वार्षिक प्रतिवेदन **Annual Report** 2018-19







सीएसआईआर - केंद्रीय खनन एवं ईंधन अनुसंधान संस्थान (वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)

CSIR - Central Institute of Mining and Fuel Research (Council of Scientific and Industrial Research) बरवा रोड, धनबाद, झारखंड - 826015, भारत Barwa Road, Dhanbad, Jharkhand- 826015, India





•	Editors	: Dr. Mohammad Shamshad Alam Sri Amar Nath Dr. R.V.K. Singh
	Sub-Editors	: Dr. Rajesh Kumar Sri. A.K. Mukhopadhyay
	Assistance	: Late Sri. S. Mukherjee
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CSIR - CENTRAL INSTITUTE OF MINING AND FUEL RESEARCH

(COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH)

बरवा रोड, धनबाद, झारखंड - 826015, भारत BARWA ROAD, DHANBAD, JHARKHAND- 826015, INDIA

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A. INITIAL

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i. From Director's Desk (Hindi) _____

निदेशक की कलम से

सीएसआईआर-केंद्रीय खनन एवं ईंधन अनुसंधान संस्थान (सीएसआईआर-सीआईएमएफआर), धनबाद के वर्ष 2018-19 का वार्षिक प्रतिवेदन आपके समक्ष प्रस्तुत करते हुए हमें अत्यंत प्रसन्नता हो रही है। इस प्रतिवेदन में वर्ष के दौरान संस्थान द्वारा किए गए अनुसंधान, विकास और विश्लेषणात्मक परीक्षण से संबंधित महत्वपूर्ण कार्यों के साथ-साथ अन्य तकनीकी क्रियाकलापों को संक्षिप्त रूप में सम्मिलित किया गया है। सीएसआईआर-सीआईएमएफआर ने अपने उद्देश्यों को पूरा करते हुए खनन, ईंधन एवं इससे संबद्ध उद्योगों के साथ पारस्परिक संबंध स्थापित किया है।

संस्थान के उल्लेखनीय एवं असाधारण प्रदर्शन को देखते हुए वर्ष 2018-19 को संस्थान के लिये एक महत्वपूर्ण वर्ष के रूप में देखा जा सकता है। इस उत्कृष्ट प्रदर्शन का अनुमान इस बात से लगाया जा सकता है कि सीएसआईआर-सीआईएमएफआर ने



बाह्य वित्त पोषित परियोजनाओं के माध्यम से अधिकतर सार्वजनिक क्षेत्र के उद्यमों के द्वारा बाह्य नकद प्रवाह के रूप में रुपया 530.46 करोड़ अर्जित कर एक सर्वकालिक रिकॉर्ड स्थापित किया है। इस संस्थान ने न केवल अपने लक्ष्य को प्राप्त किया है, बल्कि सीएसआईआर देहरादून घोषणा के अनुसार आत्मनिर्भर बनने की दिशा में भी अग्रसर है। बौद्धिक संपदा के अन्तर्गत संस्थान के 06 पेटेन्ट एवं 3 प्रतिलिप्याधिकार स्वीकृत हुए और साथ ही 10 पेटेंट दायर भी किए गए।

सीएसआईआर-सीआईएमएफआर ने अयस्क तनुकरण हेतु नियंत्रित विस्फोटन तकनीक; नत कोयला संस्तरों/ स्तम्मो के लिए नई निष्कर्षण पद्धति, संख्यात्मक अनुरुपण के माध्यम से बेहतर पूर्वानुमान; पेस्ट फिलिंग प्रौद्योगिकी आदि का प्रयोग करते हुए कोयला और खनिजों का अधिकतम निष्कर्षण और उनका कुशल उपयोग करने के लिए सराहनीय अनुसंधान के क्षेत्र मे विशेष योगदान दिया है। मेट्रो, रेलवे एवं हवाई अड्डों जैसे सामरिक महत्व के क्षेत्रों में नवीनतम विकास हेतु सुरंगों का निर्माण, संरचनाओं के विध्वंस आदि को प्रभावी ढंग से करने के लिए सुझायी गई विभिन्न तकनीकें अत्यंत सहायक सिद्ध हुई हैं। इस संस्थान द्वारा कोयला गुणवत्ता मूल्यांकन, कोयला सज्जीकरण, कार्बनीकरण, दहन, गैसीकरण, द्रवण जैसे विभिन्न कार्यों के माध्यम से एवं सामान्य जन के लिए बिजली के बेहतर उत्पादन हेतु संबद्ध पर्यावरणीय मुद्दों को संबोधित करते हुए कोयला और ऊर्जा क्षेत्रों में महत्वपूर्ण अनुसंधान और विकास संबंधी योगदान दिए गए हैं। वृहत् एवं लघु खनन कार्यों के माध्यम से किए जाने वाले खनिज निष्कर्षण के परिणामस्वरूप पारिस्थितिक असंतुलन की समस्याओं को दर करने के लिए पर्यावरणीय प्रबंधन और पर्यावरणीय प्रभाव आकलन एवं उसके प्रबंधन संबंधी अध्ययन भी किए गए।

सीएसआईआर-सीआईएमएफआर ने विस्फोटकों और सम्बद्ध उपकरणों, खान संवातन और सुरक्षा उपकरणों, कार्मिक सुरक्षा उपकरणों, ज्वाला-सह और आंतरिक रूप से सुरक्षित उपकरणों, विद्युत केबल, खनन और संबद्ध औद्योगिक घटकों, तार रज्जुओं, केज और सस्पेंशन गियर घटकों, हवाई रज्जुमार्ग आदि जैसे क्षेत्रों में परीक्षण, मूल्यांकन और अंशांकन सेवाएँ प्रदान की हैं ताकि खनन उद्योगों में उनका सुरक्षित उपयोग सुनिश्चित किया जा सके।

शोधकर्ताओं के लक्ष्यों, क्रियाशीलता और समर्पण की भावना के साथ-साथ विदेशी भागीदारों सहित देश के खनन, ईंधन और संबद्ध उद्योगों से प्राप्त असीम सहायता और सहयोग के कारण ही वर्ष 2018-19 के दौरान सीएसआईआर-सीआईएमएफआर का उत्कृष्ट प्रदर्शन संभव हो पाया है। यह आशा की जाती है कि संस्थान उपलब्ध विशेषज्ञता, तकनीकी ज्ञान एवं अनुभव के साथ-साथ प्रभावी मानव संसाधन के आधार पर ही संबंधित उद्योगों से प्राप्त संसाधनों का प्रयोग करते हुए मुक्त बाजार नीति के परिपेक्षय में वर्तमान प्रतिस्पर्धा में बने रहने में सक्षम होगा।

संस्थान को खनन, ईंधन और संबद्ध उद्योगों की प्रगति के लिए वैश्विक चुनौतियों का सामना करने हेतु शुभचितंकों एवं हितधारकों से उपयोगी और मूल्यवान सुझावों की अपेक्षा रहेगी।

(प्रदीप कुमार सिंह)





i. From Director's Desk (English) ____

FROM DIRECTOR'S DESK

It is a matter of great pleasure to present the Annual Report of CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad for the year 2018-19. The report contains important activities in abridged form of the research, development and analytical investigation along with other technical activities of the Institute during the year. CSIR-CIMFR has attained its objectives and established the correlation among the mining, fuel and allied industries.

It is gratifying to acknowledge the year 2018-19 as momentous year for the fabulous performance of the Institute. This excellent performance has been established

from the fact that CSIR-CIMFR has achieved an all time record in external cash flow of ₹530.46 crore mostly generated from public sector enterprises as externally funded projects. The Institute has not only achieved its own target but also way forward in line of Dehradun Declaration towards achieving self sustenance. The Institute has filed 10 patents and been granted 6 along with 3 Copyrights as a part of intellectual property.

CSIR-CIMFR has made commendable R&D contributions for extraction of coal and minerals and their efficient utilization by introducing controlled blasting technique for minimizing ore dilution, new extraction methodology for inclined coal pillar, advance prediction using numerical simulation, paste filling technology for maximum recovery of mineral etc. The different techniques for effective management of civil construction for tunnels, metros & railways, airport development, structures demolition etc. are of paramount importance for the recent development in strategic sectors. The Institute has rendered R&D intervention in the field of coal and energy sectors by addressing coal quality assessment, coal beneficiation, carbonization, combustion, gasification, liquefaction and associated environmental issues for efficient generation of electricity for the masses. The environmental management and environmental impact assessment studies were undertaken to overcome the problems of ecological imbalance caused due to mineral extraction from large and small scale mining operations.

CSIR-CIMFR also extended testing, evaluation and calibration services for explosives and accessories, mine ventilation and safety equipment, personnel protection equipment, flameproof and intrinsically safe equipment, electrical cables, mining and allied industrial components, wire ropes, cage and suspension gear components, aerial ropeways, etc., for their safe use in mining industries.

The radical performance of CSIR-CIMFR during 2018-19 has only been possible due to sense of mission, action and dedication of researchers as well as immense help, cooperation and support received from the Mining, Fuel and allied industries of the country including the foreign partners. It is expected that the available expertise, knowhow and experience as well as effective Human Resources of the Institute would be able to withstand the competition and survive in the free market policy by the mobilization of resources from its user industries.

The Institute is looking forward for fruitful suggestions and valuable inputs from the stakeholders to cope-up with the global challenges for the advancement of Mining, Fuel and allied industries.

KSino

(Pradeep K Singh) Director





ii. 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, House No. 11-12-362, Road No 6, Sri Rama Krishna Puram, PO: saroor Nagar, Hyderabad	: Member
3.	Dr. Tridibesh Mukherjee , former Director, Tata steel, No. 6A, Road No. 10, Circuit House Area (East), Jamshedpur – 831001	: Member
4.	Prof. Ashok Kumar Singh , Former Head, Centre for Mining Environment, Department of Environmental Science & Engineering, IIT- ISM, Dhanbad	: Member
5.	Shri A. P. Panda , CMD, South Eastern Coalfields Ltd.P.O SECL, Seepat Road, Bilaspur – 495006	: Member
6.	Shri Prakash Tiwari, Director (Operations), NTPC Ltd., New Delhi	: Member
7.	Shri R. Subramaniam, Director General 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-Indian Institute of Petroleum, Dehradun (DG, CSIR's nominee)	: Member
10.	Dr. Santosh Kapuria , Director, CSIR- Structural Engineering Research Centre, Chennai	: Member
11.	Dr. Sunil Kumar Singh , Director, CSIR – National Institute of Oceanography, Goa	: Member
12.	Dr. Pradeep Kumar Singh , Director, CSIR - Central Institute of Mining and Fuel Research, Dhanbad - 826015	: Member
13.	Dr. Siddharth Singh , Sr. Principal Scientist, CSIR - Central Institute of Mining and Fuel Research, Dhanbad - 826015	: Member Secretary



CSIR - CIMFR •



iii. LIST OF MANAGEMENT COUNCIL

1.	Dr. Pradeep Kumar Singh, Director, CSIR-CIMFR, Dhanbad	: Chairman
2.	Dr. K. Muraleedharan, Director, CSIR-CGCRI, Kolkata	: Member
3.	Dr. Gautam Banerjee, Chief Scientist, CSIR-CIMFR, Dhanbad	: Member
4.	Dr. R. V. K. Singh, Chief Scientist, CSIR-CIMFR, Dhanbad	: Membe r
5.	Dr. R. K. Sinha, Sr. Principal Scientist, CSIR- Headquarters, New Delhi	: Member
6.	Dr. Abhay Kumar Singh, Sr.Principal Scientist, CSIR-CIMFR, Dhanbad	: Member
7.	Dr. M. K. Sethi, Sr. Scientist, CSIR-CIMFR, Dhanbad	: Member
8.	Ms. Pallabi Das, Scientist, CSIR- CIMFR, Dhanbad	: Member
9.	Dr. A. K. Raman, Principal Technical Officer, CSIR-CIMFR, Dhanbad	: Member
10.	Mr. Jai Prakash Indora, CoFA, CSIR-CIMFR, Dhanbad	: Member
11.	Mr. Dasmath Murmu, AO, CSIR- CIMFR, Dhanbad	: Member Secretary

iv. STRENGTH OF STAFF OF CSIR-CIMFR AS ON 31-03-2019

Group/Grade	SC	ST	OBC	General	Grand Total
Director				01	01
Group iv	20	09	24	88	141
Group iii	18	08	28	55	109
Group ii	08	04	01	31	44
Group i	17	09	01	58	85
Administrative	20	17	12	91	140
Total	83	47	66	324	520

v. EXPENDITURE FOR THE YEAR 2018-19

Head	Amount (Rs. in Lakh)
Capital	1821.989
Revenue	8390.944
Staff Quarters	108.467
Total	10321.400



B. MINING AND OTHER ALLIED SECTORS

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B. MINING AND OTHER ALLIED SECTORS

1. BUSINESS DEVELOPMENT AND INDUSTRIAL LIAISON (BDIL) GROUP

1.a. BDIL

- 1. Prof. R. K. Khandal, Former Vice Chancellor, UP Technical University and presently President, R&D and Business Development, Glycals India Ltd., Noida was the Chief Guest of 73rd CSIR-CIMFR Foundation Day on 02.04.2018 at CSIR-Central Institute of Mining and Fuel Research, Dhanbad. Industry meet was also organized on same day and about Seventy five participants were attended from different industries.
- 2. Brain storming session was organized on National Technology day at CSIR-Central Institute of Mining and Fuel Research, Dhanbad on 11.05.2018 to discuss the scope of futuristic R&D work under the mandate of CSIR-CIMFR. It was attended by all Scientists of CSIR-CIMFR, Dhanbad.
- 3. Shri R. K. Singh, Minister of state (Independent), Ministry of Power and Renewable Energy, Govt. of India, Sri Gurdeep Singh, Chairman, NTPC and Sri A. K. Bhalla, Secretary, Ministry of Power visited Resource Quality Assessment laboratory and Coal to Liquid plant at CSIR-CIMFR Digwadih campus on 25.05.2018 and interacted with concerned Scientists.
- 4. Sri Saryu Rai, Minister of Parliamentary Affairs and Food and Supply Department, Government of Jharkhand visited CSIR-Central Institute of Mining and Fuel Research, Dhanbad as Chief Guest on 24th September 2018 for Indian International Science Festival (IISF-2018) at CSIR-CIMFR, Dhanbad. IISF programme was organized during 24th and 25th September at CSIR-CIMFR Barwa road and Digwadih campuses respectively. About 2100 School children visited in both the campuses from different Schools from rural and urban areas.
- Dr. Shailesh Nayak, Director, National Institute of Advanced Studies, Bengaluru and Distinguished Scientist and Former Secretary, Ministry of Earth Sciences, New Delhi visited CSIR-CIMFR, Dhanbad as Chief Guest of 76th CSIR Foundation Day celebration. He delivered foundation Day lecture at CSIR-CIMFR Auditorium on 04.10.2018.
- 6. National Science Day celebrated on 28.02.2019 at CSIR-Central Institute of Mining and Fuel Research, Dhanbad. Prof. K. K. Shukla, Director National Institute of Technology, Jamshedpur delivered lecture as Chief Guest on "Challenges for Scientific and Technological Research & Development in India".

1.b. HUMAN RESOURCE DEVELOPMENT (HRD)

Following are the Activities perfromed by the HRD

Two Executive Development Programmes were conducted by HRD, CSIR-CIMFR, Dhanbad for knowledge dissemination as mentioned below:





SI.No.	Name of Course	Duration	Participating Organisation
1.	A short term course on "Technologies for safety Enhancement in Mines"	3 – 8 December, 2018	Executives from NCL, Tata Steel, CIL. ECL, MCL, NMDC etc.
2.	Executive Development Programme on "FLP Equipment"	21 – 25 Januray, 2019	Executives from ONGC (Kolkata, Mumbai, Delhi, Ahmadabad, Vadodra, etc)

7. IN-House Training arranged.

SI.No.	Name of Course	Duration	Participating Organisation
1.	IPR(Intellectual Property Rights) Training Programme (Dogwadih Campus)	10 – 11 May, 2018	Scientists and Technical Officers from CSIR-CIMFR
2.	Training on "ISO 9001:2015 for Internal Auditors	27 – 18 June, 2018	Scientists and Technical Officers from CSIR-CIMFR
3.	Training on "Laboratory Quality Management System and Inernal Auditing (ISO/IEC/ 17025:2017)	17 – 18 July, 2018	Scientists and Technical Officers from CSIR-CIMFR
4.	Awareness Training Programme on "ISO 9001:2015"	30 – 31 July, 2018	Scientists and Technical Officers from CSIR-CIMFR

- 8. Vocational/Project Trainings for the PG & UG Engineering and Science students were arranged according to their academic session. 129 PG Science/Engineering and 239 UG Science/Engineering a total of 368 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 Sindri, BHU, IIT, NIT, BITS Pilani, Central University, Patna University, etc come to get their project training/internship as their academic requirement.
- Facilitation Provided for CSIR-CIMFR personnel to attend in organised Seminar, Symposium, Workshop: 538 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.
- 10. A National Conference on "Recent Challenges in Mining Industry" was organized on 28th April, 2018 by Mining Engineers Association of India Dhanbad Chapter in association with CSIR-CIMFR, Dhanbad.
- 11. All India Seminar on "Technological Advancement and Engineering Mining Methods (TAEMM-2018)" was organised during 24-25 August, 2018 at CSIR-CIMFR Auditorium, Barwa Road, Dhanbad.
- 12. National Seminar on "Rock Blasting Techniques" was organised during 23-24 November, 2018 at CSIR-CIMFR
- 13. International Conference and Exhibition on "Energy and Environment: Challenges and Opportunities" was organized during 20-22 February, 2019.





- 14. Five Numbers of visit of students from different Colleges/Universities like IIT(ISM), Dhanbad, BHU, BITS Pilani were organized to different labs of CSIR-CIMFR, Dhanbad to get acquainted with the knowhow and enhance their knowledge in engineering science total participants :126.
- 15. Total eleven lectures were organised on Technical Topics from CSIR-CIMFR Personnel and experts from industries.

1. c. INFORMATION TECHNOLOGY & PROJECT MONITORING (IT & PM)

Project cell acts as a bridge between the Project Leaders and the Sponsoring Agencies on one hand and acts as facilitator between Scientists, Director and different wings of administration including accounts.

- Project cell acts as repository of the project documents, progress reports, fund receipt and utilization reports, project completion reports.
- Periodically updating all the information concerning project in such a way that any specific information about a particular project is available readily.
- Coordination of all externally funded projects.
- Help in review meeting to Project Leaders and Project Coordinators of CSIR-CIMFR Plan projects.
- Maintenance of project related database.
- Organizing review meeting of In-house projects.
- Preparation of annual budget related to R&D infrastructure development in consultation with the Scientists.
- Coordination of IT facilities of CSIR-CIMFR.
- To help in the preparation of Research Council and Management Council documents by way of providing necessary input such as number of consultancy / sponsor / collaborative / Grant-in-Aid/ In-house projects that are ongoing, completed and taken-up.
- Organizing project categorization committee meeting.
- Reply to Audit para raised by CAG Audit team if any related to projects in consultation with project Leaders, project Coordinators and Head of the respective sections.

CSIR-CIMFR, Dhanbad received external cash flow of ₹530.46 Crore in the financial year 2018-2019. The break-up of fund received in the financial year 2018-2019 from Government (₹10.97 Crore), Public Sector Units (₹494.17 Crore), Private Sectors Units (₹25.25 Crore) and Foreign Exchange Units (₹0.07 Crore) is depicted in Fig.1.



