2017-18 ANNUAL REPORT
वार्षिक प्रतिवेदन

CSIR TECHNOLOGY AWARD 2017

presented to CSIR - Central Institute of Mining and Fuel Research, Dhanbad
for Business Development and Technology Marketing
on the occasion of CSIR Foundation Day Platinum Jubilee function
26th September 2017, Vigyan Bhawan, New Delhi.

Award Received by: Dr. Pradeep K Singh; Dr. Ashok K Singh; Dr. Shripal Singh; Mr. Moti L Banra; Mr. Manoj K Sethi; Dr. Ran Vijay K Singh and Mr. Tarit B Das.

सीएसआईआर-केंद्रीय खनन एवं ईंधन अनुसंधान संस्थान

(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद)

CSIR-Central Institute of Mining & Fuel Research

(Council of Scientific and Industrial Research)

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CONTENT

A. INITIAL

I. From Director's Desk

I am pleased to present the Annual Report of CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR) for the period 2017-18 highlighting the R&D activities and accomplishments of the institute.

A brief description of each project has been outlined to acquaint the readers with the research activities undertaken during this period. These include all major areas in the fields of mining and fuel technologies. In addition, many studies were conducted to facilitate safe execution of major civil constructions such as hydro-electric projects, metro rail, airport, etc. Studies for providing solutions to mitigate environmental problems and evaluation of safety standards of different items used in mining and allied areas were also taken up.

The readers, while going through this report, would appreciate the sincere efforts of my colleagues to achieve the technical objectives in the projects by linking research with technology and maintaining a high standard of service to meet the expectations of mining, fuel and allied industries. These are amply demonstrated by the scientific investigations carried out in a good number of sponsored, consultancy and service to industry projects funded by different industries for providing them scientific solutions. Proactive research programmes were continued through Grant-in-Aid and In-house projects. The external cash flow of the institute during this period was Rs.332.64 crore, out of which Government fund was Rs.3.64 crore, public sector fund was Rs.294.68 crore and private sector fund was Rs.34.32 crore. Know-how of CSIR-CIMFR developments were released for commercial exploitation and a good number of patent applications were filed. Several awards including National Geo-science award have been conferred to our scientists for their outstanding R&D contributions.

R&D dialogues, executive development programmes, supervision of Ph.D. theses and master's dissertations were continued with full dedication and devotion as a regular practice. The institute has also continued to devote considerable attention to improve and add new test facilities and analytical services of global standard for the benefit of the user industries. About 84 quality papers were published in reputed journals of India and abroad whereas 62 papers were presented in national and international seminars, symposia, workshops, etc.

Finally, I would like to mention though I have a high level of satisfaction after stock taking, I am reminded of the bigger challenges we have to accept specially for national energy security in the backdrop of rising concern about climate change. However, I am confident about the capability of this laboratory to face challenges posed by the country's mining and fuel industries.

PK Singh

(Pradeep K Singh)
Director, CSIR-CIMFR

II. अनुसंधान परिषद की सूची / LIST OF RESEARCH COUNCIL

1.	Prof. E.S Dwarakadasa, CEO &MD Karnataka Hybrid Micro Devices Ltd ,Plot #103, 4th cross Electronic city, Bangaluru-560100	Chairman
2.	Prof.(Dr.)T.C.Rao (Former Director, CSIR-AMPRI), Hyderabad	Member
3.	Dr. Tridibesh Mukherjee, (former Director, Tata steel) No. 6A, Road No. 10, Circuit House Area (East), Jamshedpur -831001	Member
4.	Professor Ashok Kumar Singh , Professor & HoD, Rajiv Gandhi Chair, ISM, Dhanbad	Member
5.	Shri B.R.Reddy, CMD, South Eastern Coalfields Ltd. ,Bilaspur	Member
6.	Shri K.K.Sharma, Director (Operations), NTPC Ltd, New Delhi	Member
7.	Shri P.K. Sarkar, Director General, Directorate Gereral of Mines Safety, Dhanbad	Member
8.	Shri L.S. Shekhawat, COO , Hindustan Zinc Ltd. ,Yashad Bhawan,Udaipur-313004	Member
9.	Dr. Anjan Ray, Director-CSIR-IIP, Dehradun (DG,CSIR nominee)	Member
10.	Dr Santosh Kapuria,Director, CSIR -SERC, Chennai	Member
11	Dr. S.K.Singh, Director, CSIR- NIO , Goa	Member
12.	Dr. Pradeep K. Singh, Director, CSIR- Central Institute of Mining & Fuel Research, Dhanbad- 826015	Member
13.	Dr. Siddharth Singh, Principal Scientist, CSIR- Central Institute of Mining & Fuel Research, Dhanbad-826015	Member Secretary

III. प्रबंधन परिषद की सूची / LIST OF MANAGEMENT COUNCIL

1. Dr. Pradeep K Singh, Director, CSIR-CIMFR, Dhanbad (Chairman)
2. Dr. G. Banerjee, Chief Scientist, CSIR-CIMFR, Dhanbad (Member)
3. Dr. Abhay Kumar Singh, Principal Scientist, CSIR-CIMFR, Dhanbad (Member)
4. Sri M. K. Sethi, Sr. Scientist, CSIR-CIMFR, Dhanbad (Member)
5. Ms Pallabi Das, Scientist, CSIR-CIMFR, Dhanbad (Member)
6. Dr. A. K. Raman, Principal Technical Officer, CSIR-CIMFR, Dhanbad (Member)
7. Dr. K. Muralee Dharan, Director, CGCRI, Kolkata (Member)
8. Dr. R V K Singh, Chief Scientist & Head, BDIL, CSIR-CIMFR (Member)
9. Dr. R. K. Sinha, Sr. Principal Scientist, CSIR HQ, New Delhi (DG's Nominee)
10. CoFA/FAO, CSIR-CIMFR, Dhanbad (Member)
11. CoA/AO, CSIR-CIMFR, Dhanbad (Member - Secretary)

IV. STRENGTH OF STAFF OF CSIR-CIMFR (AS ON 31.03.2018)

Group/Grade	SC	ST	OBC	General	Grand Total
Director	-	-	-	01	01
Group IV	20	10	24	93	147
Group III	16	07	24	50	97
Group II	08	05	00	37	50
Group I	17	09	01	65	92
Administrative	21	11	12	78	122
Total	82	42	61	324	509

V. EXPENDITURE FOR THE YEAR 2017-18

Head	Amount (Rs. in lakhs)
Capital	1360.717
Revenue	8562.993
Staff Quarters	126.168
Total	10049.878

B. MINING AND OTHER ALLIED SECTORS

1. BUSINESS DEVELOPMENT AND INDUSTRIAL LIAISON (BDIL) Group

1.1. BDIL

1. Shri V. K. Saraswat, Hon'ble Member, NITI Aayog, New Delhi was the Chief Guest of 72nd CSIR-CIMFR Foundation Day and Industry Meet held on 02.04.2017 at CSIR-Central Institute of Mining and Fuel Research, Dhanbad. About Seventy participants were participated from different industries.

2. Shri Saryu Rai, Minister of Parliamentary Affairs and Food and Supply Department, Government of Jharkhand visited CSIR-Central Institute of Mining and Fuel Research, Dhanbad on 20.07.2017 as Chief Guest and discussed on "Cleaning of Damodar River Basin Project" at Barwa Road Campus and also did plantation at Digwadih Campus.

3. Shri A. Jayakumar, Secretary General, Vijnana Bharati visited CSIR-Central Institute of Mining and Fuel Research, Dhanbad as Chief Guest on 11th September 2017 in CSIR Platinum Jubilee celebration of this Institute. About 6000 School children were present from different Schools. An Industry meet and Exhibition on Public Outreach Open day for Indian International Science Festival (IISF-2017) was also organized during 11th to 13th September 2017, where participants from industries presented their views for future need of the industry.

4. Padmashri Dr. Lalji Singh, Managing Director, Genome Foundation, Hyderabad visited CSIR-CIMFR, Dhanbad as Chief Guest of 75th CSIR Foundation Day celebration. He delivered lecture on "Genetic Diversity in Indian Population and health implication". Prof. Sumit Chattopadhyay, Director, IICB, Kolkata was also present as Guest of Honour on this auspicious occasion held on 09.10.2017.

5. Industry Meet was also organized on 27.11.2017 for "Better Creation of Testing Facilities" at CSIR-Central Institute of Mining and Fuel Research, Dhanbad.

6. International Workshop was organized on 1st and 2nd December, 2017 on "Implementing 2^0C and below 2^0C compatible climatic change mitigation curious – implication for Indian Coal Sector". Prof. D. C. Panigrahi, Director, IIT (ISM) Dhanbad was the Chief Guest of the Workshop.

7. Jigyasa Programme was organized by CSIR-Central Institute of Mining and Fuel Research, Dhanbad on 20-21 December, 2017. The Students of Central School (Kendriya Vidyalaya) were attended and interact with the Scientists to know the Scientific activities of this Institute.

8. National Science Day celebrated on 28.02.2018 at CSIR-Central Institute of Mining and Fuel Research, Dhanbad. Prof. Dhananjai Pandey former Director IIT, BHU, Varanasi and presently Prof. & Coordinator, School of Material Science, BHU, Varanasi delivered lecture as Chief Guest on "Grand Engineering Challenges of the Country : The Indian Perspectives".

1.2. HUMAN RESOURCE DEVELOPMENT (HRD)

Following are the HRD Activities during FY 1st April, 2017 – 31st March, 2018

1. During the said period following two Executive Training Programmes were conducted by HRD, CSIR-CIMFR, Dhanbad for knowledge dissemination. Details of the programmes are mentioned on page no. 2

Sl. No.	Name of Course	Duration	Participating Organisation
1.	Executive Development Programme on "Coal Testing and Analysis"	29th May to 9th June, 2017	Executives from NTPC
2.	Executive Development Programme on "FLP Equipment"	5th to 09th February, 2018	Executives from ONGC, Ankleshwar, Ahmadabad, Vadodra, etc.

2. Vocational/Project Training for the PG & UG Engineering and Science students were arranged according to their academic session. 97 PG Science/Engineering and 149 UG Science/Engineering a total of 246 students 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 Sidri, BHU, IIT, NIT, BITS Pilani, Central University, Patna University, etc. came to get their project training/internship as their academic requirement.

3. Facilitation Provided for CSIR-CIMFR personnel to attend in organised Seminar, Symposium, Workshop: 127 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. In-House Training Programme on "Laboratory Quality Management System and Internal Auditing as per ISO/IEC 17025:2005" organised during 23-23 August, 2017 for CSIR-CIMFR Scientists.

5. एक दिवसीय तकनीकी संगोष्ठी – "भारत की उर्जा सुरक्षा मे प्रौद्योगिकीय अंत:क्षेप" दिनांक 11.5.2017 को सीएसआईआर-सीआईएमएफ़आर मे आयोजित किया गया.

6. एक दिवसीय कार्श्शाला – "ठोस खनिज ईंधन के गुण्वत्ता की निगरानी – मुद्दे एवं चुनौतिया" दिनांक 5.7.2017 को सीएसआईआर-सीआईएमएफ़आर मे आयोजित किया गया.

7. Seminar on "Mining Industry – Future Prospects and Challenges" on 17th June,2017 organised at CSIR-CIMFR in association with MEAI, Dhanbad Chapter.

8. वर्तमान वैश्विक परिस्थितियों में भार्तीय संस्कृति, एकता एवं राजकाज में हिंदी की भुमिका" 10.01.2018 को सीएसआईआर-सीआईएमएफ़आर मे आयोजित किया गया.

9. 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 know-how and enhance their knowledge in engineering science – 395.

   i. 76 Students of 6 Kendriya Vidyalaya under "JIGYASA" Programme visited at CSIR-CIMFR, Barwa Road Capmus on 20th December, 2017.

   ii. 56 Students of 6 Kendriya Vidyalaya under "JIGYASA" Programme visited at CSIR-CIMFR, Digwadih Capmus on 21st December, 2017.

   iii. 29 Worksmen's Inspector (Mech) of Miner's and Metal Workers Education visited at CSIR-CIMFR, Dhanbad on 19th January, 2018.

10. Lectures organised on Technical Topics and Personal from CSIR-CIMFR delevered lecture to the delegates from 14 industries.

i. Lecture was delevered on "Maintenance of Mining System: Current Trends to Technology and Management" by Dr. Uday Kumar, Director of Resarch and Innovation on 6th November, 2017.

ii. Lecture was delevered on "Blast Evaluation and New Thoughts for Futuristic Research" by Dr. P. Pal Roy, Former Outstanding Scientist on 15th December, 2017.

iii. Lecture was delevered on "Strata Management based single lift depillaring of total thickness of a thick coal seam" by Mr. Rakesh Kumar, Principal Scientist on 15th December, 2017.

iv. Lecture was delevered on "Challenges of the Underground Coal mining" by Dr. Angad Kushwaha, Chief Scientist on 22nd December, 2017.

1.3 PROJECT MONITORING AND EVALUATION (PME) CELL

PME Cell of the institute provides support to different departments of the institute for successful completion of various projects covering the mining, fuel and its allied industries. The main activities of PME Cell during the period was as follows:

- 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 readily available.
- Preparation of quarterly and annual performance reports of all the ongoing projects in consultation with project leaders/coordinators of the projects.
- Preparation of Annual Budget in consultation with the scientists.
- To help in the preparation of Research Council and Management Council documents by way of providing necessary inputs such as number of consultancy / sponsor / collaborative / GAP / In-house projects that 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.
- Organizing project categorization committee meeting and In-house project monitoring and evaluation committee meeting.
- 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.

CSIR-CIMFR, Dhanbad received external cash flow of Rs. 332.64 crore in the financial year 2017-18, of which Government fund is Rs. 3.64 crore, public sector Rs. 294.68 crore and private sector Rs. 34.32 crore as depicted in Fig.-1. Performance of the institute in terms of external cash flow generated in the financial year 2017-18 is compared with that of last two years and is shown in Fig.2.

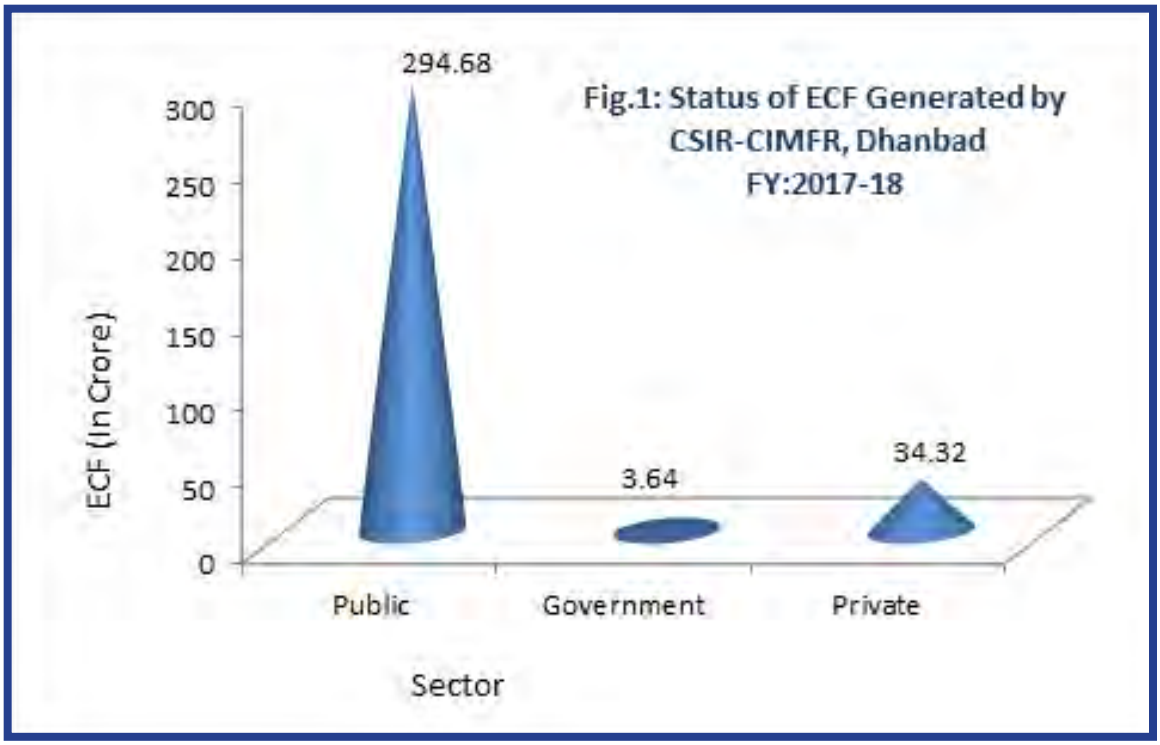


Fig.1: Status of ECF Generated by
CSIR-CIMFR, Dhanbad
FY:2017-18
294.68
3.64
34.32
300
250
200
150
100
50
0
ECF (In Crore)
Public
Government
Private
Sector

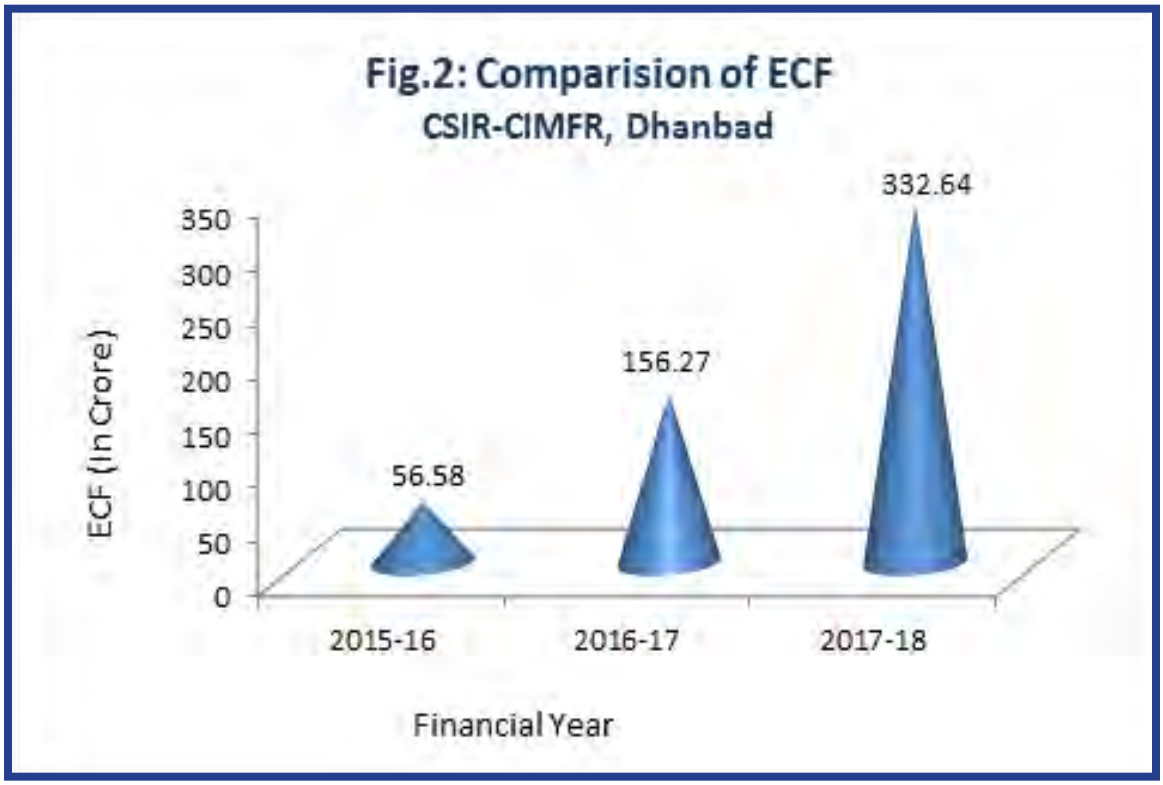


Fig.2: Comparision of ECF
CSIR-CIMFR, Dhanbad
332.64
156.27
56.58
350
300
250
200
150
100
50
0
ECF (In Crore)
2015-16
2016-17
2017-18
Financial Year

Glimpses of the Photographs of CSIR-CIMFR Foundation Day (02-04-2017)

Glimpses of the Participation of CSIR-CIMFR in Swadeshi Mela -2017 held at Sanskritik Sankul, Chauka Ghat, Kashi, Varanasi from October 08-17, 2017

Glimpses of Photographs on the occasion of Republic Day (26-01-2018)

Glimpses of Photographs on the occasion of National Science Day (28-02-2018)

1.4 KNOWLEDGE RESOURCE CENTRE (Barwa Road)

CIMFR KRC is actively engages in acquisition 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 rending 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	: 33356
CD Collection	: 896
Current Journals subscription	: 62
Translation of Foreign Language Articles	: 495
Photocopies of Technical Articles	: 342

1.5 SCIENCE COMMUNICATION AND PUBLICITY DEPARTMENT (SCPD)

Annual Report: Reports related to the activities like R&D work, supporting services, etc., for the year 2017 - 18 were collected from all the departments of the institute, edited, compiled and is in the process of publication 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 publication such as CIMFR Annual Report, Project & Work Record Book, Pocket Address Book, etc. brought out during the year by the laboratory were distributed to CIMFR scientists and other mining and technical institutions, educational organizations and different R&D laboratories in India and abroad on exchange and complimentary basis.

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 2018 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 2018 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 in 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) AN ISO 9001:2008 Certification Program:

(i) DNV, Kolkata successfully completed its 3rd Periodic Audit on 24th May'2017 and 4th Periodic Audit on 23rd October' 2017 at CIMFR, Dhanbad.

(ii) One round of Internal Auditing completed at CIMFR during this period.

(iii) Management Review Meeting Conducted at Director Level.

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

(C) External Cash Flow through Premium and Royalty received is :₹8,59,073=00 (Rupees Eight Lakhs Fifty Nine Thousand and Seventy Three Only).

(D) New Agreement/ MoU signed:

Sl.No.	Title of the Agreement	Party Name and Address	Date
1	Memorandum of Understanding Bet' CSIR-CIMFR, Dhanbad and BIT, Sindri	BIT, Sindri	23.06.2017
2	Agreement bet' CSIR-CIMFR and APMEL, Vijaywada for 'Design and manufacture of Longwall powered supports and setup of a testing laboratory'	Andhra Pradesh Heavy Machinery & Engineering Limited, Vijayawada, Andhra Pradesh	04.07.2017
3	Agreement for the Development of Certified Reference Material for Coal between CSIR-CIMFR and CSIR-NPL, New Delhi	CSIR-National Physical Laboratory, New Delhi	05.07.2017
4	Agreement bet' CSIR-CIMFR, Dhanbad and DMT, Germany for the joint Mining R&D work	DMT GmbH & Co. KG, Am Technologie park 1, 45307 Essen, Germany	12.09.2017
5	Agreement for Licensing of "Dry Fog Dust Suppression System for Crushing, Screening and Loading Plants and Mining Area"	M/s. Control Systems and Solutions, 28/2F, Nakuleswar Bhattachrjee Lane, Kolkata – 700 026	12.09.2017
6	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	Various agreements were signed
7	Agreement for Auger Sampling Study at MCL Siding, Talcher, Odisha	CSIR-CIMFR, Dhanbad and NTPC Ltd., New Delhi	29.11.2017
8	Memorandum of Agreement for the joint organization of training program for Mining Industry	CSIR-CIMFR, Dhanbad and The Mining Geological and Metallurgical Institute of India, Kolkata	16.12.2017
9	Hydro-geological Data generation for aquifer mapping by constructing exploratory and observation wells, conducting pumping tests and water quality analysis in Uttar Pradesh and Punjab	CSIR-CIMFR, Dhanbad and WAPCOS Ltd., 5th Floor, Kailash 26, Kasturba Ghandhi Marg, New Delhi – 110 001	13.01.2018

1.7 TESTING CELL

Testing Cell of CSIR-CIMFR, Barwa Road Campus, Dhanbad is a single focal cell that 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 laboratories of CSIR-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 CSIR-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/component/materials.

Total 626 numbers (six hundred & twenty six only) of testing and evaluation reports of various samples including equipment/components were issued by the cell during the year 2017 to 2018 and an amount of revenue of Rs. 1,48,08,447.00 (Rupees one crore forty eight lakhs eight thousand four hundred forty seven) only were generated through the same.

2. ELECTRICAL DESIGN

During April, 2017 to March, 2018, 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).

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.

I. 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 3rd 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. Calibration work of twenty-five instruments like Slide caliper, Micrometer, Mercury-in-glass Thermometer, Dial Thermometer, Temperature Scanner, Temperature Bath, Stop Watch, Universal Calibrator, Analog Micro-

ammeter, Voltmeter, Digital Multimeter etc. of Testing Laboratories of CSIR-CIMFR HQ was carried out during 2017-18.

Automatic street light control device was also designed and fabricated at CSIR-CIMFR during the above time period for timely switching ON/OFF street light at Barwa Road campus area of CIMFR.

2. Testing of following two electric cable samples was carried out:

   1. 2 core X 1.0 sq mm flexible cable for Miners' Safety LED Cap Lamp as per IS: 2593-1984. Manufacturer: M/s Industrial Precision Products, 62/1A, Netaji Subhas Road, 2nd Floor, Room No. 17, Kolkata – 700001, India. The sample was received from General Manager (Safety), M/s Eastern Coalfields Limited, Office of the Chairman cum Managing Director, Sactoria, P.O. Dishergarh, Dist. Burdwan, West Bengal, Pin – 713333.

   2. 2 core X 1.0 sq mm flexible cable for Miners' Safety LED Cap Lamp as per IS: 2593-1984. The sample was received from Chief Executive, CSK Technologies, 1st Floor, S.A. Towers, H. No. 3-5-885/1, Himayath Nagar, Near Old M.L.A. Qtr., Hyderabad – 500029.

II. ECF catalyzed and budget handled (CSIR & other Agencies): ECF of Electrical Design Section, CSIR-CIMFR, Dhanbad generated during 2017-2018 is Rs. 23.43 Lakhs.

Glimpses of the Photographs of Seminar on "Mining Industry - Future Prospects and Challenges" held at CSIR-CIMFR, Dhanbad on 17-06-2017 on the occasion of Inaugural Ceremony of Mining Engineers' Association of India, Dhanbad Chapter

Glimpses of the events of National Technical Seminar on "Technological Intervention in Energy Security of India" held on 11th May 2017 on the occasion of Technology Day

3. GEO-MECHANICS, MINE BACK FILLING AND NON-CONVENTIONAL GASES

3.1. GEO-MECHANICS

During April 2017 to March 2018, 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 Singareni collieries company Ltd, M/s Indian Metal and Ferro Alloys Ltd., Odisha; M/s Tata Steel Ltd., M/S Reliance Cement Company Pvt. Ltd., SAIL, South Eastern Coalfields Limited, Bilaspur; Bharat Coking Coal Ltd, Dhanbad, etc.

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 preparation and 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 and 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. The final report has been submitted. This would help in assessment of roof behaviour during final extraction and take remedial measures.

In Moonidih and Lohapatti collieries of WJ area, BCCL, the RMR has been evaluated on the basis of Geotechnical studies and rock samples test at 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 help to mine management in the formulation of SSR.

In Jamadoba collieries of Tata Steel Ltd., XV seam and XI seam have been developed by Bord and Pillar method of working. Geotechnical studies and sample testing work have been completed for RMR evaluation and report is under preparation.This study would be helping to mine management in formulation of SSR.

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 creates 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 a major delamination plane. During drivage of 5.5 m width roadways with bolter miner with thin layers of shale and coal in immediate roof is the major challenge to support synchronizing fast drivage of gate roads. Support design of roadways has been done on the basis RMR and bolter-miner bolting arrangement after rigorous geotechnical and engineering studies.

At Siyal Ghogri coal mine, Reliance Cement Company Ltd., Chhindwara (M.P.), strata monitoring of development roadways during drivage to assess the roof behavior with the help of geotechnical instrumentation during development is in progress. The shaly-coal roof is very weak and friable vulnerable to fall down after an advancement of one-two pillars due to persisting geological weakness with blasting of solid. Mechanical means of coal extraction is advised to counter the vibration/shock impact. Under this circumstances the monitoring data are very helpful in the evaluation of support system, which is keep on updating.

From Jamuna UGRO Sub Area, SECL, the evaluation of RMR and support design with suitable method of work in LK II Seam of Jamuna 1/2 incline and MK seam of Jamuna 5/6 inclines was assigned with both the empirical and numerical simulation approach. The field visit has been completed and report is under preparation.

In Mahagiri Mines (Chromite) of M/s IMFA Ltd., the field visit has been completed for evaluation of RMR and design of systematic support rule (SSR) for decline and development roadways of different cross section below 12mRL to-395mRL. The report is under preparation.

3.2. MINE BACK FILLING

1. Advice on stabilization with stowing for Mine No. 3 & 4, Orient Colliery, MCL

A MGR railway alignment is proposed to runs over caved-out old workings, depillared panels as well as long standing coal pillars of HR Top, HR Bottom and IB seams of Mine no-3 & 4 of Orient area of Mahanadi Coalfields Limited (MCL). The job of stabilizing this old and partially abandoned working by stowing was entrusted to CSIR-CIMFR. Accordingly a site visit was carried out by stowing team for collecting preliminary data and details of panels. It was decided during discussion with MCL and OPGC officials that the main entrance (Incline No 12) and ventilation return of Mine No – 4 has to be secured as MCL has planned to develop/extract this seam by Continuous Miners in future. Two approach was pondered upon, firstly through blind backfilling, secondly via conventional gravity stowing by breaking the isolation stoppings of the old workings. The pipe route and the design of ground based Katora bunker was given to OPGC officials to stabilize old working over which the MRG route is proposed.

This project will help the mine management to stabilize old working below MGR and will help the OPGC management to transport coal to their power plant safely.

2. Advice on high density hydraulic filling using mill tailings to fill void of stoping area at Mochia and Balaria underground mine, HZL

The main objective of the project was to determine the strength of the fill material (mill tailings) with different percentage of OPC(3%, 4%, 5%, 8% and 10%) at different curing period (7, 14, 28 and 56 days) and to report the change in percolation rate of the fill with change in percentage of fines (- 25 to + 400 microns) so that the condition of minimum percolation rate is maintained. Determination of change in settlement rate with change in pulp density of the fill etc, Laboratory test results indicate that the percolation rate of total tailings was least but when fines were eliminated from total tailings (Size > 106µm) the percolation rate increased to 73.59 cm/hr.

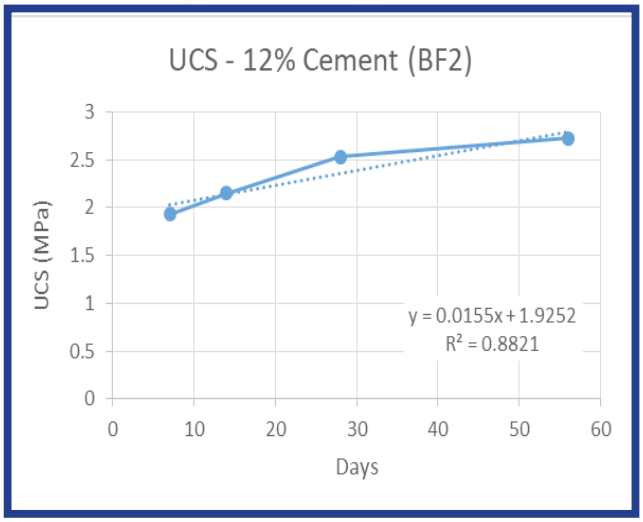
The UCS of the paste mixes increases with the increase in curing period and cement percentage. The investigation on rheological properties of Zawar mill tailings in under progress.

