonconventional gas reservoirs developed and commissioned through the SERB funded project on coalbed methane had been formally inaugurated by Dr. Pradeep K Singh, Director, CSIR-CIMFR in presence of Dr. Debadutta Mohanty, Principal Investigator/Senior Scientist, Dr. Ajay K Singh, Senior Scientist, Dr. H. Singh, Sr. Principal Scientist, and Dr. R. Singh, Chief Scientist of Strata Mechanics and Non-conventional Gases Group, CSIR-CIMFR, Dhanbad.

Highlights of the Visit of Honourable Union Minister of Science & Technology and Earth Sciences, Dr. Harsh Vardhan, Dr. Girish Sahni, DG, CSIR, Sri D. N. Singh, IAS and Dr. Sudip Kumar to CSIR - Central Institute of Mining and Fuel Research on 16th May 2016

At the outset Dr. Pradeep K Singh welcomed the Honourable Minister, Director General, CSIR, distinguished guests and experts from industry in the Industry Meet and apprised them about the various ongoing activities of the Institute, new initiatives taken up specially in the direction of formulation of new Mission and Vision of the Institute, MoUs/agreements signed, ECF generated etc. Further he also briefly highlighted the significant achievements and future plans of the Institute.

He then invited the experts for their comments and to share their experience and views on the role and performance of CSIR-CIMFR in addressing various issues pertaining to their field of activities.

The following points emerged during the discussion:

- The role of CSIR-CIMFR was duly appreciated by the industry people for effectively addressing the production, productivity and safety issues faced by the mining industry.
- The initiatives undertaken in the field of sampling and analysis of coal were also appreciated, which have helped in providing quality coal to the power sector,s thereby improving the efficiency and reducing the cost.
- It was reiterated to take up more initiatives on converting waste to wealth, like mine water to potable water, overburden rock to sand for mine filling and civil construction use etc. This will further help to address the issue of sustainability vis-a-vis development.
- Design of washeries as per the quality of coking coal is another area of interest which came up during discussion.
- To fulfill the objective of Make-in-India. CSIR-CIMFR should come up with new ideas and innovative R&D programme.
- Under Skill Development programme, CSIR-CIMFR should provide training in the relevant field to help the industry.
- Setting up of internationally acclaimed flameproof testing laboratory fulfilling the IEC standards in collaboration with CSIR-CIMFR.

Hon'ble Minister appreciated CSIR-CIMFR for addressing such issues raised by the industry and assured to provide guidance to them in foreseeable future also. He, however, suggested that:

- Policy should be people driven to address the concerns of the common man.
- Industry experts should come up with suggestions on innovative ideas and policies.
- Research activities should be taken up on contentious issues like GHG emission, global warming, waste-to-wealth issue, environmental and occupational health aspects.
- Efforts should be made in developing symbiotic relationship between CSIR-CIMFR and Industry keeping in view the mutual benefits.

The Honourable Minister visited different laboratories of the institute and the following suggestions given by him are listed:

1. Bhagwant Singh Advanced Mining Research Centre

Hon'ble Minister inaugurated the Bhagwant Singh Advance Research Centre, and visited the Scanning Electron Microscope (SEM) facilities and the High Performance Computing (HPC) facilities where he was apprised of the purposes and capabilities of the installed systems.

He suggested that the HPC system should be connected with the Central Server so that it can be shared by all the researchers working on the same field.

Hon'ble Minister, after the inauguration along with Dr. Girish Sahni, DG, CSIR, Sri D N Singh, IAS and Dr. Sudip Kumar planted one plant each in the premises.

2. Flame Proof Testing lab

Honourable Minister was shown about the testing procedures for different types of equipments used in mining industry. The Hon'ble Minister expressed his pleasure and satisfaction on the work being done in the division.

3. Rope Testing Lab

During the visit the Hon'ble Minister enquired about the purpose and process of conducting the rope tests. After explaining the details, a destructive test of a winder rope was demonstrated before the Honourable Minister.

4. Address to Scientists and Staff in the Auditorium

- Complimented CSIR-CIMFR as one of the few labs of CSIR which is really fulfilling CSIR mandate specifically for addressing the industrial needs and demands.
- Appreciated the efforts of the CSIR-CIMFR scientists for working in difficult conditions and focusing research activities for the benefit of the common man as per the mandate of the government in particular and the nation as a whole.
- Appreciated the efforts to achieve self sufficiency within 2-3 years and suggested to emulate the same business model in all other labs of CSIR.
- He explained the need to commercialise the technologies which have already been developed.
- He informed about the Govt. of India scheme of Digital India which would help in establishing world class connectivity for prompt and efficient sharing of knowledge so that scientists are thoroughly acquainted with similar job being taken elsewhere.
- He further reiterated that the state of the art facilities are already available with the scientists who need to have passion to do great things with killer instinct.
- Need to go a step further, act in proactive manner, think out of the box, generate new ideas, identify the critical issues and diagnose the problems and find innovative solutions.
- He emphasised that it is the most opportune and right moment for the scientific community as the Honourable Prime Minister, at the helm of affairs, have full faith in the capabilities of scientists.