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Fig. 1: Break-up of fund received in the financial year 2018-2019 from Government, Public Sector Unit, Private Sector Unit & Foreign Exchange

1. d. KNOWLEDGE RESOURCE CENTRE, (KRC) BARWA ROAD

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 through current Awareness service (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	:	34038
CD Collection	:	984
Current Journals subscription	:	67





1. e. SCIENCE COMMUNICATION AND PUBLICATION DEPARTMENT (SCPD)

- i. 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 published in the form of CSIR CIMFR Annual Report 2017-18.
- **ii. R&D Roadmap and Highlights:** A booklet on R&D Activities and Highlights covering important research activities and significant achievements of the institute including R&D Roadmap was published during the year.
- **iii. CSIR-CIMFR Leaflet:** Leaflet containing CSIR-CIMFR Vision, Mission, Quality Policy and Major Areas of Activities was compiled and published.
- **iv. CSIR Annual Report:** An abridged report on important R&D work and other technical services of CSIR CIMFR for the year 2017-18 was compiled, edited and sent for inclusion in CSIR Annual Report.
- v. Display Advertisement: Seven numbers of display advertisements were prepared and released to various 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.
- **vi. Distribution of Publications:** Different reports brought out during the year by the laboratory were distributed to various mining and other technical institutions, educational organizations and different R&D laboratories in India and abroad on exchange and complimentary basis.
- vii. 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.
- **viii. CSIR-CIMFR Project and Work Record Book:** Matter related to CSIR-CIMFR Project and Work Record Book for the year 2019 was collected from various departments / Section, printed and distributed amongst all the scientists, officers and other staff members of the institute.

1.f. STANDARDS, TECHNOLOGY MANAGEMENT & INTERNATIONAL S&T AFFAIRS

(A) ISO 9001:2015 Certification Program:

- i. DNV, Kolkata successfully completed its 5th Surveillance audit as per ISO 9001:2008 on 26th April' 2018.
- ii. The first unified certification as per ISO 9001:2015 version of CSIR-CIMFR Barwa Road Campus, Digwadih campus, Ranchi, Nagpur and Bilaspur units were successfully completed by TUV Nord Germany/ India on 16th Nov' 2018. This Quality Management System Certification is valid upto 29/12/2021.
- iii. One round of Internal Audit completed at CSIR-CIMFR during this period.
- iv. Management Review Meeting conducted at Director Level.
- v. Two days Internal Auditor Training Program as per ISO 9001:2015 & ISO 19011:2011 standards held on 27–28 June' 2018 at CIMFR, Dhanbad.





- vi. Two days Awareness Training Program on ISO 9001:2015 for HoS/ HoRG/ Auditee held on 30- 31st July' 2018 at CSIR-CIMFR, Dhanbad.
- vii. Four days training program on Laboratory Quality Management Systems & Internal Audit as per IS/ ISO 17025:2017 held during 05-08 March'2019.

(B) International S&T Affairs work:

i. Twenty two scientists sent on deputation abroad for attending seminar, symposia, conference, bilateral exchange program, business development & fellowship

(C) External Cash flow generated:

i. Premia & Royalty received : ₹11,17,488=00 (Rupees Eleven Lakhs Seventeen Thousand Four Hundred and Eighty Eight Only).

(D) New Agreement/ MoU signed:

Sl.No.	Title of the Agreement	Party Name and Address	Date
1.	Memorandum of Understanding bet' CSIR-CIMFR and Rail Vikas Nigam Limited, New Delhi	Rail Vikas Nigam Limited, New Delhi	11/04/2018
2.	Memorandum of Understanding bet' CSIR-CIMFR and Binod Bihari Mahto Koylanchal University, Dhanbad	Binod Bihari Mahto Koylanchal University, Dhanbad	31/05/2018
3.	Agreement for Licensing of A Method for Solid Blasting in Underground Coal Mines "Pentadyne HP"	M/s. IDL Explosives Ltd, Kukatpally, Santhnagar (IE), P.O: Hyderabad – 500018	24/08/2018
4.	Agreement for sponsored research on Empirical validation of the use of granular aluminum to make high-energy ANFO type blasting agents	Smartchem Technologies Limited (STL), Sai Hira, Survey No: 93, Mundhwa, Pune	12/10/2018
5.	Agreement for sponsored research on Empirical validation of the use of recycled lubricant oils to make high energy ANFO type blasting agents	Smartchem Technologies Limited (STL), Sai Hira, Survey No: 93, Mundhwa, Pune	12/10/2018
6.	Agreement for Consultancy project on Total Cost of Ownership (TCO) of Blasting with ANFO vs Emulsions	Smartchem Technologies Limited (STL), Pune	12/10/2018
7.	Agreement for consultancy project on Post-Blast Fumes Assessment using ANFO at Kayad mines of Hindustan Zinc Limited	Smartchem Technologies Limited (STL), Pune	12/10/2018
8.	Implementation of blasting & explosives techniques in the hilly terrain and border / Himalayan region of India	Border Roads Organization, Ministry of Defence, Seema Sadak Bhawan, Ring Road, Delhi Cant, New Delhi	16/11/2018





Sl.No.	Title of the Agreement	Party Name and Address	Date
9.	Security & Sensitivity clearance of a project titled "Scientific Investigation on Resuming Exploratory Drift Work of Nyera Amari II Powerhouse at Martshala Sampdrup, Jongkhar, Bhutan	Druk Green Power Corporation Limited (DGPC), a government company, Thimphu, Bhutan	19/11/2018
10.	MoU for designing of mining activity & blasting pattern in quarry sites	Irrigation Department, Govt. of Uttarakand, Dehradun	15/12/2018

1.g. 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 testing laboratories of CSIR-CIMFR Barwa Road Campus, Dhanbad for 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 9001:2015 for satisfying customers need in getting systematic and quality oriented services in respect to the testing and certification of equipment/component/ materials.

Testing and evaluation reports in Total 422 (four hundred & twenty two) numbers only of various samples including equipment/components were issued by the cell during the year 2018 to 2019 and an amount of revenue Rs. 1, 54, 69,058.00 (Rupees one crore fifty four lakh sixty nine thousand fifty eight) only which included Foreign Currency - US\$7647(seven thousand six hundred and forty seven)={(Rs.5,29,582.00) rupees five lakh twenty nine thousand five hundred and eighty two} only were generated through the same.

2. ELECTRICAL DESIGN SECTION

Electrical Design Section has undertaken various assignments on in-situ study and advice on the condition of steel aerial ropes (track and haulage) and 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 Uranium Corporation of India Limited (UCIL), Singhbhum (East), Jharkhand, (4) M/s The Singareni Collieries Company Limited, Kothagudem Collieries – 507101, Dist. Khammam, Telengana, (5) M/s Conveyor & Ropeways Services Pvt. Ltd., Kolkata, (6) M/s Kumaon Mandal Vikas Nigam Ltd., Nainital, Uttarakhand (7) Mahanadi Coalfields Limited, Odisha, (8) Jakhu Ropeway at Shimla, HP and (9) Nicco Parks and Resorts Ltd., Kolkata etc.

Following in situ studies were carried out in different ropeways/winder installations:

- 1. In situ nondestructive evaluation and advice on the present condition of winding ropes of Talcher Colliery, Mahanadi Coalfields Limited, Odisha,
- 2. Evaluation and advice on the present condition of haulage rope of detachable grip monocable passenger ropeway at Trikutpahar, Deoghar, Jharkhand,





- 3. In situ nondestructive evaluation of winding ropes running at Narwapahar Mines of UCIL 04 (four) visits in 02 (two) years,
- 4. In situ nondestructive evaluation and advice on the present condition of track and haulage ropes at Nainital Ropeway, Uttarakhand,
- 5. Evaluation and advice on the present condition of haulage rope of Naina Deviji Monocable aerial ropeway at Shri Naina Deviji, Himachal Pradesh,
- 6. Evaluation and advice on the present condition of haulage rope of Jakhu Ropeway at Shimla, HP,
- 7. In-situ investigation and advice on the present condition of four nos of track ropes and two nos of haulage ropes of passenger cable car aerial ropeway installation of M/s Timber Trail, Asia Resorts Limited, Parwanoo (HP) two visits,
- 8. In situ evaluation and advice on the present condition of haulage rope of Pushkar site of M/s Damodar Ropeways & Infra Ltd, Rajasthan,
- 9. In situ evaluation and advice on the present condition of haulage rope of detachable grip monocable passenger ropeway at Maihar, M.P.,
- 10. Evaluation and advice on the present condition of rope of Cable Car and ropes in Flying Eagle installed in Dreamland Amusement Park , Siliguri, West Bengal,
- 11. In situ non-destructive evaluation and advice on the present condition of two haulage ropes of bicable aerial ropeway passenger cable car installations at Namchi, Gangtok, Sikkim,
- 12. In situ non-destructive evaluation and advice on the present condition of track and haulage ropes of bi-cable aerial ropeway passenger cable car installation at Gangtok, Sikkim,
- 13. Assessment and advice on the present condition of haulage rope at Nicco Parks and Resorts Limited at Salt Lake, Kolkata, West Bengal,
- 14. Assessment and advice on the present condition of haulage rope of monocable passenger ropeway at Science City, Kolkata, WB,
- 15. In situ nondestructive study of 11 chair car systems and 34 man riding chair lift systems of SCCL,
- 16. Evaluation and advice on the present condition of winder ropes of Turamdih mines of M/s Uranium Corporation of India Limited at Turamdih, Jharkhand,
- 17. In situ investigation and advice on the present condition of haulage rope of DRV passenger ropeway at Darjeeling, West Bengal Two visits.

Besides above, calibration work of 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 2018-19.





Some photographs of in-situ study of winder ropes and aerial ropes.







3.a. METALLURGY - (MACHINE HEALTH MONITORING GROUP)

During April 2018 to March 2019, the Metallurgy Section of CSIR-CIMFR has undertaken various R&D assignments related to safety in mining as well as other industries which are given below:

 During this period, the section conducted scale down flooding tests of Aerosol Generator for Class-A fire load to demonstrate fire extinguishing capability. Appropriate numbers of Aerosol generator of Firepro make FP 5700, FP 500 & FP 100 has been used for this purpose.



Generation of Class A fire load

 Advice and study on winding ropes of different sizes used for hoisting at Surda Mines has been carried out during this period 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.









most of the wire

Fine pearlite in the transverse section of Cold drawn structure with formation of martensite and stress corrosion

- 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 were 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.
- Studies and investigation of physico- mechanical & chemical properties for proto type steel cog (50T) and props (30 T) upto 3m height. 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 has been examined under the acidic water condition and found that it can sustain accelerated weathering condition.

3.b. MATERIAL TESTING LABORATORY AND WORKSHOP SECTION

Material testing laboratory and workshop section has carried out several R & D activities during April 2018 to March 2019, related to safety of mining and allied industries. Details of the activities are given below:

Non-destructive examinations of vital components of Man Winding System and Man Riding System of Chasnalla Colliery, SAIL (work order no. DGM/CC/W.O/18-19/58 dated 06/06/18) for assessment of their quality for further use in the installation. Vital components of Man Winding systems like friction wedge rope cappels, D Plate, Safety Hook, fork links, swivels, pin, 'D' shackles, etc. and vital components of Man Riding System like Anchor hook, Chase Block, White Metal Rope Cappel, Wheel Shaft etc. were undertaken for the test. For surface and subsurface imperfections, Magnetic particle crack detection (MPCD) was conducted, whereas, Ultrasonic flaw detection (UFD) for assessment of internal flaws. Conditions of most of the vital components of Man Riding system were found satisfactory except chase block of Man Riding Car. It is revealed the presence of internal flaw / imperfection of harmful character in the chase block.





Conditions of most of the vital components of Cage Suspension Gear system of Up-cast Man Winding system were found satisfactory except bands of FWRC of North side, Bottom Shackle and Cage Shackle of South side. It is revealed the presence of internal flaw of imperfection of harmful character in band of FWRC and surface imperfection of harmful character in Bottom Shackle and Cage Shackle. Condition of most of the vital components of Cage Suspension Gear System of Down-Cast Man Winding System found satisfactory. On the basis of this study it is recommended that Man Riding System of Upper Seam, Inclined – 5 Mines and Man Winding Systems of Upper Cast and Down Cast may safely be used in the installation for next schedule date of examination after getting permission from competent authority.



Man Winding system at Chasnalla

Non-destructive examinations of vital components of Winder and C.S Gear of Pit No – 2 (M) & (K) at Gopalichak Colliery, PB Area BCCL was done for assessment of their quality for further use in the installation. Vital components of Winder and C. S Gear like friction wedge rope cappels, D Plate, Safety Hook, , 'D' shackles, Tie Rods, Triangular Plar etc., were undertaken for the test. For surface and subsurface imperfections, Magnetic particle crack detection (MPCD) was conducted, whereas, Ultrasonic flaw detection (UFD) for assessment of internal flaws.

Conditions of most of the vital components of Winder and C.S Gear of Pit – (K) were found satisfactory except Tie Rods and Connecting Rods. It is revealed the presence surface imperfection of harmful character in the chase block.

Conditions of most of the vital components of Winder and C.S Gear of Pit No – 2 (M) were found satisfactory except pins of bottom shackle and pin pin of cage shackle.

On the basis of this study it is recommended that winder and C.S gear components of Pit No – 2 (M) & (K) at Gopalichak Colliery may safely be used in the installation for next schedule date of examination after getting permission from competent authority



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Components of Winder at P. B. Area

Beside that this section has been carried out testing and evaluation of wire ropes – 29nos, Safety Hooks-01 no., C. S. Gear – 09 nos.Distribution Plate - 1 no., Rope Cappel (FWRC) –02 nos., Bridle Chain – 23 nos., Lashing Chain – 30 nos., Cage shackle with pin –08 nos., Pin- 32 nos., Chase Block – 03 nos., C type coupling – 73 nos., Drawbar – 05nos; Haulage rope Cappel with pin – 1 no., Mine Car coupling – 42 nos., Band – 04 nos., Inner Plate – 02 nos., Link Plate – 03 nos., D Shackle –10 nos. The tested items were



reported and reports have been sent to the concerned customers through proper channel.

CSG & allied samples for its quality evaluation:

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

3.c. ROOF SUPPORT TESTING LABORATOTRY

The Roof Support Testing Laboratory has undertaken various assignments on design and development of mining equipments and roof supports for mining, 'Make in India' and 'Bharat Swachh Abhiyan'.

Project (Research and Development)

A coal S&T project sanctioned by Ministry of Coal, Govt. of India titled" Design & development of Truck Mounted Mobile Coal Sampler for instant coal ash & moisture analyser at site from railway wagon/ truck" in two phases has been completed successfully.

The objective for the phase one of the project has been successfully completed and proved the feasibility of the nuclear technique method with Dual-gamma-ray Transmission for analysis of coal ash and moisture content. It has resulted into a fruitful outcome and the technology has given satisfactory output values of coal ash and moisture content within the permissible range.







The second phase i.e to Design & development of integrated Truck Mounted Mobile Coal Sampler for instant coal ash & moisture analysis has been also successfully completed. The objective of developing the coal sampler which can find unbiased random samples from the truck/ wagon on the site has been fulfilled as depicted in figure.1

A full scale Truck Mounted Mobile Coal Sampler for Instant Coal Ash & Moisture Analyser at Site from Railway Wagon / Truck was designed, developed and fabricated under 'Make in India' programme. This equipment was incorporated with all other equipments, installed and given successful coal analysis results with closer estimates / good agreement during field trial at various mines of SCCL as shown in figure.2 & 3.



Figure.1 (Truck Mounted Mobile Coal Sampler for instant coal ash & moisture analyser at site from railway wagon/ truck)



Figure.2 (Sampler test showing the closer estimates of ash % with M/s SCCL test)



Figure.3 (Sampler test showing the good agreement of moisture % with M/s SCCL test)





Roof Support Testing Laboratory has been sanctioned an In-house project under 'Dehradun Declaration' (Bharat Swatchh Mission) a flagship programme of Prime Minister of India titled **"Design & Development of Wheel controlled Sewage Discharge System in Trains"**. This project has been sanctioned with a view to make the railway track / platform as well as total environment more hygienic and healthy in Indian Railways. Procurement and fabrication of the prototype working model is in process. The patent has been filed for this novel design.

Another project titled' **Studies and investigations of physic- mechanical & chemical properties for prototype steel cog (50T) and props (30T) upto 3mtr.Height"** was sponsored by M/s. Eastman Export (P) Ltd., Ludhiana (Punjab) has been completed and final report was sent to the party. In this project physico-mechanical properties such as axial load test, eccentric load test and overload test were determined and advised accordingly. The samples were also assessed in view of design compatibility. Metallurgy division of the CIMFR has also collaborated with this project to assess the various chemical constituents in the samples.

4.a. GEO-MECHANICS SECTION

Geomechanics Section has undertaken various assignments on rock mass characterization of roof rocks, design of support system for mine openings, geotechnical instrumentation & monitoring and other ground control problems. 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., Steel Authority of India Limited, South Eastern Coalfields Limited, Bilaspur, Gainwell Commosale Pvt. Ltd., Kolkata, Ambuja Cement Ltd., Raipur etc.

At Adriyala Longwall 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 roofis 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 Kondapuram mine, 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 may create problem during extraction. The final report has been submitted.

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 recommends roof bolt based support system for 4.5m x 3.5m decline, 6.0m x 3.5m decline junction, 4.0m x 3.0m crosscut, 3.0m x 3.0m ore drive/trough drive, 6.0m x 3.0m haulage junction, 4.0m x 3.0m footwall drive. The designed factor of safety is more than 2.0, which postulates that the structure is long term stable.

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 submitted accordingly. This study would help to mine management in formulation of SSR.

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 these circumstances the monitoring data is very helpful in the evaluation of support system, which is continuing.





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.

At Jamuna UGRO Sub Area, SECL, the evaluation of RMR and support design along with suitable method of work in LK II Seam of Jamuna1/2 incline and MK seam of Jamuna 5/6 inclines was assigned. Both the empirical and numerical simulation approach has been used to design of support system and method of coal pillar extraction. The interim report has been submitted and the final report is in progress.

At Gare Palma IV/8 mine, Ambuja Cement Limited (ACL), Raigarh based on available borehole cores seam wise RMR has been determined. After exposure of different coal seam the reassessment of the determined RMR would be done. The interim report has been submitted and progress of mine development is being checked regularly.

At Bicharpur underground mine, Shahdol, M.P., two inclines of dimension 5.5m x 3.5m and gradient 1 in 5 are to be constructed up to a total length of around 1150m until it crosses the coal seams namely IV, III & IIA. The 3-way junction at an interval of 150-200m is for the connection of two inclines. The excavation machine is two Road headers and the synchronized support system has been formulated. The different roof support elements like rockbolt, wire-mesh, goalpost, RCC slabs etc. has been advised with complete specifications. Also, the design of manholes, different fittings like J-hook, handrail, drain etc. has been provided. The interim report has been submitted and final report is in progress.



Study of Roof Fall at Siyal Ghogri coal mine, Reliance Cement Company Ltd., (M.P.)







Study of Floor Heaving at Siyal Ghogri coal mine, Reliance Cement Company Ltd., (M.P.)

4.b. MINE BACK FILLING DIVISION

The Mine Backfilling Division has undertaken various assignments on mine backfilling for both underground and opencast mines, fly ash utilization, design of underground dams and identification & stability of old unapproachable workings below important structures.