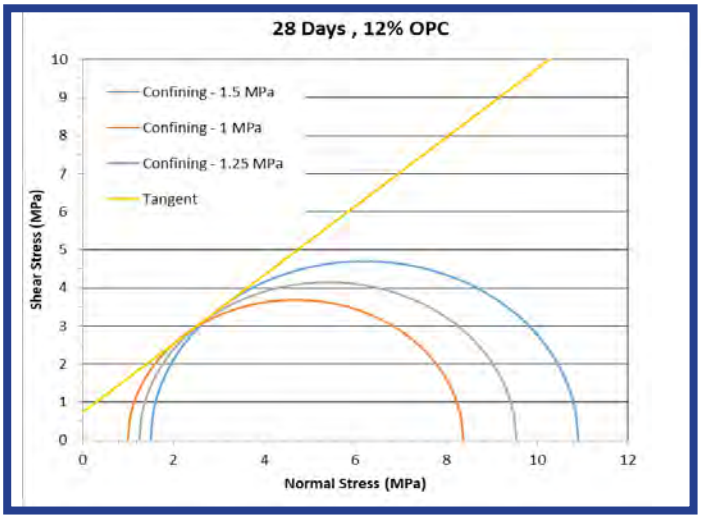
The findings of this project will help the mine management to design the fill mix, fill plant as per the existing/ planned stope dimensions.

3. Advice on the replacement of cement with Flyash for filling the stopes of Rampura Agucha Mines of 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. Slump test on Agucha mill tailings indicate that to achieve a targeted slump of 21 cm, a water concentration of 27.71% is required. The spread at this consistency was found to be 36.5 cm. The geo-technical characterization of paste fill indicates that UCS of paste mixes increases with the increase in curing period and cement percentage. Similarly, tri-axial test results indicate that the cohesion of the paste mix increases with the increase in curing period and cement percentage, but this increase in both UCS and Cohesion was found to be less when OPC is replaced with flyash. A part of study wrt rheological properties of Agucha tailings is under progress and will be completed soon.

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.

4. 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. During the field visit open fire was observed at the edge of forest area. Accordingly, it was decided to shift ash dumping to this site in order to choke the fire and to arrest its lateral movement. The dumping method was altered so that the entire fire line is covered with ash – OB With this study it was possible for DCPP, JSPL to dispose the coal ash in environment friendly manner. Regular monitoring is being carried out by CIMFR scientists to find the efficacy of coal ash filling in open cast coal mines.

5. **Design of backfill system & instrumentation for stope block 05 at Mahagiri mines, IMFA**

Backfilling facilitates ground stability, reutilization of waste material, maximum ore recovery from the stope and many more. It is essential to have a suitable backfilling system for underground metalliferous mines. Considering the production and capital investment of block 05 at Mahagiri mines, IMFA It was decided to use cemented hydraulic filling technology for block 05. IMFA approached CSIR-CIMFR for designing and commissioning of backfill system including pipeline layout, barricade design and instrumentation for monitoring inside the stope.

Numerical simulation studies were carried out by using PLAXIS-3D (Finite Element method) to understand the stress development during backfilling (Figure 1). Based on the numerical sand empirical studies barricades were designed.

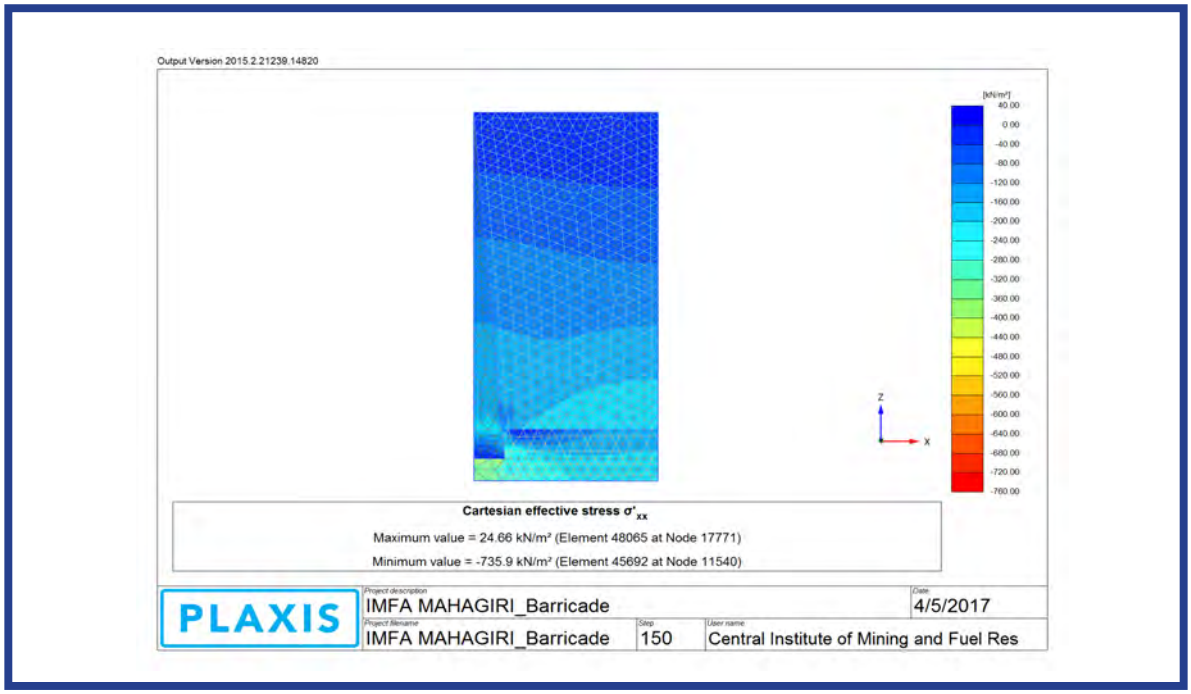


Figure 1: Horizontal stress profile for the 2nd stage (entire back filled stope)

Laboratory studies were conducted for decantation pipes applicability. Suitable instrumentation plan was suggested for monitoring various backfilling parameters.

Engineered barricades are built across horizontal drives/cross cuts to retain the back fill slurry in the stope. Barricades form an integral part of the complete back filling system in underground mines. These are installed at the cross cuts of a stope to contain the Hydraulic fill. They must be designed to withstand the hydraulic pressure exerted by the Hydraulic fill before it cures sufficiently to support its own weight. A backfilling plant has been constructed at the surface with a filling capacity of 100 m^3/hr has been established in Mahagiri Mines (Chromite) (Figure 2). The Backfilling plant is established so as to draw desired quantity of fill material, mixing of filling ingradients in required proportion, transportation of the mixture deep into the stope using pipeline network, regulating the filling quality as per the requirement through automatic control.

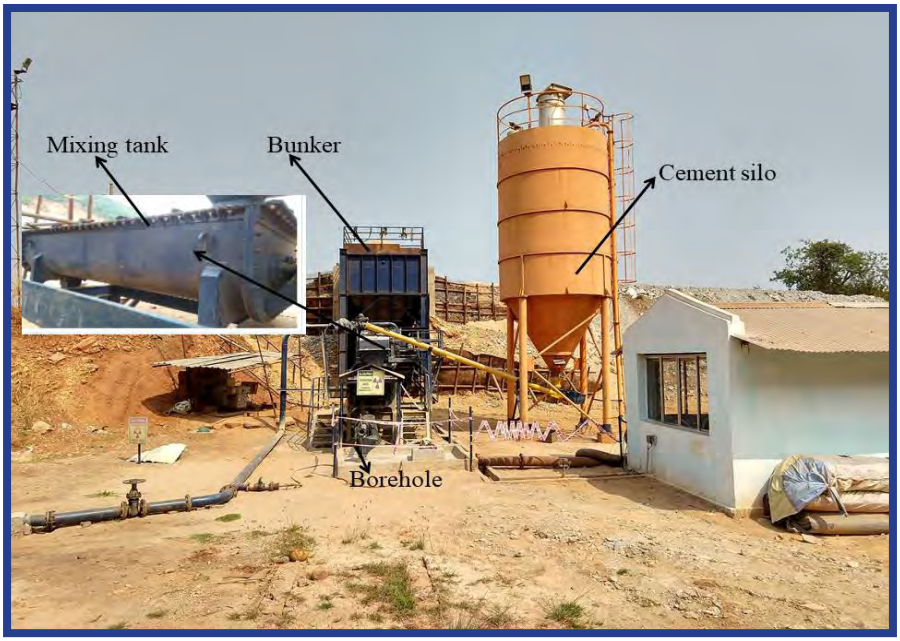


Fig 2: Backfilling plant

To monitor the variation of pressure during backfilling. Load cell (LC) were installed at the inbye of lower portion lower portion of the auxiliary barricade. Similarly contact pressure cell (CPC) were firmly attached to the upper portion of the main barricade as shown in figure 3. Also, total pressure cells (TPC) which were mounted on a cage installed inside the stope (Figure 4). Each cage consists of two pressure cells one for vertical pressure measurement and other for horizontal pressure measurement inside the stope.

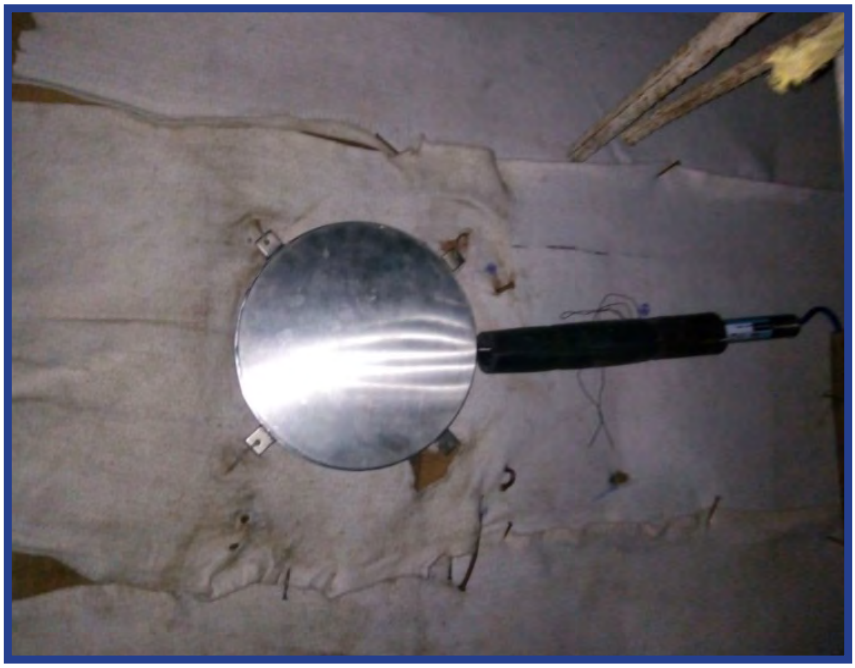


Fig 3: CPC attached inbye of barricade.

Fig 4: TPC installation inside the stope.

It is recommended that instrumentation monitoring need to be carried out periodically, the quality of cemented hydraulic fill need to be checked timely by preparing cylindrical samples at the mine site. Quality of backfill need to be maintained in terms of particle size distribution, density etc.

3.3. NON-CONVENTIONAL GASES

The section undertakes investigations on safety in underground coal mines from methane hazard, estimation of greenhouse gas emission from coal mining and handling activities and oil and natural gas systems, Estimation of coalbed methane/shale gas resource potential in virgin coal blocks, CO_2 sequestration in geological formation and CBM wells, and underground coal gasification.

S & T Research Projects

1. **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 samples were carried out to assess shale gas potentiality in Jharia and Raniganj coalfields. 3D//2D seismic studies has been completed by National Geophysical Laboratory, Hyderabad at Rangamati B in the East of Jhanjhara, Raniganj coalfield. All these properties are being investigated in Jharia Coalfield. The work is in progress and it will be completed by August 31, 2018.

2. **Estimation of Fugitive Carbon Dioxide Emissions from Indian Coal Mining Activities**

   Carbon dioxide in coal seam is found in low concentration compare to methane and it is generated during coalification process and adsorbed on the internal surface of coal pores. The main objective of this research project is to develop emission coefficient for carbon dioxide for the estimation of this gas in the atmosphere from coal mining activities.

Industry sponsored Projects

1. Studies on Gas Desorption of Borehole Core Samples for Determination of Maximum desorbable Gas Content and Prediction of Specific Gas Emission from IX Top and Bottom Coal seams at Nimcha Block, ECL.

2. Scientific study for caving behavior of Adriyala LW Panel No. 1 of Adriyala project area, SCCL by installing the piezometer for continuous monitoring of Adriyala LW Panel, SCCL (Part B).

3. 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 Potentiality and Quantitative estimation of Shale Gas Resources by direct method in Mohuda sub-basin of Jharia Coalfield.

4. MACHINE HEALTH MONITORING

4.1. METALLURGY

The Metallurgical Laboratory of CIMFR is known for its testing of various mine appliances for Mining and Allied Industries. The laboratory is also engaged in various researches also. Beside that it also does various investigations for failure of mining equipment/component. During the period April 2017 to March 2018 the following work has 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.

   Percentage reduction in diameter of wires was found to be less than 10% and in many cases it was less than 1%. The condition for lubrication also found to be satisfactory. It indicates that it is suitable for use in mines further. The study is in progress.

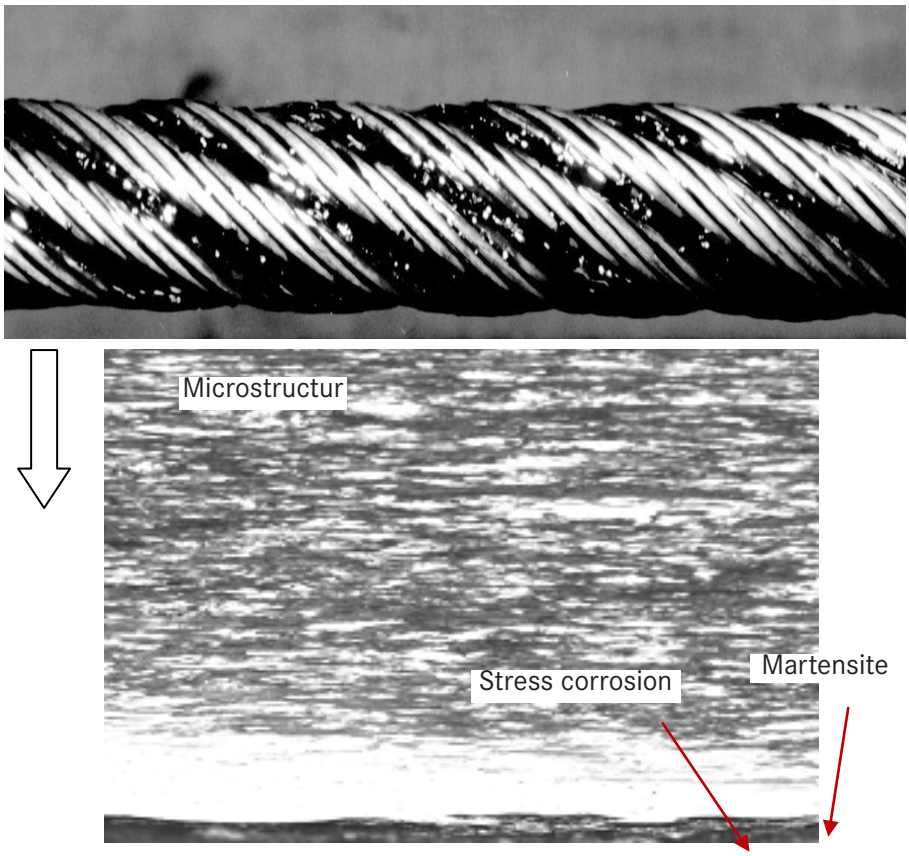
2. **Studies and investigation of physico- mechanical & Chemical properties for proto type steel cog (50T) and props (30 T) upto 3m height . (Joint project of metallurgy &RTL)**

   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 steel Cogs and steel props have been examined under the acidic water condition and found that it can sustain accelerated weathering condition. The study has been completed.

3. **Advice and study on winding ropes of different sizes used for hoisting at Surda Mines**

   To assess the quality of friction winding ropes after using for prescribed life. Five wire ropes of different size have been investigated. The lubrication condition was poor except for one sample. Also there is a formation of martensite and corrosion pittings. It indicates that it should be lubricated properly for further use in mines. The study has been completed.



B. Infrastructure & Technical Services

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

- 12 reports send in 2017-18 amounting - ₹ 3, 34,228/
- From sponsored project - ₹ 2, 09, 450/-
- Total ECF amounting - ₹ 5, 43,678/

4.2. ROOF SUPPORT TESTING LABORATORY

During April 2017 to March 2018 the Roof Support Testing Laboratory has undertaken various assignments on quality evaluation of mine support, coal S&T R&D projects including design & development under Dehradun declaration.

GAP project titled "Design & development of truck mounted mobile coal sampler for instant coal ash & moisture analyser at site from railway wagon / truck".

A above mentioned project (sanctioned in two phases i.e. phase-I & phase-II) sponsored by Ministry of Coal, Govt. of India has been completed satisfactorily. Under this project a technology has been developed.

Technology developed:

Under phase-I A nuclear technique was developed to assess instantly the ash, moisture content and GCV of the coal. Nuclear technique methods with dual gamma-rays transmission for analysis of coal for ash and moisture content have been established. And in phase – II a full scale truck mounted mobile coal sampler for instant copal ash & moisture analyzer at site from railway wagon/truck has been designed developed, field trialed at SCCL and the results so obtained have been validated. The draft report has already been submitted. However, final report is yet to be submitted.

A In-house project has been sanctioned on 'Bharat Swachch Mission' launched by PM titled" Design & Development of Wheel Controlled Sewage Discharge System in Trains" under Dehradun Declaration. This in-house project was sanctioned to make the track/ platform as well as total environment more hygienic and healthy in Indian Railway. Conceptual design of the proposed technology to achieve the objective has been prepared. Procurement and fabrication of the prototype working model is in process. The patent has been filed for this novel design.

Project on "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 on his request. This final project report is in process.

5. MINE FIRE, MINE VENTILATION AND MINERS' SAFETY

5.1. MINE FIRE

1. **Advice on determining the state and extent of the fire, its rate of progress at Sarubera (E) colliery, Kuju Area, Central Coalfield Limited**

   The manager Sarubera(E) Colliery,Kuju Area, CCL(Ramgarh) has referred a problem to determining the state and extent of the fire, its rate of progress in OB dump and its surrounding exposed area at the Sarubera (E) colliery.

   The studies undertaken to prognosticate fire conditions, its magnitude/ intensity and extensity and the direction of its propagation. At first, entire area has been divided into grid/node and temarature were measured at each grid through infrared camera at an interval of three months. The objectives were being - to assess and evaluated the state and extent of fires and its direction of propagation.

   It transpired from thermography, preliminary data analysis and discussion with colliery authorities that the coal has been exhausted long ago and now exposed faces are engulfed in active fires. Shallow depth fires had come up to the surface and spread over the region.

   To assess the rate of progress of open fire, nearest underground panel i.e. proposed to be extracted were selected and studied -

   i. Surface cover of proposed panel was about 60 – 70 m. During physical observation of the surface cover no any significant cracks or subsidence observed and thermal mapping of overhead surface shows ambient temarature.

   ii. Interpretation of goaf gases in seam-II; nearest to the fire area revealed no any symptoms of heating. The temperature of water coming out from overlying goaved out area of Seam-II to seam-I through upward boreholes were also found at ambient.

   Hence fire is extensive in localized area, scientific study is going on for final conclusion and recommendations.

2. **Control and Prevention of fire in Gare Palama, IV/ 2 & 3 opencast mine of Raigarh Area, SECL.**

   In terms of the direction of Hon'ble National Green Tribunal (NGT), Central Bench Bhopal- to organize scientific study that's findings come in term of recommendations for the purpose to extinguish/ contain the fire as well as taking steps for prevention of fire ranging or commencing in new areas of Gare Palma IV/2&3 Opencasts Coal Mine, Raigarh Area, South Eastern coalfields Limited; problem was referred.

The scope of the work comprises of advisory, demonstrative and training. Hence at first, thermal investigations to determine the status and extent of fire in benches as well as loose coal were carried out. Fires of higher intensity or blazing fires at both the OB dump and coal benches were dealt using water mixed with fire retardants chemicals (Demonstration of firefighting operation carried out in presence of mine authorities).

In view of preventive measures, it was advised that - overburden dump and coal benches must be monitored fortnightly using Infra-red thermometer and Thermo-vision camera to detect any symptoms of heating in an early stage. Temperature below 50°C is presumed safe. Temperature at the range of 50- 70°C and above; seeks for arrangement of control measures. If any inconsistency/ symptoms of heating observed – silica gel (mixture of sodium silicate and Di-ammonium phosphate) must be sprayed to deal the fire and to stop its future recurrences.

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

The mine management of Jitpur colliery (SAIL), Dhanbad has referred a problem to determine the incubation period of XIV seam coal of Jitpur Colliery. Indeed, coal has ambiguously the molecular $C_{10}H_7O$, attains thermodynamic equilibrium over the years, but the little added oxygen (aerial oxidation) of coal can tilt the thermal stability and leads to rising the temperature. The rise in coal temperature, up to the point of ignition, within certain period is customarily known as Incubation period. Incubation period can be as short as few days or as long as months or years; and usually used to indicate the potential hazard of a spontaneous heating. Aerial oxidation occurs naturally and triggered by several site-specific parameters. Therefore, coal samples collected from mine panel have been analyzed in the laboratory for different parameters to evaluate thermal properties of coal and thereby to evaluate its tendencyof fire spontaneously.

Since intrinsic coal characteristics is not enough to predict the incubation period; therefore, extraneous mining and environmental conditions created due to or during mining operations were also relocked. Finally, analyzing and inferring coal characteristics data, apparent circumstances and mining conditions; the incubation period of coal seam XIVof Jitpur has been projected as One and half Years. However, it should be emphasized that the absolute value of the incubation period is not uniquely defined.

4. Interpretation of intrinsic and extrinsic data, exogenous conditions of coal seams 16, 16A & 16 B of Upper seam and 12, 13/14 seam of Deep mine Chasnalla colliery and thereof advising the Incubation period

The Manager Mines (Coal), Chasnalla Colliery, SAIL-ISP, Dhanbad has referred a problem for Interpretation of intrinsic and extrinsic data, exogenous conditions of coal seams 16, 16A & 16 B of Upper seam and 12, 13/14 seam of Deep mine Chasnalla colliery and thereof advising the Incubation period.

The coal samples were collected from different locations of the coal seams (XVI, XVIA & XVI B of Upper seam and XII, XIII/XIV) seam of Deep mine of Chasnalla colliery and analyzed in the laboratory (proximate and other relevant parameters)and tendency of each coal sample to fire spontaneously were evaluated.Critical analysis of crossing point temperature (CPT), ignition point temperature (IPT), moisture content and fixed carbon value signifies that coal is less liable to spontaneous heating.The minute but measurable content of pyretic sulphur signifies least scope of spontaneous heating.

Apart from several exogenous factors that plays significant role in initiating and aggravating the fires; notably are topographic factors, geological disturbances, faults, weak zones, cavity regions, gradient and thermal in homogeneities and site-specific conditions were assessed and evaluated.

Analyzing all relevant data and apparent circumstances implicates that the Incubation period for Coal seams XVI, XVIA/XVIB, XIII and XII of Chasnalla Colliery to be projected as one and half year.

5. Advice for control and prevention of fire in slided material at the bottom of deep mining zone along the highwall (around 700m) at Rajmahal OCP, ECL

The General Manager (S&R), Eastern Coalfield Limited(HQ) has referred the problem i.e. Advice for control and prevention of fire in slided material at the bottom of deep mining zone along the highwall (around 700m) at Rajmahal Open cast Project. The objectives were being-

- advice the suitable measures to prevent the spreading fire in new areas and

- extinguishing the fire in deep mining area exposed/ broken coal which is raging.

To meet the above objectives, studies undertaken. Thermal mapping of entirefire affected area, through high performance thermo vision camerabeing carried out. The state and extent of the fires in slide mass in deep mining zone along the highwall were measured Entire slided zone in deep mining area were engulfed in active fires and temperature ranges from 800^{0}C to 280^{0}C. Temperature of the hot spots in crushed coal, OB dump and its surrounding area were measured.

For dealing the fires with most easy and economical way different fire-fighting/flame retardant/fire retardant/rapid cooling chemicals were selected for application at specific over rigorous studies on coal.

Firefighting chemicals, $MgCl_{2,}$ $CaCl_2$, DAP, Lime etc. of different compositions and concentrations were used to deal the fires. Chemicals were mixed in water and sprayed through high pressure jetting. Summing up, fire has brought under control and work is under progress.

6. Advice of suitable methodology for combating fire and safe extraction of coal pillar (catching on exposure) by open cast method at Shankarpur colliery, ECL, Jambad OCP, ECL

Extensive fires in exposed galleries of Shankarpur OCP of Kenda Area, ECLwas great concerned to mine management due to the safety and productivity of the mines. Hence, the problem was referred for scientific study i.e. -

- to prognosticate fire conditions were therefore advice the suitable measures to deal with extensive fire in exposed gallery mouth and save the precious coal and

- safe extraction of coal pillars catching fires on exposures.

The problem was undertaken and heating liability of coal were assessed. As intrinsic coal characteristic is not enough to decide the measures therefore, site-specific extraneous conditions were also examined - to identify and prioritize the mitigation options.

Comprehensive thermal monitoring of exposed coal faces, surroundings and loose coal at the floor of col bench has been carried out to ascertain the intensity of fire. In thermal mapping, almost all exposed galleries at Shankarpur OCP were engulfed in active fires; temperature ranges from 120^{0}C- 1000^{0}C and above mainly caused by spontaneous heating of coal and carbonaceous material.

To deal with fire in exposed galleries, i.e. for selection of cost effective firefighting chemicals, site-specific conditions were examined. Finally, fires of higher intensity (>500 ^{0}C)or blazing fires at the exposed coal faces were dealt with fire/flame retardant chemicals (MgCl2+ CaCl2 in the ratio 1:1 of definite concentration according to site specific need) mixed in water tanker of capacity 5000lt (0.08%w/v) and sprayed over exposed faces through high-pressure pump(4-7kg/cm2) mounted over water tanker. As a result, temperature brought down 70-90^{0}C immediately.

Similarly, fires of lower intensity (100-500^{o}c) in coal Benches and in loose coal mass has been dealt with DAP mixed in water (concentration 0.02% (w/v))through high pressure water jetting for which water pipes lines are laid up to the coal benches. Finally, firefighting team has been trained and work in under progress.

5.2 MINE VENTILATION

The department has undertaken two R&D projects from CIL R&D Board, MOC, GoI and various industry sponsored projects related with the problems of oppressive climatic condition at workplaces in underground mines, extent and rate of progress of fire in abandoned mines. Investigation into causes of sudden occurrence of fire in one of power Plants situated in Punjab state, etc. Testing of brattice cloth and ventilation ducting as per BIS norms and calibration of Anemometer, Velometer and Manometer have also been carried out.

(A) R& D project

1. 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 and framing of guidelines for prevention and mitigation of explosion hazard in Indian coal mines. The project is in progress.

2. 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. Outcome of this project the 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, fire ladder (FL) of the seam and optimisation of panel ventilation system by computational fluid dynamics (CFD) modeling.

(B) Industry Sponsored Project

1. The problem of oppressive workplace environment in three coal mines, viz. 6 & 7 Pit Jamadoba colliery, TATA STEEL, Mohan colliery, WCL and PVK-5 , SCCL has been taken up 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.

2. 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.

3. Analysis of root cause of incidence of fire in coal conveyor at Talwandi Sabo thermal Power Ltd., Punjab :A Power Plant [capacity: 3×660 MW], is situated in Banawala, District Mansa Punjab, belongs to Talwandi Sabo Power Limited (TSPL), India. The coal for the plant is brought from Mahanadi Coalfields Limited (MCL), Odisha at a distance of about 1500 km. Suddenly, fire was occurred in a segment of idle belt conveyor named as C10A and C10B in the coal handling plant (CHP) on 17th April 2017 at around 10:40PM. This has occasioned damage of conveyor gallery structure in a span of length 33mis shown in Figure 1. Immediately fire was extinguished. In future, to avoid similar incidence of fire by way of applying preventive measures M/s Talwandi Sabo Power Ltd assigned a job to CSIR-CIMFR, Dhanbad for in-depth scientific study to find out cause of fire and recommend precautionary measures. CSIR-CIMFR, Dhanbad took up the assignment, visited the site and collected primary and secondary data including collection of coal samples from Yard no. 2 Heap No. 201 and analyzed in the laboratory. On the basis of results of laboratory investigation comprising determination of critical temperature, proximate parameters, temperature based evolution of gases under fire ladder study of coal samples and field investigation it was also concluded that the coal is more prone to spontaneous heating due to less moisture content high ambient temperature it may accelerate due to loss moisture content, temperature based sensor like LHS cables attached with DVJB should activate at a temperature of 70 ± 5°C rather than a temperature of 85 ± 5°C.because Critical oxidation temperature of coal used is of the order of 70 ± 5°C. In addition activation of safety devices should be based CO and H_2 sensor as per the results of fire ladder study. Prevention of loss of moisture from coal by treatment of coal at reclaiming end with water and suitable chemical, cooling of coal followed by inspection of belt conveyor route by experienced person would always be helpful in distinguishing spillage of material or any sagging of belt etc.

Fig.1: View of damaged conveyor line

4. Prevention and control of spontaneous combustion/fire in coal heap at Talwandi sabo power limited TSPL (3x660 mw), Punjab. In the plant about four lakh tons of coal was stocked in four yards in form of 12 heaps. The geometry of coal stock yard is shown in Figure 1. Due to delay in commissioning after extinguishment of occasional fire in belt conveyor consumption number of spontaneous heating/ blazing fir at different locations were occurred in coal stock heaps in yard as shown in Figure 2.