डॉ. हर्ष वर्धन
डॉ. गिरीश साहनी
का
हार्दिक अभिनंदन


अभिनदन
झारखण्ड
Dr. Harsh Vardhan


माननीय केंद्रीय मंत्री
डॉ. गिरीश साहनी
का


Dr. Girish Sahni
Dr. Harsh Vardhan


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Glimpses of the photographs of various events organised at CSIR-CIMFR, Digwadih Campus during 2016 - 17

After inauguration of pilot plant for coal to oil on 08.04.2016 Dr. Girish Sahani, Director General, CSIR is being explained by Dr. Sudip Maity. Dr. P. K. Singh, Director, CIMFR and others are also seen.

Visit of Coal Secretary Shri Anil Swarup on 09.04.2016. Dr. A. K. Singh is explaining the activity of Resource Quality Assessment Laboratory. Dr. P. K. Singh, Director, CIMFR and others are also seen.

A view of group dance by Krishna and Gopiyan on 15.04.2016 under Spring Festival programme.

A view of duet dance programme on 15.04.2016 under Spring Festival programme.

Inaugural view of Executive Development Programme on Coal Combustion on 25.04.2016. Shri P. Pal Roy, Outstanding Scientist, Shri S. R. K. Rao, Dr. Istiyaque Ahamed, Shri T. B. Das along with delegates participating in programme are seen.

Visit of Dr. Harsh Vardhan Hon'ble Minister for Science & Technology at CIMFR-DC on 15.05.2016. Dr. Sudip Maity is explaining about coal to oil pilot plant to the Minister. Dr. P. K. Singh, Director, CIMFR, Dr. Ashish Mukherjee, Scientist-In-Charge are also seen.

Visit of Dr. Harsh Vardhan, Hon'ble Minister for Science & Technology at CIMFR-DC on 15.05.2016. Dr. A. K. Singh, Scientist showing geological fossils to the Minister. Dr. P. K. Singh, Director, CIMFR and others are also seen.

Inaugural view of Executive Development Programme on Coal Preparation on 20.06.2016. Shri P. Pal Roy, Outstanding Scientist, Dr. Istiyaque Ahmed, Dr. Ashish Mukherjee, Scientist-In-Charge and delegates participating in programme along with faculty members are seen.

Dr. P. K. Singh, Director, CIMFR addressing to the audience on 30.06.2016 after signing MOU on 28.06.2016 between CIMFR, CIL and NTPC at New Delhi.

Flag hoisting by Dr. P. K. Singh, Director, CIMFR on the occasion of Independence Day on 15.08.2016.

Children participating in drawing competition on 11.09.2016 under the CSIR Foundation Day Programme.

Ward of CIMFR-DC staff participating in essay writing competition on 11.09.2016 under the CSIR Foundation Day programme.

Participants during Anuvad and Nibandh writing on 15.09.2016 under the Hindi Pakhwara Programme.

Inaugural view of Executive Development Programme on Coal Preparation and Coke Making on 02.10.2016. Shri P. Pal Roy, Outstanding Scientist, Dr. Istiyaque Ahamed, Shri T. B. Das, faculty members and delegates participating are seen

Inauguration of Vigilance Awareness Week on 31.10.2016. (L to R) Shri Sanjay Kumar, A.O., Dr. T. Gouricharan and Dr. Ashish Mukherjee are on the dias.

On the occasion of India International Science Festival on 10.11.2016 students of various schools are visiting CIMFR-DC Lab. Dr. Sanjoy Choudhury is explaining about the activities of Coal Preparation Department.

Training programme organized for the officials of the Central Pollution Control Board during 18-20 Nov. 2016 on Sampling and Analysis of Coal. A view of faculty members and officials participating in the programme on 20.11.2016.

Martyr Shasi Kant Pandey's body is passing in front of CIMFR-DC gate. Dr. Ashish Mukherjee, Scientist-In-Charge, CIMFR-DC and staff members of CIMFR are paying homage to the martyr on 19.12.2016.

Participants during Anuvad and Nibandh writing on 15.09.2016 under the Hindi Pakhwara Programme.

Inaugural view of Executive Development Programme on Coal Preparation and Coke Making on 02.10.2016. Shri P. Pal Roy, Outstanding Scientist, Dr. Istiyaque Ahamed, Shri T. B. Das, faculty members and delegates participating are seen

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Glimpses of the photographs during NxGnMiFu International Conference (NexGen Technologies for Mining and Fuel Industries), held at Vigyan Bhavan, New Delhi during 15-17 Feb. 2017.


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International Conference on
NexGen Technologies for Mining
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and Fuel Industries


International Conference on
NexGen Technologies for Mining
and Fuel Industries


V K SARASWAT
HARSH VARDHAN


K SARASWAT


SHEKHAWAT
SANJIV SINGH


SANJIV SINGH
K K SHARMA


International Conference on
NexGen Technologies for Mining and Fuel


D P SINGH
TOM ALBANESE


Indigenous developments for CM


INSMART SYSTEMS


Dr. Girish Sahni
Dr. Harsh Vardhan
Pradeep K Singh
Prof A. K. Singh

सीएसआईआर–केंद्रीय खनन एवं ईंधन अनुसंधान संस्थान

(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)

CSIR-Central Institute of Mining & Fuel Research

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