During this period, this division has taken up industry sponsored projects from Gare Pelma IV/5 and IV/4 underground coal mines of Hindalco Industries Limited, Sindesar Khurd mines of Hindustan Zinc Limited, Rampura Agucha mines of Hindustan Zinc Limited, Mochia & Balaria mines of Hindustan Zinc Limited, Rajpura-Dariba mines of Hindustan Zinc Limited, Mahagiri mines of Indian Metals & Ferro Alloys Limited, Jindal Steel & Power Limited, Korba Super Thermal Power Station of NTPC Ltd., Ramgundam Super Thermal Power Station of NTPC Ltd., Surakachar underground coal mine of South Eastern Coalfields Limited, Orient Colliery of Mahanadi Coalfields Limited, Odisha Power Generation Company Limited, GDK 10 Incline of Singareni Collieries Company Limited, Balaghat underground mine of Manganese Ore India Limited, Adani Power Limited, Bhelatand Colliery of Tata Steel, Monoharbahal Colliery of Eastern Coalfields Limited, LANCO Amarkantak Power Limited, Adriyla Longwall Projects of Singareni Collieries Company Limited, Collieries Company Limited etc.

This division has developed the technology of paste filling using mill tailings and the technology has been successfully implemented at various underground metal mines for backfilling purpose. The technology developed for utilization of bottom ash in underground coal mines has been successfully implemented at various underground coal mines of SCCL and SECL. The technology for utilization of fly ash in admixture with overburden has been successfully implemented at Gare Pelma IV/1 opencast mine using ash from Dongamahua Captive Power Plant of JSPL. The identification of voids and its stability due to unapproachable old workings were carried out for 10 MMTA coal washery of Adani Power Limited at Korba region. Studies were conducted for identification of voids and its stability analysis below railway track of Andal - Sitrampur railway line at Salanpur area, ECL. Also stabilization guidelines were provided at unapproachable voids at Orient Colliery, MCL. Design of stowing plant and improvement of stowing efficiency was carried for Balaghat metal mine of MOIL and Bhelatand Colliery of Tata Steel. Studies were conducted for use of crushed overburden for filling the voids in underground coal mines. The technology has been successfully implemented at different underground





coal mines of HIL. Design guidelines were provided for backfilling of different primary stope blocks at Mahagiri mines, IMFA. Technology for dry rock fill of secondary stopes in underground metal mines has been developed for implementation at RD mines of HZL. The technology for partial replacement of cement with fly ash for cemented fill for backfilling of stopes in metal mines has been developed and successfully implemented at various metal mines. The design of underground dams for adverse ground condition has been provided for construction at GDL 10 Incline, SCCL.



Fracture identification inside coal pillar for underground DAM construction, GDK 10 Incline, SCCL



Numerical modelling: Safety analysis of railway line above pre-existing underground workings.



Paste backfill experimentations



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4.c. NON-CONVENTIONAL GASES

The section is involved in R&D works on safety in underground mines from methane emission, evaluation of coalbed methane/shale gas resource potential in virgin coal blocks and working underground mines, CO₂ sequestration in geological formation and CBM wells, estimation of methane emission from coal mining and handling activities and oil and natural gas systems and underground coal gasification.

Investigation was carried out to determine rate of methane emission from B.P. seam, Lakhimata Colliery, Mugma area, ECL and III (Top) seam of ³/₄ Incline Chandmari Section, Bastacola Colliery, BCCL for the categorization of degree of gassiness of coal seams.

In-situ gas content of coal seam and enclosing strata of XI seam was determined to predict specific emission from the XI Seam, Jamadoba Colliery, Jharia Division, Tata Steel Ltd. for ventilation purposes. The *in situ* gas content varies from 0.67 to 2.16 m³/t for the coal samples collected from in-seam borehole in XI seam, 0.02 to 0.09 m³/t for the roof rocks and 0.02 to 0.13 m³/t for the floor rock samples. The predicted values of specific gas emission at the XI Seam, Jamadoba Colliery was estimated as 5.69 m³/t on the basis of data obtained from surface borehole No. TJS/257/A/1 for 550 TPD production and 4.56 m³/t for the set of boreholes drilled from underground workings.

A maximum of 0.76 m³/t as in-situ gas content at a depth of 48m of IX coal seams was determined in borehole No. MCBL#02 drilled at Nimcha coal block, ECL. Specific gas emission for R-IX(T) and R-IX Bottom seams was estimated as 0.32m³/t and 0.41m³/t respectively.

On the request letter of the Head, Druk Green Power Corporation (DGPC), Bhutan, a team of three scientists of CSIR-CIMFR, Dhanbad visited exploratory drift work at Martshala, Bhutan to resume the exploratory drift work wherein five causalities were occurred on 15th June, 2018 due to methane explosion. The team visited the site with the engineers of DGPC, Bhutan and held a series of discussions with project team members. Accordingly, a record note of minute of the meeting was prepared to finalize scope of work for CSIR-CIMFR, Dhanbad.



Fig. 1: CISR-CIMFR Scientists with executives of DGPC, Bhutan at the portal of Exploratory Drift, Martshala, Jongkhar, Bhutan.



A detailed investigation was carried out by scientists of CSIR-CIMFR, Dhanbad for the re-establishment of the ventilation system and resuming the exploratory drift work. The concentration of methane was detected within explosive range beyond at RD350m. A standard operating procedure (SOP) has been submitted for re-establishing ventilation system in the exploratory drift to keep the methane concentration within statutory limits. Coal/rock core and gas samples was collected for laboratory study to identify the source of methane emission. The work is in progress.

The measurement of 3D/2D seismic study has been completed at Radhanagar, Jharia coalfield by CSIR-NGRI for identification of subsurface lithology, type of formation and occurrence of thick shale beds. The drilling point has been selected at Rangamati for shale reservoir characterization study. Megascopic properties like colour, hardness, fracture, specific gravity, homogeneity, banding etc., have been done for 50 shale core samples. Surface area, pore size and pore volume were measured of 65 shale core samples to evaluate pore characteristics and pore structures. Detailed mineralogical and Petrographicalmaceral studies of 80 shale core samples, FTIR and XRD analysis of 40 shale core samples, Rock-Eval pyrolysis of 60 shale core samples, SEM-EDAX analysis of 50 samples are completed. These data are required to characterize shale gas reservoir in Damodar river basin of India.

A total of 30 shale/coal samples were analyzed for high pressure methane adsorption isotherms supplied by GSI, Kolkata on different dates from two boreholes drilled in Jharia namely JMSG-1 and JMSG-2 to assess shale gas potential in Jharia Coalfield.

Coal/rock Samples were provided by M/s Mining Associate Private Limited from Sohagpur East & West blocks, Shahdol, Madhya Pradesh to estimate the elasticity, stress and strain of the core samples. Petrographic and adsorption isotherm analyses are also to be conducted to determine the thermal maturity and methane storage potentiality of the coal seam.

During mining operation and handling system coal gases emit in the atmosphere. The main objective of this research project to develop emission coefficient of carbon dioxide which is required for the quantification of carbon dioxide emission in the atmosphere as result of mining operation and handling system. A fiber glass chamber has been developed to measure the carbon dioxide emission flux from coal benches of surface mine. The work is in progress.

The study on methane emission has been conducted nearly 40 open/underground coal mines in different coalfields of the country. The methane emission coefficient was developed for surface and underground coal mines and is used to quantify the methane emission in the atmosphere. Interim report has been submitted to the Ministry of Environment, Forest and Climate Change (MoEFCC) for the Biennial Update Report I.

The specification and designed/drawing of sorption induced setup with high-pressure vessel have been completed to develop a set up for the measurement of micro strain/deformation as a result of CO_2 and other gases sorption. Physical and chemical properties, total organic carbon (TOC), XEM, FTIR and XRD of 45 coal core samples of different coalfields have been determined to study the change in strain/ deformation as the result of CO_2 sorption by the samples. The project is awarded under 4M Programme of CSIR, New Delhi. The work is in progress.

Detailed geological assessment was carried out on the basis of available data. Barrier panel width was estimated through empirical methods using the geo-mechanical properties of coal/rock. Panel size is suggested have better ground control for UCG operation. Core samples were collected from the borehole drilled at Kalimela area for further study. The work is sponsored by M/s Ergo Exergy Technology Inc., Canada.





4.d. ROCK MECHANICS LABORATORY

Rock Mechanics Laboratory, under the research group of Mechanics of Solid has undertaken various assignments on Physico-Mechanical properties investigation for different rocks from different Coal field, Mineralized zones and different exploratory basins.

During this period, our team offered recommendations for Physico-Mechanical properties of Rock/ coal cores on the basis of various geotechnical investigation and statistical assessment. The esteemed organizations were M/s Cuprum Bagrodia Ltd., various Regional Institutes of CMPDI, Subansiri Lower HE Project of National Hydroelectric Power Corporation, M/s Ambuja Cements Limited, Gujrat, M/s Tata Steel Ltd., M/s MECL and M/s Adani Enterprise Ltd., Eastern Coal field ltd. (Nimcha Colliery), etc.

The department has been able to place an order for state of the art MTS 815.02 Stiff Testing machine for static cum dynamic testing of rock. The machine will significantly increase the capability of department in conducting various high-end researches on rocks pertaining to Dynamic and Fatigue testing, Direct tensile testing, Fracture toughness test, High temperature test etc. The machine is expected to be installed and commissioned in Autumn, 2019.

The department has guided eight master's dissertations in the field of geology and applied geoinformatics from Central university of Karnataka and Vinoba Bhave University, Hazaribagh. In addition to it the department guided nine students from IIT BHU, Central University of Karnataka and BIT Sindri for their undergraduate and postgraduate internships of one or more month.

The various project undertaken by Rock Mechanics Laboratory during this period are presented here under. The objective of all this project were to determine the statistically significant value of Physico-Mechanical Properties of various rock formations encountered at various depth of different coal field / hydropower projects. This data are very useful in reliable analysis and design of mining and civil engineering projects

- Scientific study for Geotechnical property of rock at Nimcha Colliery, Eastern Coal Field Ltd., and advice thereof.
- Assessment of physico-mechanical properties of BH # BBD/MM/014 (P-12) of BarulBagdiha Block, Raniganj Coal Field.
- Assessment of physico -mechanical properties of BH # MARJA 45 (P-76) of Rajbar-A, Auranga Coal Field.
- Assessment of Physico-mechanical properties of BH # MGS-61 (NP-23) of Gourandih South Block (CIL Block), Raniganj Coalfield,
- Assessment of Physico-Mechanical Properties of Rock Core Samples of Total CBM Solution.
- Geotechnical property assessment of limestone rock core samples from singsar mine area, Gujarat.
- Scientific study of Geo-technical investigation on rock core samples to be used in mine design for coal exploration of NMET Nan-Birra Block, MECL.
- Advice on borehole geotechnical data for mine design and coal exploration of Tata Steel Ltd., Jamadoba, Jharia Coalfield.
- Assessment of physico-Mechanical properties of BH# TBU 254, Tata steel ltd., Jamadoba and Jharia Coal Field.




- Assessment of Sonic Velocity and slake durability index properties of rock core samples from BH# MMGM 08, 09 and 12 of Gere-Pelma sector of Mand Raigarh Coal Field, Chattis Garh.
- Advice for geo-technical studies of rocks for depillaring of proposed B12, B13 and B14 panels in R-VI seam at Khottadih Colliery, Pandaveswar Area, Eastern Coal Field
- Scientific study of Geo-technical investigation for mine design for coal exploration of Barul-bagdiha block, Raniganj Coalfield

5.a. MINE FIRE

The Mine Fire section of CSIR-CIMFR undertaken assignments related to determination of the state and extent of the fire, its rate of progress, control and Prevention of fire, determination of incubation period, suitable methodology for combating fire and safe extraction of coal pillar by open cast method and ascertaining suitability for reopening of sealed off fire area.

A study on determining the state and extent of the fire, its rate of progress at Sarubera (E) colliery, Kuju Area of Central Coalfields Limited was taken up during the period. Extensive field study was taken up which included thermography of the entire area in a grid/node pattern using infrared camera at every three month interval. To assess the rate of progress of open fire, nearest underground panel proposed to be extracted were selected and studied. Surface cover of proposed panel was about 60-70 m. During physical observation of the surface cover no cracks or subsidence observed and thermal mapping of overhead surface shows ambient temperature. 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 was also found at ambient. Hence fire is extensive in localized area.

Another important study undertaken was control and prevention of fire in Gare Palama, IV/ 2 & 3 opencast mine of Raigarh Area of SECL. 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 fire fighting operation carried out in presence of mine authorities). As preventive measures, it was advised to monitor overburden dump and coal benches fortnightly using Infra-red thermometer and Thermovision camera to detect any symptoms of heating in an early stage. Temperature below 50°C may be considered safe while its higher values attract 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.

Scientific study of coal seams 16, 16A & 16 B of Upper mine and coal seams 12, 13/14 seam of Deep mine Chasnalla colliery (SAIL-ISP) and thereof advising the incubation period was also taken up. 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. 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.

Moreover, our consultancy services extended to 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





study required thermal mapping of entire fire affected area, through high performance thermo vision camera. 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 80°C to 280°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 MgCl2, CaCl2, DAP, Lime etc. of different compositions and concentrations were used. Chemicals were mixed in water and sprayed through high pressure jetting. The fire has been brought under control and work is under progress.

Another study on Advice for 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. The study involved assessment of heating liability of coal and site specific extraneous conditions - to identify and prioritize the mitigation options. The thermal monitoring of exposed coal faces, surroundings and loose coal at the floor of coal bench suggested that almost all exposed galleries at Shankarpur OCP were engulfed in active fires; temperature ranges from 120°C - 1000°C and above mainly caused by spontaneous heating of coal and carbonaceous material. To deal with fire in exposed galleries, fires of higher intensity (>500°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 in the range of 70-90°C immediately. Similarly, fires of lower intensity (100-500°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, fire fighting team has been trained and work has been completed.

Study for ascertaining the environmental conditions / possibilities of fire in large old isolated area standing on pillars which was intended for reopening was undertaken at Churi Colliery, N.K. Area, CCL. This study was aimed to meet the two main objectives- ascertaining the environmental condition of isolated area on the basis of thermo-compositional study and advise for reopening of old isolated area based on study report. To meet the above objectives, we have carried out (a) assessment of thermo-compositional condition of old isolated area (b) monomeric study of different stoppings of isolated area and (c) collection of other relevant geo-mining parameters. The study is under progress.

Another Study for advising the safe and cost effective methodology to deal with fire at Sarisatolli coal mine, ICML, CESC Ltd., was undertaken. The study involved thermal mapping of the study area to identify the status and extent of the fire in different locations. On the basis of temperature monitoring, the suitable chemical additives were applied on the fire at different locations to cool down for safe mining operations. The efficacies of chemical additives are evaluated before and after chemical application. The hot mass strata cool down sharply from 800°-500°C to 80-50°C using cost-effective chemicals through a suitable methodology suggested for its dealing. The location map and fire dealing arrangement are shown below.







5.b. MINERS' HEALTH AND SAFETY

The Miners' Health and Safety section of CSIR-CIMFR, Dhanbad has undertaken a number of R&D and service assignments with a view to create healthier workplace environment and improve occupational safety for the miners. These include air borne respirable dust study, free silica determination in air borne respirable dust collected on filter paper, performance evaluation of self-rescuers and breathing apparatus, calibration of various instruments used in mines, and testing & certification of PPEs. During this period, our services reached out to different organizations and companies viz., Northern Coalfields Limited, South Eastern Coalfields Ltd., Mahanadi Coalfields Limited ,Eastern Coalfields Ltd., Hutti Gold Mines Co. Ltd. Karnataka, Industrial Components, J.K.Dey & Sons, Kolkata, Intech Safety Pvt. Ltd. Kolkata, S.G. Electro-chemicals, Nagaf Engineering Pvt. Ltd., Kolkata, Sunflag Iron and Steel Co. Ltd., Nagpur etc.

Study focusing air borne respirable dust concentration at various workplaces of the Hutti, Uti and Heerabuddini gold Mines and its analysis was undertaken for The Hutti Gold Mines Company Limited, a Govt. of Karnataka enterprise. The scope of work of the study includes dust generation profile of major work places (static sampling) and dust exposure profile (Personal Sampling) of important category of workers as specified in DGMS circulars and other areas as required by the company, analyzing the dust samples for determination of respirable dust concentration in mine atmosphere, free silica determination for maximum permissible limits and advice on control measures wherever required. Assessment of respirable dust, personal exposures of miners and free silica contents in dust were undertaken to find out the associated health risk of mine workers in 3 gold mines at 33 workplaces (66 samples): Hutti (an underground mines), Uti (an open cast mines) while Heerabuddini (exploratory mine) of HGML located in the Raichur district of Karnataka which is the only company that produces gold by mining and processing the gold ore. Direct-on-Filter method using Fourier Transform Infra-red (FTIR) Spectroscopy determined free silica in respirable dust. The study was to be carried out in two phases over a period of one year. First round of study was complete and an interim report was sent.



Fig 1: Respirable dust sampling using PDS at crusher house of HGML, Raichur

A glimpse of the major services offered to industry during the period are mentioned below:

■ Performance Evaluation of Various Safety & Rescue Equipment Used in Mines:

Self Contained Self Rescuer (SCSR) and Close Circuit Breathing Apparatus are the major life support equipment during disaster in coal mines. To ensure their performance during emergency, their





periodical evaluation as per Indian Standard is required. A total of 11 SCSR samples of different make and model from various manufacturing industries and coal mines have been evaluated on artificial breathing simulator machine in laboratory condition as per IS 15803:2008 ,DGMS (Tech.) Circular No. 08A of 2008.

Testing of Miners' Safety Equipments

Mining operations around the world pose a great risk to worker's health and safety. Thus, it becomes inevitable that the PPEs which are going to be donned by the workers are quality tested and meet all the standards. The department has a wide range of state-of-the-art facilities to assess and certify the quality of the PPEs which include: Safety Helmets, Safety Boots, Flame Safety Lamp, LED Caplamp and testing of other major safety equipments used for their safety viz. methanometer, Multigas Detector, LMD etc. For the year 2018-2019, four batches of flame safety lamp, two batches of safety helmets and one batch of LED Cap lamp were tested at our laboratory.

Respirable Dust Analysis

Occupational exposures to silica are associated with the development of silicosis, lung cancer, pulmonary tuberculosis, and other respiratory diseases. Mining industry and miners' working therein are more prone to exposure to respirable dust containing free silica. Hence, the knowledge of % silica in mine dusts can help in adopting suitable control technologies in order to reduce exposure risk. Accordingly during 2018-19, the laboratory carried out analysis of 26 numbers of air borne respirable dust samples (collected on filter paper) from different work places of various collieries for free silica analysis, respirable dust concentration and maximum exposure limit using Direct-on-filter method of FTIR Spectroscopy conforming to DGMS (Tech) (S&T) Circular No.1,2010.

5.c. MINE VENTILATION

One R&D project on Coal Dust Explosibility study sponsored by M/S CIL R&D Board, Kolkata is being implemented in the department. It has recently completed another R&D project on safe liquidation of thick coal seam of Raniganj coalfields. Various industry sponsored projects related to the problems of oppressive climatic condition at workplaces in underground mines, prevention and control of fire in coal mines, extent and rate of progress of fire in abandoned mines are also undertaken by the department. Testing of brattice cloth and ventilation ducting as per BIS norms and calibration of Anemometer, Velometer and Manometer has also been carried out as a routine job.

(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. Under this project coal characteristics of 76 coal samples collected from firey and degree III gassy mines covering as many as six subsidiaries of CIL has been determined by various experimental methods, viz. Proximate and Ultimate analyses, Gross Calorific Values and Differential Scanning Calorimetric study. Further, major equipments like 20 litre explosion chamber, Particle Size Distribution Analyser have been procured to fulfill objectives of the project. CFD simulation for dispersion of coal dust in 20 litre spherical chamber has been carried out. The project is in implementation stage.