   To save coal worth rupees several lakhs daily and environment protection specially around villages, CSIR-CIMFR, Dhanbad carried out laboratory investigation comprising Thermal characteristics of coal, thermo-decomposition,

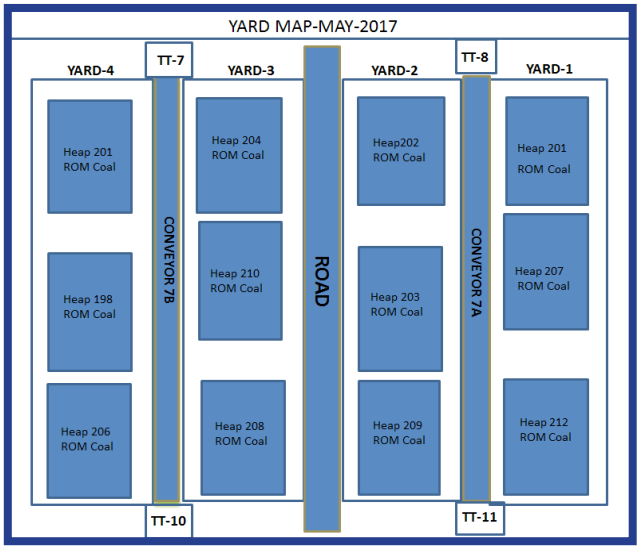


Fig 1 : Representation of Layout of coal yards

Fig 2: View of fire affected coal heaps

Thermal behavior by differential scanning calorimetric (DSC) and proximate parameter studies including thermal scanning of coal heaps. In addition of suitable firefighting chemical having strong inhibiting property in laboratory has been selected. Accordingly, It was recommended for treatment of coal at reclaiming end with water and selected chemical to avoid loss of moisture in addition to cooling of coal. Utilization coal should occur according to the principle of "first-in,first-out." "Windrow method"with compactness of in 1.0m layers should be followed while heaping coal.

(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. MINING METHODS AND DESIGN SIMULATION

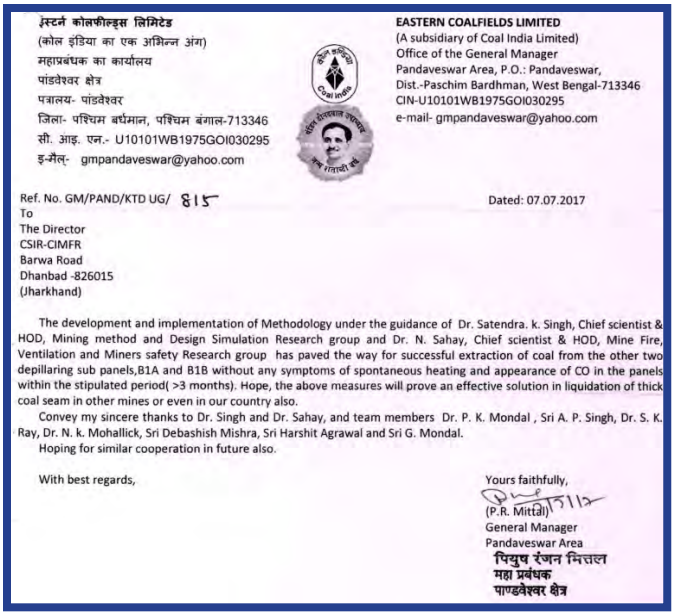
6.1 MINING METHODS

Mining Methods section belongs to Research Group "Mining Methods and Design Simulation", plays an important role and has significant contribution for safe operations of underground coal mine workings across PAN-India with due regard to conservation and productivity. This section is entrusted with several ground control problems referred by the mining industry, to do the necessary scientific studies with many challenging geotechnical problems which need to be provided with solutions on urgent basis, involving aspects of advanced rock mechanics, numerical modelling techniques, subsidence engineering, strata monitoring and management etc. The present day high production methods of mining using Continuous Miner, following straight line of extraction are being designed by this section, as well as implemented at many sites, to name a few are Sarpi project, Khottadih colliery, Jhanjhra projects in Eastern Coalfields Limited (ECL); Vijaya west mine, Churcha RO mine, Khairaha u/g mine, Kapildhara u/g project in South Eastern Coalfields Limited (SECL); Lohapatti mine in Bharat Coking Coal Limited (BCCL) and Tandsi mine in Western Coalfields Limited (WCL).

On umpteen occasions, the sub-surface (overlying goaves, water bodies, seams, etc) and surface properties are to be protected by suitably designing the methods of mining and related issues in a comprehensive mode. Some innovative methods of mining like - working below very competent and massive basalt trap formation in WCL or like working the bump-prone seam at the deepest location in India (Chinakuri Mine No. 1&2) are being designed and ready to be implemented after in-principle approval from the Inspectorate and acceptance from the Mine Operator. With the use of paste filling and related numerical modeling exercises, the Highwall mining at West Bokaro (TISCO) mine has been designed and ready to be implemented where the coal recovery may be (on modest note) increased from ~ 27% to ~ 75% of extraction.

MoC, S&T Grant & CIL R&D Board have provided final approval letters addressing two important but new areas of research “Design of Pillars for Different Mining Methods in Deep Coal Mine Workings” and “Establishing Underground Coal Extraction Methodology beneath Massive Competent Strata: Design and Demonstration at Mauri Mine, Kanhan Area, WCL”, respectively.

It is worthable to highlight some of the received letters of appreciation from the industry (ECL) where more number of pillars per panel can be extracted in a very low incubation period on the basis of the methodology developed by CSIR-CIMFR, which is a part of the completed R&D GAP project. The same methodology has been also praised by the CMPDIL. The project is now being implemented as extension in Madhusudanpur Colliery, ECL and was asked to implement the same methodology. A glimpse of the same is given below:



ईस्टर्न कोलफील्ड्स लिमिटेड
(कोल इंडिया का एक अभिन्न अंग)
महाप्रबंधक का कार्यालय
पांडवेश्वर क्षेत्र
पत्रालय- पांडवेश्वर
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Ref. No. GM/PAND/KTD UG/ 815 Dated: 07.07.2017

To
The Director
CSIR-CIMFR
Barwa Road
Dhanbad -826015
(Jharkhand)

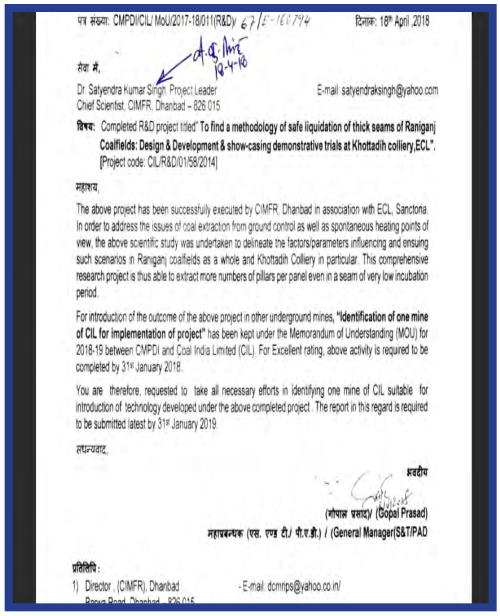
The development and implementation of Methodology under the guidance of Dr. Satendra. k. Singh, Chief scientist & HOD, Mining method and Design Simulation Research group and Dr. N. Sahay, Chief scientist & HOD, Mine Fire, Ventilation and Miners safety Research group has paved the way for successful extraction of coal from the other two depillaring sub panels,B1A and B1B without any symptoms of spontaneous heating and appearance of CO in the panels within the stipulated period(>3 months). Hope, the above measures will prove an effective solution in liquidation of thick coal seam in other mines or even in our country also.

Convey my sincere thanks to Dr. Singh and Dr. Sahay, and team members Dr. P. K. Mondal , Sri A. P. Singh, Dr. S. K. Ray, Dr. N. k. Mohallick, Sri Debashish Mishra, Sri Harshit Agrawal and Sri G. Mondal.

Hoping for similar cooperation in future also.

With best regards,

Yours faithfully,
(P.R. Mittal)
General Manager
Pandaveswar Area
पियुष रंजन मित्तल
महा प्रबंधक
पाण्डवेश्वर क्षेत्र



पत्र संख्या: CMPDI/CIL/ MoU/2017-18/011(R&D)/ 67/E-16794 दिनांक: 18th April 2018

सेवा में,

Dr. Satyendra Kumar Singh Project Leader
Chief Scientist, CIMFR, Dhanbad – 826 015
E-mail: satyendraksingh@yahoo.com

विषय: Completed R&D project titled “To find a methodology of safe liquidation of thick seams of Raniganj Coalfields: Design & Development & show-casing demonstrative trials at Khottadih colliery,ECL”. [Project code: CIL/R&D/01/58/2014]

महाशय,

The above project has been successfully executed by CIMFR, Dhanbad in association with ECL, Sanctoria. In order to address the issues of coal extraction from ground control as well as spontaneous heating points of view, the above scientific study was undertaken to delineate the factors/parameters influencing and ensuing such scenarios in Raniganj coalfields as a whole and Khottadih Colliery in particular. This comprehensive research project is thus able to extract more numbers of pillars per panel even in a seam of very low incubation period.

For introduction of the outcome of the above project in other underground mines, **“Identification of one mine of CIL for implementation of project”** has been kept under the Memorandum of Understanding (MOU) for 2018-19 between CMPDI and Coal India Limited (CIL). For Excellent rating, above activity is required to be completed by 31st January 2018.

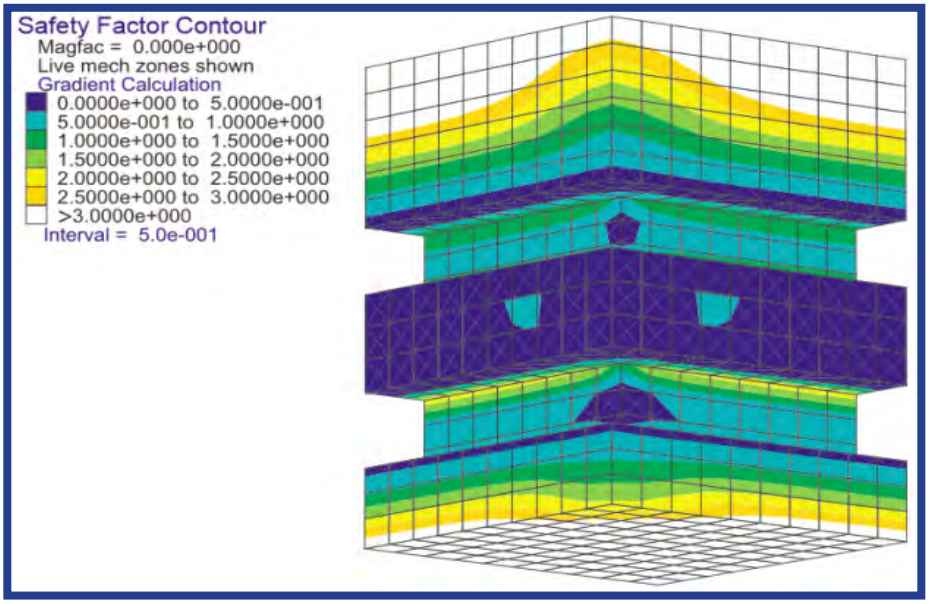
You are therefore, requested to take all necessary efforts in identifying one mine of CIL suitable for introduction of technology developed under the above completed project. The report in this regard is required to be submitted latest by 31st January 2019.

धन्यवाद,

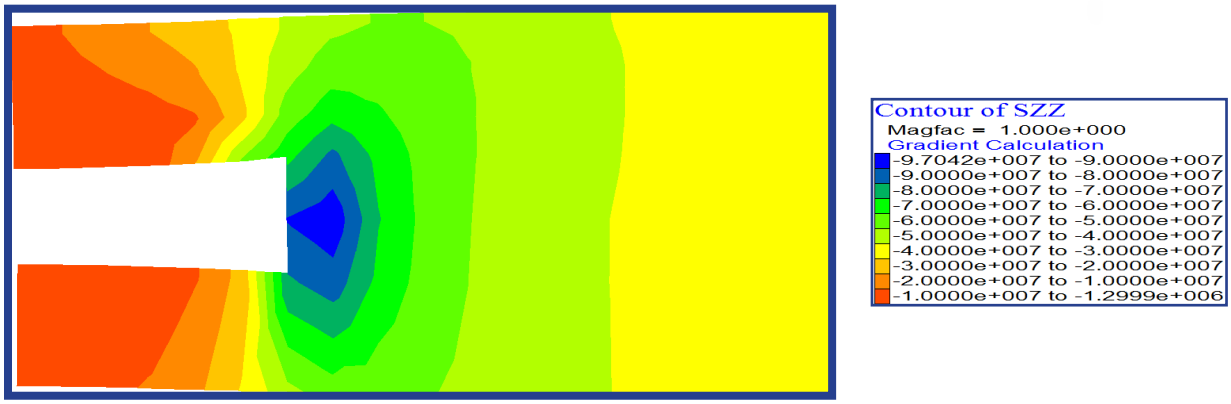
भवदीय

(गोपाल प्रसाद) (Gopal Prasad)
महाप्रबन्धक (एस. एण्ड टी./ पी.ए.डी.) / (General Manager(S&T/PAD

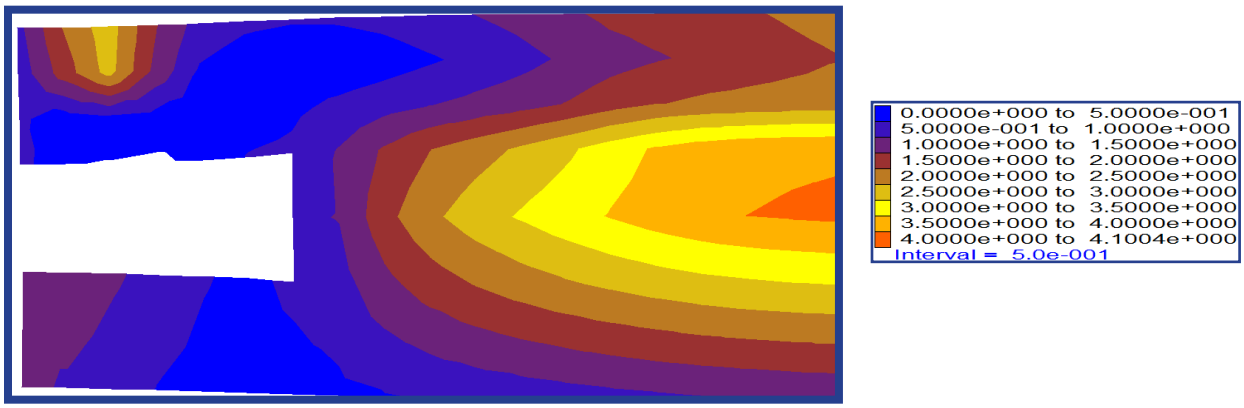
प्रतिलिपि:
1) Director ,(CIMFR), Dhanbad - E-mail: dcmrps@yahoo.co.in/



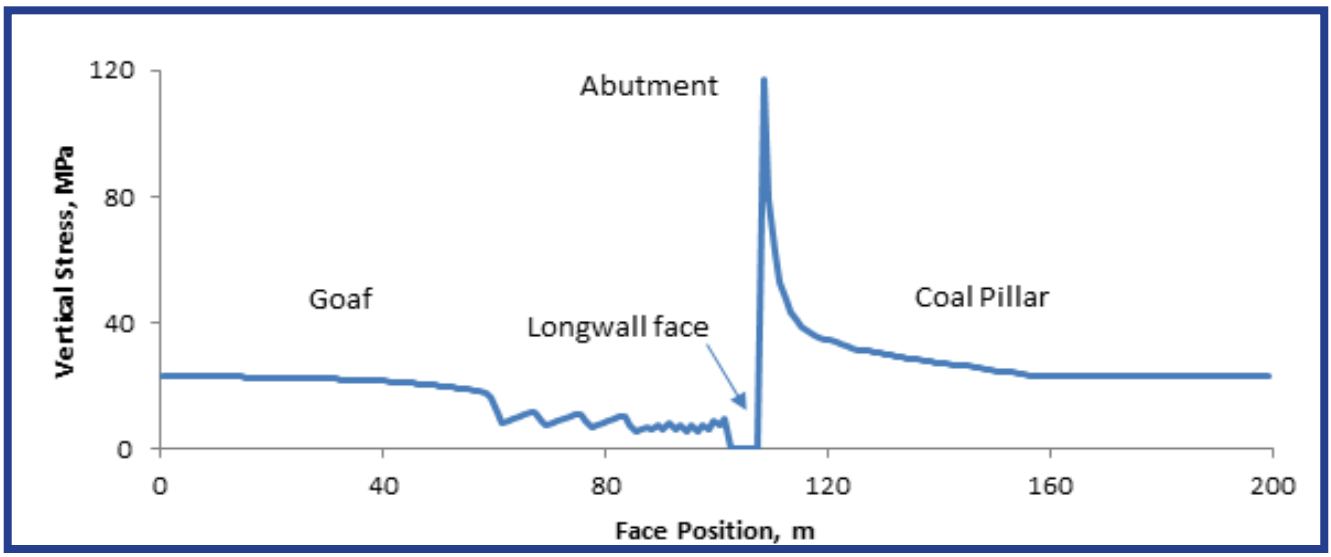
Safety Factor contours of parting between Section 1 and 2 (46LN Panel) [Stability of the partings between sectionalised workings], Gare Palma IV/5 mine.



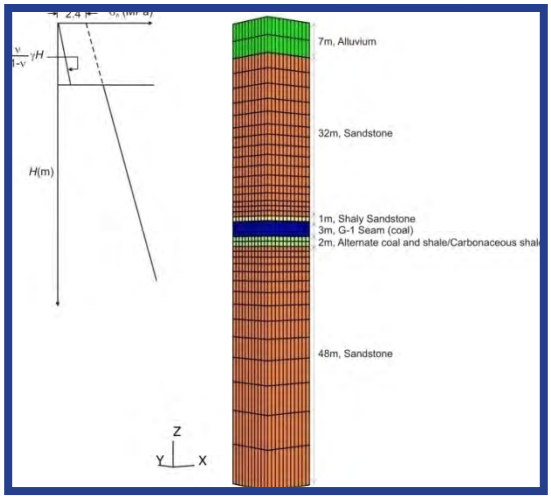
(a): Contour of Vertical Stress



(b): Safety Factor Contour



Distribution of vertical stress along Longwall panel in XV seam of Moonidih colliery



The quarter symmetry model showing different strata in Surakachhar mine along with horizontal in-situ stress initialization graph for pothole study, with objective to protect East-West Rail Corridor (operated by IRCON).

6.2. MINE DESIGN AND SIMULATION

R&D work in underground coal and metal mining problems related to method of mining, numerical modeling, rock mechanics ground control and strata monitoring are being undertaken by CSIR-CIMFR. During the period April 2017 to March 2018 Mine Design & Simulation Section initiated a number of industry sponsored projects and completed previous year's projects.

The clients included M/s Singareni Coal Company Limited, M/s Hindustan Zinc Limited, M/s Tata Steel, M/s IMFA and various subsidiaries of M/s Coal India Ltd., like BCCL, ECL, SECL and MCL.

Apart from the project related activities, the department imparted training to the students (under the HRD banner of CSIR-CIMFR) of various engineering colleges. Scientists and staff of the department are also associated with different inter departmental projects.

During the year 2017-18, the department conducted different laboratory (numerical modelling) and field investigations for several industry sponsored projects and undertook six new projects. Thus, department earned an external cash flow (ECF) of more than Rs. 85 lakhs.

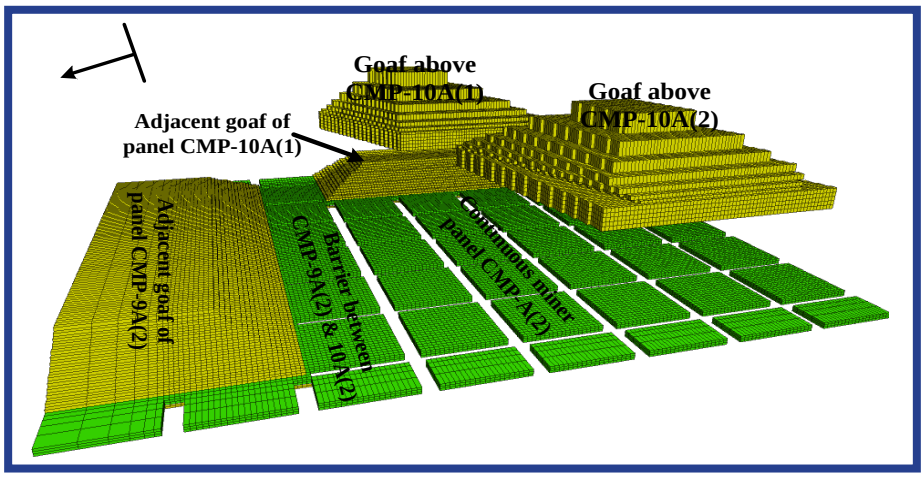


Fig. 1: Flac 3D grid showing the overlying and the adjacent goaf.

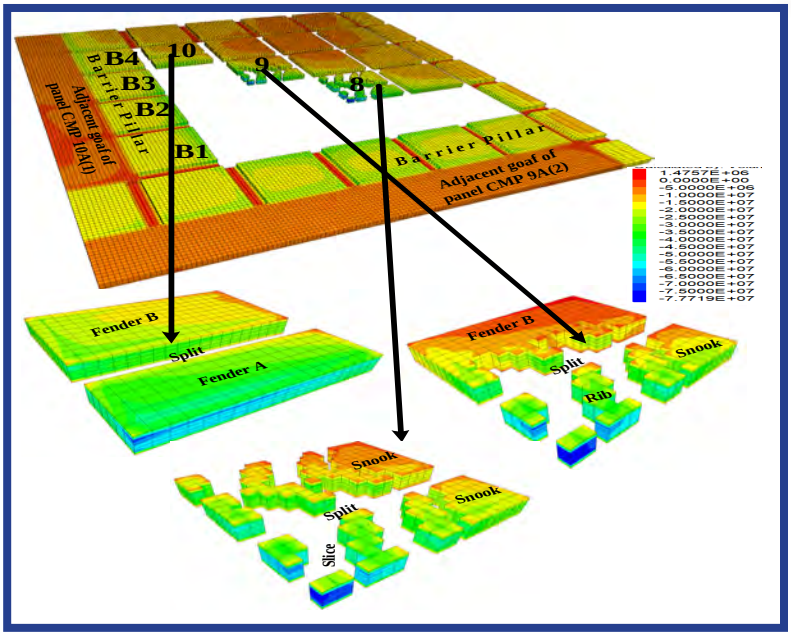


Fig. 1: Vertical stress contour during depillaring of the coal seam by continuous miner.

GAP PROJECTS

1.0 Development of Tele Robotic and Remote operation Technologies for underground coal Mines

This project is being jointly carried with CSIR-CMERI, Durgapur. Design of compat able 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 report was submitted. The Technical Sub-Committee of Standing Scientific Research Committee has recommended conducting further field trial after approval from DGMS for fine tuning of the prototype so as to use it for remote monitoring of environmental parameters in any underground coal mines which is under process.

A brief overview of the projects completed:

i. At VK-7 Incline mine, Kothagudem Area, SCCL based on field investigation and comprehensive numerical modelling study, a suitable method of mining using Continuous miner technology has been suggested for fast and safe extraction of CMP-9 and CMP-10 panels in King seam. Based on study report, the competent authority gave permission for extraction of those panels. Mine management also entrusted CSIR-CIMFR to monitor the strata and seek necessary advice during extraction of those panels. Based on field monitoring study, necessary advice was rendered during successful extraction of the CMP-9 panel. At present extraction in the CMP-10 panel is going on.

ii. 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. Based on monitoring study, necessary advice was given time to time.

iii. At Digwadih colliery, Tata Steel, mine management sought advice from CSIR-CIMFR regarding suitable extraction methodology for XVI seam, lying at a shallow depth of cover under built-up area. Based on field and numerical modelling study, a suitable design was suggested.

iv. At 21 incline mine, Yellandu area, SCCL, strata monitoring investigation was conducted by CSIR-CIMFR during extraction of the thick seam by Blasting Gallery method in panel 'BG S & U' in Queen Seam. Under close association of CSIR-CIMFR, mine management successfully extracted the panel.

v. Scientific studies were conducted for review of "Ground Control Management Plan" of Rampura Agucha and Kayad mines of M/s Hindustan Zinc Limited. During the study period, CSIR-CIMFR scientists visited both the mines number of times and gave necessary advice and suggestions regarding ground control aspects associated with both the mines.

vi. A scientific study was conducted to ascertain the thickness of crown pillars below 85mRL up to -39mRL at different levels with stop height of 50m at Mahagiri mines (Chromite) in Sukinda valley of M/s IMFA. Recommendations of the study were submitted to M/s IMFA for its implementation in the mine.

vii. At Bhelatand (A) colliery of Tata Steel, a scientific study was conducted for the design of extraction methodology in 13 and 14 seams with controlled effect on the floor of upper worked out waterlogged seams. The study was completed and the final report was submitted to mine management. Based on the study report extraction in the mine is going on.

viii. At Gopinathpur colliery, ECL, a scientific study was conducted to assess and design the barrier against Pusai river to avoid chances of slide down of barrier along the interface with Gopinathpur seam. After field and numerical modelling study, the barrier against Pusai River has been designed to avoid chances of sliding down of the barrier along the interface with Gopinathpur seam. Recommendations of the study were submitted to mine management for its implementation in the mine.

ix. At Orient mine No.1&2, Orient area, MCL, mine management requested CSIR-CIMFR, Dhanbad to conduct a scientific study for systematic liquidation of Hingir Rampur (HR) seam standing on pillars in multi-sections. Based on field investigation and numerical modelling, a detailed study has been carried out. Suitable methods of extraction were suggested for the fast and safe liquidation of pillars. Recommendations of the study were submitted to mine management for its implementation.

At present 4 number of projects are running in different coal fields.

7. CSIR-CIMFR NAGPUR RESEARCH CENTRE (UNIT – I)

(Rock Excavation, Fragmentation, Geo-technique & Mine Modeling)

CSIR-CIMFR Unit -1, Nagpur has undertaken a number of projects for mines and tunnels. This includes projects in the sub area of blasting, rock fragmentation, numerical modelling, mine slopes and geo-hydrological problems. During the current financial year 27 new projects are enrolled by the centre thus, earning significant external cash flow (ECF) for the department and lab as a whole. Mining technology group of Nagpur centre not only initiated new externally funded projects from industry but worked for successfully completion of about 20 projects which were enrolled earlier.

Various mining organisations and civic sector organisations like metros, railways, irrigation projects, etc., have shown keen interest in CSIR-CIMFR knowhow and utilized the knowledge of laboratory in the blasting and infrastructure development. Some new in-house projects were also initiated for enhancing the mining research status. Other supportive academic activities namely training of students, etc., (HRD related) were also undertaken for mining engineering students of nearby colleges and interaction held with polytechnic institutes which is engaged in teaching in mining discipline. Division's R&D endeavour has brought laurels for the CIMFR scientists in the form of honours/awards and publication of technical papers in various international and national events i.e. conferences /workshops/seminars, took active participation of scientists in international and national events has brought synergy between mine safety, mine production and R&D efforts.

A grants-in- aid project entitled, “Development of a selection methodology for Roadheader and Tunnel Boring Machine (TBM) in different geological conditions for rapid tunnelling” is undergoing at the Nagpur centre in collaboration with IIT-ISM, Dhanbad. So far varying geological conditions as encountered during tunnelling have been reviewed and an assessment has been made about the causes (other than geology) that retards the tunnelling progress. The comprehensive literature review has identified the geological sites, areas and projects where machine excavation using ‘Road header and TBM’ is feasible. Major equipment and facility creation is under process. In this series, MoU with NHPC is under last stage of finalisation for generating data from the TBM Sites.

Nongtrai limestone mines of M/s Lafarge Umiam Mining Pvt. Limited (LUMPL), Meghalaya is planning to raise its mine production through activity expansion. Planning details for expansion of the mines from 2.0 MTPa to 5.0 MTPa was worked out and compiled in consultation with mine management considering several safety and precautionary measures with futuristic perspective. To achieve the objectives of this ongoing sponsored project, evaluation of the rock mass properties (in-situ and lab properties), the blasting studies have been done to ascertain the safety and production enhancement requirements.

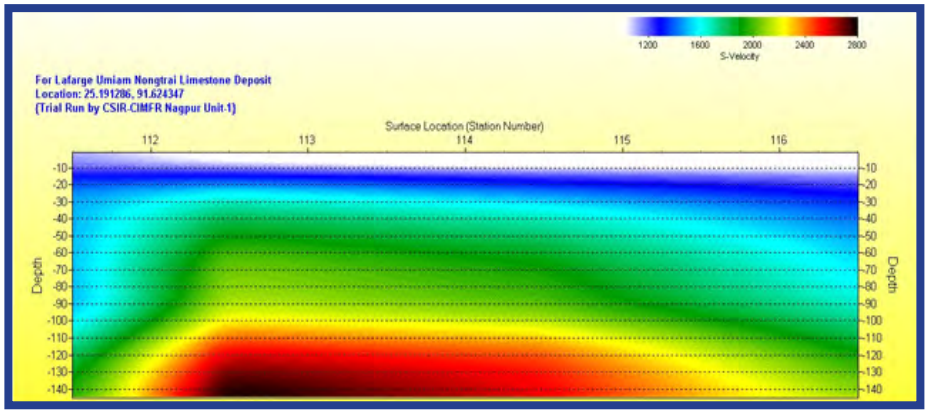


Fig 1 : Determination of sub-surface geology using 2D geophysical data (MSWA results of Nongtrai mine of LUMPL, Meghalaya)

In this study, field work was conducted with the help of ‘multichannel surface wave analysis (MSWA), to ascertain the in situ properties of rock mass and to evaluate the use of this method for determination of cavities in the rock (Fig. 1). A comprehensive analysis of the borehole logs of the LUMPL mine site was conducted in the form of horizontal plans along with different borehole orientations and this revealed presence of voids and clay at different depths (Fig 2). The pot hole potential risk rating that causes subsidence has been determined as low for the mine site.

Blast trials were conducted to find out the attenuation relationships of the ground vibration and air overpressure along with the frequency domain of the ground vibrations. This data was used to find out the maximum charge per delay that can be used to conduct safe blasting operations in the mines. It was ascertained from the study that the vibration levels while using a maximum charge / hole of 63 kg and five cooperating holes, did not cross the stipulated

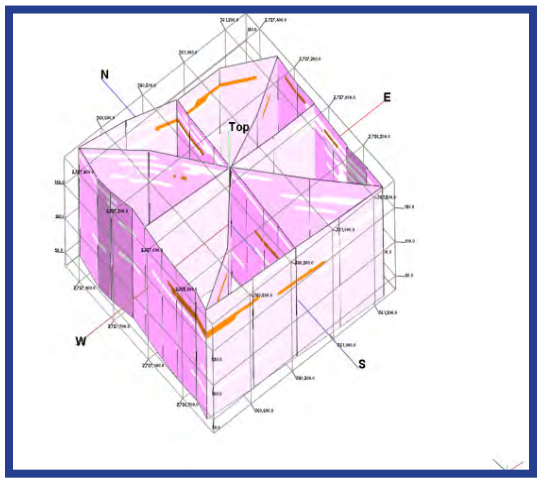


Fig 2: Identification of voids using 3D Mapping at LUMPL mine

vibration levels that practically attenuate within the mine area. Based on this, a predictive regime for blasting was evolved along with the blast patterns.

Number of open-cast mines, in which blasting work is carried out for mineral production are encircled with small and medium size villages with human population. The blasting practices in such nearby mine villages cause impact in terms of vibrations, noise and fly rocks. In the new and changing scenario the division's research and development priorities have been directed towards the socially relevant problem of affected villagers. Division's R&D work has been widened further to various hydro-electric power projects e.g. Rammam H.E.P. (III), Darjeeling, West Bengal (Fig. 3 & Fig. 4). In this way, R&D backbone of 'underground construction' and 'sub-surface sciences' is strengthened (Table 1) and substantial cost savings has been done through R&D (Table 2)

Fig. 3 : Excavation of multiple tunnels at complex geological conditions at Rammam Hydro-electric project-III.

The simple and user friendly 'in-hole delay cut blasting' and 'bottom air decking' resulted in the overall progress/pull per round and substantial reduction of over break. Applied techniques favour application of deeper rounds like 5-6m for greater productivity which is not possible in the conventional blasting. The CIMFR methodology has improved not only productivity but also safety and has resulted in 7% savings of total project cost (≈ 99.2 Crores).

(a) With controlled blasting (no damage) (b) With conventional blasting (damage)

Fig. 4 : Pictures captured by borehole inspection survey for detection of damage zones at Rammam HEP

Table -1 : Comparison of test blast results with controlled blasting
(In-hole-delay cut method at Rammam HE Project, Darjeeling, West Bengal)

S. No.	Parameter	Conventional Blasting	In-hole delay cut method
1	Diameter of blast hole	45mm	45mm
	Depth of blast hole	4m	4m
2	Total no. of blast holes	96	96
3	No. of relief holes (Ø=79mm)	4	3
4	Charge per round	224.8 Kg_3	216.8 Kg_3
5	Specific charge	1.78 kg/m^3	1.4 kg/m^3
6	Specific drilling	3.0m/m	2.4m/m
7	Blast vibrations (at 30m)	7.6 mm/s	5.4 mm/s
8	Pull per round	3.0 m	3.8 m
9	Over break	0.3m - 0.6m	0.1m - 0.25m

Another important project dealt by team Nagpur is related to Bangalore Metro Rail Project for 'Controlled blasting for rock excavation near sensitive and critical structures' (Fig. 5a & 5 b).

Simulation based blast design parameters helped in conducting initial trial blasts safely. CIMFR controlled blasting techniques at Bangalore Metro Rail Project yielded with reduced damage by 16.6%. Flyrock & airblast problems were effectively controlled by optimised blast design and proper muffling arrangement.The bottom air decking improved overall progress and reduced ground vibrations by 30-40%. The energy relief soft blasting bottom damage by 80-85%, which resulted in cost savings of 20 Crores (Table 2). In this way, the controlled blasting methods improved not only safety but also productivity.

Fig. 5 (a): Rock excavation near critical structures at City Market station of Bangalore Metro Rail Project

Fig. 5 (b): Rock excavation near sensitive structures at Majestic station of Bangalore Metro Rail Project

Table 2 : The returns of CIMFR controlled blasting techniques at the Bangalore Metro Rail Project

Name of Metro Station	Savings in	Cost savings (Rs. in Crores)
City Market	Reduced damage	1.5
	Backfill concrete	1.125
Chikpet	Reduced damage	2.25
	Backfill concrete	1.6875
Majestic	Reduced damage	7.5
	Backfill concrete	5.625
	Total	19.6875

With an objective to provide technical R&D support for the industry and various mines, the benefits of R&D studies are availed by the sponsoring agencies for both long term benefits and immediate gains in terms of statuary compliance. The centres activities have strengthened new clientele for CIMFR industrial liaison with Indian mineral industry.

In the new and changing scenario priorities have been fixed for socially relevant R&D work. Various mining organisations and civic sector organisations like metros, railways, irrigation projects, etc., shown keen interest in CSIR-CIMFR knowhow and utilized the knowledge of laboratory in the blasting and infrastructure development. Some new in-house projects were also initiated for enhancing the mining research status. Other supportive academic activities namely training of students,etc., (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.

CIMFR unit-1 mining technology group of Nagpur and its scientists got appreciation from industry in the form of honors/ awards. One book and more than 03 dozen technical papers in various international and national journals, conferences /workshops/seminars have been published (Annexure -I) . Some of these publications got very good citation index and are referred widely all over the world. Promotion of Hindi language for technical work and day-to-day official work was an additional effort taken up by the centre. At the centre, efforts are on to build its infrastructure facility.

8. NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT

8.1. ENVIRONMENTAL ASSESSMENT AND REMEDIATION

i. Quality Evaluation of Stack Emission, Ambient Air and Effluent Discharge of Tenughat Thermal Power Station with Suggestive Remedial Measures

Objectives:

- Evaluation of stack emission, ambient air, water/effluent and Environmental Statement of TTPS
- Monitoring of all the environmental parameters on monthly basis and Environmental Statement will be made once in a year.

Results & conclusion: Environmental parameters were monitored at Tenughat thermal power plant. Stack emission, ambient air and water discharge samples were collected and analysed for different environmental quality parameters on monthly basis. At the end of the project duration, Environmental statement was prepared and finally recommendations were made for better remedial measures.

ii. Investigation of leaching properties of bottom ash & fly ash of KodermaThermal Power Station

Objectives:

- Collection of dry fly ash and pond ash from KTPS.
- Laboratory experiment to obtain leachate from fly ash and pond ash.
- Characterisation of leachate with respect to water quality parameters.

Results & conclusion:

- On the basis of laboratory investigation, it is concluded that the leachate of fresh fly ash showed more concentrations of few heavy metals as compared to pond ash leachate. During actual field conditions, when the fly ash is disposed in ash pond, there may be chances that few of the unwanted metals may leached out from disposed fly ash in long term duration and if the ground strata is permeable for leachates, they may percolate through ground strata and may reach up to the groundwater. To avoid this, a proper lining system should be created in all ash ponds to avoid metals percolation through ground strata.

- On time to time basis it is necessary to carry out study of groundwater quality near the ash disposal site and proper remediation should be done to avoid contamination of nearby groundwater.

iii. Environmental quality monitoring, mitigative measures and related advice for Kathautia Open Cast Coal Mines, Daltonganj, Jharkhand

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 current environmental status of the mining area. The detailed study with respect to air, water, noise, soil and Flora & Fauna has been carried out in the year 2017-18. To know the air quality of the area, different air quality-monitoring stations have been fixed in the core and buffer zones. Sampling and analysis of $PM_{2.5}$, PM_{10}, SO_2 and NO_2have been carried out on seasonal basis for the monitoring year. Total five sampling stations have been selected for air quality monitoring on the basis of wind direction and other meteorological parameters. All the measuring parameters are well below the threshold level prescribed by National Ambient Air Quality Standards at all the monitoring sites except the working zone. To assess the impact of mining on water quality, eight water samples have been collected from different locations. This comprises of two ground waters, three mine effluents, 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. 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 revegetation of overburden dumps should be done to control soil erosion, denudation of agricultural land and nearby riverine system, wetlands and to improve the aesthetics of the area. The mine management has been implementing, these measures to make mining operation eco-friendly in this coal mine of M/s Hindalco Industries Ltd.

iv. EIA study and preparation of EMP of Jitpur Colliery

Steel Authority of India (SAIL) is the largest corporate entity and steel makers in the country.SAIL-ISP, approached CSIR-CIMFR for detailed study of Environmental Impact Assessment (EIA) of the running Jitpur Colliery and 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 follow:

- ❖ 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.
- ❖ To assist in Public Hearing and presentation at MoEFCC, New Delhi.

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. From the base line data and EIA result, management plan has been prepared for implementation in the respective areas for eco-friendly coal from Jitpur colliery. It is expected that with the implementation of management plan, environmental quality will be improved. 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.

v. Chemical analysis of water samples and their interpretation

Central Ground Water Board, Ranchi approached CSIR-CIMFR for chemical analysis of water samples. The sampling part of the project carried out by CGWB. The parameters of water samples analysed as per work order and compare with the Indian standard IS: 10500 (2012) for drinking water. The interpretations of various parameters are also incorporated in the report.

Objectives: Collection and evaluation of water quality of different groundwater samples near the power plant

Results & conclusion: Water samples were collected from Kariyawa Village Pond water, Kariyawa Village Tube Well water and BadaBisodih Village open well water of Koderma thermal power plant From analytical results it has been found that the 25 water quality parameters analysed in water samples have not shown any of their concentration at alarming level as compared to IS 10500: 2012, Indian Drinking water specifications. Few of the water quality parameters like Total dissolved solids, Total alkalinity, Total hardness, Calcium hardness and Magnesium have been found more than the acceptable limit of Drinking water specification (IS: 10500) in tube well and open well water but their concentrations were less than the permissible limit of Drinking water Specification in absence of alternate source. The higher concentrations of these parameters in ground water may be due high mineral content present in ground strata.

vi. Advice to find out the total Hydro-geological yield of Aquifer and their management for a Singsar Limestone Mine of M/s Ambuja Cements Limited, Gujarat

Objective: Groundwater Seepage Modeling using MODFLOW Software.

Results and Discussion: The aquifer present in the area is mainly of Miliolitic lime stone, Gaj formation and Deccan Trap Basalt which lies at shallower as well as deeper depth. The Arabian sea and singora river are the main seepage water sources. The TDS value is very high in ground water due to Arabian Sea water.

vii. Hydro-geological Studies for Singsar Limestone Mine of M/s Ambuja Cements Limited, Gujarat

Objective: Study of Ground water table & its yield, Hydrological potentiality assessment, hydrological 3D terrain features analysis for estimate Groundwater availability.

Result and Discussion:

- The Singsar limestone mine nearer to Arabian sea in south direction and Somat River in east direction. Surface runoff, excessive precipitation, ground water inflow from Somat River and Arabian Sea, all hydrological parameter lead to negative impact for mining.
- Analysis of Groundwater level in the Pre-monsoon seasons varies in the range of 4.5 m to 48 m bgl whereas post-monsoon water lever ranges between 3.70 m to 16.00 m bgl and average fluctuation of water level 8.73 m bgl between pre and post-monsoon seasons.
- On the basis of Physico-Chemical parameter analysis for ground water quality assessment it is found that the value of Chloride, Sulphate and Alkanity are below the acceptable limit," pH, Total Hardness and Ca Hardness and Mg Hardness are under the permissible limit and TDS, salinity, Total Hardness are above the permissible limit.
- The total dynamic reserve core zone is 47.67 mcm/annum and total surplus reserve 32.00 mcm/annum. This reserves would proportionally decrease or increase as per rainfall pattern.
- The river /drainage of the study area flowing from NW direction to S and SW finally meet the Arabian Sea. The ground water available throughout the year in the study area. The ground water recharge is high due to presence of miliolitic limestone.

viii. Water Conservation Study of four Units at Roam, Chapri, Kendadih and Surda Villages in the periphery of Rakha, Kendadih and Surda Mining areas of Indian Copper Complex, Ghatsila

Objective: Water Conservation Study / Rain Water Harvesting of four Units at Roam, Chapri, Kendadih and Surda Villages in the periphery of Rakha, Kendadih and Surda Mining areas of Indian Copper Complex, Ghatsila.

Results and Discussion:

- All the tributary Nalas are seasonal and the Subarnarekha is the perennial source of water in the area.
- Steep slope is to be found in the south western part of the study area and gentle or low slope can be found in the middle part of the study area, mostly situated on either side of the Subarnarekha.
- Soil in this area reveals that there is no wide variation in the natural material.
- Particle size analysis shows that the texture of the soil is of sandy loam in nature.
- The entire study area (watershed) of the project is94.95 Sq. Km), the total surface water potential is estimated at 91.20 MCM/annum. After the implementation of Rain water harvesting structures in the study area, the total recharge potential is to be estimated 24.647 MCM/annum. By the implementation of rainwater harvesting in the study area there will be increase in ground water recharge potential of 0.857 MCM/annum.

ix. Generation of Environmental Parameters, Critical Evaluation of Parameters, Preparation of EIA and Management Plan for Sijua and Bhelatand Colliery

Objective: To generate Environmental Data and Preparation of EIA and EMP.

Results and Discussion:

- The Sijua Colliery is bounded by Jogta section of Mudidih Colliery of BCCL at North, Kanakani&Loyabad Colliery of BCCL in the East, Bhadrichauk section of BCCL at the west & Bhelatand Amalgamated Colliery of TATA STEEL at the south side.
- Geologically, both the collieries comprise of Archaean Metamorphics separated by unconformity from Talchirs, which is overlain by coal bearing Barakars, Barren Measures (devoid of coal) and Raniganj Formations (coal bearing).
- Main surface water source of the area is River Damodar.
- Concentration of $PM_{2.5}$,PM_{10}SO2, NOx, and Co_2 is within the permissable limit asper the National Ambient Air Quality Standards (NAAQS).

x. Generation of Environmental Parameters, Critical Evaluation of Parameters, Preparation of EIA and Management Plan for Bhelatand Coal Washery (BCPP)

Objective: To generate Environmental Data, Preparation of EIA and EMP.

Results and Discussion:

- Main Drainage of the area is River Damodar.
- The prominent streams draining the western and eastern part of the buffer zone are Katri Nadi, Khudia Nadi, Jarian Nala and Domohani Nala, both tributaries of Damodar river.
- Geologically, both the collieries comprise of Archaean Metamorphics separated by unconformity from Talchirs, which is overlain by coal bearing Barakars, Barren Measures (devoid of coal) and Raniganj Formations (coal bearing).
- Concentration of $PM_{2.5}$and PM_{10}andSO2, NOx, COwere well within the limit as per the National Ambient Air Quality Standards (NAAQS). Zero Effluent discharge policy has been suggested and adopted by the company

xi. Studies on the addition of low cost bio-adsorbent to Industrial and agricultural waste for mitigation of Cr (VI) from waste water in Sukinda Chromite Mines, Odisha

Objectives:

- Qualitative assessment of ground water in Chromites mining area.
- Mitigation of hexavalent chromium from water by adsorption process using bio-adsorbent

Results & conclusion: Twenty water sample (surface and ground water) is collected from different location of sukinda chromite mining area in the month of Nov 2017. Water temperature, pH, and electrical conductance (EC) were recorded at the time of sample collection by using a water quality tester. The water samples collected from different sampling sites were analyzed in the Laboratory following standards methods of APHA. The Hexavalent chromium of water sample collected from Sukinda chromite mining area is determined colorimetrically by reaction with 1,5 di-phenylcarbazide in acid solution. The result of physico chemical analysis shows that the concentration of hexavalent chromium is found above the permissible limit. As Cr (VI) is carcinogenic in nature so its removal from water is very necessary. Removals of Cr (VI) experiment were conducted by using agricultural wastes as an adsorbent as shown in Fig 1& 2. From Fig 1& 2 it is clear that 97.5 % removal of Cr (VI) occurs at pH 1.

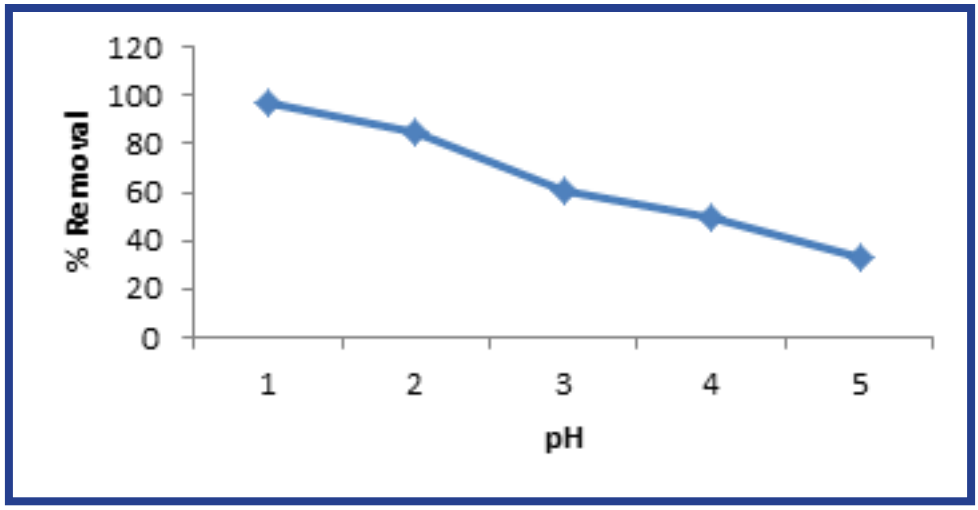


Fig 1: Adsorption of Cr (VI) by agricultural wastes at different pH

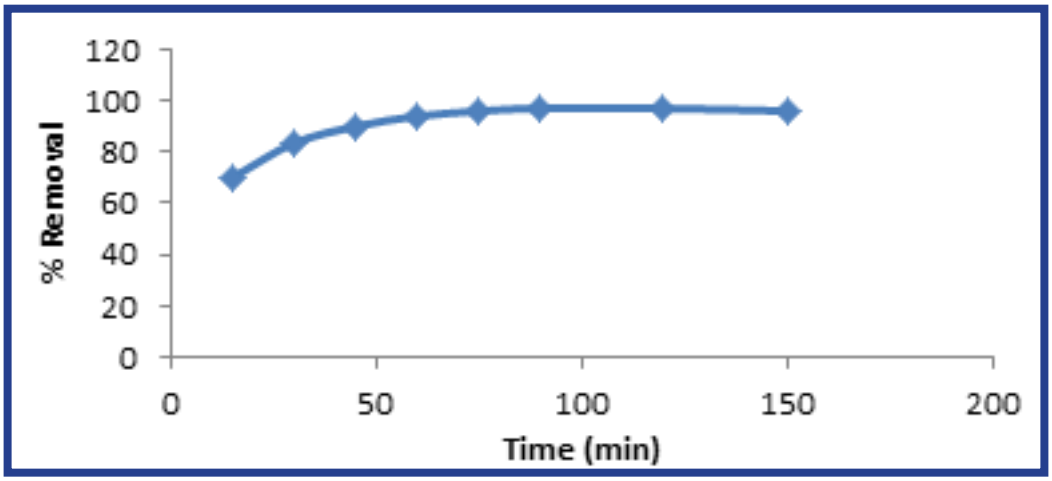


Fig 2: Effect of contact time on Cr (VI) removal by agricultural wastes at pH 1.

xii. Fugitive Dust Emission Monitoring at Crushing and Screening plant, Donimalai Iron Ore Mine before installation of Dust Suppressing System M/s NMDC, Donimalai, Bellary, Karnataka

Objectives:

- Estimation of fugitive dust (SPM) at ±25 mt from source by RDS
- Estimation of respirable dust (<10µm) on 8 hourly basis by Personal Dust Sampler
- Estimation of PM10 and PM2.5 around Donimalai township

Results and Conclusion: Among the selected sites of air monitoring stations, the fugitive dust concentration (SPM) values ranged from 1121-7040 µg/m^3 at screening plant near entry door of Apron feeder (DS4) followed by 232-4292µg/m^3 at Crushing plant in front of office (DS2), 955-3011 µg/m^3 at Screening Plant near Tertiary Screen (DS1), 1340-2935 µg/m^3 at Motor area of screening plant (DS5), 227-2045 at B-room (DS3). The values at all sites were above National Ambient Air Quality Standards (NAAQS) for fugitive emission (1299 µg/m^3). Among the selected sites the DS4 is the most polluted sites followed by DS2, DS1, DS5 and DS3 with respect to SPM hence need air pollution management schemes to reduce the SPM for the protection of human life and property.

PM10 and PM2.5 are far above normal permissible limit in work place environment as prescribed by DGMS. For ambient conditions outside the plant, PM10 is twice while PM2.5 slightly higher than thrice the value of NAAQS of CPCB of MOEF& CC.

Percentage of silica in all the samples of RespirablePersonal Dust was within permissible limit (DGMS norm of less than 5%). Though free silica (%) is higher than the respirable dust concentration but is within the permissible limit of <5%.

xiii. Installation of an Automated Bricks Making Plant for Utilization of Lean Tailings (Rejects of Pellet Plant) at Donimalai Complex, M/s NMDC, Donimalai, Bellary, Karnataka

Objectives

- Identification and assessment of abandoned mine waste land in India,
- Quantification of available mine waste and its present rate of generation,
- Analysis of physico-chemical properties of waste materials and characterization of wastes,
- Development of suitable technologies for different uses of mine waste and abandoned mine land,
- Field installation of mine waste utilization plant in a mine,
- Demonstration of abandoned mine rehabilitation technology in two mines,
- Development of strategies for utilization of mine waste and rehabilitation of abandoned mine lands throughout the country.

Results and Conclusion: Laboratory tests results of collected samples showed that soil particles passed through IS sieves of size 4.75 mm and retained on 0.075 mm are well graded sand having coefficient of uniformity and coefficient of curvature 28 and 0.7, respectively. The sieve analysis data of iron ore wastes after mining is given in Table 1 and graphically depicted in Fig. 1. The moisture content of sample was 9.429% and the bulk density was 1.072 g/cm^3 (Table 2) indicating high soil moisture retaining capacity with low bulk density. The plastic limit and liquid limit of the soil sample was approximately 25% and 28%, respectively which shows kaolinite mineral is present in it and has moderate soil binding capacity. The value of plastic and liquid limit is used to classify fine grained soil. The pH and EC were 6.38 and 84.7 millisiemens per metre (mS/m). The chemical analysis for total carbon and total nitrogen were 0.56% and 0.081%, respectively. This indicated low nutrient content in the soil.

Table 1: Sieve analysis of lean tailings

Type of soil	Sieve size (mm)	Weight retained on each sieve (g)	% weight retained on each sieve	Cumulative percentage	% finer
Coarse sand	4.75	163.7	27.2	27.2	72.8
	2.00	189.3	31.5	58.7	41.3
Medium sand	0.425	172.0	28.6	87.3	12.7
Fine sand	0.075	61.7	10.28	97.58	2.42
Slit and clay	Passing 0.075	11.3	1.88	99.46	0.54

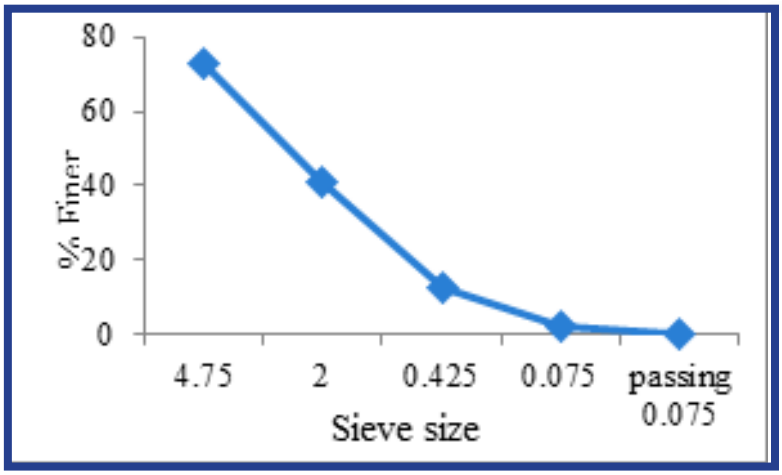


Fig. 1: Percentage finer vs. sieve size

Table 2: Physcio-chemical parameters of lean tailings

Parameter	Values
Plastic limit (%)	24.6
Liquid limit (%)	29.33
Bulk density (g/cc)	1.072
Moisture content (%)	9.429
pH	6.38
Electrical conductivity (µs/m)	84.7
Total carbon (%)	0.56
Total nitrogen (%)	0.081

Lean tailings bricks were prepared with lean tailings:cement:sand ratio of 10:2:1, 9:3:1, 8:4:1 indicated compressive strength of 4.13, 6.15, 5.58 Newton/milimetre^2 (N/mm^2), respectively (Table 3) showing higher compressive strength compared to ordinary fired clay brick (3.5 N/mm^2). The compressive strength of iron ore wastes of all the samples provided higher values due to better composition of soil grain sizes, plasticity and liquid limit of the waste samples. Sample having ratio of 9:3:1 (lean tailings:cement:sand) considered more favorable with higher compressive strength after 21 days of curing compared to the ratio of 10:2:1 and 8:4:1. The bulk density of different brick ranged from 1.88 to 2.09 g/cm^3 while the values of normal fired clay brick were 1.95 g/cm^3.

Lean tailings have been mixed with sodium silicate (9:1 and 8.5:1.5) and cement (9:1, 8.5:1.5 and 8:2) as well as sodium silicate and sand (9:1:1). After preparation of the bricks were kept in oven from 12-48 hr (Table 4). It has been found that strength of bricks had increased with more duration of heating. For manufacturing strong and economical bricks by NMDC Limited, an optimum mixture of lean tailings and cement (9:1) is selected with 18 hr heating of brings to get a strong brick of 5.18 N/mm^{2}compressive strength compared to ordinary fired clay brick (3.5 N/mm^2) available in the market. However, different mixture of bricks may be manufactured as per the requirement by the users.

Table 3: Compressive strength test of bricks manufactured by mixing lean tailings, cement and sand

Mixing ratio (Lean tailings: cement : sand)	Weight of brick (kg)	Compressive strength (N/mm^2)	Compressive strength (kg/cm^2)	Bulk density (g/cm^2)
10:2:1	3.49	4.13	42.15	2.086
9:3:1	3.21	6.15	62.78	1.919
8:4:1	3.14	5.58	56.95	1.877
Normal fired clay brick	3.50	3.50	35.71	1.950

Table4: Compressive strength test of bricks manufactured by mixing lean tailings, sodium silicate cement and applying heating

Mixing ratio	Comprehensive strength (kg/cm²)	Comprehensive strength (N/mm²)	Heating duration (hr)	Weight of bricks (g)	Bulk density (g/cm²)
(a) Lean tailings : sodium silicate					
9:1	34.98	3.43	24	3450	2.06
8.5:1.5	36.32	3.56	24	3550	2.12
(b) Lean tailings : cement					
9:1	78.92	7.73	48	3400	1.00
8.5:1.5	124.66	12.22	48	3250	1.94
8:2	143.50	14.06	48	3200	1.91
9:1	40.36	3.96	12	3070	1.84
9:1	49.33	4.83	15	2950	1.76
9:1	52.91	5.18	18	3050	1.82
(c) Lean tailings : sodium silicate : cement					
9:1:1	41.70	4.09	24	3500	2.09
Fired clay brick	35.71	3.50	-	3500	1.950

8.2. MINE SUBSIDENCE AND SURVEYING

1. **Feasibility extraction of IX/6-S panel with hydraulic sand stowing under built-up area at Digwadih colliery of Tata Steel Limited**

   The Digwadih colliery is located in western part of Jharia coalfield of Dhanbad district in Jharkhand. The colliery management proposed to extract 6S panel of dimension 290 m x 194 m with hydraulic sand stowing in IX seam. The height of extraction of 6S panel is equal to seam thickness i.e. 2.94 m whereas depth of extraction varies between 419 and 452 m. The dip of seam is 1 in 7. The proposed mining method is bord and pillar with 75 percent of extraction. The important surface features over and around the proposed panel are single and double storeyedkachha and pucca buildings (Sonarambasti), three numbers of seasonal tank, Main J. C. railway line and village road. The proposed 6S panel is overlain by old stowed and caved goaves in XI, XIV, XV, XVA, XVI and XVIA seams. All the goaves of the immediate above seam i.e. XI seam were stowed. The parting between IX and XI seam is 67 m. The subsidence prediction is done by modified influence function method on the surface as well as XI seam floor due to proposed extraction of 6S panel of IX seam. Recently extracted 4S panel of IX seam located west of the proposed panel has also been taken into consideration to assess the cumulative impact of surface movements.

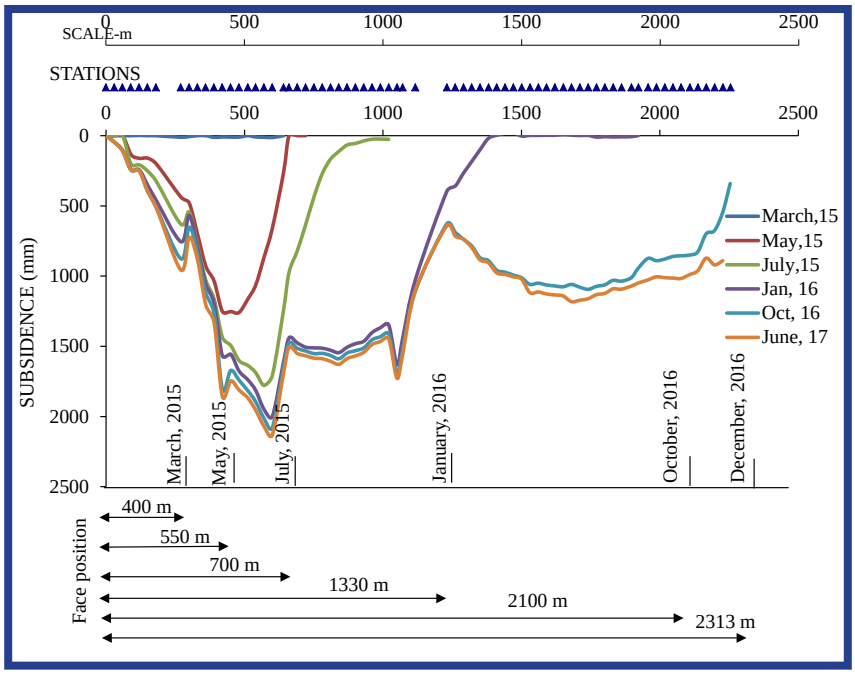
   The maximum subsidence, slope, compressive and tensile strain on the floor of XI seam due to extraction in 6S panel with 30 cm stowing gap are 374 mm, 8.86 mm/m, 1.72 mm/m and 1.34 mm/m respectively. The maximum subsidence, slope, compressive and tensile strain at the surface due to extraction in 6S panel with 30 cm stowing gap are 63 mm, 0.38 mm/m, 0.39 mm/m and 0.21 mm/m respectively. The cumulative maximum subsidence, slope, compressive and tensile strain at the surface due to extraction in 6S with 30 cm stowing gap are 102 mm, 0.73 mm/m, 0.60 mm/m and 0.32 mm/m respectively. The above magnitude of ground movements are well within the safe limit (i.e. tensile strain less than 3 mm/m) at surface as well as floor of XI seam. These anticipated subsidence values are not likely to cause any damage to surface features and structures as well as floor of XI seam. Therefore, it is recommended to extract the panel with percentage of extraction of 75 percent for 2.94 m thick coal in proposed IX/6S panel with hydraulic sand stowing. It is recommended to maintain stowing gap less than 30 cm. It is recommended to monitor subsidence movements during depillaring of 6S panel to know the actual movement to validate the subsidence prediction model.

2. Subsidence investigations over panel no.1 during retreating at Adriyala Longwall Project of Singareni Collieries Company Limited

Subsidence investigations were conducted over longwall panel no. 1 of seam – I during March, 2015 to June, 2017 at Adriyala mine of the Singareni Collieries Company Limited located in Godavari Valley Coalfield. The objective of the study was to establish the subsidence and strain values over the longwall panel as well as to correlate the field measurements with the predicted values. The panel having a strike length of 2313 m and dipping 1 in 5.5 along width was located at an average depth of 410 m from the surface. The panel, under single-seam mining condition, was extracted to a height of 3.50 m by longwall method of mining with caving using double shearer drum. The important surface structures and features over and around the panel include SRSP irrigation canal, active overburden dump and a Rachapalli village. This study conducted during the above period led to the following conclusions:

Maximum subsidence movement over the intact ground was 1346 mm at the dip side of the panel, amounting to 37% of extraction thicknesses. Maximum subsidence movement over the active dump was 2132 mm, 1.58 times the subsidence measured over intact ground, due to the influence of unconsolidated dump. Maximum slope, compressive and tensile strains observed over active dump were 10.84, 4.77 and 1.96 mm/m respectively. The values were erratic due to irregular compactness of dump. Maximum slope, compressive and tensile strains observed over intact ground were 13.01 mm/m, 5.23 mm/m and 4.78 mm/m respectively. Subsidence profile across the panel was inclined slightly towards dip but almost symmetric in nature.