Figure 1. Bombcalorimeter

Figure 2. Differential Scanning Calorimeter



Fig. 3 a, b, c. Time sequence of contours of Turbulent Kinetic Energy at t= 20, 40, & 60ms

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. 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 of the seam and optimisation of panel ventilation system by computational fluid dynamics (CFD) modeling. The study has helped the mine management to extract 12 pillars in a panel without any symptoms of heating. It may be mentioned here that earlier mine management used to seal the panel due to fire/heating and could extract maximum 6 pillars. Needless to mention, that nowadays this comprehensive technology is being practiced by the mine management.

(B) Industry Sponsored Project

- The problem of oppressive workplace environment in five mines, viz. Sijua colliery, TATA STEEL, Bahula mine of Kenda Area, ECL, Zawarmala mine, Mochia and Balaria Mines of Zawar Group of Mines of 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 of ventilation network of the mine by computer simulation studies.
- 2. The problem of spontaneous heating / fire in three underground coal mines, viz. Shyamsundarpur colliery, ECL, Parascole Colliery, ECL, Adriyala Longwall Project, SCCL has been dealt with success to improve production and productivity of the mines keeping due importance to safety. CSIR-CIMFR, Dhanbad was assigned two different projects. First one for control of heating/fire in extracted panel





and another in sealed off areas in Shyamsundarpur colliery, ECL. In the first case fire was controlled by sealing the fire affected area of the mine. In the second case the production of the mine was stopped and it resumed production within 10 days of occurrence of heating in sealed off area of RVIII seam. During depillaring operation , fire occurred in the RVIII Top and Bottom seam. Fire was controlled with ventilation control technique and reopened the area successfully. Environmental monitoring in the longwall panel no. 2 is being carried out by CSIR-CIMFR Dhanbad. The mine is having Tube Bundle system for monitoring of underground environment and the project is in progress.

- 3. Extent and rate of progress of fire below sub surface at XIII, XIV and XV Seam of Kankanee colliery (BCCL) have been determined by the data obtained through boreholes made at strategic locations measuring the fire parameters, viz. pressure, temperature, gas compositions of fire area and advised for its control.
- 4. Ventilation system was designed for safe drivage of two inclines at Bichharpur underground coal mine at Shadhol District of Madhya Pradesh. This new mine is being operated by M/s Ultratech Cement Ltd.

(C) Testing

During the reporting period seven Anemometers were received from M/s Tata Steel Ltd., Jamadoba, M/s Nanda Manufacturing Co., Kolkata, M/s Micon Engineers, Kolkata and M/s Ventwell Corporation, Kolkata and calibrated as per standards. Three numbers of ventilation ducts (semi-rigid and flexible) were tested as per BIS.

6.a. MINE DESIGN & SIMULATION SECTION

(Under Mining Methods & Design Simulation Research Group)

A number of R&D works, including sponsored and consultancy assignments in underground coal and metal mining problems related to the method of mining, numerical modelling, rock mechanics & ground control problems and strata monitoring's are being undertaken by the Mine Design & Simulation Section. This section initiated a number of industry-sponsored projects and also completed a number of projects taken earlier.

Mechanisation is the best option to improve the low production and the productivity problems of underground coal mines. This section is contributing significantly for the mechanised extraction of underground coal seams. Continuous miner (CM) based mechanisation is getting preference by the industries, mainly due to its easy adaptability in the Indian geomining conditions by a moderate level of investment with comparatively higher production and productivity. In India, a number of coal seams are being extracted by using CM based technology. As the multiple coal seams exist in most of the coalfields, the CM is deployed to extract the coal pillars under the goaved-out workings in some places. There would be a need in future to deploy CM below goaved-out workings at a number of sites. It is itself challenging to work under goaved-out workings, especially when the overlying goaves are highly asymmetric in nature like consisting of caved zones, barrier pillars, etc. above the workings. The problems increase when the working is at a higher depth of cover. This section is engaged in VK-7 Incline mine of the Singareni Collieries Company Limited (SCCL), where the developed coal pillars at the King seam under the goaf of Queen seam (Top seam) are being extracted by the deployment of the CM. Mechanized underground extraction of low height coal seams is also a requirement to achieve good production and productivity level. The Eastern Coalfields Limited (ECL) introduced Low Height Continuous Miners (LHCM) in collaboration with Gainwell Commosales Private Limited [GCPL, formerly Tractors India Private Limited] in RVII and RVIIA Seams at 3&4 Incline of the Jhanjra Project Colliery





due to the less thickness of the seam. The LHCM is introduced first time in India. This section has successfully reduced the general support requirement for the Low Height Continuous Miner (LHCM) workings by assessing the support requirement for development of RVII and RVIIA seam by LHCM at 3&4 Incline of Jhanjra Project Colliery, ECL. The section is also engaged in instrumentation and strata monitoring of LHCM Projects at Jhanjra Project Colliery, ECL. This section also developed a number of empirical formulations for the extraction of inclined coal seams. Some of the works done by the section are shown in Figures 1 to 4.

The clients included M/s Singareni Coal Company Limited (SCCL), M/s SAIL and various subsidiaries of Coal India Ltd., Gainwell Commosales Private Limited (formerly TIPL), etc.



Fig. 1: Determination of rock load height from the safety factor contours.





Fig. 2: Distinct element modelling to estimate the strength of the coal pillar.



Fig. 3: Development of the shear band in the inclined coal pillar.

Fig. 4: Simulation of strain energy (J) during depillaring of the coal seam.

During the year 2018-19, the department conducted different laboratory (numerical modeling) and field investigations for several industry-sponsored projects and undertake four new projects. A brief overview of the some of the completed projects by the section is as follows:

A suitable extraction methodology was proposed and stability analysis was carried out by field investigation and numerical modeling for XIV seam at Jitpur colliery, SAIL. The thick XIV seam was extracted in three lift with a combination of longwall mining. At Rani Atari mine, Chirimiri area, SECL, the development was done in the seam II by Low Capacity Continuous Miner (LCCM) Technology. The strata monitoring investigation was conducted and necessary advice was given regarding stability of development workings from time to time. At Shantikhani Mine, Mandamari Area, SCCL, the strata





monitoring investigation was conducted by CSIR-CIMFR during the development of Area-1 and Area-1A of Salarjung seam by continuous miner technology. Strata monitoring investigation was conducted and based on field observation and analysis of the instrument readings, necessary advice was given from time to time. A safe cut-out distance was suggested at Shantikhani Mine, Mandamari Area, SCCL for development of Area-1 and Area-1A of Salarjung seam of 1 in 4 to 4.5 dip by continuous miner technology. "Design by measurement" method was implemented for establishing the cut-out distance for the continuous miner. Low height Continuous miner (LHCM) has been introduced at the 3&4 Incline, Jhanjra Project Colliery, ECL to extract the low height coal seams RVII and RVIIA by Gainwell Commosales Private Limited (Formerly, TIPL). Based on the field investigation, physico-mechanical properties and numerical modeling, the existing support system was re-assessed and the recommended support system was successfully implemented in the LHCM working panels. At present, 3 numbers of projects are running in different coalfields.

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

6.b. MINING METHODS

Mining Methods section belongs to Research Group "Mining Methods and Design Simulation". The section 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 with request to do the necessary research studies. Often, many challenging geotechnical problems 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. Some notables are as follows:

- Coal recovery is proposed to be enhanced in High Wall mining at West Bokaro (TISCO) mine with inclusion of paste filling technology in the web-cuts based on related numerical modeling exercises by CIMFR. The inclusion of paste-filling allows further thinning of web-pillars thus enhanced coal recovery from the locked-up coal in web-pillars where the coal recovery may be (on modest note) expected to increase from ~ 27% to ~ 67% of the given coal reserve on its first of its application in India.
- The extent of the subsidence has been studied in Kapuria block of BCCL, to limit within the acquired land and not affecting the surface area that belongs to area other than the BCCL. Thus the study ensured kicking-off new longwall project at Kapuria block (BCCL) which would augment coal production to meet the production target.
- The production in seam II of Gare Palma IV/4 and Gare Palma IV/5 was pending for scientific study due to presence of forest cover and tribal land. The study outcomes open-up the way for extraction of depillaring panels without stowing which was otherwise proved to be very slow and uneconomical and thus not adoptable by mine operators. The research study ensured no adverse subsidence effect over surface.
- Continuous Miners have been introduced in India in underground coalmines more than two decades back for mass production during depillaring as well as now for development of virgin seams. Till date, the single-pass extraction height of CM has not been permitted to exceed 4.5m in any coal mines of India. For the first time, a CM is being introduced to depillar a seam (5.4m thick) in a single pass. To enable the same, extensive research studies with the help of numerical modelling exercises





and empirical evaluation were done by the section and would take up industry-sponsored research project for validation by geotechnical instrumentation following "design by measurement".

- The RIII/II (Samla) seam of Khottadih colliery of ECL has a potted history of failure of longwalling due to severe ground control problem. Now, 3 panels have been prioritized and a research task was given to this section to provide a suitable and feasible method of depillaring which may address the incavable roof and associated geotechnical issues. The cavability index has been found as 10729 of the main roof, which comes under category "cavable with substantial difficulty". The comprehensive research undertaken by the section recommended the panel width, barrier pillar design, scheme of instrumentation and scheme of induce blasting etc.
- 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 workings below very competent and massive basalt trap formation in WCL are being designed and ready to be implemented after in-principle approval from the Inspectorate and acceptance from the Mine Operator. One ongoing MoC S&T Grant project and one ongoing CIL R&D Board sponsored research projects are expected to address the two important but new areas of research broadly as "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 noteworthy to highlight one research work conducted at ECL where more number of pillars per panel can be extracted in a very low incubation period on the basis of the "Tandem Approach" (TA) methodology, developed as a part of the completed R&D GAP project. The final report submitted got appreciation from CIL R&D board as well as implementing mine operators. The project is now being implemented as an extension in Khas Kajora Colliery, ECL in a fresh R&D project proposal so that a mine operator of thick seam (thickness > 4.8m) in Jharia and Raniganj coalfields can implement TA and may receive the benefits using the guidelines and formulation developed for implementation methodizes, the latter expected to be as an important deliverables of this project.

step 0	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wpS	web6	wp6	web7	wp7	web8	wp8	web9	6dw	web10	wp10	web11
step 1	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wp5	web6	wp6	web7	wp7	web8	wp8	web9	9dw	web10	wp10	web11
step 2	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wpS	web6	wp6	web7	wp7	web8	wp8	web9	wp9	web10	wp10	web11
step 3	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wp5	web6	wp6	web7	wp7	web8	wp8	web9	wp9	web10	wp10	web11
step 4	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wp5	web6	wp6	web7	wp7	web8	wp8	web9	6dw	web10	wp10	web11
step 5	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wp5	web6	wp6	web7	wp7	web8	wp8	web9	8dw	web10	wp10	web11
step 6	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wp5	web6	wp6	web7	wp7	web8	wp8	web9	wp9	web10	wp10	web11
step 7	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wp5	web6	wp6	web7	wp7	web8	wp8	web9	6dw	web10	wp10	web11
step 8	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wpS	web6	wp6	web7	wp7	web8	wp8	web9	8dw	web10	wp10	web11
step 9	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wp5	web6	wp6	web7	wp7	web8	wp8	web9	wp9	web10	wp10	web11
step 10	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wp5	web6	wp6	web7	wp7	web8	wp8	web9	6dw	web10	wp10	web11
step 11	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wp5	web6	wp6	web7	wp7	web8	wp8	web9	8dw	web10	wp10	web11
step 12	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wp5	web6	wp6	web7	7qw	web8	wp8	web9	6dw	web10	wp10	web11
step 13	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wp5	web6	wp6	web7	wp7	web8	wp8	web9	6dw	web10	wp10	web11
step 14	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wp5	web6	wp6	web7	wp7	web8	wp8	web9	6dw	web10	wp10	web11
step 15	web1	wp1	web2	wp2	web3	wp3	web4	wp4	web5	wp5	web6	wp6	web7	wp7	web8	wp8	web9	6dw	web10	wp10	web11

Step-wise progression of cutting (in white) and paste-filling (in yellow and orange) cycles, the virgin webribs/pillars in grey colour considered for the numerical modelling exercises (at West Bokaro Colliery, Tata Steel).



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Plan projection of subsidence influence for panels at different depth (at Kapuria mine, BCCL)



Underground plan of Seam II of Gare Palma IV/4 mine, showing developed panels to be extracted



Sectional projection of subsidence influence along BB' for panels at different depth (at Kapuria mine, BCCL)



Recommended modified panels in R-III/II (Samla) seam for depillaring as submitted to Khottadih Colliery (ECL)



Showing sequence of extraction in a pillar with two side goaves, butt & face cleats as well as two sets of joints superimposed (RVI seam, Khottadih Colliery, ECL for CM introduction of 5.5. m single-pass height)





7.a. MINE PLANNING

1. Design of safe excavation pattern and support system for proposed new railway tunnel between Ratanpur and Jamalpur stations.

Eastern Railway has assigned this project to CSIR - CIMFR to design a new tunnel and monitoring of existing tunnel in jamalpur. The length of tunnel is about 300m due to environment clearance for constructing a long main tunnel.

Objectives:-

- Tunnel design and monitoring of existing tunnel in Jamalpur
- To determine the geotechnical parameters of such for designing of the tunnels.
- Monitoring of blast induced ground vibration should be carried out in regular basis in existing tunnel.

Work Done:- The core samples collected from six boreholes i.e(three in the existing tunnel and three in proposed tunnel).All the boreholes are drilled in the core alignment of the tunnel. Core gives firsthand information about the rock quality near the borehole, as well as structural information and indications of the amount of water present.

Borehole data used to determine the geotechnical parameters for designing of the tunnels.

To reduce the risk of accident, detailed monitoring scheme of blast induced ground vibration and strata behavior has been prepared. It was recommended that the monitoring job should be carried out in regular basis both in the existing and proposed tunnels. This project is ongoing.

2. Development of microcontroller based fully automated coal transportation system.

An in house project has been taken up for automation of existing manually operated coal handling pilot plant of Digwadih Campus using different sensors and IoT technique. The present system is manually operated from control room using push button switches. In total 8 push button switches are being used for operating the pilot plant. The proposed system will convert this manual control unit to a fully automated mobile based control unit. Here the processing unit also communicates with Gateway module to send information to cloud database for remote monitoring. To make the system efficient, fast and user friendly, the operator can use android based smart phone to monitor and operate motors of coal handling pilot plant.

Objective

Optimize the coal transportation system using IoT and microcontroller based control units.

Finding:-

- Internet of things (IOT) instead of gsm or Bluetooth wireless technology to facilitate the operation of plant from onsite as well as any remote location.
- Programmed Interlocking Protection is provided to avoid the damage of belt due to loaded start-up and from getting extra loaded at the time of uneven start-up.
- Real time physical sensors are used to sense parameter of motor and to pass data to computational systems for processing hence further actions such as operation of motor can be automated.
- Mobile-app based control unit.
- Automatic And Manual Control Methods To Stop Or Start The Induction Machine To Avoid System Failure.
- Emergency stop button is provided to stop system at a time.





3. Preparation of Mine closure plan in respect of Khagra Joydev Coal Mine

Damodar Valley Corporation (DVC) Kolkata Division has assigned this project to CSIR- CIMFR to prepare mine closure plans as per the MOC guidelines. In this project efforts have been made to minimize mining footprints on surrounding ecosystem. The baseline data has been collected for mine closure process such as geological, mining scheme, safety and environmental control measures. A schedule for mine closure activity is proposed in sync with the mine life. Financial outlay for mine closure activities are estimated to ensure zero effect on socio-economic and environmental aspects after the mine plan. This project is ongoing.

Objectives:

- Protect public health and safety.
- Productive and sustainable after use of the site.
- Protect the flora and fauna of the area.
- Minimize environmental damage and thereby encourage environment sustainability.

7.b. MINE SUBSIDENCE AND SURVEYING

Mine Subsidence and Surveying Section conducted subsidence investigations and three dimensional prediction of subsidence in coal and non-coal mines located in different parts of India. Projects carried out by the department is mentioned bellow :

The mine management of Digwadih Colliery proposed to extract 9S panel of dimension 540m x 148m with hydraulic sand stowing in IX seam. The height of extraction of 9S panel is 2.94m whereas depth of extraction varies between 375 and 402m. 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 storied kachha and pucca buildings, one seasonal water tank, boundary of the railway acquired land at a distance of 90 m away from the panel, drain, Tata high tension line of 11kV and village road. The 9S panel is overlain by old stowed and caved goaves in XI, XIV, XV, XVA, XVI and XVIA seams. The subsidence prediction is done by modified influence function method on the surface as well as XI seam floor due to proposed extraction of 9S panel of IX seam. The maximum subsidence, slope, compressive and tensile strain on the floor of XI seam due to extraction in 9S panel with 30 cm stowing gap are 359 mm, 7.28 mm/m, 2.77 mm/m and 2.03 mm/m respectively. The maximum subsidence, slope, compressive and tensile strain at the surface with 30 cm stowing gap are 66 mm, 0.33 mm/m, 0.25 mm/m and 0.14 mm/m respectively. The cumulative maximum subsidence, slope, compressive and tensile strain at the surface 30 cm stowing gap are 124 mm, 0.88 mm/m, 0.56 mm/m and 0.42 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 with hydraulic sand stowing. Depillared workings of XI seam should be free from water logging. It is recommended to maintain stowing gap less than 30 cm for safety viewpoint.









Three dimensional view of surface due to extraction of 9S panel

Subsidence study was carried out at Turamdih and Mohuldih mines of Uranium Corporation of India Limited. It is operating six underground mines for the production of magnesium diuranate for nuclear power generation. Subsidence investigations were conducted in two mines namely Turamdih and Mohuldih, located in East Singhbhum district of Jharkhand state. Horizontal Cut & Fill with post pillar mining method is being followed in both the mines. Turamdih mine having an area of 557.18 acre is covered by 87.51 acre of forest land. Out of 288.20 acre, the forest land is covered by 110.16 acre in Mohuldih mine. There are workings below the forest cover in both the mines. Subsidence investigations were conducted using Global Navigation Satellite System (GNSS) and Total Station in four patches (three in Turamdih and one in Mohuldih) encompassing the forest cover with respect to underground workings. Altogether 110 pillars were anchored at an average interval of 50 m around the periphery of the forest land in Turamdih mine. A total of 15 pillars were fixed at an interval of around 15 m over the stope and drives in Mohuldih mine. Global co-ordinates were determined for each station by GNSS. No symptom of subsidence movement was clinched over the stopes. The surface topography was intact without causing any impact on forest land. It is recommended to continue land subsidence investigation acknowledging the significance of ground movement due to underground stoping operation on forest land. It is also recommended to conduct subsidence investigation over stoped out areas as well as present working stopes for the safety of existing surface structures.