The angle of draw at the raise and dip side of the panel was 10° and 13° respectively. A few hairline cracks were observed on newly constructed experimental wall. There was no impact on the buildings of the Rachapalli village. No remarkable impact on SRSP canal was observed. There was no adverse impact on the surface terrain due to mining induced subsidence.



Subsidence profiles with respect to face position at different period of time

3. Scientific study into the causes of ground movement at Nandgaon village lying within the leasehold area of Kurja colliery of Hasdeo area

Kurja underground mine (also known as Kurja-Sheetaldhara project) is located 10 km south of Bijuri railway station on Anuppur-Chirimiri branch line of the SE railway in the eastern part of Shohagpur coalfield within Korea district

of Chattisgarh. Nandgaon village is lying over the developed pillars of C3 and C4 panels in seam C which is located in the eastern part of Kurja colliery. The depth of developed pillars in panel C3 is from 172.0 m to 182.6 m. The villagers noticed a few cracks on the walls of their buildings on 24th February, 2015 when the depillaring with caving was going on in C2 panel which is west of C3 panel. Hence, the mine management desired to have scientific investigation into the cause of subsidence movements over the Nandgaon village. Therefore, the Mine Management of Kurja colliery requested Director, Central Institute of Mining and Fuel Research (CIMFR), Dhanbad, to conduct above study. This report covers the possible causes of ground movements in Nandgaon village for safety of villagers and their properties stand point of view.

Nandgaon village, located in the eastern part of the Kurja mine of Shohagpur coalfield, was affected due to ground movement causing damage to surface structures on 24th February, 2015. Based on field investigations and data provided by the mine management it was found that bending and cracking of the long beam of the dolerite sill and heaving of the floor of the seam C probably could have affected the village leading to damage to a few houses and lowering of water levels in a few wells located in the same area. It is recommended to get subsidence investigations by an independent party to know the magnitude and extent of ground movement, if any.

9. ROCK EXCAVATION ENGINEERING GROUP

9.1. EXPLOSIVE AND EXPLOSION LABORATORY (EEL)

During April 2017 to March 2018, 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.

Final reports of two completed projects were sent to the sponsor organization M/s SCCL, Kothagudem during this financial year 2017-18. Under one continued projects sponsored by M/s SCCL, total 57 samples of permitted explosives and 98 samples of permitted detonators were evaluated for their different quality parameters at SCCL sites and underground mines to advice on their quality, safety and performance parameters. Evaluation of these explosive and detonator samples of various manufacturers collected from different areas by SCCL management revealed useful information on their conformity or deviation from declared / expected values. Moreover, twenty samples of permitted explosives were also evaluated for their concentration of toxic gases in the post detonation fumes after five minutes of blasting at the face. Analysis of results revealed that quality of most of the samples of permitted detonators met the quality requirement of resistance, drop, snatch, series firing current, no fire current and strength parameters. 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 17 samples checked during 2017-18 under the continued project only 9 samples of permitted explosives were meeting all the statutory requirements but 8 samples failed to meet the statutory requirement of either AGS and/or VOD parameter and thus failed to meet the overall quality requirements. 28 out of 41 (i.e. 68.29%) permitted delay detonators (except 0 delay) samples failed to meet the quality requirement of delay timings at least two detonators of those batches were having their delay timings outside the expected range i.e. beyond 5% of allowable deviation in delay timings.

Under a collaborative project with M/s gulf Oil Corporation Limited, Hyderabad an improved emulsion explosive formulation meeting all statutory requirements of group P_5 permitted explosive including shelf life of six months was developed and its field trials were successfully completed. DGMS has given permission for use in underground coal mines. In the same project, emulsion explosive formulations meeting requirements of P_1 and P_3 group of permitted explosives have already been successfully developed during previous financial years. We have received royalty of Rs. 2,92,270/= during financial year 2017-18 from M/s GOCL, Hyderabad on ex-factory sale price for the usage of the above mentioned developed permitted emulsion explosives inIndian underground coal mines.

M/s Solar Industries India Limited, Nagpur sponsored a project on assistance in the development of P_5 emulsion permitted explosive, which was successfully completed and a new emulsion P_5 explosive was developed and reported during this financial year 2017-18.

Glimpses of the Photographs on the occasion of CSIR Foundation Day (09-10-2017)

Glimpses of the Photographs of Drawing competition on the occasion of CSIR Foundation Day

9.2 ROCK EXCAVATION ENGINEERING

During April 2017 to March 2018, 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.

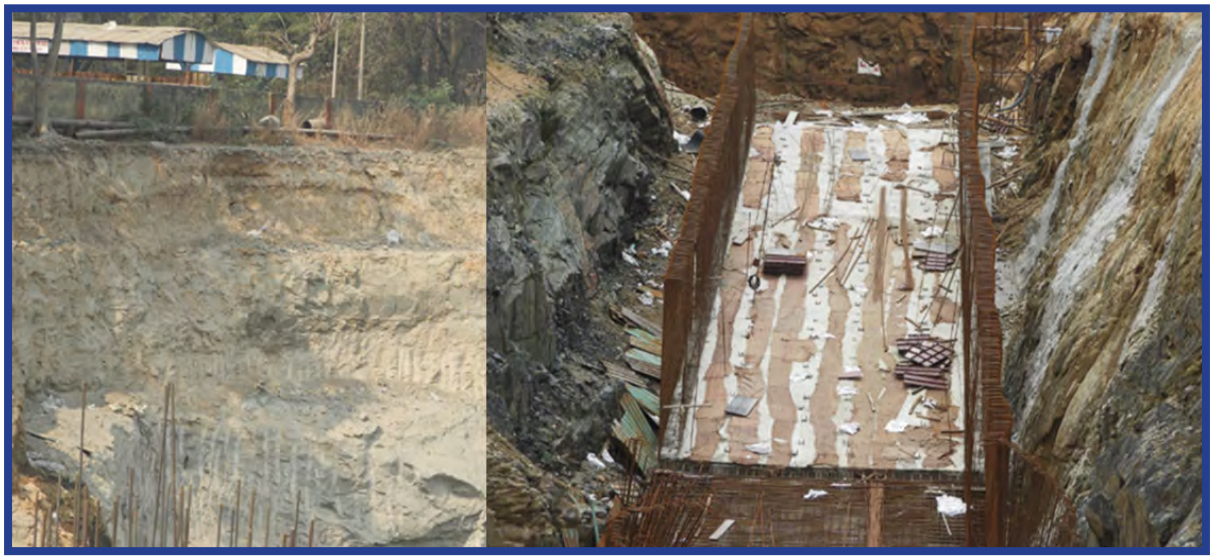
During this period, designing of blasting methodology, planning of controlled blasting operations, blast optimization and safety studies have been undertaken for various organizations and companies viz. Navi Mumbai International Airport Project, West Bokaro Group of mines, M/s Tata Steel Ltd., Kayad underground Mine, M/s Hindustan Zinc Ltd.,Badjna Colliery, M/s Eastern Coalfield Ltd., Pakri Barwadih Coal Mines, Gagal Limestone Mine of M/s ACC Limited (HP), Pathariya Limestone Mine, M/s ACC Limited (CG), Naubasta & Bankuiyan Limestone Mine, M/s Jaypee Rewa Plant, Murlia Block Limestone Mine, M/s J K Cement Works, M/s ENKEBEE Infrastructure Private Limited and M/s Sawra-Kuddu HEP (Himachal Pradesh Power Corporation Limited), Shimla. Moher & Moher-Amlohri extension opencast project of M/s Sasan Power Limited, Noamundi, Katamati, Joda East and Khondbond Iron Mines of OMQ division of Tata Steel Ltd., Sindesar Khurd Mine of M/s Hindustan Zinc Limited, Ramnagore Colliery of M/s Steel Authority of India, Rampura-Agucha Mine of M/s Hindustan Zinc Ltd., hard rock excavations at 2 X 660 MW Obra-C Project site, Obra, Uttar Pradesh.,Tasra opencast project of M/s Steel Authority of India, National Thermal Power Corporation Limited (NTPC), UltraTech Cement Limited, Indian Railways, Ambuja Cement Limited, West Bengal Mineral Development & Trading corporation Ltd., Rajasthan State Mine & Mineral Ltd. Udaipur, Rajasthan, Andhra Pradesh Mineral Development Corporation Ltd. etc. In Khargone Super Thermal Power Project (2 x 660MW), 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 one Rail-Over-Bridges (ROB No. 127), near Kahalgaon Railway Station, between Bhagalpur and Pirpainti section of Eastern Railways, Malda Division, etc.

The Rock Excavation Engineering Division has received a prestigious project of National importance i.e. the flattening of Ulwe hill as a part of land development work for the Greenfield project of Navi Mumbai International Airport. A team of six personnel including Scientists, Technical Officers and Project Fellows are continuously monitoring and supervising the blasting practices at the Ulwe Hill site. In the Kashlog Opencast limestone mine of M/s Ambuja Cement Limited, Darlaghat, Himachal Pradesh, and Pachami Hatgacha Stone Mines of WBMDTCL in Birbhum District, West Bengal, the deep-hole controlled blasting were carried out and their impacts on the safety and stability of the various nearby structures/houses were assessed. This Department is also involved continuously for the last seven years in establishing the controlled blast design patterns at Aditya Limestone Mine, Shambhupura, Chittorgarh of M/s UltraTech Cement Limited as a support organization 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. In Mangampet barites project of APMDC, District Kadapa, Andhra Pradesh and Jhamarkotra Rock phosphate Mine of Rajasthan State Mine & Mineral Ltd. Udaipur, Rajasthan, controlled blasting were carried out successfully to develop safe and optimum blast design patterns to control ground vibration, noise/air overpressure and flyrock without affecting the nearby villages.This department has successfully completed the excavation of hard rock using controlled blasting technique for Wagon Tippler Complex in close vicinity (20 m) of active Petrol Pump, Railway Line, Switch yard and Fuel Storage Tank. This department has once again started the monitoring of excavation of additional tunnel using blasting after getting approval from the honourable NGT based on CIMFR pervious report.

Drilling and mucking operation at Package-III of the Ulwe hill, NMIA.

Monitoring of ground vibration in the periphery of NMIA project at different houses/structures of the nearby villages

Demolition of ROB-127 near Kahalgaon Railway Station between Bhagalpur – Pirpainti Railway Line of Eastern Railway



Controlled blasting carried out within 20 m from active Petrol Pump, Wagon Tippler Complex TSTPS, NTPC, Kaniha

10. ROCK SLOPE AND EQUIPMENT SAFETY

10.1 ROCK SLOPE

1. Advice on slope design of Bhado Tola internal Dump at Rajmahal OCP, ECL

The dump slope faces are designed to be stable, but where they are located in naturally variable or uncertain conditions, failures inevitably develop. The loss following a slope failure is more than simply a cost encompassing unbudgeted expenditures and revenue reduction but can result in to physical loss from injuries or, worse, fatalities. The challenge is to minimize not only the incidence of failures but the severity of losses that result from those failures. The dump slope failure problems continue to be a source of human and financial losses as envisaged by recent failure at a few Open Cast mines. Applied research at the mine site and implementation of results into designs and operating practices can significantly reduce the incidence of failures.

M/s ECL entrusted CIMFR for the slope stability study of existing Bhado Tola internal dump at Rajmahal OCP. Presently, the height of the dump is 160m. The dump is more than seven years old. The mine management has planned

to push the existing internal dump by 50m westward from its existing toe level of the dump. After comprehensive geotechnical study, the existing dump was designed for long term stability. It helped the mine management to get sufficient space at the adjacent pit bottom to extract coal from deeper level, which otherwise was left due to non-availability of space at pit bottom.

2. Advice on Slope Stability Condition of the dip side highwall at Telwasa OCM Majri Area, WCL

M/s WCL entrusted CIMFR for the slope stability of the Coal and OB benches in the hanging wall of an up-throw strike fault in the dip side of the property of Telwasa OCM of Majri Area. A mining method has been suggested to develop the 120 m deep pit in close vicinity of the daylighting faults and embankment without sacrificing the safety in and around the pit. The study helped the mine management to mine out coal at the pit bottom with the consideration of faults.

3. Advice on Slope Stability Condition of dumps at Quarry-AB and Quarry-SE, West Bokaro, Tata Steel

M/s Tata Steel Ltd entrusted CIMFR for the Tycoon and Auditorium dump slope stability study of Quarry-AB of West Bokaro Collieries. The optimum slope design was done after comprehensive study for 100m high dumps. A proper dumping design and methodology were suggested to take care of the existing 60m high single lift of the dump. It helped to achieve a long term slope stability for the dumps.

4. Advice on Slope Stability Conditio of Guruda Overburden Dump at Tiringpahar Manganese Mine, Tata Steel Ltd, Ritesh Kumar, CNP/4536/17-18, 110m high external dump was designed

M/s Tata Steel Ltd entrusted CIMFR for the external dump (Guruda Overburden dump) slope stability study of Tiringpahar manganese Mine, Tata Steel Limited (TSL). Presently, the height of the dump is 82m. The mine management has planned for 110 m high external dump. A safe dump slope design has been suggested for the proposed 110m high external dump. The geotechnical study helped the mine management to deepen the pit to get extra ore by accommodating the extra OB during pit lowering within the existing dump by increasing the dump height to 110m.

5. Advice on slope stability of final dip side highwall slope at Medapalli OCP, SCCL

M/s SCCL entrusted CIMFR for the slope stability of the failed area of dip side highwall at Medapalli OCP. The opencast area is situated on the southern bank of Godavari River. The coal deposit has the incrop almost parallel to the river bank and on the dip side; it extends below the river bed. The coal seam is dipping at about 10 degree. F4 fault is daylighting within the dip side slope. After detailed slope stability study, the 140m high dip side highwall was designed to exploit the balance coal below failed zone and adjacent to Godavari river. It helped mine management to mine out the locked up coal of the pit which was closed by DGMS after collapse.

6. Advice on proposed ultimate overall slope angle of both Band I & II ore bodies at Sukinda Mines (Chromite), M/s IMFA Limited

M/s IMFA Ltd. entrusted CIMFR for the slope stability study and optimum pit slope design for ore body Band-I and II at Sukinda Mine (Chromite). The mine is fully mechanized. Shovel dumper combination is used for overburden removal as well as ore mining. After geotechnical study, the optimum slope design of proposed 149m deep Band-1 and 120m deep Band-2 pits along with adjacent 60m high external dump was done for safe exploitation of chromite from Band -1 and Band-2 ore bodies both. It helped the mine management to deepen the Band-1 pit safely along with the safety of the 60m high external dump at pit head. Further, the mine management could get extra ore by developing the adjacent Band-2 ore body.

10.2. FLAMEPROOF AND EQUIPMENT SAFETY

(A). PROJECTS COMPLETED

01. Assessment of electrical safety parameters and advice on one no. Increased Safety Ex 'e' and Non-Sparking Ex 'n' Motor, rated at 1050KW, 6.6KV, 2Pole in Frame Size: 1SD7450-2 as per IS/IEC 60079-7:2006 & IS/IEC 60079-15 : 2005 for use in Zone 2 and gas group IIA, IIB & IIC hazardous area

M/s. BHEL, Bhopal offered One No. aforesaid Increased Safety Ex 'e' and Non-Sparking Ex 'n' Motor along with drawings for necessary assessment of electrical safety parameters and advice at their shop. On the basis of Assessment of electrical safety parameters and advice as per IS/IEC 60079-7:2006 & IS/IEC 60079-15 : 2005, the motor under reference confirms to the applicable requirements of type o protection Ex 'e' and Ex 'n' respectively for use in Zone-2 and Gas Group IIA, IIB & IIC hazardous area as defined in IS : 5572.

The stator winding temperature rise is calculated as per Equation – 1 and found well below that of the insulation class 'B'. However, class of insulation of the stator winding is class-F.

The rotor temperature in locked rotor condition is calculated as per Equation – 3 and is limited to temperature class T3 at an ambient temperature of max. 47°C.

The time tE for aforesaid Ex 'e' motor is 15.85Sec. Therefore the safe time TE to switch off the motor under abnormal or locked rotor conditions is before / within 15.85sec.

02. Advice on electrical safety parameters of one no. Increased Safety Ex 'e' and Non-Sparking Ex 'n' Motor, Rated at 3210KW, 6.6KV, 4Pole in Frame Size: 1SJ7718-4 as per IS/IEC 60079-7: 2006 & IS/IEC 60079-15: 2005 for use in Zone 2 and Gas Group IIA, IIB & IIC hazardous area

M/s. BHEL, Bhopal offered One No. aforesaid Increased Safety Ex 'e' and Non-Sparking Ex 'n' Motor along with design drawings for necessary assessment of electrical safety parameters and advice at their shop. On the basis of assessment of electrical safety parameters 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 'n' for use in Zone 2 and Gas Group IIA, IIB & IIC hazardous area as defined in IS : 5572 and the stator winding temperature rise is calculated as per Equation – 1 and found well below that of the insulation class 'B'. However, the class of insulation of the stator winding is class-F. The rotor temperature in locked rotor condition is calculated as per Equation – 3 and is limited to temperature class T3 at an ambient temperature of max. 40°C.The time tE for aforesaid Ex 'e' motor is 5.67sec. Therefore the safe time tE to switch off the motor under abnormal or locked rotor conditions is before / within 5.67sec

03. Assessment of electrical safety parameters and advice on One No. Increased Safety Ex 'e' and Non-Sparking Ex 'n' Motor, Rated at 1000KW, 6.6KV, 2Pole in Frame Size 1MA7712-2 as per IEC: 60079-7:2006 and IEC: 60079-15:2005 for use in Zone-2 and Gas Group IIA, IIB & IIC hazardous area

M/s. BHEL, Bhopal offered One no. aforesaid Increased Safety Ex 'e' and Non-Sparking Ex 'n' Motor, along with design drawings and necessary assessment of electrical safety parameters and advice at their shop. On the basis of assessment of electrical safety parameters 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 and Gas Group IIA, IIB & IIC hazardous area as defined in IS: 5572. The stator winding temperature rise is calculated as per Equation -1 and found well below that of the insulation class 'B'. However, the class of insulation of the stator winding is above class-F. The rotor temperature in locked rotor condition is calculated as per Equation -3 and is limited to temperature class T3 at an ambient temperature of max. 45°C and the time t_E for aforesaid motor is 11.60sec. Therefore the safe time t_E to switch off the motor under abnormal or locked rotor condition is before/within 11.60sec.

04. Assessment and Advice for suitability of Electrical equipment installed in Zone 1 &2 hazardous areas of Ankleshwar asset of ONGC

M/s. ONGC, Ankleshwar (Gujarat) offered different certified increased safety motors for their suitability to use in hazardous explosive atmosphere. This electrical equipment are installed in Zone 2 area as declared by ONGC and being maintained and operated by ONGC. The lists of increased safety electrical motors are given below which are installed in Ankleswar asset of ONGC. The object of the project was physical assessment of these increased safety motors for suitability to use in their respective area of installation. Based upon the physical assessment of different certified Ex 'e' & Ex 'n' motors installed on heater treater units of ONGC assets, the listed certified equipment are suitable for safe use in Zone – 2 hazardous atmospheres of (Ankleswar and Gandhar assets) of ONGC.

05. Assessment of electrical safety parameters and advice on partially pressurized Type 'Z' purged Three Nos. Ex 'P' Local Control Panels for WET Gas Compressor, FCCU, BPCl-Kochi in Size of 800(W)X2200(H) X 1000(D), DHDT, BPCL-Mumbai in Size of 2400(W)X2450(H)X1500(D) and NHT ISOM, BPCL-Mumbai in Size of 2400(W)X2450(H) X1500(D) for use in Gas Group IIB & IIC and Zone 2 hazardous area

M/s. Electronics Corporation of India Ltd. (ECIL), Hyderabad – 500 062, India, offered three nos. aforesaid Ex 'P' Local control panel along with design drawings for necessary Assessment of electrical safety parameters and advice at their shop.

On the basis of assessment of electrical safety parameter and advice as per NFPA 496-1982 and IS/IEC 60079-2:2006 the Partially Purged Ex 'P' Control Panel for Wet Gas Compressor for use n Gas Group: IIB & IIC and Zone 2 hazardous area under reference confirms to the applicable requirements of type f protection Ex 'p' for use in Zone 2 hazardous area as defined in IS 5572.

The minimum time required for pre start purging of the Ex 'p' Panel and associated tubes and ducts at flow rate of 30m^3/hr, is calculated as per Equation – 1 as 36 minutes & 13 minutes.

The pressurized local control panel and associated dusts were purged with Five (5) volume of the free air volume of the Ex 'p' unit with associated dusts and tubes as required in IS/IEC 60079-2:2006 and NFPA 496-1982.

The temperature classification of the above panel is considered as T3 based on the verifications of the attached electrical equipment with it.

Provisions are made to set the values of reference pressure points using solenoid valves and the pressure gauges for "pressure established", "low pressure" and "very low pressure" along with indicating lamps and warning hooter. The Ex 'p' panel power is out-off when inside overpressure falls below 5mm as per IS/IEC 60079-2:2006 and 2.5mm WC as per NFPA 496-2008.

06. Assessment of Flameproof System Design for E.O.T. Cranes of 2T Capacity Span Pendant operated 14 Nos. (Fourteen), 5T Capacity Monorail 02 Nos. (Two) and 5T Capacity EOT cranes 04 Nos. (Four) for use in Gas Group IIA & IIB hazardous area

M/s. Dinesh Enterprises, Kalyyan (W) – 421 304 offered aforesaid E.O.T cranes along with design drawings for necessary assessment of flameproof system design of E.O.T. Cranes of different capacity.

Based upon the physical assessment of assembly of EOT cranes, Span Pendant operated and monorail using flameproof electrical equipment and mechanical parts of verifications of the submitted documents the

flameproof EOT crane of 2T Capacity Span Pendant operated 14 Nos. (Fourteen), 5T Capacity Monorail 02 Nos. (Two) and 5T Capacity EOT cranes 04 Nos. (Four) under reference may be suitable for use in Gas Group IIA/IIB atmosphere.

11. CSIR-CIMFR ROORKEE RESEARCH CENTRE (Geo-technical Engineering & Underground Space Utilisation Group)

During April 2017 to March 2018, the CSIR-CIMFR Research Centre, Roorkee has undertaken assignments of translational research and extended technical expertise as knowledge partner in the following areas of National importance projects:

- Design of highway tunnels and railway tunnels
- Design of cut slopes along roads, in mines and above tunnel portals
- Rock mass characterization
- Tunnel instrumentation and monitoring
- Optimization of rock excavation by blasting
- Safety related problems for tunneling sectors

The major clients included Rail Vikas Nigam Ltd., Kolkata & Rishikesh; THDC India Ltd., Tehri; Central Railway, Mumbai; ITNL (IL&FS), Ahmedabad; M/s Larsen & Toubro Construction; M/s Hindustan Construction Co., Mumbai; M/s Consulting Engineers Group Ltd. (CEG), Udaipur; Rithwik Power Projects Ltd., Joshimath; Indic Geo Resources Ltd. (Chandan Steel Ltd.), Mumbai; Haryana State Industrial Infrastructure Development Co., Panchkula and M/s UTM Engineering Pvt. Ltd. Gurgaon.

Z- Morh Tunnel Project in J&K state for road traffic is being constructed by M/s ITNL in challenging higher Himalayas at an altitude of approximately 3400m on Srinagar-Sonamarg highway. The 6.5 km long tunnel is mainly to by-pass the snow and avalanche prone areas to provide all-weather road which is also used by defence. CSIR-CIMFR has worked to refine the design of supports. In case of difficulty in collecting the rating of various parameters of RMR/Q in poor rock mass, CSIR-CIMFR suggested to use GSI and then get RMR/Q from GSI. It is also suggested that geology and the ground water condition ahead of the tunnel face shall be probed in advance. Since there are number of support classes, overlap of support classes is possible in such varying and fragile geology. Analysis of deformation monitoring data and installation of adequate supports in appropriate time is important to enable the site personnel to achieve safe and stable working environment inside the tunnel. Back-analysis has been suggested for further refinement of designs using the monitoring data especially in fault areas and considering the seismic intensity (Photos 1, 2 & 3).

Photo 1: West portals of Escape and Main Tunnels of Z-Morh Project Under Construction on Srinagar-Sonamarg Highway, NH-1 (Source: ITNL, Gandhinagar)

Photo 2: East portals of escape and main tunnels of Z-Morh Project showing track of avalanche above tunnel portal (Source: ITNL, Gandhinagar)

Photo 3: Inside view of ventilation cavern showing lattice girder support covered with shotcrete, Z-Morh Project, J & K (Source:ITNL, Gandhinagar)

Photo 4: Cores of borehole BH-65 of depth between 53.50m and 59.00m, Package-2 of RVNL Rishikesh-Karnprayag rail link project

Rishikesh-Karnaprayag Rail Link Project: Rail Vikas Nigam Limited (RVNL) is executing 125km long single track new broad gauge rail link between Rishikesh and Karnaprayag. The entire length of the rail link has been divided into six packages in which total 105km of tunnelling will be carried out. In order to obtain geo-mechanical parameters for design of tunnels in Package 2 between Byasi (Rishikesh) and Maletha (Srinagar), RVNL has entrusted CSIR-CIMFR for supervision of geotechnical investigations. There are four tunnels, T5 (9.76km long), T6 (200m long), T7 (1.4km long) and T8 (15.12km long) planned in Package 2 of the project. CSIR-CIMFR is working as knowledge partner to review the entire geotechnical investigation process with a view to generate adequate data for conventional or TBM tunnelling and supervising specialized tests like Borehole TV scanning, dilatometer tests and hydrofracture tests. During the reporting period dilatometer tests in borehole nos. 76 & 77 and BHTV tests in borehole nos. 58, 73, 74, 76 & 77 have been supervised. In addition, the core logs of Borehole nos. 56, 57, 58, 62, 63, 65, 68, 73, 74, 76, 77, 78, 79 and 80 have been inspected and the core samples for various geotechinical tests have been selected (Photo 4). Once the geotechnical tests would be completed it is planned to use the data for studying the trend of variation of deformation modulus and the insitu stress along the rail link alignment.

THDC-Tehri Pumped Storage Plant (PSP) Project in Tehri, Uttarakhand of 1000 MW capacity involves construction of an underground machine hall (powerhouse) on the left bank of river Bhagirathi along with other associated underground structures. CIMFR Roorkee Centre is providing technical assistance for critical rock mass excavation in Pump Storage Power Project of THDC Ltd., near Tehri. Controlled blast design for excavation of Butterfly Valve Chamber (BVC), Penstock Assembly Chamber (PAC) and Transformer Hall and Power House and large number of inter connecting galleries/ tunnels are carried out in close proximity (less than 10.0 m) of HPP project housing very sensitive electro-mechanical equipment (Photo 5). Critical excavation in Busbar-5, Upstream and downstream Surge Shafts and Powerhouse are currently in progress under CIMFR Supervision.

To understand the behavior of rock mass and the interaction of support systems, THDC has carried out an extensive scheme of instrumentation for the underground structures. Instrumentation includes multi-point borehole extensometers, load cells and deformation monitoring bireflex targets. THDC has associated with CIMFR Regional Centre, Roorkee for the study of geotechnical instrumentation and interpretation of data during construction of the underground structures of PSP project. CIMFR is providing technical advice to THDC in order to assess engineering behaviour of the HPP and PSP underground structures by evaluation of instrumentation data.

Parsik Tunnel located on Mumbai-Kalyan mainline in Thane, Maharashtra is facing water seepage problem. The 1.3km long railway tunnel is approximately 10m wide and about 6m high. The entire length of tunnel is brick lined up to SPL and at some locations below SPL also and the tunnel is excavated entirely in Basalts of Deccan Trap Formations. This

double track tunnel is used by all trains that run between Thane and Kalyan and was opened for traffic in the year 1916. Central Railways has entrusted CIMFR Regional Centre, Roorkee to carry out studies to resolve the seepage problem. A scheme of grouting the tunnel from inside together with cleaning of the chocked drains and clearing of structures on the ground surface has been suggested to resolve the water seepage inside the tunnel. The suggested scheme is being implemented by Central Railway (Photo 6).

Photo 5: Underground power house complex

Photo 6: View of 102 years old Parsik tunnel portal

Sirohi Bypass Tunnel Project: M/s L&T has constructed 290m long 4 lane tunnel on Beawar-Pali-Pindwara section in NH44 in the state of Rajasthan under NHDP of National Highway Authority of India. This NH-14 highway is in operation since 2014. Twin tunnels, each of 13.36 m wide and 99.0 m height, were constructed between Chainage 220+900 and 221+220 m bypassing Sirohi city. The tunnels are typical D-shaped, 13.360 m wide and 9.0 m height. The tunnels are located below opposite rocks slopes of the two ridges which form a small discontinuous gorge above the tunnels. During monsoon of 2015 and 2016, heavy seepage of water from crown and side wall are observed at several points inside tunnel. M/s L&T requested CSIR-Central Institute of Mining and Fuel Research, Regional Research Centre Roorkee for undertaking a study to evaluate the causes leading to extensive failures of the excavated slope and the reason for the seepage of water inside the tunnel and to recommend solution for control of seepage (Photos 7 & 8). The project is in progress.

Photo 7: Collapse of slope above Sirohi tunnel portal

Photo 8: Seepage inside Sirohi bypass tunnel

Rail Vikas Nigam Limited (RVNL) is constructing 3rd line between Goelkera and Manoharpur in Chakradharpur Division of South Eastern Railway. As such one more rail tunnel will be required between Mahadevsal and Posoita Railway stations on the uphill side of the existing up line tunnel popularly known as Saranda Tunnel. This broad gauge railway line is an important rail line connecting east to west, i.e. Howrah and Mumbai. The tunnel dimension is 6.5m wide and 7.5m high modified horse-shoe type considering the minimum requirement as per moving dimensions of the railways. RVNL has entrusted the work of vibration monitoring and dynamic analysis in the nearby existing tunnel during blasting and assessment of supports of tunnel to CIMFR Regional Centre, Roorkee. Controlled blasting techniques have been used for construction of Saranada Tunnel. The stability issues of adjoining tunnel has been successfully resolved by meticulous planning of various stages of excavation and comprehensive and continuous blast induced vibration monitoring to prevent any structural damage to the adjoining tunnel. The supports comprising of rock bolts, shotcrete and steel ribs have been designed as per the geology encountered after each blast (Photos 9 & 10).

Photo 9: View of vibration monitoring outside downline tunnel portal and along the tunnel alignment

Photo 10: Rock excavation and support design in Saranada railway tunnel on Mumbai-Howrah rail line

Vishnugaad-Pipalkoti Hydroelectric Project, Pipalkoti is important World Bank funded hydropower project located in Chamoli District of Uttarakhand. CIMFR Roorkee is giving technical assistance for rock mass excavation of using controlled blasting techniques for construction of various underground hydropower structures such as power house, transformer hall, head race tunnel, disilting chamber etc. Transfomer hall, surge tank and powerhouse are to be excavated in extremely unfavourbale rock mass conditions. CIMFR Roorkee Centre have optimized blast design parameters by monitoring blast induced ground vibrations in such locations (Photos 11 & 12).

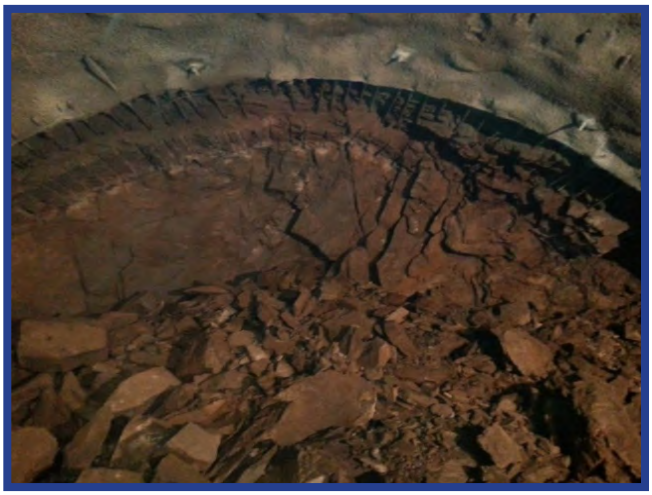


Photo 11: Demonstration of controlled blasting techniques for over break control in underground excavation at Vishnugaad-Pipalkoti Hydroelectric project

Photo 12: Rock excavation for construction of desilting chamber at Vishnugaad-Pipalkoti Hydroelectric project

Similar to works in Vishnugaad-Pipalkoti Hydroelectric Project, CIMFR Roorkee is providing technical assistance for safe rock excavation at Tapovan-Vishnuggad Hydroelectric Poject, Joshimath and Singoli-Bhatwari hydroelectric project, Rudraprayag, Uttarakhand.

Khanak Stone Mine of HSIIDC: During this period, another important applied reseach project undertaken is assessment and mitigation of ground vibration & air overpressure and optimization of blast design parameters at Khanak Stone Mine of Haryana State Industrial and Infrastructure Development Co. (HSIIDC), Khanak, Haryana. M/s HSIIDC have entered into mining to exploit 280 hectare of quartizite rich deposit at Khanak. CIMFR Roorkee is providing technical know-how for safe exploitation of the mineral. CIMFR team has made initial site visit for field experimentation and blast vibration monitoring. The study is in progress.

Potash Research Mine Project: Working on study of deep seated underground potash deposits and development of suitable design of mining (including solution mining) in Rajasthan for the project sponsored by M/s IGRL (Chandan Steel Ltd.). Objective is to develop a Potash Research Mine with provision of royalty to the CSIR-CIMFR for the entire life of mine. The potash is mainly used as fertilizer. The current import of potash is around 4.6 million tones which entails foreign exchange of approx. Rs. 10,000 Crores per annum. Under this project the lease application for prospecting and mining is under consideration by the concern authorities. The detailed discussions were held at NITI Aayog with all concern mining authorities and Ministry of Mines, Government of Rajasthan. It is highlighted that currently the entire requirement of potash in India is met by imports. The work at site shall commence on grant of prospecting licence for the first potash mine of India.

Glimpses of the Photographs on the occasion of Swachhta Pakhwada organised during 7-21 November, 2017

Glimpses of the Photographs on the occasion of Independence Day (15th August, 2017)

12. STRATA MECHANICS

i. Field and laboratory investigations for safe and efficient underground extraction of developed (B&P method) coal seams

Objectives: Application of basic rock mechanics principles for improvement in practical conditions of underground coal mining.

Results & conclusion: Investigations carried out for underground extraction of a developed (on bord and pillar) thick seam and 4 is found that mining of total thickness of a thick coal seam in single lift is one of the efficient methods under Indian geo-mining conditions. Overlying coal band of a developed thick seam is taken during retreat, which results heightened barrier pillars and pillars at the goaf edge. Field studies found that the increase in pillar height affects the depillaring operation adversely, especially, during caving of the strong/massive roof strata (Fig. 1). Dilution in strength due to the increased pillar height caused catastrophic failure of barrier pillars and goaf overriding. This warranted a systematic study of pillar strength variation for the different heights of pillar. A review of different pillar strength estimation approaches for an analysis of the dilution in strength of the heightened pillar suggested that numerical modeling provides a better option for such a systematic study. Accordingly, investigations are conducted on simulated models in laboratory (Fig.2) adopting a recognised numerical modeling procedure. The observed nature of variations in pillar strengths with the increase in its height in the numerical models (Fig. 3) and empirical formula is found to be matching. But, a mismatch is found between the strength values of the two approaches with an increase in height of the pillar (Fig. 4). Considering validity of the empirical formulation in Indian coalfields, a relationship is developed to incorporate a correction in the strength values of the numerical models. The suggested correction on the basis of this simple study of the pillar strength variation would be helpful for the use of the established simulation tool during the depillaring of a thick coal seam.

Continuous Miner based mechanized depillaring has shown good potential for extraction of large number of developed coal seams on bord and pillar method. In this approach, application of RBBLS at the goaf edge (Fig. 5) is a beautiful example of a balanced amalgamation of science and technology. Scientific strength for the application of RBBLS is obtained from the stress redistribution in and around a goaf edge of the depillaring panel. A technological opportunity to accomplish the task of goaf edge support by RBBLS is created due to the availability of good underground machines for the installation of high capacity, pre-tensioned, resin grouted and stiff roof bolts. The confinement dependent performance of a plain reinforcement (cable/rock bolt) make it sensitive to small redial dilation. This sensitivity is, generally, overcome by a modified cable/bolt (Garford bulb) but it is not required at the goaf edge; especially in Indian coalfields due to high value of the mining induced stress (Fig. 6). A RBBLS is found to be effective ahead of the goaf edge only and it becomes ineffective inside the goaf due to radial dilation caused by the tensile condition of the roof (Fig. 7). If a modified cable/bolt is used in RBBLS, it will keep strengthening the overlying strata inside the goaf. Overlying strata of Indian coalfields, generally, break with large overhang, which will be worsened by the application of the modified cable/bolt.

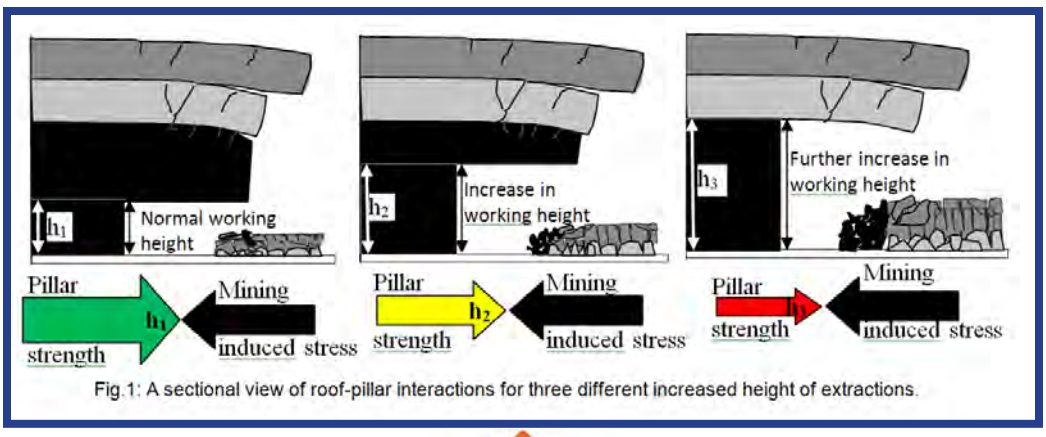


Fig.1: A sectional view of roof-pillar interactions for three different increased height of extractions.

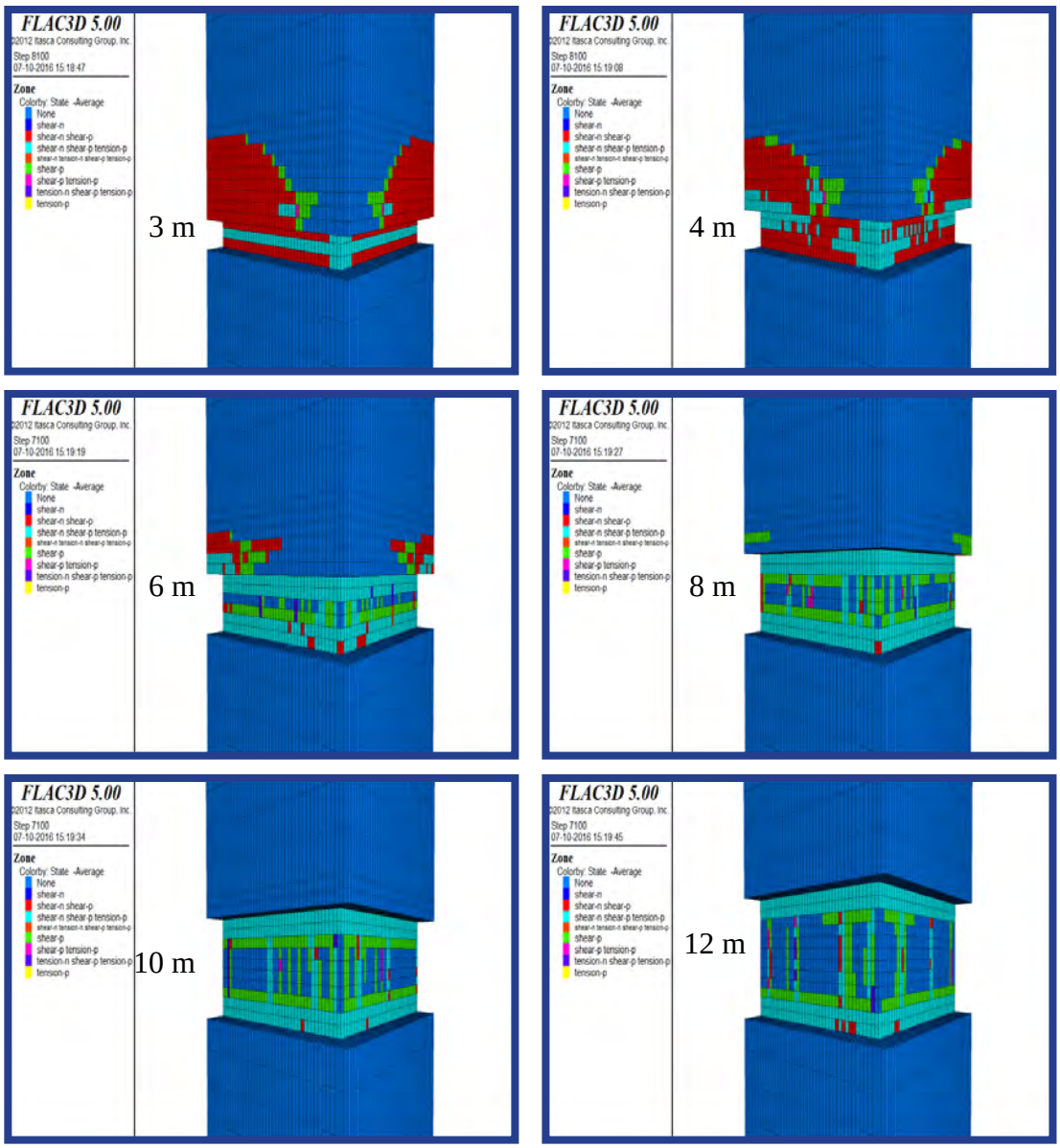
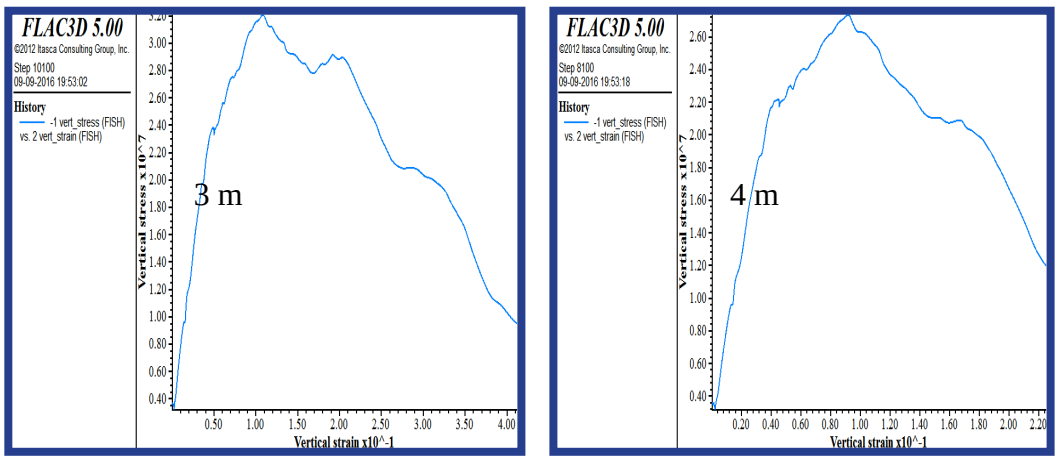


Fig. 2: State of different models of the heightened pillars tested in Flac^{3d} by varying pillar height from 3m to 12m



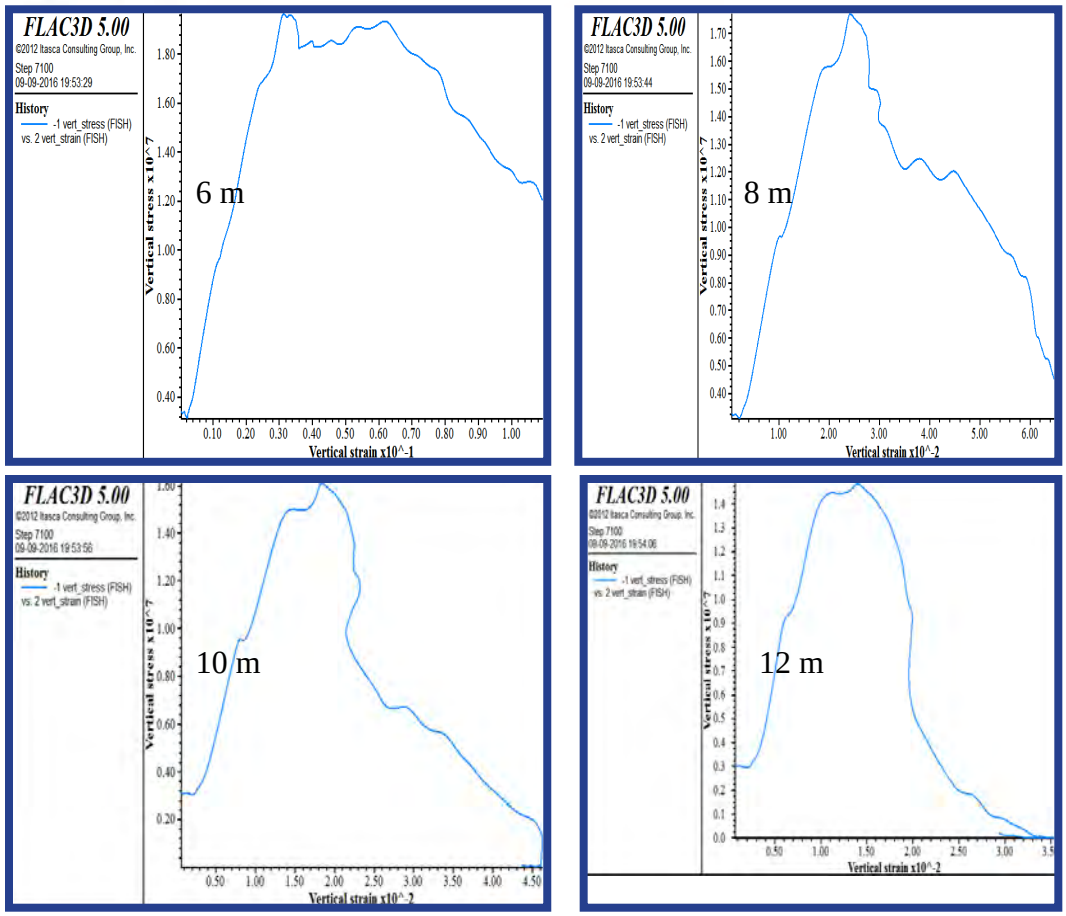


Fig.3. Stress-strain characteristics of a pillar with varying heights for 3m to 12 m extraction heights during the depillaring

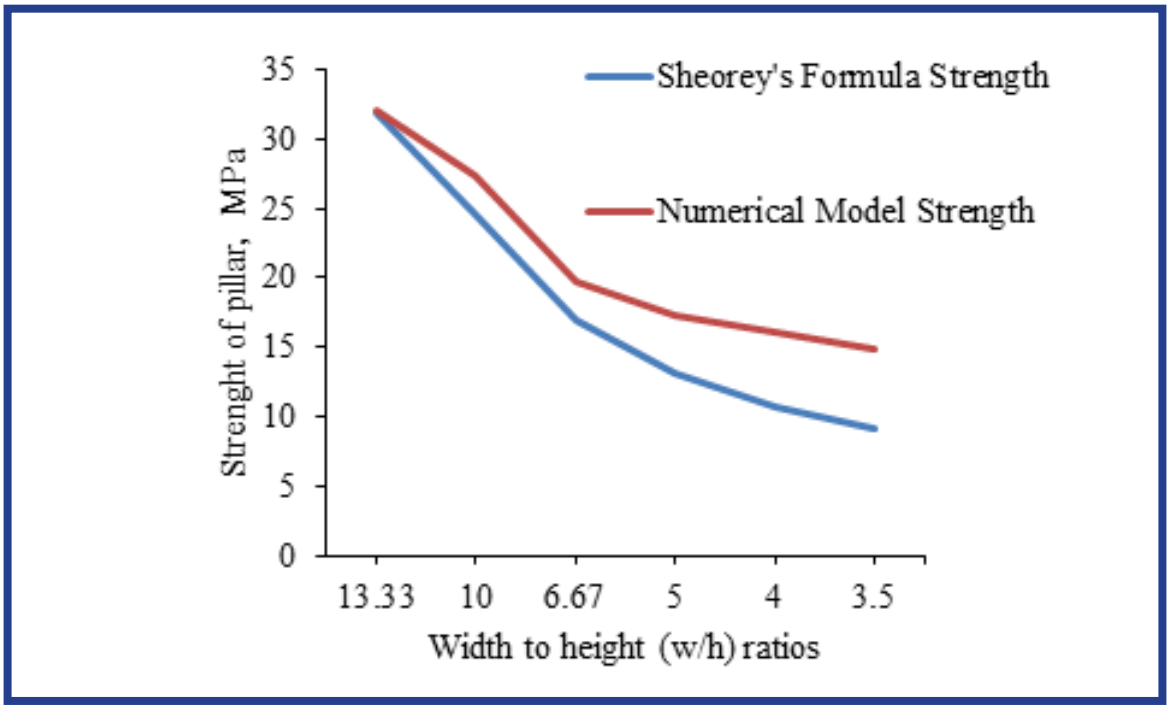


Fig. 4: Variation in strengths of heightened pillars obtained by CMRI formulation and numerical modelling.

Fig.5: Application of RBBLS (high density of bolts) to resist extension of roof fall ahead of the goaf edge.

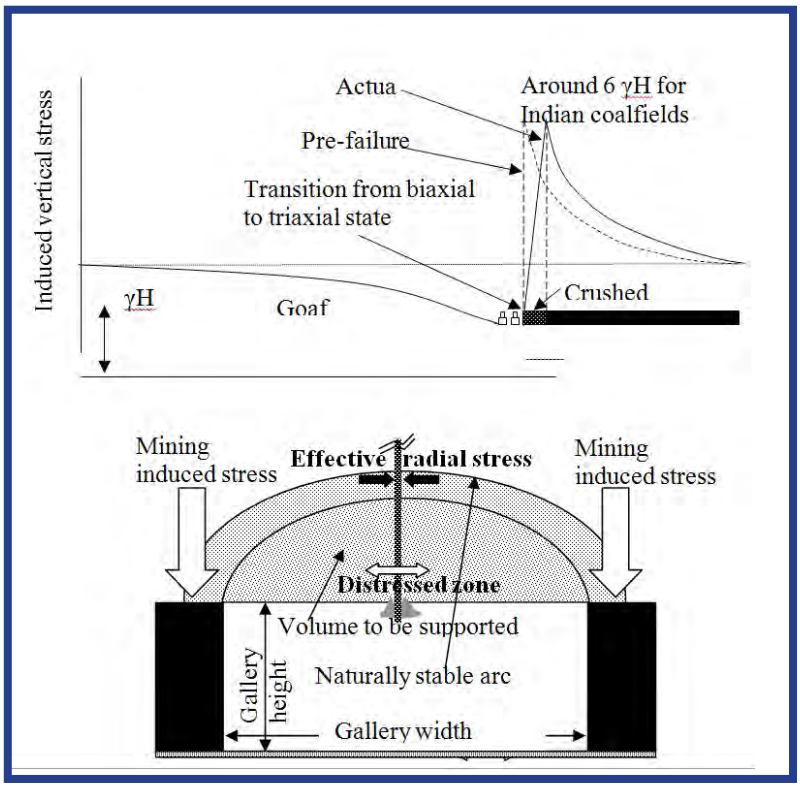


Fig.6: Mining induced stress redistribution and its favourable effect on bolts at the goaf edge.

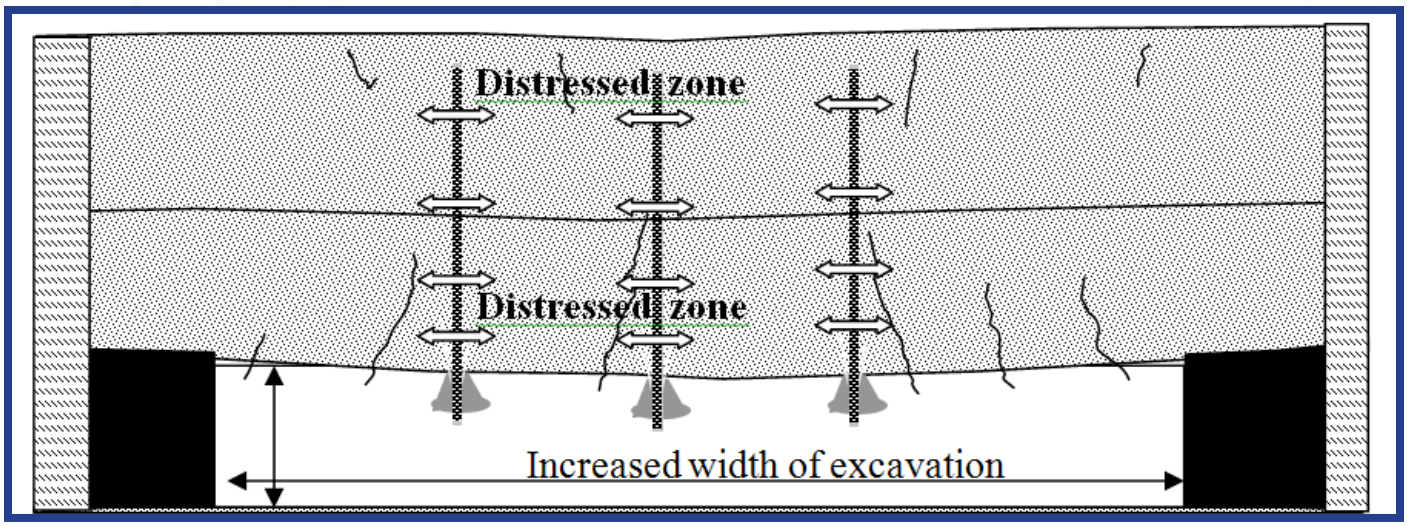


Fig. 7: Radial dilution in the capacity of bolts inside the goaf due to tensile roof condition.

Glimpses of the Photographs of CSIR-CIMFR Management Council

Glimpses of the Photographs of Hindi Pakhwada held at CSIR-CIMFR during 01-14 Sep. 2107

C. FUEL SCIENCE SECTOR

1. COAL PREPARATION AND CARBONIZATION

i. COAL PREPARATION

During April 2017 to March 2018, the Coal Preparation section has undertaken various projects on washability, sampling of indigenous and imported coals, flotation, Dry beneficiation etc.

The clients included SAIL, Kolkata, Singareni Collieries Company Ltd.,Hyderabad, Adani Pvt.Ltd. Gurgaon, Hindalco, Bharat Coking Coal Limited, Central Coalfields Limited, SAIL Collieries Division, Chasnalla.

Project: "Sampling and Analysis of imported coal unloaded at Port ends for SAIL"- 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 2017-18 sampling from eight (8) vessels was carried out at unloading ports of Vizag, Paradeep and Haldia and the analytical report was submitted.

Project: "Washability and characterization of seams IV, V & VI bore hole coals from Parsa Block supplied by Adani", The objectives of the project to study the bore-hole washability followed by different characterization tests of raw and cleaned products from three different seams, supplied by Adani. The characterization of bore hole coal core samples reveals that the ash percentage of raw coal varies between 42.0 to 61.0%. Moisture percentage (on as received) of the raw coal varies between 3 – 7%. Similarly VM percentage of raw coal varies between 19 – 24%. The gross CV of the core samples varies between 2100 – 3600kcal/kg. HGI of five raw coal samples varies between 66-78. The washability characteristics are poor for the very high coals.

Project: "Washability and Characterization of coal sample supplied by Singareni Collieries Company Limited" – The objective is to study the cleaning potentialities of the coal supplied from different mines of SCCL to RKP Washery. The ash content of the feed sample is 40% and the detailed washability tests indicated 23% material lying above 2.0 specific gravity, with high ash content. The theoretical yield% obtained for the size fraction 50 – 0.5 mm at 31% clean coal ash is 79.3%. The flow sheet for washing the coals was developed and equipment sizing was suggested.

Project: "Supervision of sample collection and washability studies on the input feed from Chasnalla washery". The objectives of the project is to study the cleaning potentialities of the input feed to the Chasnalla Washery. The washability studies indicated that when the ROM coal is crushed to 75 mm, the theoretical yield% at 13% ash content is 51.5%, while for the coal crushed to 20 mm, the theoretical yield% at 13% ash content is 54.0%,

Project: "Study for technical feasibility of washing BCCL coking coal at 13% ash content and the related yield middlings and rejects". The objectives is Study for Technical Feasibility of washing BCCL Coking Coal at 13% ash content and the related Yield , Middlings and Rejects. In case of the coal tested from Angarpathra the theoretical yield% at 13% ash content is 28%, while for the coal tested from Akashkinaree the theoretical yield% at 13% ash content is 13%.

Project : "Development of an On-line Washability analyzer" the online model of the analyzer was installed and commissioned at the coal washing pilot plant and initial tests were carried out with high non coking coals and data were generated and software was developed for the online washability analysis.

Online Washability Analyzer

Project: "Collection & Testing of Coking Coal seam samples of CCL Mines". The objective of the project is to carry out studies on the cleaning potentialities of different sources of CCL. The detailed washability of the coarse coal and laboratory flotation tests of the coal fines were carried out for 11 different sources. The theoretical yield at 13% ash content was determined and flow sheet was developed.

Project: "Washability studies of three coal samples from Bhatgaon area of SECL". The objective is to study the washability characteristics of the coal sample followed by generation of clean coal aiming at G5 product grade and suggestion of suitable beneficiation route. The washability characteristics of all the three samples tested is easy to wash and the Near Gravity Material (NGM) at the desired specific gravity of separation is less, indicating the ease of separation.

Project: "Sampling and Analysis of Coal Stock at Parbatpur Central Coal Mines" The objective of the project is to characterize the coals after collecting the representative samples from the stocks lying at Parbatpur Central Coal Mines and preparation of samples for characterization as per the standard procedure. The average ash contents of the coal stocks laying at Parbatpur Central Coal Mines are 25.4%, Moisture 1.8%, VM 20.9% and Fixed Carbon is 51.9%.

Project: "Washability & Flotation tests from Coal core of Exploration Boreholes (Gare Block IV/4 & IV/5). The objective of the project is to study the washability and flotation characteristics of the coal sample supplied by HINDALCO. The characterization of bore hole coal core samples reveals that the ash percentage of raw coal varies between 23.0 to 40%. Moisture percentage (on as received) of the raw coal varies between 5.1 – 6.9%. Similarly VM percentage of raw coal varies between 20.8 – 28.5%. The gross CV of the core samples varies between 3850 – 5130 kcal/kg. The seam II sample contains less ash and all the rest samples are more or less under similar ash contents. The washability characteristics are good and the coal is easy to wash.

ii. COAL CARBONIZATION

Project: "Capacity assessment of coke oven plant: Lucky Coke Manufacturer, Purulia". The objective of the project is to determine coal throughput, coke producing capacity and productivity of the plant. Based on the various measurements and information provided by the sponsor monthly coal requirement of the said plant were assessed as 4272 Mt and by charging the assessed quantity of coal and considering the theoretical coke yield as 70% the plant will produce 2990 MT of coke. The coke yield may vary with respect to quality of coal charged and oven operating conditions.

Project: "Capacity assessment of coke oven plant: Jwala Coke Pvt. Ltd, Purulia". The objective of the project is to determine coal throughput, coke producing capacity and productivity of the plant. Based on the various measurements and information provided by the sponsor monthly coal requirement of the said plant were assessed as 3473 Mt and by charging the assessed quantity of coal and considering the theoretical coke yield as 70% the plant will produce 2431 MT of coke. The coke yield may vary with respect to quality of coal charged and oven operating conditions.

Project: "Capacity assessment of coke oven plant: Lucky Coke Industries, Bokaro". The objective of the project is to determine coal throughput, coke producing capacity and productivity of the plant. Based on the various measurements and information provided by the sponsor monthly coal requirement of the said plant was assessed as 2778 Mt and by charging the assessed quantity of coal and considering the theoretical coke yield as 70% the plant will produce 1945 MT of coke. The coke yield may vary with respect to quality of coal charged and oven operating conditions.

Project: "Studies on devolatilisation of coal (supplied by Monnet Ispat & Energy Limited) for preparation of semi coke for use in ferro-alloy production". The objective of the project was to study de-volatilisation of the given coal for preparation of semi coke and Characterization of the product for its suitability in ferro-alloy production. Medium temperature carbonization of low ash non-coking coal at temperature level 750°C to 800°C was able to produce the coke like product (Semi-coke/Form-coke) suitable for Ferro-alloy Production.

Project: "Techno commercial feasibility study of coke dry quenching in by-product type coke oven plant: Jindal Steel and Power Ltd. Angul". The objective of the project is to Study techno commercial feasibility and advice for installation of coke dry quenching (CDQ) in JSPL, Angul's coke oven plant. The studies concluded that for JSPL, Angul's by product recovery coke making units, Wet Quenching of incandescent Coke is a better option than Coke Dry Quenching, because of its larger break down hours, carbon losses, fines generation, excess man power requirement, greater power consumption, operational hazards etc. and detail cost analysis of CDQ with respect to wet quenching.