The section carried out study on Subsidence movements and its impacts due to extraction of coal bed methane at Sohagpur block, Madhya Pradesh. Coal Bed Methane (CBM), a natural gas occurring in coal seams, is a relatively new source of energy in India. Reliance industries Limited was awarded with two CBM Blocks viz. SP (West)-CBM-2001/I and SP (East)-CBM-2001/I. These are located in the Shahdol / Anuppur districts of Madhya Pradesh and have an area of about 495 km² and 500 km² respectively. 331 and 37 development wells have been drilled in SP (West) - and SP (East). Subsidence investigation was conducted over a segment of the block of around 2 km² enveloping shallow depth of seam i.e. the most influential zone to assess surface ground movements due to the production of CBM and its impact on water bodies, vegetation and surface structures. The study area covers five production wells, railway lines, air strip, school and residential guarters, dug wells, national highway road (NH-78). There are five major regionally persistent coal seams (seam V, IV, III, II & I) and two local seams (seam L2 & L1). The production of CBM was from Seam V and Seam L1 from a depth range of 344 to 754 m within study area and the total CBM production from the block till May, 2018 was 269.5 million m³. A total of 85 subsidence monitoring stations were laid along four lines covering five production wells (SW-10-27, SW-10-26, SW-11-26, SW-10-25 and SW-09-25). Level of groundwater table was measured in dug wells at different intervals in Lalpur, Katkona, Semra and Pipartara villages. No subsidence was observed. The surface topography was intact without causing any impact on surface structures and features. Fluctuation in groundwater table observed to be seasonal and there was no sign of reduction in groundwater table with time due to extraction of CBM. This remark is also an informative factor of no strata disturbance due to CBM operation. It can be concluded that for CBM extraction from a depth of around 500 m or below with this geo-mining condition it is not likely to cause subsidence impacting water bodies, vegetation, structures and surroundings. This subsidence investigation due to extraction





of CBM at Shahdol is being carried out for the first time in India and hence provides valuable reference data for future studies of similar nature in CBM fields. Acknowledging the significance of such data in India for similar activities, it is advisable to consider monitoring the land subsidence, employing new and developed techniques in future, once the field matures.



8. MINE MECHANIZATION, AUTOMATION AND TECHNOLOGY DEVELOPMENT

There are various on-going S&T Projects under this research group.

Under the S&T project titled "Development of Vision Enhancement System for Foggy Weather", sponsored by Ministry of Electronics and Information Technology, Govt. of India., we have developed the system which provides vision enhancement to vehicle loading, safe navigation and maneuvering system in low light and no visibility situation. Some of the system specification includes:

- Multiple thermal and high definition cameras with softwares and image processors
- On board computer to reduce the blind spots by providing better view angles.
- GPS voice assistance, navigation system and reliable radar system accurately details the traffic data and real time position of the vehicle
- Warning the driver of potential obstacle, or approaching vehicle.
- Audio visual signal from multiple electronic sensors, actuators and cameras in the back received during reversing the vehicle to avoid unfortunate accidents.
- On-board vehicle weighing arrangement integrated with GPS to measure and monitor on-line weight of loaded mineral on truck/wagon throughout the transportation route as well as to control overloading of mineral on truck/wagon while loading.
- Specially designed vest for pedestrians entering the mine premises which can be seen from over a mile away along with helmet mounted thermal monocular for vision enhancement in most adverse condition and a small, discreet electronic obstacle avoidance unit which efficiently and accurately detects obstacles that may lie directly in one's path and notifies the user through intuitive vibrations.
- Anti-collision laser warning system





- Programmable led strip mounted over the loading basket which can be lit, dimmed and blinked during the time of loading.
- Fog and haze penetrating customized head lamp, roof and bumper mounted massive fog lamps to illuminate the surrounding for a better visibility.

The objective of S&T project titled "**Setting-up of Information and Facilitation Centre for Empowering Living of Schedule Caste in Jharkhand State**", sponsored by Ministry of Electronics and Information Technology, Govt. of India, is to establish Gramin Suvidha Kendra (Information and Facilitation Centre) for SC/ST community of Jharkhand state.

The main objective of the S&T Project titled "**Development of Digital Mine using Internet of Things**" sponsored by Ministry of Electronics and Information Technology, Govt. of India, is to develop a 3D digital mine. Work is in progress.

Under the S&T project titled "**Setting-up Safety Testing Laboratory for Electronics and Information Technology Products**", sponsored by Ministry of Electronics and Information Technology, Govt. of India, and established an Electronics & IT products Safety Testing Laboratory (EISTL). This new testing laboratory is approved by Ministry of Electronics & Information Technology (MeitY) and provides safety testing of Electronics and IT equipment including electrical business equipment, Audio, Video and similar Electronics equipment. The EISTL lab will cater the need of various Electronics & IT products manufactures, buyers and stakeholders and provide the testing facilities in one roof for all types of Electronics and IT products. The lab is accredited with NABL and now being recognized by BIS for testing and certification with an objective to provide quality testing services using well equipped infrastructure with the help of qualified professionals.

Under the R&D Project titled" **Intelligent Dry Fog Dust Suppression System**", sponsored by NMDC Limited, developed system is a smart solution for removing dust generated during different mining activities such as extraction, loading and unloading, transportation, storage and processing as well as other industrial processes. The system utilizes hybrid nozzle by combining the features of ultrasonic nozzle and atomizing nozzle to spray dry fog which provide atomization of water drops in the range of sub-micron metre size (1–20 µm size) for proper agglomeration with dust particles (PM2.5 and PM10) and allowing them to settle down by adding less than 0.1% moisture in the surrounding atmosphere. The technology has been filed for patent and licensed to M/s Control Systems and Solutions, Kolkata. The system has been installed in Donimalai Crushing and Screening Plant of NMDC Limited located at Ballery district in Karnataka state.



Dry fog dust suppression system installed in Donimalai Iron Ore Mine of NMDC Limited: (a) Air compressor and receiver, (b) Control panel, (c) Dry fog nozzles, and (e) Dust emission status before and after installation of the system DIOM





Further Under on-going R&D Project titled **"Mine Transport Surveillance System"** sponsored by NMDC Limited our research group has filed a patent application for the developed technology. A MoU has been signed with NMDC Limited for installation of the system in all of their mines and pellet plant. The system has been successfully installed at Tirap Opencast Mine of North Eastern Coalfields Limited as well as Kumara swamy Iron Ore Mine, Donimalai Iron Ore Mine and Pallet Plant of NMDC Limited. The RFID devices have been tested by SAMEER, Kolkata and approved by Wireless Planning Coordination (WPC). MTSS has been developed for controlling unauthorized transportation of mineral from mines, accurate and fool-proof weighing by proper positioning of trucks and controlling overloading, periphery surveillance of mine boundary, on-line monitoring and surveillance of mining activities as well as improving safety, production and productivity of opencast mines. CSIR-CIMFR has received 'MEAI-NMDC Award 2018' and Certificate of Merit for 'CSIR Technology Award 2018' for development and implementation of the indigenous MTSS in different mines. M/s Dadhwal Weighing Instruments, Dhanbad has been selected as an Implementation Partner for commercialization of the system.



Mine transport surveillance system: (a) Weighbridge automation, (b) Mine periphery surveillance and (c) Long range proximity devices

Under the project titled **"Strata and support behaviour investigation of longwall panel-3 in R VI seam of Jhanjra project"**, M/s Gayatri Project Limited, Hyderabad entrusted CSIR-CIMFR, Dhanbad to conduct a scientific study of strata and support behaviour monitoring while extraction of retreating Longwall Panels of R VI seam at Jhanjra Longwall Project. The report on comprehensive strata and support behaviour investigation of Longwall Panel-3 carried out and submitted by CSIR-CIMFR during the period October 2018 to March 2019. The panel extraction is progressing with safety. The snapshot of the Mean Load Density and loading on supports are given below:



Leg pressures during the period from January to March, 2019

In another project, the SCCL management has entrusted the work to CSIR-CIMFR, Dhanbad to design suitable pillars of rhombus shape for working Top Section in trunk roadway and Bottom Section along gate roadway with Bolter Miner, to design support system for development of longwall gate roads & trunk roadways and to design instrumentation and strata management plan suitable for working





Salarjung Seam at Shantikhani Longwall Project. Stress distribution on a typical parallelepiped pillars of trunk roadways is shown in the figure given below.



Stress distribution on a typical parallelepiped pillars of trunk roadways

Under the in-house project titled **"Development of Parallel Numerical Techniques for Large-Scale Geo-Mining Problems"** we have utilized HPC system that can simulate very large domain insitu conditions of geo-mining problems. Design domain of mining structures such as tunnel, galleries, pillars, barriers, etc., are usually large and numerical analysis requires huge computational resources to solve these design problems. The results of developed parallel FE codes for 1D and 2D problems are shown in the figure given below.



The results of developed parallel FE codes for 1D and 2D problems

Contribution In Science For Society

An integrated real-time system titled "**Coal Analysis and Tracking System (C-SAT)**" has been designed and developed to track from sampling from hundreds of loading and unloading sites spread all over India tfor testing, uploading and report generation at four testing laboratory of CSIR-CIMFR at Digwadih, Ranchi, Nagpur and Bilaspur. This has increased the transparency and efficiency of the total system and utilised by all relevant department of CSIR-CIMFR, and other stake holders Coal India and other power utilities.

9. NATURAL RESOURCES & ENVIRONMENT MANAGEMENT

Natural Resource and Environmental Management Group (NREM) has undertaken a number of studies related to environmental problems and management in the mining and allied industries especially the issues related water resource and solid waste management during the period of April 2018 - March 2019. The major work involvement of the research groups are: radioactivity and heavy metals study in





coal and fly ash, remediation of hexavalent chromium from mine waters using low cost bio-adsorbents, technology development for Zero Liquid Discharge in Steel Plants, groundwater exploration and old mine workings by using resistivity imaging, monitoring of environmental parameters, mine waste utilization for societal befits and EIA/EMP study for sustainable mining.

The NREM research group is accredited by NABET in the domain of mining and coal washeries and undertaken some prestigious EIA/EMP projects to cater to the industrial requirement of obtaining environmental clearances in different parts of the country such as Khanak stone mines (Haryana); Mica, Quartz and Fluorspar mine (Nellore, A.P.), Lignite Mines (Gujarat) and Coal Mines (West Bengal). The R&D project undertaken is towards mitigation of environmental hazards and development of sustainable technology. The major objectives of the project on "Long term study on radioactivity and heavy metals content in coal and fly ash of Talwandi Sabo Power Limited" are quantification of heavy metals content and natural radioactivity levels of raw coal and coal residue and assess the associated health risk. The study assess the risks of contamination of the natural resources and environment while simultaneously evaluating associated human health risk and radiation hazard indices from the activity concentrations of ²²⁶Ra, ²³²Th, and ⁴⁰K in predicting any radiological hazard to general public.

The R&D project on cost effective technology for attaining zero liquid discharge is funded by Ministry of Steel, Government of India. The physico-chemical properties of slag are being evaluated and experiments are being carried out to understand efficacy of slag in removal of effluent matrix. It is also planned to test other industrial effluents to understand the broad spectrum efficacy of the steel slag in wastewater treatment. Subsequently the experiment will be scaled up to the level of continuous or semi-continuous prototype development.

The project on low cost bio-adsorbent for the removal of hexavalent chromium in the industrial and agricultural waste is funded by Department of Science & Technology, Govt of India, under the scheme of Women Empowerment (DISHA). Qualitative assessment of groundwater resources in the chromite mining areas of Orissa and mitigation of the hexavalent chromium of waste water by adsorption process using bio-adsorbent was the major objectives of this project. For this purpose low cost bio-adsorbent was prepared from industrial and agricultural wastes.



3 D plot for interactive effect of pH versus time on the removal efficiency of Cr (VI)





The project on geophysical method for mine working characterization is funded by Science & Engineering Research Board, Department of Science & Technology, Govt of India, under the scheme of National Post Doctoral Fellowship (NPDF). The study is carried out by Resistivity Imaging system, to determine rock weatherability and potentiality of groundwater characterization. Exploration of groundwater, assessment of hard cover at shallow depth of workings, delineation of old mine abandoned workings was carried out using resistivity imaging.



Groundwater exploration at UCIL

Old mine working detection at Salanpur area.

Resistivity imaging survey results

Advice to find out the total hydro-geological yield of aquifer and their management was done for Singsar Limestone Mine of M/s Ambuja Cements Limited, Gujarat. Evaluation of the drainage showed that mine is nearer to Arabian Sea in south direction and Somat River in east direction. Some of the parameters that were assessed include surface runoff, excessive precipitation, groundwater inflow from Somat River and Arabian Sea apart from analysing all hydrological parameter that leads to negative impact on mining. The physico-chemical parameter analysis indicated that the value of Chloride, Sulphate, Alkalinity is within the acceptable limit, pH, Total hardness, Ca hardness, Mg hardness under the permissible limit whereas TDS, Salinity, Total Hardness cross the permissible limit.



3D model of the limestone mine area

Water quality assessment at Ghazipur, UP and Punjab state in association with WAPCOS Limited was carried out. Further, work was repeated for Mining Associate Pvt. Ltd., Asansol, West Bengal. The study included water sample collection through exploratory well, during Step Drawdown Test (SDT) and Aquifer Performance Test (APT). Water samples were analysed for major cations (Ca²⁺, Mg²⁺, Na⁺, K⁺), anions (F⁻, Cl⁻, HCO₃⁻, NO₃⁻ SO₄²⁻), heavy metals (Fe, Mn, Cu, Pb, Zn, Ni, Cr, Se, and As) and other general





parameters (EC, pH, TDS, Alkalinity, Total hardness). The analytical parameters were compared with the specified limits for drinking water by WHO (2006) and Bureau of Indian Standard (BIS-2012) to assess its suitability for drinking purposes.

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 to understand the effect of mining activities on the environment.

Water conservation study was conducted at Indian Copper Complex, Ghatshila, Chaibasa District, Jharkhand with the objective to study the water conservation/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, Ghatshila. Results indicated that river tributaries / nalas are seasonal and the Subarnarekha River is the perennial source of water in the area. A steep slope is found in the south western part and gentle or low slope can be found in the middle part of the study area, mostly situated on either side of the Subarnarekha. There is no wide variation in the natural soil characteristics and particle size analysis shows sandy loam in nature. It was suggested that implementation of rain water harvesting structures can improve the total recharge potential up to 24.647 MCM/annum and while increasing groundwater recharge potential up to 0.857 MCM/annum.

Environmental Impact Assessment and Environmental Management Plan (EIA/EMP) work were undertaken at Khanak stone mines of HSIIDC at Bhiwani; Mica, Quartz and Feldspar mine of SRK Kalichedu village, Nellore district, AP; Surkha (N) Lignite Mine, District-Bhavnagar and Mat no Madh Lignite Mine, District Kutch with Amodh (G-19 Extension) Lignite Mine, District Bharuch as well as for Kasta mines, West Bengal. Baseline environmental study in respect of air, water, noise, soil and flora & Fauna has been undertaken and EMP has been prepared with reference to Mica Mine of SRK. Environmental reclamation, remediation plan, natural and community resource augmentation plan corresponding to the ecological damage assessed in accordance with term of reference (TOR) issued by Ministry of Environment, Forest and Climate Change (MoEF&CC), New Delhi and accordingly advise is put forth. Based on analytical evaluation of data preventive measures were suggested.

10.a. EXPLOSIVE & EXPLOSION LABORATORY (EEL)

Explosive and Explosion Laboratory undertook different 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.

Final reports of one completed project sponsored by M/s SCCL, samples of permitted explosives and permitted detonators were evaluated for their different quality parameters at SCCL sites to advice on their quality, safety and performance parameters. Evaluation of these explosives 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, samples of permitted explosives evaluated for determination of concentration of toxic gases in the post detonation fumes after five minutes of blasting at the face have met the statutory requirement of toxic gases in post detonation fumes under their actual usage conditions in underground coal mines. Moreover, thirty-seven samples of permitted detonators of different manufacturers met all the quality requirements. But, twenty samples of permitted explosives and forty-eight samples of permitted detonators failed to meet at least one of the quality parameters as specified in SCCL purchase order.





Explosive and Explosion Laboratory has received two sponsored projects one from M/s IDL Explosives Limited, Rourkela and another from M/s Regenesis Industries Pvt. Ltd., Secunderabad for the studies of their products to meet the requirements of P_5 explosive for use in underground coal mines as a P_5 explosive. We have completed most of the activities related to these projects except shelf life determination. Hopefully, it will be completed within their project durations.

10.b. ROCK EXCAVATION ENGINEERING

The Rock Excavation Engineering research group of CSIR-CIMFR has undertaken various assignments on blast optimization and safety related problems for mining, quarrying, construction, demolition and tunnelling.

During this period, designing of blasting methodology, planning of controlled blasting operations, blast optimization and safety studies of various organizations and companies viz. Border Roads Organization (BRO), CIDCO of Maharashtra state Government, Donimalai Iron Ore Mine, Bailadila Iron Ore Mine, Kirandul Iron Ore Mine of M/s National Mineral Development Corporation (NMDC) Ltd., Noamundi, Katamati, Joda East and Khondbond Iron Mines of OMQ division of Tata Steel Ltd., Sindesar Khurd Mine, Zawar Group of Mines, Kayad Underground Mines of M/s Hindustan Zinc Ltd., UltraTech Cement Limited, National Thermal Power Corporation Limited, West Bengal Power Development Corporation Limited, Department of Irrigation, Government of Uttarakhand, West Bengal Mineral Development and Trading Corporation Limited, Udaipur Cement Works Limited, Dhar Cement Works, Gagal Limestone Mine of M/s ACC Limited (HP), Gare Palma Coal Mines of M/s ACL (Chhatisgarh), Bhanora West Opencast of Eastern Coalfields Limited and Barjora North Coal Mine of M/s MCL, Obra C Project, Obra, Uttar Pradesh., Tasra opencast project of M/s Steel Authority of India Limited, Bayal Quartz and Feldspar Mine (Haryana), Ena Colliery of M/s BCCL, JSW Steel Limited (Moitra Coal Block, Hazaribag), etc., were undertaken.

The Department has received a project of national importance from Border Roads Organization (BRO) in which the Department will help BRO team in widening of the strategically important roads passing nearby the Indo-China/Indo-Pak borders using modern rock blasting techniques and enhancement of the speed of construction of roads in difficult border areas. A Memorandum of Understanding (MoU) was signed between BRO and CSIR-CIMFR in November 2018 for providing technical help for different such projects of BRO located in various border areas. In this aspect, a team from the Department has already visited five critical border roads being constructed by three BRTFs near the Indo-China border to gauge the nature of problems in January 2019. The widening of an important road being constructed by 14-BRTF got stuck up since long as the important structures such as markets and army camps were located in the vicinity of road. During the site visit, the CSIR-CIMFR team suggested the methodology for effectively widening of the road using modern rock blasting techniques without affecting the structures of nearby vicinity. Similarly, the team also suggested for enhancing the pace of road work with controlled blasting in scientific manners for other two roads of 48-BRTF and two roads of 761-BRTF.





CSIR-CIMFR team with BRO officials at a strategic road in Arunachal Pradesh





The Department is involved in the flattening work of Ulwe hill as a part of land development work for the Greenfield project of Navi Mumbai International Airport (NMIA) since June 2016. The diversion of Ulwe river had to be accomplished before the onset of the monsoon in June 2019 which was successfully completed on time. There were many critical and difficult sites at NMIA. Amongst them, a mega cliff in Package-III area of the NMIA was demolished with the design and guidance of CSIR-CIMFR team.



Preparation for demolition of mega cliff at Package – III area having 72 m height and 110 m length with varying width of 7 to 13 m, NMIA

At 2 x 660 MW STPP Khargone Project of NTPC, Madhya Pradesh, controlled blasting was carried out in close proximity of various sensitive structures of the plant, viz. foundations of reservoirs, chimney, Outer Drain near 32 KV LT Line, etc. In Daroli Limestone Mine of M/s Udaipur Cement Works Limited, Udaipur, Rajasthan and Sitapuri Limestone Mine of Dhar Cement Works, deep-hole controlled blasting was carried out and their impact on the safety and stability of the various nearby structures were assessed. Based on the results of the blasts and subsequent analyses of data, optimized controlled blast design patterns were suggested for the mines for total safety of the nearby village structures.