Besides, this section is actively associated with testing of carbonization properties on the samples supplied by various industries on regular basis.

New Instrument:

STA-8000 with off line and online FTIR and GC-MS (PerkinElmer)

2. COMBUSTION SCIENCE AND TECHNOLOGY

Thrust Areas

- Impact of coal qualities, blending in power Plant Performance
- Clean Coal Technology
- Estimation of carbon emission factors of Indian coals & lignite and GHG emission coefficients of key sectors
- Preparation of National GHG Inventory for Energy and Manufacturing Industries
- Mercury emission from Coal fired Power Plants; trace element assessment of coal and combustion products
- Preparation of guidelines for estimation normative coal requirement by different industries as required for framing policy decisions in respect of judicious allocation of different grades of coals
- Quality monitoring of coal for efficient power generation

Facilities Available

A) Thermo-gravimetric Analyser
B) Drop Tube Furnace
C) Fuel Evaluation Test Facility
D) Direct Mercury Analyser
E) Automatic Bomb Calorimeter

Projects Funded by External Agencies

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

Objective:

- Preparation of GHG emission Inventory for Energy and Manufacturing Industries (emission from fossil fuel combustion) for the years 2011-2015 with special emphasis on 2012 (Base year, BUR-2), 2014 (Base Year, BUR-3) and 2015 (base year, TNC)
- Estimation of oxidation factor for coal combustion in thermal power plants

Work done: Prepared National GHG inventory for energy and manufacturing industries for the year 2011-2014.

Conclusion: The present work is a significant contribution towards the preparation of National Energy Sector Inventory of GHG emission for onward communication of Govt. of India to UNFCCC.

Benefits achieved: National GHG Inventory for Energy and Manufacturing Industries for the year 2011-2014.

Project Status: Continuing.

2. Assessment of Normative coal requirement for different industries (Phase-I)

Objective: Assessment of normative quantity of coal requirement for different industries based on industry wise technical inputs received from Coal India.

Work done: Normative requirement of coal for about 200 different industries was evaluated based on available literature and information provided by various industries/sectors and Coal India Limited.

Conclusion: This report finally recommends allocation of normative requirement of coal quantity for different industries.

Benefits achieved: This will help to take policy decision by Ministry of Coal, Govt. of India for judicious coal allocation and to prevent misuse of precious coal of different grades presently mined in India.

Project Status: Continuing.

3. Assessment of Mercury emissions from MPPGCL thermal power plant (SGTPS)

Objective of the project:

- Assessment of mercury content of coals used by thermal power plant.
- Direct measurement of emissions of mercury from stacks
- Estimation of mercury emission factor
- Assessment of heavy metals like Hg, As, Pb, Cr in fly ash and bottom ash sample

Work done:

- Collection of relevant plant data like input rates of coals, PLF, Generation, Source of coal etc., from power plant officials.
- Direct measurement of mercury emissions from power plant boiler unit of 500MW by adopting standard procedure for solid and gaseous sampling.
- Collection of samples of coal, fly ash, bottom ash and mill rejects.
- Assessment of feed coals which include Proximate, GCV, concentration of mercury and chlorine.
- Analysis of the Hg in the stack sample, coal sample and its ash sample was carried out.
- Assessment of heavy metals like Hg, As, Pb, Cr in fly ash and bottom ash samples of three boiler.

Conclusion: Mercury emissions results showed that the emission values are well below the national threshold values of 0.03mg/NM^3.

Benefits achieved: Mercury emission data will be very useful to the client for getting compliance to the existing emission norms. The heavy metal contents of coal and combustion products will be utilized for assessing environmental impact on air, water and soil.

Project Status: Completed.

4. Process development for producing modified activated carbon for vapour phase mercury capture

Objective: Process development for activated carbon making for its use in gas phase mercury removal.

Work done:

- Preparation of char from bamboo and prosopis juliflora
- Fabrication, Installation and commissioning of Charcoal activation unit by steam and air mixture
- Test run for preparation of activated carbon by using bamboo char in the activation unit

Conclusion: Project activities are under progress.

Benefits to be achieved: The developed product is meant for “Activated carbon injection” for vapour phase mercury capture from flue gases.

Project Status: Continuing

5. Utilization of Sludge by blending with coal

Objective: To study combustion behaviour of coal and sludge blends

Work done:

- Preparation of sludge sample
- Preparation of different binary blends of coal and sludge
- Combustion study of the coal sample and coal-sludge blend samples were carried out with the help of Drop Tube Furnace

Conclusion: The present work is significant as a large amount of sludge samples were unutilized and lying in the ground.

Benefits achieved: Possible utilization of sludge by blending with coal.

Project Status: Continued.

3. GASIFICATION AND LIQUEFACTION

1 A. Project Report:

1. Development of Co-Fe based bi-metallic supported catalyst for Coal–to–Liquid synthesis in the Pilot Plant

Objectives:

- To develop Co–Fe based bi-metallic catalyst and to study the Coal–to–Liquid conversion in Pilot Scale in an integrated plant consisting of air blown gasifier and a multi-tubular fixed bed reactor (Catalyst Capacity: 10.0L)
- To generate basic design & process parameters for further scale-up
- To characterize the products (liquid and gaseous)

Results & conclusion: An independent third party evaluation of Coal–to–Liquid process data have been successfully completed by M/s PDIL, Noida during 24–29 July, 2017.

Pilot Plant was operated with indigenously developed catalyst and total effective reaction time for Fischer–Topsch was 24hrs. Total liquid product obtained was 1545ml, Out of that, aqueous product was 1180ml and Liquid hydrocarbon product was 365ml. Product was analyzed in IIP, Dehradun. Some important properties of CTL crude are: Gross calorific value: 11,113 cal/gm, Aniline point: 50^{0}C, Flash point (^{0}C): 21, Fire point (^{0}C): 32, Cloud point (^{0}C): -4

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

Objective: To observe the self aggregation phenomenon of asphaltene in molecular scale and develop an easy method in order to minimize asphaltene aggregation by trapping various guest molecules within the asphaltene aggregates for efficient conversion of coal to liquid

Results & conclusion: From the present study following points came to the force:

- Asphaltene content was determined from various coal derived tar. It was observed that the weight percent of the asphaltene content was different with various sources, however, the nature of asphaltenes separated from various sources exhibited similar properties. This was also ascertained by characterization with CHN, FTIR, UV-vis and Fluorescence spectrophotometry.
- The onset of aggregation of asphaltene in CCl_4 solvent has been observed using fluorescence spectroscopic studies. Thus inflexion points at ca. 12, 25 and 50 mg L^{-1} could be identified as the onset of various stages of aggregation of asphaltene solution.
- It has been observed that although asphaltene has certain properties of surfactant but it always does not behave as common surfactants. The critical aggregation concentration (CAC) of the coal derived asphaltene sample under investigation in dry CCl_4 has been found to be 3.63 x 10^{-3} mol L^{-1} at 22^{o}C and 40% relative humidity
- The π-π interaction is the dominant force for the self aggregation has been established in the present work by using water directly as a probe material. It is found tensiometrically and fluorimetrically that on addition of micro-quantities of water the aggregation is inhibited.
- Our studies indicated that asphaltene formation was remarkably reduced in presence of micro-quantities of water. So, in view of choking problems in the pipelines of the reactor system during various coal conversion process use of water in microquantities may be the troubleshooter.

3. Catalytic petcoke Gasification Study

Objectives:

- To investigate catalytic petcoke gasification reactivity/kinetics using thermo-gravimetric analysis by direct addition of catalyst to petcoke.
- Selection of suitable catalyst.
- Co-gasification reactivity/kinetics of petcoke with coal/biomass which contains inherent catalyst.
- Study the effect of catalyst loading, blend composition on petcoke reactivity.
- Study the gasification performance of petcoke in higher scale with most effective catalyst.

Results & conclusion: Alkali and alkaline earth metals based compound doped in petcoke were found to be suitable for catalytic petcoke Gasification reaction below 1000 ºC. Petcoke gasification with these catalysts was conducted at four different temperatures such as 850^{0}C, 900^{0}C, 950^{0}C and 1000 ^{0}C with 1, 3 and 10% catalyst loading for kinetic and reactivity study. This study will help us to generate a systematic data base for catalytic gasification of pet coke and its blends with biomass or coal. Further, prediction of the behaviour of a particular feed towards catalytic gasification can be assessed and accordingly efficient gasifier for handling pet coke at lower temperature can be developed. Further work may be taken up in pilot scale gasifier with the selected catalyst.

4. Development of Air Blown Fluidized Bed Gasifier

Objectives :

- Development of fluidized bed gasifier (FBG) along with suitable fuel feeding, ash extraction system and retrofitting with available facility.
- Evaluation of the gasification performance of high ash coals and maximization of performance by adjusting the operating parameters and blending with biomass feeds.
- Study the techno-economic feasibility, operational performance and issues of fluidized bed gasifier with different feed stocks like high ash coals and its blends with biomass.

Significance: From previous studies, it is observed that high ash Indian coals can be successfully gasified in FBG without any operational problems like agglomeration and clinker formation with proper synchronization of different operating parameters. Further, it is also observed that blending of small quantity of biomass with coal improves its carbon conversion, which is also reflected in syngas quality. Based upon experience gained and findings, it is obvious that fluidized bed gasifier is most suitable to handle high ash coals. Further, FBG is attractive option for generation of tar free syngas for different industrial applications such as methanol, power, liquid fuels, fertilizer, chemicals and other thermal applications. NITI AAYOG already initiated a colossal program to develop indigenous technology for coal to methanol involving different stake holders. As a member of this group and under the guidance of NITI AAYOG, CSIR-CIMFR initiated a program to develop the Fluidized Bed Gasifier to the capacity which represents the hydrodynamics and other features of large scale commercial gasifier. Further, evaluation of techno-economic feasibility, operational performance of the proposed fluidized bed gasifier with different feed stock will be established. These database will help to design and develop commercial scale gasifier for utilizing high ash coal for different applications.

4. INDUSTRIAL BIOTECHNOLOGY AND WASTE UTILISATION

Bio-methanation of coal mill and washery rejects

Objective is screening and characterization of suitable coal mill and washery rejects for bio-methane production. Isolation, identification and selection of suitable fungi and bacterial consortium for bio- methane production from coal mill rejects. Designing of suitable indigenous reactor for bio-methane production from coal mill rejects. Optimization of process parameters for bio-methane production from coal mill rejects. To study the possibility of utilizing spent slurry for value added products extraction. Progress: Screening and characterization of suitable coal mill and washery rejects. For bio-methane production is under progress.

5. CSIR-CIMFR BILASPUR RESEARCH CENTRE

1. Testing and Analyses of coal received from different organisations

Resource Quality Assessment of virgin coal resources of Chhattisgarh, M.P., Odisha and Uttar Pradesh. Borehole coal core received 15898.18 m (meter). Results dispatched 30197.21m. Samples prepared 30197.21m. Total number of samples prepared (including BH, PO, HGI and projects):78725. Pending Meterage of borehole as on 31/03/2018: 11217.54m.

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

The study includes visual lithological logging of borehole coal cores of around 10942 metres, 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.

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

The study includes visual lithological logging of boreholes coal cores of around 23826.67 meters, testing of ash and moisture percentage (on AD basis) of band by band samples (around 48475 samples charged as per the old rate and 9572 samples charged as per new rate) and preparation and testing of sectional overall samples functioned as separate project. 58,044 samples have been analyzed for Proximate, GCV, AFT, HGI and the results have been already dispatched to the sponsor.

4. Study of quality of coal received at Sipat Super Thermal Power Station (NTPC) from SECL for power generation, Phase-II

Details of rakes siding wise which were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

5. Study of quality of coal received at Sipat Thermal Power Station (NTPC) from SECL for power generation, Phase-I

Details of rakes siding wise which were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

6. Study of quality of coal received at NSPCL, Bhilai from SECL for power generation

Details of rakes siding wise which were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

7. Study of quality of coal received at GMR-Warora from SECL for power generation

Details of rakes siding wise which were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

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

   Details of rakes siding wise which were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

9. **Study of quality of coal received at Torrent Power Limited from SECL for power generation**

   Details of rakes siding wise which were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

10. **Study of quality of coal received at Shri Singaji Khandwa Thermal Power Station from SECL for power generation**

    Details of rakes siding wise which were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

11. **Study of quality of coal received at Jindal Power Limited-Tamnar from SECL for power generation**

    Details of rakes siding wise which were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

12. **Study of quality of coal received at MPPGCL, Amarkantak Thermal Power Station from SECL for power generation**

    Details of rakes siding wise which were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

13. **Study of quality of coal received at Korba Super Thermal Power Station (NTPC) from SECL for power generation, Phase-I**

    Details of rakes siding wise which were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

14. **Study of quality of coal received at Korba Super Thermal Power Station (NTPC) from SECL for power generation, Phase-II**

    Details of rakes siding wise which were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

15. **Study of quality of coal received at Sanjay Gandhi Thermal Power Station (MPPGCL-SGTPS) from SECL for power generation**

    Details of rakes siding wise which were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

16. **Study of quality of coal received at Chhattisgarh State Power Corporation Generation Company Limited, CSPGCL from SECL for power generation**

    Details of rakes siding wise which were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

17. **Study of quality of coal received at Nabha Power from SECL for power generation**

    Three hundred sixteen (316) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

18. Study of quality of coal received at RRVUNL from SECL for power generation

Four hundred seventy seven (477) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

19. Study of quality of coal received at MPPGCL-STPS from SECL for power generation

Eighty nine (89) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

20. Study of quality of coal received at GSECL from SECL for power generation

Two hundred thirty eight (238) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

21. Study of quality of coal received at NSPCL, Bhilai from SECL for power generation

Three hundred sixty eight (368) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

22. Study of quality of coal received at LANCO, Amarkantak (Unit-II) from SECL for power generation

Three hundred thirty three (333) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

23. Study of quality of coal received at BALCO from SECL for power generation

Two (02) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

24. Study of quality of coal received at RKM POWERGEN from SECL for power generation

One hundred forty seven (147) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

25. Study of quality of coal received at NTPC-SIPAT from SECL for power generation

Sixty two (62) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

26. Study of quality of coal received at NTPC-Korba from SECL for power generation

One hundred sixty eight (168) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

27. Study of quality of coal received at Adani Power Maharashtra Limited from SECL for power generation, Phase-I

Three hundred eighty one (381) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

28. Study of quality of coal received at TRN Energy Pvt. Ltd. from SECL for power generation

One Hundred eighty eight (188) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

29. Study of quality of coal received at Maruti Clean Coal & Power Ltd. from SECL for power generation

Two hundred nineteen (219) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

30. Study of quality of coal received at Rattan India Power Ltd. from SECL for power generation, Phase-I

Sixty six (66) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

31. Study of quality of coal received at UPRVUNL, PARICHHA from SECL for power generation, Phase-I

Forty seven (47) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

32. Study of quality of coal received at Jhabua Power Ltd. from SECL for power generation, Phase-I

Two hundred five (205) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

33. Study of quality of coal received at Adani Power Ltd. from SECL for power generation, Phase-I

One hundred seventy six (176) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

34. Study of quality of coal received at PSPGCL, Ropar from SECL for power generation, Phase-II

Eleven (11) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

35. Study of quality of coal received at MAHAGENCO from SECL for power generation, Phase-II

Four hundred forty (440) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

36. Study of quality of coal received at Torrent Power from SECL for power generation, Phase-II

Four hundred (400) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

37. Study of quality of coal received at NTPC-SIPAT from SECL for power generation, Phase-III

One hundred seventy six (176) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

38. Study of quality of coal received at NTPC-MEJA from SECL for power generation, Phase-I

Fourteen (14) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

39. Study of quality of coal received at NTPC-Farakka from NEC for power generation, Phase-I

Sixty five (65) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

40. Study of quality of coal received at GMR-Warora from SECL for power generation, Phase-II

Five hundred fifty two (552) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the resultswere dispatched to the sponsor.

41. Study of quality of coal received at NTPC-Bongaigaon from SECL for power generation, Phase-I

Three hundred eighty six (386) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

42. Study of quality of coal received at NSPCL, Bhilai from SECL for power generation, Phase-II

Two hundred ninety five (295) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

43. Study of quality of coal received at NTPC, Bongaigaon from SECL for power generation, Phase-I

Eighty three (83) rakes siding wise were analyzed for Proximate, GCV, AFT, HGI and the results were dispatched to the sponsor.

6. CSIR-CIMFR NAGPUR RESEARCH CENTRE, UNIT (II)

Project report:

1. **Quality assessment of Imported coal samples to be utilized in the Power station of M.P. Power Generation Co Ltd, near Nagpur**

   Objective: Quality evaluation of imported coal samples supplied to power stations of MPPGCL.

   Conclusions: The analytical data shows that the most of the samples are having high moisture content, low ash content with high Gross Calorific Values. The total moisture contents are also high. The total sulphur contents are low with a majority of the samples having a sulphur content less than 0.5 %. The Ash Fusion Temperatures show initial deformations for a majority of the samples. The size analysis data shows that the majority of the coal is falling in the 50-5 mm size range and the fines i.e less than 5 mm size range is with acceptable range of upto 15 %.

2. **Quality Evaluation of Indian coal and oil samples and imported coal samples received from Bhusawal Thermal Power Station, Dist. Jalgaon, Maharashtra**

   Objectives: The objective of the project is the quality evaluation of month wise, Unit wise coal and oil samples received from Bhusawal Thermal Power Station, Bhusawal.

   Conclusions: The parameters analysed show that the imported coal samples show low ash content with corresponding high GCV. In comparison the Indian coal samples analysed show high ash content (for all the Units) and corresponding lower GCV. However, the month wise trends show similarity in quality. Ultimate analysis also shows similar trends to that of the Proximate analysis. The total sulphur contents in most of the samples are below 1.0 %. The Ash Fusion Temperature ranges for the Imported coal in general is less than that of the Indian Coals. The quality of the mill samples for imported coal and Indian Coal is also similar to that of the samples received for all the Units.

   The Furnace Oil and Light Diesel Oil show that the Furnace Oil has lesser GCV than that of the Light Diesel Oil. The data generated from this analysis will aid the power station in effective utilization of the coal received. It will also aid in the technological calculations required for generation of electricity.

3. **Collection, preparation and analysis of 180 No coal samples at loading ends of WCL, supplied to STPS, Sarni**

   Objectives: The objective of the project is the quality evaluation of coal samples collected from rail rakes dispatched to Satpura Thermal Power Station, Sarni.

   Conclusions: The quality assessment of the rail rakes dispatched from different sidings of WCL show a wide range of values for the parameters analyzed. The coal from EDC & BG sidings Pench Area and Palachourai siding, Kanhan Area show good quality for most of the samples. These contain low ash content and corresponding high GCV. Only

a few samples show high ash content and low GCV. The samples show low Total Moisture content. In comparison, the samples of DumriKhurd siding, Nagpur Area and Ghuggus siding, Wani Area show high ash content and low GCV.

4. **Study of Specific Diesel Consumption (SDC)of AKWM opencast coal mine of Bharat coking coal Limited**

Objectives: The major objectives of benchmarking specific diesel consumption (SDC) in AKWM opencast mine are:

- to benchmark specific diesel consumption (SDC) based on actual operation of HEMMs during field trials and quantify diesel savings
- to develop a mine specific benchmarking model for estimating SDC
- to study the effect of mine and engine operating parameters
- to study the effect of mine and engine operating parameters on SDC

Conclusions: The proposed study would aim at setting specific diesel consumption norms for HEMMs and estimate diesel saving potential in AKWM opencast mine of BCCL. The study would aware management and technical personnel of BCCL regarding the importance of fuel efficiency and benchmarking in HEMMs at present operating conditions. The outcome of the study is beneficial to BCCL for establishing the specific diesel consumption norms for HEMMs. The diesel saving potential in the mine is 6.75% based on the study. Final report submitted on July 2017.

5. **Washability characteristics of coal supplied from WCL**

Objectives: To determine the yield of cleansof coal samples from 3 mines at desired ash level of 33 % and 34 %.
Conclusions: The ROM coal shows ash % of 46.7 % and the yield of cleans at 33 % ash is 73 % at 1.96 specific gravity and yield of cleans at 34 % ash level is 71 % at 1.96 specific gravity.

6. **Quality assessment and Evaluation of Coal Samples Received from Indorama synthetics at Nagpur District, Maharashtra (India) Limited**

Objective: The objective of the project is quality assessment and evaluation of Coal Received from Indorama synthetics (India) Ltd at Nagpur District, Maharashtra as per the scope of work given below.

Conclusions: The analytical data shows that the most of the samples are having high moisture content, ash content is mostly above 35 % with moderate Gross Calorific Values. The total moisture contents are also high. The results of Volatile matter vary in the range 20 % to 28 %. The Fixed Carbon content and Gross Calorific Value content shows that the coal is bituminous in character and suitable for end use.

7. CSIR-CIMFR RANCHI RESEARCH CENTRE

1. **Characterisation, Testing and Analysis of Coal**

Around 11068 (approx) meters coal core processed and about 2287 nos. samples were prepared and 149 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.Quality samples prepared 171 for different Private, PHs of NTPC, CCO, CCL and MCL through the testing and analysis of referee and quality coal samples.

2. **Characterisation studies of coal seams encountered in borehole numbers-CSNB-12, 13, 16, 18, 19 and CMTBL-34, 40, 41 of Brahmanbil Block, Talcher Coalfield, Orissa**

Around 149 samples were received during the period and was analysed. The analytical results viz. proximate and 60% RH & 40^{0}C and GCV was 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.

3. **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 directly.

4. **Quality assessment of coal at Salanpur-B and Barul Bagdih Blocks, Raniganj Coalfield through characterization testing and analysis of bore hole coal core**

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

5. **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.

6. **Technical advice on quality monitoring of coal at unloading 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.

7. **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.

8. **Quality assessment of coal from Saunda B. siding, Urimari Project, Barka Sayal area of CCL for Utilization in thermal power plant**

   Approx100 percent of the samples will be tested for proximate and GCV under standard condition (at 60% RH and 40^0C).

9. **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.

10. **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

11. **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.

12. **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.

13. **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.

14.Technical advice on quality 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.

15.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.

16.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.

17.Technical advice on quality monitoring of coal (loading area- NK, Piparwar, Barka Sayal, Kuju and 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.

18.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.

19.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.

20.Technical advice on quality monitoring of coal (loading area- NK and Piparwar area) For Tenughat Thermal Power Station, Lalpania

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.

21.Technical advice on quality monitoring of coal (loading area- NK, Piparwar area and Barkasayal) for NTPC Dadri

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.

22.Technical advice on quality monitoring of coal (loading area- IB and Lakhanpur area)

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.

23.Technical advice on quality monitoring of coal (loading area- IB and Lakhanpur area) for Talwandi (loading end)

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.

24.Technical advice on quality monitoring of coal (loading area- Piparwar, Barkasayal, NK and Kuju area for Badarpur Thermal Power Station, Badarpur)

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.

25.Technical advice on quality monitoring of coal at unloading end of NTPC-TSTPS, Kaniha, Phase- II

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.

26.Technical advice on quality monitoring of coal at loading end of Lakhanpur area for APGENCO, DVC, HINDUJA, HPGCL, NTECL, VEDANTA, WBPDCL, TANGEDCO, MAHAGENCO, NTPC SIMHADRI, OPGC, TSTPS and HPL

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.

27.Technical advice on quality monitoring of coal (loading area - Barkasayal and Argada) for TANGEDCO

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.

28.Technical advice on quality monitoring of coal (loading area - Piparwar and Barkasayal) for KBUNL

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-Piparwar, Barkasayal, Kujju and NK) for BRBCL Nabinagar

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 – Piparwar, Kujju and NK) for GGSSTP (Punjab)

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- Argada, Kujju, Barkasayal, Piparwar and NK) for VALLUR (NTECL)

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.

32.Technical advice on quality monitoring of coal (loading area - Kujju and NK) for GNDTP (Punjab)

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.

33.Technical advice on quality monitoring of coal (loading area – Piparwar, Kujju and NK) for GHTP (Punjab)

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.

34. Technical advice on quality monitoring of coal for NTPL at loading end of Jagannath, Bharatpur, IB, Lakhanpur Basundhara, Phase- I

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.

35. Technical advice on quality monitoring of coal for NTPC-TTPS at loading end of Jagannath, Bharatpur, IB, Lakhanpur Basundhara, Phase- II

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.

36. Scientific study on quality monitoring of coal (loading area – NK, Piparwar, Barkasayal, Argada and Kujju) for CCL

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.

37. Scientific study on quality monitoring of coal (loading area – NK, Piparwar, Barkasayal, Argada, Kujju and Chainpur) for CCL

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.

38. Scientific study on quality monitoring of coal (loading area – NK, Piparwar, Barkasayal, Argada, Kujju, Chainpur, Rajrappa and Hazaribagh) for CCL, Phase-III

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.

39. Scientific advice on quality monitoring of coal at loading end of MCL siding for Talwandi Sabo, Phase- II

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.

40. Scientific advice on quality monitoring of coal at loading end of MCL areas for NTPC-TSTPS, Kaniha, Phase- II

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.

41. Scientific advice on quality monitoring of coal at unloading end of NTPC-TSTPS, Kaniha, Phase- III

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. RESOURCE QUALITY ASSESSMENT

1. Testing and Analysis (Chemical)

Several thousands of coal, coke & other carbonaceous samples were analyzed as aid to industry and basic research in addition to earning the ECF of around Rs. 25 lakh.

2. 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.

3. Testing and Analysis (Petrography)

During the above mentioned period micro petrographic analysis of about 68 number of samples has been done during this year.

4. Evaluation of coal quality at unloading point of NTPC, Vindhyachal Super Thermal Power Project, Singrauli, MP

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

5. Coal quality evaluation at unloading point of NTPC, Vindhyachal Super Thermal Power Project, Singrauli, MP

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

6. Coal quality assessment of borehole coal core samples received from Tete Province of Mozambique for industrial application

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.

7. 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 40°C, Ash and Gross Calorific value to fix the received grade.

8. Quality monitoring of coal at loading point (ECL mines) for NTPC, Farakka, WB

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 40°C, Ash & Gross Calorific value to fix the received grade.

9. Coal quality monitoring at loading end (NCL mines) for NTPC, Rihand Thermal Power Station, UP

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 40°C, Ash and Gross Calorific value to fix the received grade.

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

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 40°C, Ash and Gross Calorific value to fix the received grade.

11. Monitoring of coal quality at loading points (NCL mines) for NTPC, Vindhyachal Thermal Power Station, MP

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 40°C, Ash and Gross Calorific value to fix the received grade.

12. 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 40°C, Proximate Analysis and GCV.

13. Characterization of coals from different coalfields explored by CMPDIL RI-II, through boreholes coal cores study – Phase III

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

14. Sample Collection and Analysis for determination of Quality and Grade of Stocks at different location of CCL

Twenty nine (29) nos. of heap from different areas of CCL were sampled the total quantity of coal covered approximate 23.5 lakh ton samples were analysed for proximate and GCV.

15. Auger sampling study at MCL siding

The modalities of sampling have been finalized after site visit of MCL Kaniha and Lingaraj. The sampling will be started very shortly.

16. Technical advice on quality monitoring of coal (loading point-Amlori and Dudhichua OCP) for NTPC Rihand, U. P., Phase-I

Technical advices were given time to time as per need of work to the sponsor of the project.

Similar projects at loading and unloading ends on Pan-India basis are being carried out. Name of these projects are as follows:

1. Technical advice on quality monitoring of coal (Loading points- Amlori and Dudhichua OCP) for NTPC Rihand, U. P., Phase –II.
2. Technical advice on quality monitoring of coal (Loading points- Jayant and Dudhichua OCP) for NTPC Singrauli, Shaktinagar, U. P., Phase –I
3. Technical advice on quality monitoring of coal (Loading points- Jayant and Dudhichua OCP) for NTPC Singrauli, Shaktinagar, U. P., Phase –II
4. Technical advice on quality monitoring of coal (Loading points-Nigahi and Dudhichua OCP) for NTPC Vindhyachal, M. P., Phase –I
5. Technical advice on quality monitoring of coal (Loading points-Nigahi and Dudhichua OCP) for NTPC Vindhyachal, M. P., Phase –II
6. Technical advice on quality monitoring of coal at Unloading point of NTPC, Vindhyachal, Vindhyanagar, M. P.
7. Technical advice on quality monitoring of coal at Unloading point of NTPC, Rihand, Rihandnagar, U. P.
8. Technical advice on quality monitoring of coal (Loading points-Bina, Morwa and Krishnashila OCP) for Haryana Power Generation Company, Phase-I

9. Technical advice on quality monitoring of coal (Loading points-Bina, Morwa and Krishnashila OCP) for Parichha Thermal Power Plant, Phase-I

10. Technical advice on quality monitoring of coal (Loading points-Bina, Morwa and Krishnashila OCP) for Aravali Power Company Private Ltd., Phase-I

11. Technical advice on quality monitoring of coal (Loading points- Jayant and Dudhichua OCP) for NTPC Singrauli, Shaktinagar, U. P., Phase-III

12. Technical advice on quality monitoring of coal (Loading point- Amlori and Dudhichua OCP) for NTPC Rihand, U. P., Phase-III

13. Technical advice on quality monitoring of coal (Loading points-Nigahi and Dudhichua OCP) for NTPC Vindhyachal, M. P., Phase-III

14. Technical advice on quality monitoring of coal at Unloading point of APCPL, Jhajjar, Harayana, Phase-I

15. Technical advice on quality monitoring of coal (Loading point- Krishanashila, Dudhichua and Bina OCP) for Anpara Thermal Power Station, Phase-I

16. Technical advice on quality monitoring of coal (Loading point- Jayant and Block-B OCP) for Rajasthan Rajya Vidyut Utpadan Nigam Limited, Phase-I

17. Technical advice on quality monitoring of coal (Loading point- Khadia, Block-B, Krishanashila, Dudhichua and Bina OCP) for Lanco Anpara Power Ltd, Phase-I

18. Technical advice on quality monitoring of coal (Loading point-Jayant, Block-B, Krishanashila and Bina OCP) for Obra Thermal Power Station, Phase-I

19. Technical advice on quality monitoring of coal (Loading point- Salanpur, Pandaveswar, SonpurBazari and Kenda OCP) for Bongaigaon TPP, DPL, NTECL, KBUNL and Talcher STPS, Phase-I

20. Technical advice on quality monitoring of coal (Loading point-Pandaveswar, SonpurBazari and Kenda OCP) for Simhadri Super Thermal Power Project, Phase-I

21. Technical advice on quality monitoring of coal (Loading point- Pandaveswar and Salanpur OCP) for NTPC Jhajjar (APCPL), Phase-I

22. Technical advice on quality monitoring of coal (Loading point- Pandaveswar, SonpurBazari, Salanpur, Mugma and Rajmahal OCP) for NTPC Farakka, Phase-I

23. Technical advice on quality monitoring of coal (Loading point-Pandaveswar, Sonpur Bazari, Salanpur, Mugma and Rajmahal OCP) for NTPC Kahalgaon, Phase-I

24. Technical advice on quality monitoring of coal (Loading point-Pandaveswar, Sonpur Bazari, Salanpur and Mugma OCP) for TANGEDCO, Phase-I

25. Technical advice on quality monitoring of coal (Loading point- Rajmahal, Pandaveswar, Mugma and Salanpur OCP) for DSTPS, DVC, DTPS, DVC, MTPS, DVC and KTPS, DVC, Phase-I

26. Technical advice on quality monitoring of coal (Loading point- Pandaveswar, SonpurBazari and Rajmahal OCP) for Barh Super Thermal Power Project, Phase-I

27. Technical advice on quality monitoring of coal (Loading point- Pandaveswar and Sonpur Bazari OCP) for NCPP Dadri, Phase-I

28. Technical advice on quality monitoring of coal (Loading point-Pandaveswar, SonpurBazari, Salanpur, Mugma and Rajmahal OCP) for WBPDCL, Phase-I

29. Technical advice on quality monitoring of coal (Loading point-Kenda, Jhanjara, Pandaveswar and Salanpur OCP) for Budge-Budge TPP, Southern TPP and Titagarh TPP of CESC, Phase-I

30. Technical advice on quality monitoring of coal (Loading point- Lodna, Kusunda, Block-II, Barora and Katras OCP) for Haryana Power Generation Company, Phase-I

31. Technical advice on quality monitoring of coal (Loading point- CV Area & Lodna OCP) for Maithon Power Limited, Phase-I

32. Technical advice on quality monitoring of coal (Loading point- Lodna, Kusunda, Block-II, Barora, and Katras OCP) for NTPC Unchahar, Phase-I

33, Technical advice on quality monitoring of coal (Loading point- Lodna, Kusunda, Block-II, Barora and Katras OCP) for Parichha TPP, Phase-I

34. Technical advice on quality monitoring of coal (Loading point- CV Area, Block-II and Barora OCP) for WBPDCL, Phase-I

35. Technical advice on quality monitoring of coal (Loading point- Sijua, CV Area, Lodna, Kusunda, Block-II, Barora and Katras OCP) for Hraduaganj TPS, Panki TPS, Farakka STPP, DPL, Budge-Budge TPP and Jhajjar Power Limited, Phase -I

36. Technical advice on quality monitoring of coal (Loading point- Sijua, CV area, Lodna, Kusunda, Block-II, Barora and Katras OCP) for DSTPS, DVC, DTPS, DVC, MTPS, DVC, CTPS, DVC, BTPS, DVC and KTPS, DVC, Phase-I

37. Technical advice on quality monitoring of coal at unloading point of NTPC, Singrauli, U. P., Phase-I

38. Technical advice on quality monitoring of coal at unloading point of NTPC Barh, Phase-I

39. Technical advice on quality monitoring of coal at unloading point of NTPC Unchahar, Phase-I

40. Technical advice on quality monitoring of coal at unloading point of NTPC Kahalgaon, Phase-I

41. Technical advice on quality monitoring of coal (Loading point of different areas of CCL) for Maithon Power Limited, Phase-I

42. Technical advice on quality monitoring of coal (Loading point of different areas of CCL) for Parichha TPP, Panki TPP and WBPDCL, Phase-I

43. Technical advice on quality monitoring of coal (Loading point of different areas of CCL) for Harduaganj TPP, Phase-I

44. Technical advice on quality monitoring of coal (Loading point of different areas of CCL) for Haryana Power Generation Company, Phase-I

45. Technical advice on quality monitoring of coal (Loading point of different areas of CCL) for MTPS, DVC, CTPS, DVC, BTPS, DVC and KTPS, DVC, Phase-I

46. Technical advice on quality monitoring of coal (Loading point of different areas of CCL) for Jhajjar Power Limited, Phase-I

47. Technical advice on quality monitoring of coal at unloading point of NTPC Dadri, Phase-I

48. Technical advice on quality monitoring of coal (Loading point-Pandaveswar, Sonpur bazari, Mugma etc. OCP) for Jhajjar Power Limited, Phase-I

49. Technical advice on quality monitoring of coal (Loading point- Jayant and Block-B OCP) for Jhajjar Power Limited, Phase-I

50. Scientific study on quality monitoring of coal (Loading point of different areas of CCL) for Maithon Power Limited, Phase-II

51. Scientific study on quality monitoring of coal (Loading point of different areas of CCL) for Parichha TPP, Panki TPP and WBPDCL, Phase-II

52. Scientific study on quality monitoring of coal (Loading point of different areas of CCL) for Harduaganj TPP, Phase-II

53. Scientific study on quality monitoring of coal (Loading point of different areas of CCL) for Haryana Power Generation Company, Phase-II

54. Scientific study on quality monitoring of coal (Loading point of different areas of CCL) for MTPS, DVC, CTPS, DVC, BTPS, DVC and KTPS, DVC, Phase-II

55. Scientific study on quality monitoring of coal at unloading point of Kota, RRVUNL Phase-I

56. Scientific study on quality monitoring of coal at unloading point of Chhabra, RRVUNL, Phase-I

57. Scientific study on quality monitoring of coal (Loading point-Pandaveswar, Sonpur Bazari, Salanpur, Mugma and Rajmahal OCP) for NTPC Farakka, Phase-II

58. Scientific study on quality monitoring of coal(Loading point-Pandaveswar, Sonpur Bazari, Salanpur, Mugma and Rajmahal OCP) for NTPC Kahalgaon, Phase-II

59. Scientific study on quality monitoring of coal at unloading point of NTPC, Rihand, Rihandnagar, U. P., Phase-II

60. Scientific study on quality monitoring of coal at unloading point of NTPC, Singrauli, U. P., Phase-II

61. Scientific study on quality monitoring of coal (Loading points-Jayant and Dudhichua OCP) for NTPC Singrauli, Shaktinagar, U. P., Phase-IV

62. Scientific study on quality monitoring of coal (Loading point- Amlori and Dudhichua OCP) for NTPC Rihand, U. P., Phase-IV

63. Scientific study on quality monitoring of coal (Loading points-Bina, Morwa and Krishnashila OCP) for Haryana Power Generation Company, Phase-II

64. Scientific study on quality monitoring of coal (Loading point-Khadia, Block-B, Krishanashila, Dudhichua and Bina OCP) for Lanco Anpara Power Ltd., Phase-II

65. Scientific study on quality monitoring of coal (Loading points-Bina, Morwa and Krishnashila OCP) for Parichha Thermal Power Plant, Phase-II

9.TECHNICAL INFORMATION AND INDUSTRIAL LIAISON

i. Knowledge Resource Centre

KRC is also 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 to expand the horizon of information base of its scientific community. Documentation, List of latest addition, Bibliographic service, OPAC search, CD-ROM search, In-house database, Internet Facility & Access to E-journals. As per the instructions of the official language implementation, KRC has been developing a variety of collection in Hindi language. Institutional repository (IR) has been established using open source software with an aim to provide online access to CSIR-CIMFR research articles. Users have been guided to maximize utilization of e-Resource. KOHA library management software has been successfully installed and union catalogue of CSIR (KNOWGATE) was implemented.

Collection Strength of KRC:

Books, Reports, Standards, Specifications and Bound Volumes	33329
CD Collection	127
Current Journals subscription	39

ii. Right to Information Cell

During the period 19 cases of RTI request were received and information was provided to them on time. Quarterly reports of all the four quarters related to RTI was sent to CIC, New Delhi.

Glimpses of the Photographs of Vigilance Awareness Week in November, 2017

Glimpses of the Photographs of CSIR-CIMFR Research Council Meeting

D. OTHERS

1. PAPER PUBLISHED IN INTERNATIONAL JOURNALS

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23. S. K. Gautam, T. Evangelos, S. K. Singh, J. K. Tripathi and Abhay Kumar Singh (2018): Environmental monitoring of water resources with the use of PoS index: a case study from Subarnarekha River basin, India. . Environmental Earth Sciences, Volume 77, February 2018, pages- 70.

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26. Singh, S.P. and Jaiswal Rinku (2017): Preparation of magnetic iron oxide nanoparticles activated carbon composite from corncob and its application for removal of organic pollutants, Research Journal of Chemical Sciences, Vol. 7(4), pp 1-9, April 2017

27. Singh, K.K.K., Singh, S. K., Singh, A. K., Ghosh, C. N. and Singh, P.K (2018): Role of MineVue Radar for Proving Abandoned and Unapproachable Mine Galleries for the Safety of Surface Structures. Journal of Geological Society of India, Vol. 91, February 2018, pp. 195-197.

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3. BOOK PUBLISHED/CHAPTER IN BOOK

1. John Loui Porathur, Pijush Pal Roy, Baotang Shen and Shivakumar Karekal (2017); "Highwall Mining – Applicability Design and Safety", Publisher: CRC Press, Taylor & Francis, UK, AA Balkema.

2. Sahoo Lalit Kumar, Bandyopadhyay Santanu and Banerjee Ranjan (2017); published a chapter on "Benchmarking Energy Consumption of Truck Haulage, Energy Efficiency in the Minerals Industry", Springer Publications,

4. PAPER PRESENTED IN INTERNATIONAL SEMINARS/SYMPOSIA/CONFERENCES

1. Bagde M. N. (2017): Field data analysis to study influence of stoping parameters on backfill dilution in hard rock underground mining. In Int. Conf Mining Industry Vision 2030 and Beyond, Organized by MEAI Nagpur Chapter, Nagpur, 6-8 Dec 2017, pp. 75-79.

2. Bayen G.K., Paramanik Tarun, Ranjan Rajiv, Kumar Manish and Gouri Charan T (2018): A Study on bio-coke preparation using high swelling coal and wood char mixture Asia Steel International Conference held at Bhubaneswar (ASIASTEEL-2018), 6-9 Feb. 2018

3. Goel, R.K. (2017): Role of instrumentation in underground excavations, Keynote paper in International Conference on "Underground Excavations in Difficult Ground Conditions: Issues & Challenges, April, CBIP, New Delhi.

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5. John Loui Porathur, Chandrani Prasad Verma, Subrata Dutta and Ambareesh Jha (2017): Design of stoping sequence at deeper horizons for a Lead-Zinc mine in sheared rock mass, in Proceedings of ISRM International Symposium "Rock Mechanics for Africa" AFRIROCK Conference, Southern African Institute of Mining & Metallurgy, Cape Town, 2-7 October (In CD).

6. Mandal P. K., Das A. J., Kushwaha A., Tewari S and Bhattacharjee R (2018): Extraction of coal pillars by continuous miner under goaf at a higher depth of cover – A case study, 2018, International Conference-cum-Exhibition, Mining Today 2018, 14-17 February 2018, Hyderabad, India.

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10. R.K. Paswan, R.K. Dubey, M.P. Roy and P.K. Singh (2017): Geotechnical characterization of strata to control pit-wall damage at a large Pb-Zn Opencast Mine. 5th Asia-Pacific Symposium on Engineering Blasting & 9th International Conference on Physical Problems of Rock Destruction. September 26-29, 2017, Zhoushan, Zhejiang, China.

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12. Sanga B and Mohanty D (2018): Numerical Simulation for Prediction of Syngas Composition from Underground Coal Gasification. Poster In: International Seminar and Exhibition Exploration of Oil, Gas, Coal, Minerals and Ground Water, held at Kolkata (EXOCMING-2018), on February 7-9, 2018, pp. 184.

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2. A. K. Bharti, K.K.K. Singh, S.K. Pal, Sahadev Kumar, Amar Prakash and P. K. Singh (2018): Mapping Coal fire using Electrical Resistivity Tomography over a Part of East Basuria coalfield, India. ETGRMI 2018, held in IIT(ISM), Dhanbad, March, 9-11, pp 128-130.

3. Arukula Deepa, Iqbal Ansari and Muniyan Sundararajan (2018): Dietary antioxidants and their indispensable role in male fertility health, Patna University Centennial Celebration, National seminar on environmental challenges: monitoring, assessment and remediation (21st–22nd march, 2018). Organized by Department of Zoology, Patna University, Patna (Bihar) In Collaboration with Centre for Environment and Energy Development (CEED), Patna. [Paper presented].

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6. Bagde M. N (2017): Application of backfilling in underground hard rock mining: An emphasis on sustainable development. In EISD'17 Compendium "National Summit on Extractive Industries & Sustainable Development, Organized by Asia-Pacific Institute of Management, N. Delhi and International Inst of Corporate Sustainability & Responsibility (IICSR), N. Delhi, 9th Sept 2017, Saurabha Mittal & Harsha Mukherjee (Eds), Enriched Publ. Pvt. Ltd, N. Delhi, 97-104. ISBN No.: 978-819346344-4.

7. Bharti A. K., Singh K. K. K., Pal S. K., Kumar S., Prakash A. and Singh P. K. (2018): Mapping Coal fire using Electrical Resistivity Tomography over a Part of East Basuria coalfield, India. Emerging Trends in Geophysical Research for Make-in-India 2018 organized by Department of Applied Geophysics, IIT(Indian School of Mines), Dhanbad, March, 9-11, pp 128-130.

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15. Goel, R.K. (2017): NATM and NMT for tunnelling, Keynote paper, Proc. 7th Indian Rock Conference INDOROCK-2017, ISRMTT, October, New Delhi, India, pp. 76-88.

16. John Loui Porathur and Pijush Pal Roy (2017): Highwall Mining - Current Scenario in India 7th Asian Mining Congress 2017- International Cooperation in Innovative Technology for Growth of Mineral Industry. Kolkata 8-11 Nov. pp. 185 – 192.

17. Kashyap S.K and Kumar Lalan (2017): Artificial Intelligence techniques: An introduction to use for modeling underground mine support system, 5th Bhartiya Vigyan Sammelan & Expo 2017 held on May11-14,2017 at Fergusson College, Pune.

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19. Kashyap S.K (2017): A journey from concept to commercialization, Key Note paper presentation at Trends in Engineering Science & Manufacturing (ETESM-2018) at Indira Gandhi Institute of Technology(IGIT), Sarang, Odisha on 28-29, March 2018

20. Mendhe V A, Singh P K, Sinha A, Mishra S and Bannerjee M (2017): Geological and Geochemical Characterization of Lower Gondwana Shale Beds of Damodar Valley for Hydrocarbon Potential and Development, 7th Asian Mining Congress, held at Kolkata (MGMI), pp. 341-354.

21. Mousumi Mallick, R.P. Singh and M.K. Verma (2018): "Study on metallurgical properties and corrosion behaviour of FMC rope used in underground coal mines", National Conference on Science and Technology of Special Steels and Nanomaterials, held in 17-18 February, 2018 at B.I.T. Sindri.

22. Nishant K. Srivastava (2017): Rehabilitation of mine-spilled soils – progress, pitfalls and promises. "Book of Abstracts for Lead Lectures" in National Seminar held in June 9-10, 2017, at BCKV, Kalyani (W.B.).

23. Pallabi Das, I. Sinha, K.K.K. Singh and P K Singh (2018): Novel Draw Solutes in Membrane Based Separation: Modeling and Design Aspects Exploration of oil, Gas, Coal, Minerals and Ground Water, Modern Techniques and Appliances, held in Swissotel, Rajarhat, Kolkata, February,7-9.

24. Pandey PK, Deshmukh S, Raina AK, Trivedi R and Murthy VMSR (2017): 'Road header performance – Impact of Geology'. The Mining Geological and Metallurgical Institute of India, 7th Asian Mining Congress, 8-11 November, Kolkata, India, pp. 257 – 262.

25. P. Pal Roy, C. Sawmliana, R. K. Singh, R. S. Yadav, N. K. Bhagat, P. Hembram, S. Ghanti and A. Mazumder (2017): Demolition of over-bridges on active rail-head tracks in populated areas, Procs. of 7th Asian Mining Congress (The Mining Geological and Metallurgical institute of India), 8th – 11th November, 2017, Kolkata, India, pp 263-270.

26. Ramulu M., Choudhury P.B., Gujjula P. and Singh P.K (2017): Controlled Blasting techniques to contain Overbreak in Tunneling Projects of Himalayan rocks, National Seminar on Mining Technology for Safety, 22-23 Dec. Bilaspur (CG), pp. 100-110. (Also published in The Indian Mining & Engineering Journal India; ISSN 0019-5944), Vol .57 No.01, pp.25-30.

27. Ramulu, M., Choudhury, P.B. and Singh, P.K. (2017): Mismatch of explosive and rock combinations at the cost of 'Opportunity Cost' in Indian blasting industry, Intl. Conf. & Expo. On Mining Industry Vision 2030 & beyond (6-8 Dec), MEAI, Nagpur, pp.194-200

28. Ratnesh Trivedi, M. Ahmad and A. K. Raina (2017): "Environment friendly progressive mine closure of a coal mine of Jharia region" IMMA-National Summit on Sustainability of UG mines in India,15-16 Dec. 2017, Nagpur, Organized by Indian Mine Manager's Association, Nagpur Branch.

29. Rajesh Kumar (2017): Unusual flowering of mango tree in the month of June: A report, National Conference on Plant Systematic & Biotechnology: Challenges & Opportunities, 28-30 November 2017, P.G. Department of Biotechnology, T.M. Bhagalpur University, Bhagalpur.

30. Roy M P, Paswan R K, Md. Sarim and Suraj Kumar (2017): Geological Discontinuities, Blast Vibration And Fragmentation Control – A Case Study. In proceeding of 7th Asian Mining Congress. November 08-11, 2017. pp. 315 – 323.

31. S. K. Roy, V. K. Singh, J. K. Singh, Ajit Kumar, R. K. Singh and Manish Kumar (2017): Optimum Dump Slope Design of an Opencast Coal Mine, National Seminar on "Production Productivity for Sustainability in Coal and Power Sectors, 5-6 May 2017, New Delhi.

32. Soni A.K. (2017): Mine Water Environment, Nat. Sem. on Resurgence of Metalliferrous Mining, Extraction Technology and Related environmental issues in India, Nov. 19, Malanjkhand Technical Association (MTA), Malanjkhand Copper Project, Hindustan Copper Limited, Malanjkhand p.12.

33. Srivastava N.K. and Tripathi R.C., (2018) Role of riparian herbs in protecting soil erosion and river water quality, National Seminar on Innovative Technology for Sustainable Development, Invited talk, Session 6 (D1S6IT1), Jadavpur University, Kolkata, 23-24 Feb. 2018.

34. Trivedi R, Ahmad M, and Raina A.K. (2017): 'Environment friendly progressive mine closure of Jharia region'. IMMA – National Summit on Sustainability of UG Mining in India, Nagpur (India),15th Dec., pp. 215 – 226.

35. Trivedi, R. Wankhede, P.M and Raina, A.K (2017): Prediction of Blast-Induced Ground at Indian Limestone Mines using ANN, Nat. Seminar on Recent Mining and environmental issues in India, 7-9 July, MEAI, Udaipur, pp.203 -210.

36. T. Gouri Charan, U.S. Chattopadhyay, K.M.K. Sinha and Pradeep K Singh (2017): Beneficiation of High Ash Indian Non-Coking Coals for Improvement In Boiler Efficiency Aus-India workshop on Low Emission Coal Technologies held at Anna University, Chennai.

37. T. Gouri Charan (2017): Effect of Mining Process of Coal on Selection of Washery Process Equipments One day MEAI Seminar held at CIMFR, Dhanbad.

38. T. Gouri Charan. U.S. Chattopadhyay, K.M.K. Sinha and Pradeep Kumar Singh (2018): Utilization Of Rejects Generated From Indian Coal Washeries: Waste to Wealth from Mineral and Mining Industries held at Bhubaneswar (WWMMI-2018).

39. T. Gouri Charan. U.S. Chattopadhyay, S.C. Maji and Pradeep Kumar Singh (2018): Studies On Technical Feasibility Of Washing Coals Fed To Chasnalla Coal Washery To 13% Ash Content. Coking Coal in Indian Steel Industry: Issues and Challenges held at Kolkata.

40. U.S. Chattopadhyay, T. Gouricharan, Pradeep. K. Singh, S.P. Basak, Md. Adnan and R. Venugopal (2018): Beneficiation of settling pond coal fines and utilization for Import substitution Coking Coal in Indian Steel Industry: Issues and Challenges held at Kolkata.

41. V.K. Singh, J.K. Singh, A. Kumar, S.K. Roy, R. Kumar, R.K. Singh and M. Kumar (2017): Geotechnical Study for Optimum Design of Dipka Opencast Coal Mine, 4th Indian Landslide Congress (ILC-2017), 8-9 December 2017, under theme "Engineered Slopes: Deep Mine & Dump Slope", IIT Mumbai.

42. Verma, H.K., Samadhiya, N.K., Singh, M. and Singh, P. K (2017): Parametric Analysis of Overbreak in Underground Excavations, Proc. 7th Indian Rock Conference INDOROCK-2017, ISRMTT, October, New Delhi, India, pp. 336-344.

43. Verma, H. K. (2017): Advancement in controlled blasting techniques for rock excavations in hilly regions, All India Workshop on All Weather Roads in Hilly Regions, Institution of Engineers (India) Uttarakhand State Centre, Dehradun, 29th April, 2017.

6. HONOURS

1. Dr R.D. Dwivedi, Scientist was invited as a committee member for Trade Test and Assessment interview for promotion from Group-I (4) to Group-II (1) on 5 & 6 Dec 2017 respectively.

2. Dr. R. D. Dwivedi, Scientist was invited as Judge for an inter-college body building competition on 31st March, 2018 in Annual college Fest "SANGRAM (29 March-1 April)" at IIT Roorkee. Participations were from IITs, NITs and other universities.

3. Dr R. K. Goel, Mr. Anil Swarup, Dr. R. D. Dwivedi and Dr. Harsh Verma Scientists received ISRMTT best paper award in INDOROCK 2017 in October 2017 at New Delhi.

Glimpses of Photographs of International Workshop on "Implementing 2°C and below 2°C Compatible Climate Change Mitigation Scenarios: Implications for India's Coal Sector" held on 1-2 December, 2017 at CSIR-CIMFR, Dhanbad







Glimpses of Photographs of Jigyasa Programme held on 20th December, 2017 at CSIR-CIMFR, Dhanbad

7. AWARDS

1. CSIR-CIMFR received CSIR Technology award for business development on CSIR Foundation Day on 26th Sept. 2017 at New Delhi.

2. Dr. P. K. Mandal, Sr. Principal Scientist received "Certificate of outstanding contribution of Reviewing" in recognition of the contributions made in the quality of the journal from International Journal of Rock Mechanics and Mining Sciences, Elsevier, February 2018.

3. Dr. Rajendra Singh, Chief Scientist received "Certificate of outstanding contribution of Reviewing" in recognition of the contributions made to the quality of the "International Journal of Rock Mechanics and Mining Sciences", Elsevier, October 2017.

4. Dr R. K. Goel, Mr. Anil Swarup, Dr. R. D. Dwivedi and Dr. Harsh Verma Scientists received ISRMTT best paper award in INDOROCK 2017 in October 2017 at New Delhi.

5. Dr. Santosh Kumar Ray, Principal Scientist received National Geoscience Award 2016 instituted by Ministry of Mines, Government of India under Mining Technology Group.

6. 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.

7. Dr. S.K. Bharati. Scientist is awarded Dr. M.G. Krishna Award for the highest number of copyrights in the year 2017 on CSIR Foundation Day 2017.

8. Dr. S.P. Singh, Sr. Principal Scientist, awarded Prof. B.K. Majumdar award for the maximum number of Ph.D. produced during financial Year 2016-17 at CSIR foundation Day by CSIR-CIMFR Dhanbad.

9. Dr. V. A. Mendhe, Sr. Principal Scientist has received Silver Medal for best paper in Indian Institute of Chemical Engineers, Kolkata

10. Dr. VK Singh, Chief Scientist MEAI-Membership Development Award 2016-17, for enrolling more than 15 life members in the (newly formed Dhanbad) chapter during the year, presented on 7th July 2017 at Udaipur.

11. Dr. VK Singh, Chief Scientist "The IME Journal Lifetime Achievement Award", in recognition of outstanding contributions to the Mining Sector in area of Slope Stability. 22 December 2017, Bilaspur, Chhattisgarh.

8. ATTAINMENT OF QUALIFICATION

1. Ms. Subhashree Mishra (Project Assistant) was awarded Ph.D. degree on 20th March 2018 from IIT (ISM), Dhanbad. The title of thesis was "Gas Reservoir Characteristics of Shale beds in Northern Part of Raniganj Coal Basin, West Bengal, India.

2. Shri Sudipta Datta, Principal Scientist was awarded Ph.D. degree in 2018 from IIT(ISM), Dhanbad. The title of thesis was Gasification studies of high ash Indian coal and biomass.

3. Shri M.K. Saini, Sr. Scientist, has been awarded Ph.D. Degree from BIT Mesra Ranchi on December 2017.

4. Shri A.L.V. Prasad, Sr. Technical Officer was awarded Ph.D degree in 2017 from RTM Nagpur University. The title of the thesis was Geochemistry and petrography of coal seams from Kamptee colliery, Kamptee coalfield, Maharashtra.

5. Smt. Pragya Chayande, Technical Officer was awarded Ph.D degree in 2017 from RTM Nagpur University. The title of the thesis was Preparation of activated carbon from waste carbonaceous materials and its evaluation as an adsorbent for scavenging aqueous pollutants.

6. Mr. A.L.V. Prasad, Sr. Technical Officer was awarded Ph. D. degree in 2017 from RTM Nagpur University. The title of the thesis was "Geochemistry and petrography of coal seams from Kamptee colliery, Kamptee coalfield, Maharashtra.

7. Mrs. Pragya Chayande, Technical Officer was awarded Ph. D. degree in 2017 from RTM Nagpur University. The title of the thesis was "Preparation of activated carbon from waste carbonaceous materials and its evaluation as an adsorbent for scavenging aqueous pollutants"

9. DEPUTATION ABOARD

1. Dr. Ashok K. Singh, Scientist visited Bucharest, Romania to attend the 69 th ICCP meeting and seminar from 03 to 09 September 2017.

2. Dr. K.M.K. Sinha, Scientist visited Shanghai, China for FE-SEM and EDX training, during 11 to 22 September 2017.

3. Dr. Krishna Murari Prasad Singh, Scientist visited Oberkochen, Germany from 23 to 27 October 2017 for Training on FE-SEM and EDS.

4. Dr. K.M.K. Sinha, Scientist visited Oberkochen, Germany for FE-SEM and EDX training, from 23 to 27 October 2017 for Training on FE-SEM and EDS.

5. Dr. Krishna Murari Prasad Singh, Scientist visited Shanghai, China and Oberkochen, Germany for FE-SEM and EDX training, during 11th r to 22nd September'2017 and from 23rd to 27th Octobe'2017 for Training on FE-SEM and EDS.

6. Dr. Rajendra Singh, Mr. Niraj Kumar and Mr. Ashok Kumar, Scientists participated in the 2017 ISRM European Rock Mechanics Symposium (Eurock 2017) from 19-6-17 to 25-6-17 held at Ostrava, The Czech Republic and Mr. Kumar presented a technical paper. Also visited the Institute of Geonics of the CAS, Ostrava and CSM, Karvina mine under the Bilateral Collaborative Research programme. Dr. Singh Chaired a technical session in the Eurock 2017.

7. Dr. R. Ebhin Masto, Scientist deputed to Pacific Northwest National Laboratory, USA from 20 March 2017 to 19 July 2017 for carrying out research work on "Nitride-based slow-release fertilizer from fly ash: surface reactions and nitrogen-use-efficiency studies" under CSIR-Raman Research Fellowship.

8. Mrs. Seema Topno, Principal Scientist, visited USA to attend a conference 30th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems, 2-6 July 2017, San Diego, California, USA and presented a paper.

9. Dr. S.P. Singh, Sr. Principal Scientist & Scientist-in-Charge visited Jakarta, Indonesia to attend the meeting of joint working group on coal between Indonesia and India from 20.04.2017 to 24.04.2017.

10. Dr. Satyendra K Singh, Chief Scientist, visited abroad for presenting paper on "An innovative initiative to design a feasible mining method in the deepest coal mine in India", in International Symposium on Mine Planning & Equipment Selection, at Lulea, Sweden during 29-31 August 2017.

11. Dr. S.P. Singh, Sr. Principal Scientist & Scientist-in-Charge visited Jakarta, Indonesia to attend the meeting of joint working group on coal between Indonesia and India from 20.04.2017 to 24.04.2017.

12. Mrs. Seema Topno, Principal Scientist, visited USA to attend a conference, "30th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems, 2-6 July 2017, San Diego, California, USA and presented a paper.

Glimpses of the Events organised at CSIR-CIMFR, Digwadih Campus

Visit of Indonesian delegation team to Drop Tube Furnace on 04.05.2017. Dr. Ashish Mukherjee, Scientist In Charge explaining about the furnace

Conference organized on River Damodar Bachao Aandolan on 02.06.2017. Sitting on the dais (L toR) Dr. Rajendra Singh, Sri Chandra Shekher Agarwal, Sri Saryu Rai-Chief Guest and Dr. D.K.Singh

Training programme for I S O Auditing on 07.06.2017. On the dais (L to R) Dr. N.K.Srivastava, Shri Amitabh Sengupta-Lead Auditor from TUV, Shri C. Chakraborty-Auditor from TUV and Dr. Ashish Mukherjee

Independence day celebration on 15.08.2017. Dr. P.K.Singh, Director addressing the gathering

Visit of School students to CIMFR-DC on 21.12.2017 under Jigyas Programme. Students are being explained by staff of RQA department about the testing and analysis of coal

Homage paying for freedom fighters on 30.01.2018. Dr. Ashish Mukherjee, Scientist In Charge, CIMFR-Digwadih Campus and Dr. T.Gouricharan red the message to the staff members

On the occasion of New Year's celebration for 2018 Dr. P.K.Singh, Director, CIMFR is interacting with staff members on 02.01.2018

Orientation training programme for new joiners. Shri Rajiv Ranjan explaining about the coke oven in coal carbonization department on 05.01.2018

Republic day celebration on 26.01.2018. Dr. P.K.Siingh, Director hoisted tricolour. Shri Anit Kumar, Security Officer is assisting him

Training on ISO Auditing organized at CIMFR-DC on 22.08.2017. Shri. Amitabh Sengupta, Auditor,TUV, Kolkata delivering a lecture under training programme

Foundation stone lying for stadium in the CIMFR-Digwadih Campus on 11.09.2017

Visit of Dr. Jay Kumar on 11.09.2017 under CSIR Capsule Programme. Shri T.B.Das explaining about the working of Coal to Liquid Plant

Essay writing competition for the wards of CIMFR-DC on 16.09.2017 under CSIR Foundation Day Programme

Drawing competition for the wards of CIMFR-DC on 16.09.2017 under CSIR Foundation Day Programme

Programme Jigyasa for students on 21.12.2017. On the dais Dr. N.K.Srivastava, Dr. T.Gouricharan, Dr. Ashish Mukherjee and Dr. P.Dutta

Glimpses of Photographs during Participation of CSIR-CIMFR in IME-2017 held at Eco Park, Rajarhat, Kolkata from November 15-17, 2017


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(विज्ञान एवं प्रोद्योगिकी मंत्रालय, भारत सरकार, नई दिल्ली के अंतर्गत सीएसआईआर की एक अंगीभूत प्रयोगशाला)

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