View of the demolished mega cliff

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 organisation wherein ground vibration, noise/air overpressure, flyrock, fragmentation assessment and training of mine officials are being undertaken at regular interval at a place which





is politically and environmentally very sensitive. For initial opening of working faces at Mukutban Limestone and Dolomite Mines of M/s RCCPL Pvt. Limited, Yavatmal Dist., Maharashtra, trial blasts were conducted at varying locations with box-cut designs as well as controlled blast design patterns in the vicinity of structures of nearby villages. Optimized blast design patterns were suggested for the mines keeping ground vibrations, noise/air overpressure and flyrocks within safe limits.

This Department has also experimented and developed safe blast design patterns for deep-hole blasting at Pakri Barwadih Coal Mining Project of National Mineral Development Corporation Limited, Hazaribagh, Jharkhand for enhanced production and productivity with greater safety to the structures of surrounding villages. Controlled blast designs were also suggested after conducting a number of trial blasts at Narayanposhi Iron and Manganese Ore Mines of M/s Aryan Mining and Trading Corporation Pvt. Limited, Sundargarh Dist., Odisha to keep ground vibrations, noise/air overpressure and flyrocks within safe limits. At Pachhwara (North) Coal Mines of West Bengal Power Development Corporation Limited, Pakur Dist., Jharkhand, and Pachami Hatgacha Stone Mines of West Bengal Mineral Development and Trading Corporation Limited, Birbhum, West Bengal, controlled blasting patterns were designed and suggested for the safety of various residential structures of the surrounding villages.

Study and evaluation of seismographs for their reliable operation and advice on technical aspects for accurate vibration monitoring were performed for the seismographs of several companies viz. Tarini Associates, Joda; Khottadih colliery, ECL; Mohanpura colliery, ECL; Mahabir colliery, ECL; Black Diamond Explo. Dhansar; IIT-ISM, Dhanbad; Kathora mines, IOCL; Bokaro colliery, CCL; Jambad OCP, ECL; IDL Explosive, Dhanbad; Parej colliery, CCL; Sukinda Cr Mine, TATA Steel; SP Mines, ECL; PB Colliery, NTPC; IDL Explosives, Asansol; IDL Explosives, Dhanbad; AKS-Explosives; Block II, IOCL; IDL Explosives, Barbil; CMPDIL, Asansol; RCML; Kenda Area colliery, ECL; Ramnagore colliery, SAIL; Dudhichua Project, NCL; Nigahi Project, NCL; Amlorhi Project, NCL; Khottadih colliery, IOCL and CESC, Sarisatolli.

11. ROCK SLOPE

The Slope Stability Department has undertaken various assignments on design and monitoring of slopes of pits and dumps of different opencast mines. Moreover, we completed the long term dump planning of five pits of Bailadila Iron Ore Mines of NMDC Limited.

During this period, the department provided optimum design of proposed final slope of deep side highwall and internal dump at North Searsole OC Patch (Phase-III) of Eastern Coalfields Limited. Ultimate overall slope angle of 160m dip pit and 70m high dump of Band I ore body at Sukinda Mines (Chromite) of M/s IMFA Ltd, Bhubaneswer was recommended. Slope Stability Condition of Joribar Overburden Dump at Bameberi Manganese Mine of Tata Steel Ltd was assessed for overall safety. Advice on optimum slope design of pits and Internal dumps at Gare Palma Sector – II & III opencast coal mines were given to Adani Enterprises Ltd. 120m dip pit and 90 m high dumps of Tubed Coal Block, Latehar, Jharkhand were designed from safety and productivity point of view.

Slope Stability Department of CSIR-CIMFR took up the challenging task of long term planning of dumps for continuation of production in scientific manner for five pits of Bailadila Iron Ore Mines of NMDC Limited. Mine management was advised to acquire 21.74 hectares of additional land beyond the west side of existing mining leasehold to form waste dump WDY6 for sustaining mining operation in scientific manner for next 20 years as shown below. The slope stability analysis of the proposed dump configuration of 170 m RL difference was found to have factor of safety of 1.43 under drained condition and hence may be considered stable. This long term planning has helped the mine management in identification of dump areas within and outside the mining lease hold to be processed for change in land use pattern and for acquisition from the concerned government agencies in advance.







Proposed waste dumps

12. STRATA MECHANICS SECTION

The Strata Mechanics Section has undertaken R&D in CSIR-4M Theme Focused Basic Research (FBR) titled "Preparation of in-situ stress map of Jharia coalfield" and an in-house project titled "Laboratory experimentations-based design of goaf edge support using high capacity roof bolts". Also, this Section was engaged in various industries sponsored and consultancy assignment related to safe mechanised depillaring using Continuous Miner (CM), ground stability over the underground galleries, design of support system and strata control and management plan on the basis of extensive field and laboratory investigations.

During this period, design of support system, strata management plan, advice for safe depillaring of CM panels, cavability of hanging overlying massive Deccan trap, ground stability over the underground galleries lying beneath and within 45m of railway acquired land and safety studies have been undertaken for various organizations and companies viz. M/s Singareni Collieries Company Limited (SCCL), M/s South Eastern Coalfield Limited (SECL), M/s Western Coalfield Limited (WCL), M/s Eastern Coalfield Limited.

CSIR-CIMFR conducted strata behaviour study for safe extraction of pillars by installing different strata control instruments in most of these panels. Considering the site details of different panels of GDK-11A Incline Mine of SCCL, the existing CM technology was used for final extraction of these CM panels. CSIR-CIMFR conducted the strata behaviour study in CM panels of Vindhya underground mines, SECL during depillaring for strata behaviour study on request of SMS Limited, the implementing agency. Detailed methodology was adopted for the final extraction of coal pillars in these panels, including support system, strata control and management plan (SCAMP).Excellent techno-economical performance of a mechanized depillaring face has considerable potential for our geo-mining conditions. Also, conducted scientific study and advised for safe depillaring as well as limit for strata control parameters in CM panels of SCCL and SECL. Stability of the ground/surface over the underground galleries lying beneath and within 45m of railway acquired land is also studied with the help of CSIR-CIMFR pillar strength empirical formulation. Accordingly, CSIR-CIMFR evaluated the support design and instrumentation requirements along with their plan for stability of the railway line and underground workings. Caveability of overlying hanging strata in the goaf is assessed for smooth caving during pillar extraction at Mathani Underground mine of WCL. A parametric study is conducted on a number of calibrated models in FLAC^{3D} for design of roof bolts in underground coal mines by varying the values of confining horizontal stress as experienced at the goaf edge for the in-house project. Efforts are being made to procure basic technical infrastructures and human resources for the capacity building of CSIR-CIMFR to measure insitu stress in different coalfields of India.









Roof lowering study by an AWTT installed in the gallery of a Bord & Pillar working Stress-strain curve characteristics of a rhomboid pillar/snook/rib



State of pillar different heights after testing their strength Design of roof bolts-based breaker line support based on estimation of rock load height



EDTCMS located after a parting from the coal seam



EDTCMS located just immediate of the coal seam

13. CSIR-CIMFR NAGPUR RESEARCH CENTRE (Unit-1; Mining Technology Group)

Scientists of the rock excavation group had undertaken various assignments on blast optimization and projects related to mining, quarrying and tunnelling involving safety enhancement in mines and to improve overall cost economics of mineral extraction. Scientific issues related to stability of the mine slopes, dump slopes, open-cut slopes were dealt in project mode to save time and cost of industrial projects thereby providing technical backup for day-to- day smooth functioning of excavation operation.

Controlled blasting practices have been implemented in various mines of WCL, UltraTech Cement, ACC Limited, India Cement etc. to exploit the 'locked-in mineral reserves' in immediate vicinity of the populated villages and important structures, which were very adjacent to the operative mines. To enhance routine mine production, the unit operation of blasting has been optimally designed. By adopting safe, planned and scientific approaches, industries got statutory clearances, within 300 meters of the villages and residential areas. Such blasting practices, needed to conduct routine blasts and exploit the mineral in large quantity also helped the mine management to minimize flyrock and ground





vibration problems, commonly faced. Its immense benefits have been realized by the society in terms of environment protection on long run.

Mines of hard rock excavations were immensely benefited with the CSIR-CIMFR advise e.g. Rajhara iron ore mines of Bhilai Steel Plant (BSP) of M/s Steel Authority of India (SAIL), Malanjkhand Cooper Project (MCP). - An Open Cast Copper mine, Rampura-Agucha Mine of M/s Hindustan Zinc Ltd.

Fig. 1 : (Clockwise)

- (a) Flyrock generation due to blasting
- (b) Blasting mats to control fly rock

(c) Field monitoring in open cast mine of ACC Cement, C.G.

(d) Ground vibration & AOP monitoring Equipments

The centre's R&D initiatives were instrumental in improved ore recovery from workplace and stope's support in metal mines. Through 3D numerical modeling both support designing and advance prediction have been made precise and focused.



Geo-hydrological studies were conducted and completed for MCP-HCL and BSP-SAIL mines. Ongoing major Grants-in aid project of centre with Central Power Research Institute (CPRI), Bangalore (Title - Development of selection methodology for road header and tunnel boring machine in different geological conditions for rapid tunnelling) headed towards next phase and desired progress have been achieved. The project was extended till Jan 2020 and full payment of all instalments received. In terms of analysis of geological data and geotechnical parameters the data from Delhi metros and Kolkata metros have been analyzed. State-of -art facilities at IIT-ISM in rock cutting developed. It is expected that in final phase, improved selection methodology for which this project objective has been designed will be achieved. Cutter design of road header, improved TBM design parameters, past experiences and field studies will be the basis in developing it.

Geotechnical studies at limestone mine of M/s Shree Cement Ltd. , Rajasthan has resulted in the evaluation & recommendation of the ultimate pit slope designs for pit depths of 150 - 200 m. Similarly, investigation were conducted in New Majri opencast - II (A) expansion coal mine of Majri Area, WCL for evaluation of overburden dump slope (s). For a dump height of 100 - 200 m, with bench height of 20 m, the designed dump slope angle of waste (overall) were suggested in the range of 21 - 26 degree.

During this period 'infrastructure construction projects' like Mumbai metro / Bangalore metro rail projects were also executed to give consultancy services and scientific advises. CSIR-CIMFR was the knowledge partner for the blasting related works (PI see photo below^[]). We as CSIR laboratory was appointed as a technical consultant for the design and monitoring of controlled blasting for rock excavations at three major stations at Bangalore metro and two major packages covering 6 underground stations at Mumbai metro. The stations at Bangalore include, City Market, Chikpet and Majestic stations and and 6 stations in Mumbai include MIDC, Marol Naka, SEEPZ, Cuffe Parade, Hutatma Chowk and Church Gate) and 2 TBM Launching sites (Pali Ground Shaft and Seepz ramp) belong to package-1 and 7 of UGC Line-3. All the proposed stations are situated at densely populated places. The proposed blasting zones are surrounded by very sensitive and critical structures like temples, high raise structures old buildings etc. at a minimum distance range of 10-30m, making the blast design as the most challenging task.





The rock excavation required at Bangalore Metro was 1.5 lakh cubic meters and at Mumbai Metro was 2.5 lakh cubic meters for both Package-1 &7. CSIR-CIMFR developed and tailor-made 'controlled blasting technology' was successfully applied at these real excavation sites.



14. CSIR-CIMFR ROORKEE RESEARCH CENTRE (Geotechnical Engineering and Underground Space Utilization)

Roorkee Research Centre of CSIR-CIMFR has undertaken assignments of translational research and extended technical expertise as knowledge partner in various projects of National importance in the areas related to (i) Design of highway tunnels and railway tunnels, (ii) Design of cut slopes along roads, in mines and above tunnel portals, (iii) Rock mass characterization, (iv) Tunnel instrumentation and monitoring, (v) Optimization of rock excavation by blasting and (vi) Safety related problems for tunnelling sectors

The major clients are - 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 Ultratech Cement, Kovaya.

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. The rocks on the slope above ventilation tunnel portal are jointed and blocky which has been supported by the galvanized wire-mesh and rock bolts (Photo 1). In the main tunnel from west portal in view of cracks in shot Crete, strengthening of support was suggested above spring level before the bench excavation. To drain out the underground seepage water from tunnel in winter, an easy siphon (gravity) drainage arrangement was suggested through long strong but flexible pipes in the eastern portal. Supports having capability of absorbing high energy were also suggested near junctions in hard sandstone strata below high rock cover (>600m) in order to minimize the effect of release of instantaneous staring energy causing failure of the tunnel stretch. It was recommended to increase the shot Crete thickness to cover the lattice girders for proper distribution of rock load in ventilation tunnel (Photo 2).







Photo 1: Rock fall protection measures along the slope at ventilation tunnel portal



Photo 2: Lattice girders with shotcrete support in ventilation cavern

Rishikesh - Karnaprayag Rail Link Project, GTI, Package 2: 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 hydro-fracture tests. During the reporting period dilatometer and BHTV tests in borehole no. 76 and hydrofrac tests in BH-66 at 96.5m and BH-59/3 at 108m have been supervised (Photo 3). In addition, the core logs of Borehole nos. B8-P1, B8-P2, B8-P3, B8-P4, 51/1, 59/3, 72, 72A1, 75 have been checked and approved. Rock samples from borehole Nos. 56, 62, 62, 63, 65, 68 and 72A were recommended for various geotechnical tests. Water samples from borehole Nos. 56, 63, 65, 68, 72 and 72A were recommended.

Rishikesh - Karnaprayag Rail Link Project - Adits 1, 2, and 3: CSIR-CIMFR Roorkee Centre has been entrusted by RVNL for the consultation work for support design, excavation methods and instrumentation scheme for Adits 1, 2 & 3, which will connect main rail unnels T1, T2 & T3 respectively. The Adits will open new faces for working in respective main tunnels. Adit 1 of 349.29m length is proposed to traverse through overburden material and interbeded limestone and shale with varying Q-value (0.08-4.4) under overburden of 1.6-166m. The first stretch of about 75m from the portal is full of highly jointed and weathered limestone interbedded with shale giving a challenging task of establishment of portal. Adit 2 of 612m length will traverse through quartz arenite with varying Q-value (0.95-6.6) under overburden of 3.9-187m. 809m long Adit 3 will traverse through grey limestone with interbedded shale having Q-value in the range of 0.17-2.64 at rock cover of 5-236m. First stretch of about 70m has to be excavated through silty soil mixed with cobbles and pebbles using pipe roof umbrella technique (Photos 3). The portal of adit 3 has been fixed on river borne material comprising of silty and sandy soil mixed with cobbles and pebbles. The slope has been supported by rock bolts, wiremesh and shotcrete. The shape of adits would be modified horse-shoe of size 8.6m x 6.9m. Excavation of Adit 3 has been started and reached uoto 16m from the portal. This stretch is being supported with piperoofs (104mm, 4mm), steel ribs equivalent to ISHB 200,







Photo 3: Piperoof umbrella with steel ribs and shotcrete in Adit 3



Photo 4: Testing of polypropylene fibre reinforced shotcrete panel at Adit 3 site

wiremesh and fibre reinforced shotcrete. The shotcrete panels have been tested at site to deisgn the mix to get the desired energy absorption capacity (Photo 4). Excavation of Adits 1 and 2 are yet to be started.

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. The rock excavation works of machine hall is completed safely. Blasting works for benching of BVC and PAC, surge shafts and bus duct- 5 are in progress. Ventilation tunnel passing 9 m below Adit-3, which is main access tunnel to HPP powerhouse is the critical excavation. CIMFR Roorkee has provided controlled blast design using multiple stages to ensure safety of the surrounding structures.

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. During the period ground survey was carried out and contour lines were mapped to construct drainage system. Further, using LiDAR survey, the tunnel portals and cut slopes outside portal were mapped. Using the collected data, tunnel portal support system having rockbolt and shotcrete system were designed and implemented at site. The measures suggested for drainage system along the tunnel alignment have reduced water seepage problem to a large extent and improved the safety of users (Photos 5 & 6). The project work is in progress.







Photo 5: Retaining wall above portal



Photo 6: Pindwara end portal

Parsik Tunnel: The 1.3km long Parsik railway tunnel on Mumbai-Kalyan mainline (between Kalwa and Mumbra local stations) cuts across the Parsik Hill in Thane, Maharashtra, India. This double track tunnel is used by all trains that run between Thane and Kalyan and was opened for traffic in the year 1916 (Photo 14). The tunnel is excavated in Basalts of Deccan Trap Formations. The rock cover above the tunnel is as high as 200-250m with about 15-20 m near the portal region. The tunnel is approximately 10m wide and about 6m high and aligned at N103°. The entire length of tunnel is brick lined up to SPL and at some locations below SPL also. The tunnel was experiencing severe water seepage problem inside the tunnel, particularly near the Kalwa end portal region. A zone of approximately 75m was reported to be affected i.e. from chainage 75 to 150m. CSIR-CIMFR undertook study for providing design for rehabilitation/repair and to prevent seepage inside the tunnel. CSIR-CIMFR in its report suggested to grout the tunnel from inside with chemical grouts. The grouting of Parsik tunnel was successfully carried and on inspection on 15/02/2019 it was observed to be mostly dry. It was also observed that the water has been effectively diverted from crown towards the drainage pipes at SPL level provided to collect the water and to transport it to tunnel drainage system (Photos 7 & 8).



Photo 7: Grouting rig and material mounted on rail wagon



Photo 8: Finished Parsik tunnel after grouting

Vishnugaad-Pipalkoti Hydroelectric Project, Pipalkoti is important World Bank funded hydropower project located in Chamoli District of Uttarakhand. CSIR-CIMFR Roorkee is giving technical assistance for rock mass excavation using controlled blasting techniques for construction of various underground





hydropower structures such as power house, transformer hall, head race tunnel, disilting chamber etc. Transformer hall, surge tank and powerhouse are to be excavated in extremely unfavourable rock mass conditions. The work is continuing from previous year. With varying geology, CSIR-CIMFR Roorkee Centre has optimized blast design parameters by monitoring blast induced ground vibrations. So far, heading in transformer hall, powerhouse, surgeshaft chamber are comleted. Rock excavation in benching of Desiltin Chamber (DC) and Head Race Tunnel (HRT) is in progress (Photo 9). Similar to works in Vishnugaad-Pipalkoti Hydroelectric Project (VPHEP), CSIR-CIMFR Roorkee is providing technical assistance for safe rock excavation at Tapovan-Vishnuggad Hydroelectric Poject, Joshimath, Uttarakhand.



Photo 9: Excavation of HRT using controlled blasting techniques in varying geology

Khanak Stone Mine of HSIIDC: CSIR-CIMFR Roorkee research Centre is associated with Haryana State Industrial and Infrastructure Development Co. (HSIIDC) for technical support of their first mining venture at Khanak, Haryana. M/s HSIIDC have also requested for blast design to undertake blasting operation as close as 100 m from the domestic houses for optimum exploitation of mineral. CSIR-CIMFR Roorkee team has carried out detailed field investigatios at site with deifferent blast dsign parameters for increasing productivity and mitigation of ground vibration & air overpressure. 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 present requirement of fertiliser mineral potash is met by import only. The current import of potash is around 4.6 million tonnes which entails foreign exchange of approx. Rs. 10,000 Crores per annum. As a result of initiative of CSIR-CIMFR and discussions with NITI Aayog, the potash exploration work in Rajasthan is under progress by MECL. On completion of exploration and grant of prospecting licence through e-auction, the site-specific mining methodology will be evolved by CSIR-CIMFR for the first potash mine in India.

Kovaya Mines: The Kovaya Limestone Mine of UltraTech Cement Ltd. is situated on the Saurashtra coast of India in Kovaya, Distt. Amreli, Gujarat. The deposit is a marginal grade limestone deposit, intermixed with Marl and is being mined through open cast. Mining operations are being carried out by fully mechanized method of mining using surface miners and by conventional method i.e. drilling



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and blasting with slope bench heights of approximately 6m and berm widths of 4.5 to 15m. These slopes have to be analysed for their stability and for the safe operations of the mines. CSIR-CIMFR team carried out the study to determine the rock slope stability conditions and idenditied potential failure mechanisms and designed optimal excavated slopes in terms of safety and reliability (Photos 10 & 11).



Photo 10: Open pit slopes of Kovaya mines



Photo 11: Open pit slopes of Kovaya mines



C. FUEL SCIENCES

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C. FUEL SCIENCES

15. COAL PREPARATION AND CARBONIZATION RESEARCH GROUP 15.a. COAL PREPARATION

Coal Preparation section has undertaken various projects on washability, sampling of indigenous and imported coals, flotation, Dry beneficiation etc. The clients included SAIL, Kolkata, Bharat Coking Coal Limited, SAIL Collieries Division, Chasnalla. During this period, Sampling and Analysis of Imported coals, rejects and slurry, recovery of additional clean coal from middling's, Substitution of imported coal through beneficiation, blending and coke making from indigenous raw materials, to provide expertise to operating coal washery for its capability to wash high ash non coking coals have been undertaken for various organizations and companies.

The Department is involved in the "Sampling and Analysis of imported coal unloaded at Port ends for SAIL" The main objective is supervision of collecting the representative samples from the stacks lying at the port ends and preparation of samples for characterization as per the standard procedure and as desired by the sponsor. The work was completed to the satisfaction of the sponsor.

The Department is involved in "Sampling and analysis of Rejects lying at Patherdih Coal Washery of Bharat Coking coal Limited", The ash content in heap no. 6 is very high i.e. 68.17% and GCV is very low i.e. 1450 kcal/kg only. GCV of Road 2093 kcal/kg is maximum and Ash content of East of Drinking water is the minimum i.e. 61.46% among all locations. Similar nature of work undertaken by the department on "Sampling and Proximate analysis on equilibrated condition with GCV of 60,000.00 MT slurry stacked at Heap No. 5 (B) dump near PS-8 at Madhuban Coal Washery" The results indicate that the slurry ash varies from 28.3% to 35.9% and moisture varies from 1.8% to 2.1% while volatile matter varies in the range of 15.2% to 18.4%, indicating low VM and the fixed carbon varied from 47.1% to 51.5%. The GCV varies from 4922 to 5698 kcal/kg.

The department was involved in an R & D project "Recovery of Additional clean coal from washery Middlings using oil Agglomeration Technique". The main objective is characterization of the middling sample followed by laboratory oil agglomeration tests. The sample supplied the party is characterized as high content and there is no liberation even after crushing it to very fine sizes. Detailed laboratory oil agglomeration tests were carried out by varying RPM, collector and furnace oil dosage and the studies showed that the reduction in ash units is 3 to 4% only, this may be due to the non selectivity and presence of more hydrophilic particles.

The Department has received a project of national importance from "Substitution of imported coal through beneficiation, blending and coke making from indigenous raw materials". The main objective is to substitute the imported coal by beneficiation, blending and coke making from indigenous raw material sources of Chasnalla, SAIL, Dhanbad by conducting detailed studies on the cleaning potentialities of high ash coals supplied to Chasnalla Washery, Jhama and coal fines. It was observed that about 30 to 40% indigenous coal, jhama and coal fines may be blended with imported coal to form a good coke. Further studies are under progress.

The department had provided consultancy on "To provide expertise to operating coal washery for its capability to wash high ash non coking coals." The objective is to provide consultancy services to the operating washery regarding its capability to wash non coking coals. Visited the washery and inspected the different units of the washery. The washery consists of crushers, screens and hydro classifier for





separation of rejects through fluidized techniques. The washery is having the capability to wash high ash non-coking coals.

15.b. COAL CARBONIZATION

The section had provided consultancy service on **"Capacity Assessment of coke oven plant for Sriram Smokeless fuel. (Aurangabad)".** The objective of the project is Assessment of coal throughput and coke production capacity of the coke oven plant advice the concerned sponsoring agency. The coke oven was investigated and capacity assessment report was prepared. Coal coke industries were benefited from the project.

The section had provided consultancy service on **"Capacity Assessment of coke oven plant for Economical Coke Company. (Aurangabad)".** The objective of the project is Assessment of coal throughput and coke production capacity of the coke oven plant advice the concerned sponsoring agency. The coke oven was investigated and capacity assessment report was prepared. Coal coke industries were benefited from the project.

The section had provided consultancy service on **"Design and Development of sole heater soft coke oven plant of coal charging capacity 4500 t/month for M/s Hari Om Industries, Aurangabad".** The objectives of the project is Design and develop an commercial scale sole-heated improved soft coke oven Battery of coal charging capacity 4500 TPM for production of low smoke fuel by low temperature carbonization of non-coking coal and commissioning it in the premises of M/s Hari Om Coke Industries, Aurangabad. Various parts of the sole heated soft-coke oven battery was designed and handed over the client for construction. Coal and coke oven industries are benefitted from this project. The work is in progress.

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

16. COMBUSTION SCIENCE AND TECHNOLOGY RESEARCH GROUP

The thrust areas of the research group is to studies on impact of coal qualities, blending in power plant performance, clean coal technology, GHG & mercury emission and estimation of normative coal requirement for different industries. The department is having three major facilities for combustion studies. The three facilities are lab scale Thermogravimetric Analyser (TGA), bench scale Drop Tube Furnace (DTF) and pilot scale Fuel Evaluation Test Facility (FETF). These three facilities are utilized for studying combustion characteristics of coals, coal blends, coal-biomass blends and previously we are serving different industries like NTPC, Reliance Energy, Tata Steel, Gondowana Geotech Pvt. Ltd., NALCO. Our department has also different facilities like Direct Mercury Analyser, Lumex RA915 mercury analyser equipped with Pyro-915 Pyrolysis Attachment, Sorbent trap Sampling Probe OLM30B for Stack Mercury emissions monitoring using USEPA Method 30B sorbent traps for studying mercury emissions from different plants.

Combustion Science and Technology Research Group of CSIR-CIMFR has undertaken different R&D and consultancy projects in the area of coal blending, GHG emission inventory, Normative requirement of coal for different industries, studies on boiler clinker formation and mercury emission.




Energy sector Inventory [Biennial Update Report (BUR-2, BUR-3) and Third National Communication (TNC)– To be communicated by Govt. of India to United Nations Framework Convention on Climate Change (UNFCCC)]: In this nationally important project the research group is involved in i) preparation of national GHG inventory for Energy and Manufacturing Industries for different years ii) estimation of country specific and sector specific NCVs and CEFs for Indian coal iii) estimation of oxidation factor for coal combustion in thermal power plant. This activity is a significant contribution towards the preparation of National Energy Sector Inventory of GHG emission for onward communication of Govt. of India to UNFCCC.



CSIR-CIMFR team in Maithon Power Limited in connection with GHG project

The research group is also involved in national Inventory development of Mercury in Emission sector in India (funded by UNDP). The Minamata Convention on Mercury is a legally-binding multilateral environmental agreement under the aegis of UN Environment that aims to protect human health and environment from anthropogenic emissions and releases of mercury and mercury compounds.

In this regard UNDP and MoEF&CC in association with six other Ministries (Ministry of Coal, Ministry of Power, Ministry of Health & Family, Ministry of Chemical & Fertilizers, Ministry of Commerce & Industry, Ministry of Finance) had initiated a project, on development of National Mercury Inventory in India. CSIR-CIMFR has been given the important responsibility of developing mercury inventory in emission sector. Our department is engaged in preparing mercury emission inventory from four major subsectors comprises of various industrial sectors e.g. power, steel, metal production, Fuel production, cement etc. Presently our department engaged in evaluation of mercury emission from 15 different industries to develop country specific emission factors.

For inventory level 1, we have already identified sources of mercury emission in India. Coal combustion, cement production, Zn & amp; Pb smelters, are major sources of mercury. Other than that oil and natural gas combustion, ferrous and non-ferrous metal production, paper industry are important sources of mercury emission. In level 1 study we found, total estimated mercury input under emissions sector is ~376 metric tonnes in 2016. Major inputs are from coal combustion (34%) followed by zinc (23%), copper (23%) & cement (10%). The output of mercury shows that about 46% of input mercury goes to the air. Among the rest, release pathways are mainly to by-products and sector specific waste. In air emission, coal combustion contributes to about 68%, followed by primary metal production and cement. We have already started mass balance study in different industries. Till now we have covered 3 power plants (of different technology and APCD), 2 steel plant, Copper, aluminium, Zinc & Lead smelter, cement plant. Initial analysis suggests there will significant deviation from default factors and Indian factors in few sectors. With Level 2 study we will have better understanding mercury flow in different sectors in India. It will not only help in better estimation of mercury emission in India, but also provide



CSIR - CIMFR





a unique document which can help in effective management of mercury emission in different sectors. Flue gas Mercury Monitoring in Thermal Power Plant and Steel Plant by CSIR-CIMFR team

The research group is involved in setting up modalities for normative coal requirement for different sectors which provide the scientific basis of estimating the normative requirement of coal in different sectors/industries at India to Coal India Limited. This will help to take policy decision by Ministry of Coal for judicious coal allocation and to prevent misuse of precious coal of different grades presently mined in India.

The research group has provided scientific inputs to CSIR-NEERI, Nagpur regarding utilization of sludge by blending with coal by studying combustion behaviour of coal/sludge blends in thermogravimetric analyser and drop tube furnace and also provided probable cause of boiler clinker formation to BkTPP, Bhirbhum, WB in their 210 MW power plant.





CSIR-CIMFR team in BkTPP, Bhirbhum to solve boiler clinker formation problem

Beside the above activities staff members of this research group actively involved in the mega project "Quality Coal for Power Generation". Contributed in sampling and analysis of coal at loading and unloading points in different sites.





17. GASIFICATION AND LIQUEFACTION RESEARCH GROUP

The gasification and liquefaction research group of CSIR-CIMFR has undertaken various activity on catalytic petcoke gasification study, development of air blown fluidized bed gasifier, gasification potential mapping of Indian coal, coal fly ash as a source of rare earth elements.

During this period, the department has undertaken the project on Catalytic petcoke Gasification Study (CSIR funded project in Focus Based Research under Chemical Theme). In this project, catalytic petcoke gasification reactivity/kinetics using thermo-gravimetric analysis by direct addition of catalyst to petcoke have been investigated. As such, gasification reactivity of petcoke is very low and needs high temperature (~1500 -1600 °C) to gasify petcoke. High temperature operation is very energy intensive process and overall efficiency of the process becomes very low. However, catalytic petcoke gasification has the ability to lower the process temperature (~ 1050 °C), and overall efficiency of the process can be enhanced as well as capex, and opex can be minimized. It has observed that alkali, alkaline earth metal-based compounds are very effective as catalyst. Selected compounds are doped in petcoke before conducting gasification reaction. After doping the catalyst, it was found that petcoke Gasification reaction occurs below 1000 °C. Catalytic petcoke gasification were conducted at four different temperatures such as 850 °C, 900 °C, 950 °C and 1000°C with different percentage of catalyst loading varying between 1 to 10%. Co-gasification of petcoke and biomass were also conducted to evaluate the effect of biomass loading on the gasification reactivity of petcoke. This study will develop a systematic data base on 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, this study will be conducted in the pilot scale fluidized bed gasifier to validate the lab scale results in the in pilot scale gasifier with the selected catalyst.

The department has received a project on Development of Air Blown Fluidized Bed Gasifier (Under the aegis of NITI Aayog). The main objectives is to Development of fluidized bed gasifier (FBG) along with suitable fuel feeding, ash extraction system and retrofitting with available facility and evaluation of the gasification performance of high ash coals and maximization of performance by adjusting the operating parameters and blending with biomass feeds. From previous experience gained in pilot scale 20 kg/h fluidized bed gasifier (FBG) with high ash Indian coal, it is found that high ash coals can be gasified in FBG without any operational issues such as agglomeration and clinker formation by proper synchronization of operating parameters. Based upon previous experience 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. The database will help to design and develop commercial scale gasifier for utilizing high ash coal for different applications. The gasifier system is under fabrication stage and will be installed and commissioned shortly.

The department is also involved in the project entitled Gasification Potential Mapping of Indian Coals and utilization Strategy (under the aegis of NITI Aayog). In this project, Basic coal properties such as, proximate, ultimate, heat value, caking index, hard grove grindability index (HGI), mechanical strength, surface area, pore structure, coal ash composition, ash fusion temperature as well as slag behavior, gasification reactivity and kinetics are essential to understand gasification behavior/performance of coal and to design & develop suitable gasifier.

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Among three types of gasifier, Entrained flow gasifier is a developed technology but may not be suitable for handling high ash coal. Fixed bed gasification technology is also a developed one but restricted up to 30-35% ash containing coal. Fluidized bed gasifier is most suitable for high ash coal but it is under developing stage. Presently there is no commercial fluidized bed gasifier in operation worldwide. *Though, coal ash content is an important parameter for selection of gasifiers, other properties as mentioned above are also crucial for gasification behaviour and performance of coal in a particular type of gasifier*

Therefore, abovementioned fundamental coal properties along with gasification reactivity and kinetics are essential to accesses the gasification potentiality of Indian coals of different coal fields. Under the aegis of NITI Aayog a project has been taken up to develop a comprehensive data (gasification potential mapping) which will guide to assess the suitability of particular coal towards gasification at the same time it will assess the potentiality of individual coal for particular type of gasifier. It will also be useful for designing and developing suitable gasifiers for Indian coals.

This research group also received the project entitled a study to explore the potentiality of using Coal Fly Ash (CFA) derived from Indian Thermal Power Plants as a resource of Rare Earth Elements (REEs) under the funding Agency: Science and Engineering Research Board, DST, GOI.

18. INDUSTRIAL BIOTECHNOLOGY AND WASTE UTILIZATION

Industrial Biotechnology and Waste Utilization Research Group has undertaken different R&D projects sponsored by DST, CSIR-SRA, GAIL, NTPC and also some in-house funded projects in the area of sustainable utilization of industrial wastes.

Ash generated after combustion of biomass and spent wash is a menace and is a huge challenge for its disposal. Based on the success achieved during the 12 FYP project, CSIR has funded a mission mode project for commercial deployment of the technology. M/s Coromandel Fertilizer, Visakhapatnam and its sister concern M/S EID Parry, Chennai is interested in our technology and the process has been successfully demonstrated to them. Potassium rich salt was extracted from the ash and the residue ash was converted into bricks.

GAIL has sponsored a R&D project for developing process for CO_2 capture from exhaust gas of GAIL Pata plant (UP). Various strains of microalgae were isolated and optimum conditions for CO_2 capture was studied. The algal biomass is rich in protein and fatty acid. Extraction of various value-added products from the algal biomass was also studied. Based on the novel development carried out in the project, 2 patents were filed: (i) Process for CO_2 (99.9%) capture by filamentous cyanobacteria in fibrous matrix photo-bioreactor using modified algal growth media (0195NF2016) and (ii) Process for sequestration of CO_2 and traces of hydrocarbon from natural gas processing industry by micro algae (No:0019NF2016). In the ongoing pilot scale study, CO_2 from GAIL Pata shall be fed to a microalgae inoculated raceway reactor.

Fly ash and industrial wastes like aluminum dross and industrial slags could be a valuable raw material for slow release nitride fertilizer. Based on the research expertise gained during the deputation to Pacific Northwest National Laboratory, USA, CIMFR Scientists have initiated studies for preparation of nitride fertilizer. Raw materials collected were characterized and the recipe for the combination of different industrial wastes and other raw materials has been identified.

Gaurigram, Chandankiyari, Dhanbad was selected for biomethane societal project. The villages comprises of 300 houses with 3500 population. Most of the villagers are depending on agriculture for their survival. Rice is the major crop cultivated in places slightly away from their houses in Kharif (June to Oct) season and few grow vegetables after the harvest of rice. Every house is having a good number





of animal husbandry and backyard kitchen garden. Coal washery fines and abundant organic wastes (poultry waste, agricultural waste, cow dung, kithcen waste) are available in Gaurigram village. Coal washery fines and the organic wastes can be effectively used for domestic biomethane production. Farmers meet was conducted for identification of potential farmers. Bio methane fermenter (2000 litre capacity, CSIR-CIMFR CROW model) is under fabrication.

Wastes from kitchen, domestic and organized sectors (like hotel, mess, institutes, etc) pose tremendous opportunity to exploit plant nutrients and carbon present in the wastes by preparing soil amendment materials. Proper utilization of these waste through biochar, composting and/ or co-composting of them, can provide sustainable organic manure. Under the CSIR-SRA funded on-going project, the process for conversion of organic wastes to biochar has been optimized, a biochar kiln has been designed and fabricated by the CIMFR workshop for production of biochar from different feedstocks. Biochar prepared from yard-waste was added to the composting materials i.e., yardwaste and food waste in different ratios to select optimum dose of biochar and compost for preparation of co-composted biochar.

Another innovative research project on bio processing of coal based industrial effluents using aquatic plants/phototrophs vis-a-vis recovery of coal-fines was funded by CPRI, Bengaluru. The greatest and the most long-standing problem in coal washing plants is the disposal of effluent, which contains suspended solids which creates serious problems of deterioration of water quality of the river or water bodies into which they are discharged. Aquatic photosynthetic organisms can remove toxic contaminants from coal-based industrial effluent far more quickly than terrestrial plants. As most of the aquatic plants have a harvesting cycle of 1–10 days, it permits several harvests in a very short time frame. Aquatic plants can grow 20 to 30 times faster than food crops. Once harvested, aquatic plants can serve as a product to offset the invested cost. CSIR-CIMFR has initiated studies for developing **a cost effective technology for treatment of coal industrial effluent by using aquatic plants**.

19.a. CSIR-CIMFR BILASPUR, RESEARCH CENTER,

CSIR-Central Institute of Mining and Fuel Research, Regional Centre, Bilaspur has undertaken various assignments on Coal Quality Monitoring, Particle Size Distribution of Blasted Roam Coal, Borehole Coal Core Analysis and Analysis and Comparative Study of samples collected by IS Method, Auger Method and FSA procedure at NTPC Kaniha, Orissa.

During this period, Coal Quality Monitoring has been undertaken for various organizations and companies viz. South Eastern Coalfield Limited and North East Coalfields of Coal India Limited, different power plants of Chhattisgarh State Power Generation Corporation Limited, Madhya Pradesh Power Generation Corporation Limited, Rajasthan Rajya Vidyut Utpadan Nigam Limited, Maharashtra State Power Generation Company Limited, Uttar Pradesh Power Corporation Limited, Adani Power Mundra, Adani Power, Tiroda's Maharashtra, Lanco Amarkantak, DB Power Limited, Dhariwal Infrastructure, GMR Warora, Jay Prakash Power, Jindal Power Limited, Jhabua Power Limited, MB Power Limited, Maruti Power, Rattan India, Reliance Power Dahanu, RKM Power, SKS Power, Torrent Power, TRN Energy and Various NTPCs viz. NTPC Sipat, NTPC Korba, NTPC Meja, NTPC Bongaigaon, NTPC Mouda, NTPC Lara, NTPC Farakka, NSPCL Bhilai etc.

Central Institute of Mining and Fuel Research Institute (CIMFR) Bilaspur unit is fully committed to studies on Coal characterization and quality evaluation of coal resources in the states of Madhya Pradesh, Chhattisgarh and Orissa. The laboratory is serving as single analytical facility for processing and Quality Assessment of coal cores generated through exploration agencies like Geological Survey of India (GSI), National Coal Development Corporation (NCDC), Central Mine Planning & Design Institute (CMPDI), Mineral Exploration Corporation Limited (MECL) and state Directorate of Geology and Mining (DGM) in the area.





Borehole Coal Core Analysis of different coalfields has been undertaken in this period - coal cores of Pathakpur, Shivsagar and Tulsi Blocks belonging to Bisrampur Coalfields, Bhilai Bazar and Amgaon blocks of Korba Coalfields, Nayadih, Nayadih Sarapal, Orgaon Potia and Kusumghat blocks of Mand-Raigarh Coalfields from the state of Chhattisgarh were analyzed by Regional Centre, Bilaspur and explored by Central Mine Planning and Design Institute (CMPDIL). Other areas under exploration arena of CMPDIL and examined by CIMFR, Bilaspur are coal cores from Singhpur North, Chulia Bulia east and Central block, Baheraband, Chainpa, Jamui, West of Sahdol block and Kewai Block of Sohagpur Coalfields belonging to the state of Madhya Pradesh and accordingly 18652m of coal cores have been analyzed in the given period and results were communicated in this activity where 1221 HGI samples were analyzed.

Apart from that, coal cores from Sendur Block of Tatapani Ramkola Coalfields, Tendumuri Jobro West and Kida Block from Mand-Raigarh Coalfields of Chhattisgarh, Tummi Kharsal Block of Sohagpur Coalfields, Sarai Upharadol Block belonging to Son - valley from Madhya Pradesh, Teliabahal and Kendudihi Block of Ib Valley and Kantaikalia North Block and Khandanal Block of Talcher Coalfields belonging to Orissa, have been examined by CIMFR, Bilaspur that aided in the exploration of the area for coal by Geological Survey of India (GSI) and 2101.23m of coal cores were analyzed and handed over to GSI in the given period.

Coal cores received are visually logged for variation of coal quality in sections constituting the core profile, and these differentiated sections are then made in to individual samples for detailed analysis of coal quality. Integrated samples from these individual sections are also prepared for detailed studies of quality and properties of potential workable sections of the coal seams. The study of borehole coal cores reveals the nature, mode of occurrence and physical variation of the sub surface coal. From the geological and geochemical data generated after core logging and analysis of coal samples, fixation of coal seam within horizons becomes possible. An idea about the quality of coal seam subjected to beneficiation is also obtained. Also, reserve estimation of a particular area or block can be done once the disposition and lateral extent of the coal seams and the quality of coal it harbors is known. Finally the feasibility of mine development is also drawn from the overall study of an area.

The laboratory collected and analyzed large number of coal samples from coal producers like SECL and NEC for determining the actual quality of coal sent to and received by the power plants (as per the Tripartite and Bilateral Agreement) as part of the Coal Quality Mega Project. The power plants includes NTPCs, State power generation companies of Chhattisgarh, Madhya Pradesh, Maharastra, Gujrat, Rajasthan, Punjab and private power plants namely Adani, Reliance, Torrent, L&T-NPL, JPL etc. The exercise has resulted in amicable settling of issues related to quality of coal consignments.

Under technical Aid to industries, that includes Coal Controller Organization and other commercial industries like that of cement manufacturing, paper mills, sponge, iron and steel etc., required analysis was carried out for 338 numbers of coal samples.

A research and development work oriented project costing 16 lakhs of Particle size analysis of Blasted ROM coal was also completed in this period. Approximately 40 Tons of ROM coal sample from Parsa Kente mines seam number 4 was supplied by Adani Enterprises limited. A comparative study was conducted to verify Auger sampling methodology. For that purpose 900 numbers of samples were collected from rakes by three different method viz. 1) Indian Standard Method 2) FSA Procedure 3) Auger Sampling Methodology at NTPC Kaniha. Analysis was done to these collected samples at CIMFR Regional Centre Bilaspur. Particle Size Analysis was also carried out for 30 numbers of samples out of 900 samples.







1. Sample collection under coal quality monitoring project through a) Rode Mode Dispatch b) Rail mode c) Rail Mode by Rapid Loading System d) Conveyer Belt



2. Analysis of Coal Sample a) AFT analysis and Proximate Analysis by TGA b) Volatile matter determination by conventional method c) GCV determination using Bomb Calorimeter d) Drying of samples for Total Moisture analysis.





TESTING AND EVALUATION FACILITIES AVAILABLE:

The laboratory is well equipped with adequate infrastructure for testing and analysis of coal and providing services to various Industries. The assessment of coal quality and determining its various properties strictly following IS specifications are carried out here. Different types of activities performed here are Coal Sampling, processing and preparation, Proximate Analysis (Conventional and Instrumental), Ultimate Analysis (Instrumental), Determination of Bulk Density and Specific Gravity, HGI of coal, Fusion Characteristics (AFT), different forms of Moisture, Gross Calorific Value (GCV), screen analysis of coal, laboratory scale coal washability studies of ROM samples and borehole coal cores, along with technical and consultancy work. The laboratory is equipped with sophisticated analytical equipments like Thermo Gravimetric Analyzer, Bomb Calorimeter, CHN Analyzer: Elementar Vario Macro Cube, Sulphur Analyzer, AFT Determinator and X- ray Fluorescence.

19.b&C. RESOURCE QUALITY ASSESSMENT RESEARCH GROUP (RQA)

1. Project Report (R & D/ Testing)

Resource Quality research group of CSIR-CIMFR, has undertaken scientific study of coal quality loaded from various sidings of coal India Limited subsidiaries unloaded at power utilities of NTPC, DVC, various State Gencos such as MSPGCL, MPPGCL, TSGECO, APGENCO, PSPCL etc and Private Power Plants. The objective of Mega project of coal monitoring is to study the quality of coal loaded from different sidings for effective utilization at thermal power stations.

The study involves collection of sample from rail rakes/conveyor belt/truck as per Fuel Supply agreement (FSA) between Coal India / SCCL and State Power Utilities. Total Moisture content is determined at the site and the parameters ash, equilibrated moisture and GCV are determined in the laboratory using the relevant IS/ASTM standards. The grade of the coal is determined depending on the analyzed GCV Value. Similar scientific studies have been carried out at unloading end.



Coal Sampling From Trucks

Coal Sampling From Rail Rakes

Coal Sampling From Conveyor Belts

Coal quality parameters affect the efficiency of power plants. A decrease in coal quality decreases the efficiency of power generation. Gross calorific value and total moisture affect the efficiency of power plants. Hence, the quality parameters are monitored both at the loading and unloading points. The quality monitoring is not only beneficial for the society by decreasing the cost of generation but also contributes in reduction of green house gases.





2. Bore Hole Coal Core Analysis

Resource Quality Assessment Research Group of CSIR-CIMFR is engaged in the quality assessment of coal/lignite seams encountered in the exploratory boreholes drilled by agencies such as GSI, CMPDI, MECL, State departments of Geology & Mines and private agencies in the different blocks of virgin coalfields of India. During this period Nagpur Research Centre carried out the study of approx. 40,000 m of coal core received from different coalfields on pan India basis. A total of approx. 85,000 band by band samples and 4000 seam /sectional overall samples were prepared and analyzed for various parameters. The data generated is used by exploratory agencies in preparation of National Inventory of coal resources and is of immense use to earmark deposits for industries as per requirement and also for effective utilization of coal resources.

The centre is also engaged in providing technical and consultancy services to coal producers and coal user industries.

3. Micro-Petrographic analysis

Since inception of Central Fuel Research Institute (CFRI) in 1946, nowadays, Central Institute of Mining and Fuel Research (CIMFR), Coal Petrology Section earlier known as Coal Geology is playing an important part to characterize the coal. Following the world trend of research in coal petrography, substantial R & D work has been carried out in this institute in the field of coal petrography. Coal petrography basically deals with the organic components known as macerals under the microscope. The micro components of coal can broadly be grouped into three, viz. vitrinite, liptinite and inertinite and inorganic component as mineral matter. These micro components are major controlling factors for all coal utilization activities such as carbonization, combustion, gasification, coal preparation, CBM industries etc. Coal petrography is considered as the best tool for determination of the maturity (rank) of coal. The rank is measured by the study of reflectance on vitrinites. Besides the basic coal petrography, viz., maceral and reflectance measurement, microlithotype analysis of coal which gives the association of maceral and mineral matter is being performed here. This institute provides facility in the field of coal petrography following ISO and BIS standards. Research microscopic facility such as Leica DM 4500 P and DMRX-P with fluorescence attachment and advanced software like Leica QWin and Petrog is available here.

Micropetrographic characterization of coal/lignite would help in relating the microscopic data to their chemical and technological properties i.e. preparation, carbonization, and combustion and also in field of Coal Bed Methane. The application of the study is an integral part of the R&D efforts which are essentially required for the execution of the various S&T projects undertaken by different divisions of CIMFR, Digwadih Campus as well as technical support to external organization viz. NTPC, BCCL, CCSO-SAIL, etc. Besides this, the petrographic study has been carried out to assess the carbonization behavior of coal samples obtained from SAIL, BCCL, imported coals and other private organizations.



Petrology Microscope



Vitrinite Maceral



Inertinite Maceral





4. Pilot Project on Auger Sampling

It is considered that the manual sampling from stationary lots, like wagons, heap etc. are considered as the last option when the other preferred methods of moving stream sampling are not available. In the absence of auto mechanical sampling system at most of the loading and unloading sites, manual sampling from wagon top is the prevalent practice in most of the sites.

Manual method of coal sampling from wagon top following IS 436 part 1 section 1, 1964 (Reaffirmed 2001) is a time consuming and tedious task. In day to day work, where supply of coal and fast movement of rakes get priority, collection of representative samples from wagons becomes difficult. In this situation, coal producers and consumers follow a modified method as laid down in their Fuel Supply Agreement. Sampling from reduced number of wagons as laid down in FSA, may be convenient in completing the sampling task within the constrained time frame, but it leads to obvious decreases of the precision of the result. An alternative method is the introduction of mechanical sampler, like auger with proper design and dimension for collection of samples from stationary wagons. This, in theory, ensures better representativeness of the samples from maximum depth (up to 1.50 meter) from the railway wagon. Like all mechanical system auger will have a bias but it is relatively free from any manual intervention in collection of samples.

National Thermal Power Corporation (NTPC) is one of the largest consumers of non-coking coals in India and took the initiatives through its Talcher Super Thermal power Plants, Kaniha to get a comprehensive study on standardization of the coal sampling from wagon top by mechanical auger and entrusted CSIR-CIMFR to undertake the study on wagon top sampling by mechanical auger.

In the above context, CSIR- CIMFR was entrusted with the work to carry out a pilot project on auger sampling with the following objective and scope of work:

- Collection of 55 samples from 55 rail rakes from Lingaraj / Kaniha Siding of MCL.
- The sampling and analyses as per Fuel Supply Agreement (FSA), BIS and Mobile Mechanical Auger.
- Preparation of coal samples to -3.35 mm at loading sites.
- Samples in size of BS 212 micron to be brought to CIMFR Dhanbad or Regional Research Centres for analyses (Proximate analysis, Equilibrated Moisture, Moisture (AD), Total Moisture and GCV).
- Screen analysis of 10 coal samples on top size 100 mm.
- Comparative evaluation of the data generated from the three methods.

The sampling experiments were carried out at two sidings i.e. Kaniha and Lingaraj under MCL. At both the sidings, coal produced from different quarries of Kaniha and Lingaraj areas were dumped and loaded in MGR/Railway rakes by pay-loaders. Generally, for MGR, 40 No. of wagons and for railway rakes, 58 No. of wagons were being loaded at Kaniha and Lingaraj respectively. Coal was sampled from MGR/Railway rakes in five and six sub-lots respectively. Total forty rakes were covered at Kaniha and 15 rakes at Lingaraj sidings. There was overhead electric wire at Lingaraj Sidings, so the coal samples were collected after taking due precautions after adjusting the boom height of auger and some time slanting the boom.

The collected samples were prepared for analysis and analyzed for proximate analysis and Gross calorific value (GCV) at 60 % RH and at 40 °C, at CSIR-CIMFR. Total moisture of the samples was also





determined for all the samples. Besides these, screen analysis of 10 coal samples on top size 100 mm was also performed. Preparation of report is under process for comparison of all the sampling methods as envisaged above.

19.d. CSIR-CIMFR NAGPUR RESEARCH CENTRE (FUEL SCIENCES)

Fuel sciences research group of CSIR-CIMFR, Nagpur has undertaken scientific study of coal quality loaded from various sidings of WCL (Chandrapur area, Umrer, Nagpur area, Kanhan, Pench & Wani-North, Wani, Pathakhera, Majri) & SCCL (Ramagundam, Bellampalli, Bhupalpalli, Kothagudem) and unloaded at power utilities of NTPC, MSPGCL, MPPGCL, TSGECO, APGENCO, KPCL, GSECL.The objective of Mega project of coal monitoring is to study the quality of coal loaded from different sidings for effective utilization at thermal power stations.

The study involves collection of sample from rail rakes/conveyor belt/truck as per Fuel Supply agreement (FSA)between Coal India / SCCL and State Power Utilities. Total Moisture content is determined at the site and the parameters ash, equilibrated moisture and GCV are determined in the laboratory using the relevant IS/ASTM standards. The grade of the coal is determined depending on the analyzed GCV Value. Similar scientific studies have been carried out at unloading end.



Coal Sampling From Trucks

Coal Sampling From Rail Rakes

Coal Sampling From Conveyor Belts

Coal quality parameters affect the efficiency of power plants. A decrease in coal quality decreases the efficiency of power generation. Gross calorific value and total moisture affect the efficiency of power plants. Hence, the quality parameters are monitored both at the loading and unloading points. The quality monitoring is not only beneficial for the society by decreasing the cost of generation but also contributes in reduction of green house gases.

CSIR-CIMFR Nagpur Research Centre (Fuel Sciences) is engaged in the quality assessment of coal/lignite seams encountered in the exploratory boreholes drilled by agencies such as GSI, CMPDI, MECL, State departments of Geology & Mines and private agencies in the different blocks of virgin coalfields of India. During this period Nagpur Research Centre carried out the study of 6847.33 m of coal core received from 15 blocks of 6 coalfields. A total of 13401 band by band samples and 1944 seam /sectional overall samples were prepared and analyzed for various parameters.

The data generated is used by exploratory agencies in preparation of National Inventory of coal resources and is of immense use to earmark deposits for industries as per requirement and also for effective utilization of coal resources.





The centre is also engaged in providing technical and consultancy services to coal producers and coal user industries. During this period 1286 coal/coke/oil samples were received and analyzed.

19.e. CSIR-CIMFR, RANCHI RESEARCH CENTRE

Ranchi Research Centre is one of the leading Scientific and Research Centre at CSIR-CIMFR, that undertakes various research projects on coal sample collection, preparation, quality analysis, quality monitoring, borehole coal core analysis, party sample analysis, as per the IS standard and Fuel Supply Agreement (FSA) at Mahanadi Coalfield Limited (MCL), Central Coalfield Limited (CCL), and various power plants of National Thermal Power Corporation Limited (NTPC), to improve the quality of life towards power utilization in India. The centre plays a key role in coal mining and power sector to support Indian Government.

The centre fosters partnerships with a network of coal mining and power plants, nationally on matters of continuous coal quality analysis and monitoring. During the financial year 2018-19, CSIR-Central Institute of Mining and Fuel Research, Regional Centre, Ranchi has undertaken various coal quality monitoring project sponsored various power plants and coal mining companies, such as Mahanadi Coalfields Limited (Lingaraj, Kaniha, Jagannath, Bharatpur, Lakhanpur, IB Valley, Basundhara), Central Coalfields Limited (North Karanpura, Piparwar, Kujju, Barkasyal, Argada, Hazaribagh, Magadh & Amarapali, Rajrappa) and power utility's, Karnataka Power corporation Ltd, NLC Tamil Nadu Power Ltd, NTECL, Tamil Nadu Generation And Distribution Company Ltd, Andhra Pradesh Power Generation Corporation Limited, Simhadri Super Thermal Power Plant, Talcher Thermal Power Station, Talcher Super Thermal Power Station, Odisha Power Generation Corporation, Maharashtra State Power Generation Company Limited, Vedanta Power Limited Jharsuguda, Talwandi Sabo Power (TSPL), Jindal Power Ltd, Hinduja National Power Corporation Ltd, Haldia Energy Ltd, Haryana Power Generation Corporation Ltd, West Bengal Power Development Corporation Ltd, Adani Power Ltd, Damodar Valley Corporation, Durgapur Projects Ltd, Mauda Super Thermal Power Station, Solapur Super Thermal Power Project, Jhabua Power Ltd, Lara Super Thermal Power Station, Darlipali Super Thermal Power Station, Indira Gandhi Super Thermal Power Project, Bhartiya Rail Bijlee Company Limited, Kanti Bijlee Ulpadan Nigam Ltd, National Capital Power Project Limited (NTPC), Barh Super Thermal Power Project, Sipat Super Thermal Power Station(NTPC), Nation Capital Power Station Dadri (NTPC), Tanda Thermal Power Station, NTPC Ltd, ROSA Power Supply Company Limited (RELIANCE), Bajaj Energy Limited, Guru Gobind Singh Super Thermal Power Plant, Guru Nanak Dev Thermal Plant, Guru Hargobind Thermal Plant, Paricha Thermal Power Plant, Patratu Thermal Power Station, Maithon Power Limited, Jhajjar Power Limited and Tenughat Thermal Power Station etc.

The Ranchi Research Centre also involved and fully dedicated to quality assessment of the borehole coal core received from various drilling agencies like Mining Associate Pvt. Ltd., APC Drilling and construction Pvt. Ltd., Thriveni Earthmovers Pvt. Ltd., South West Pinnacle and Central Mine Planning & Design Institute (CMPDI) of various part of Jharkhand, Odisha, Chhattisgarh, West Bengal, Maharashtra, Madhya Pradesh and the coal fields namely Rajmahal (Bhalukasba), Raniganj (Kabitirtha, Lalgang, Shunuri, Itapara south), Birbhum (Salbhadra Gomarpharil), East Bokaro (Chalkari Extension Angawali), Auranga (Rajbar), IB Valley (Rampaia Dip Extn), Sohagpur (Chainpa, Shahdol, Jamui), Singrauli (Hatta Dhudhmania, Bandha North) and North Karanpura (Badam dip side, Dhadhu East). Total coal core received in financial year 16706.11 meters and coal core logging has done, 28692 number of sample has generated for band by band analysis as per the advice. Based on band by band results we have received seam over analysis advice from client and generated 5196 number of samples for SOV and GCV analysis. Special test significant quantity for the same bore holes, 612 samples Ultimate Analysis, 579 samples Ash Fusion Temperatures (AFT), 559 samples Hardgrove Grindability Index (HGI), 508 samples LTGK coke type, 508 samples swelling index, 219 samples total sulphur and 69 samples density analysis.





Based on CSIR - Central Institute of Mining and Fuel Research analytical data the coal resources and reserve estimation has been calculated and ore body modelling will be made by concern mining companies. These reserve estimation and ore body modelling will more effective to prepare mining scheme and mining plan in mining industries. And the special test analytical data will be used in power plants and steel plants for smooth functioning plant and to enhance the production in power sector as well as steel industries.

CSIR-CIMFR Ranchi also provide the consultancy services to government and private organization by analysis of coal samples received from different parties namely Punjab state power co. ltd, Jharkhand state mineral development co. Ranchi, Nabha power ltd, NTPC Kahalgaon, Vimul Dugdha Utpadak and Bihar state milk co foundation. Ranchi etc. which helped them proper economic way of production and utilization of coal.

Ranchi Research Centre is well equipped with adequate infrastructure for testing and analysis of coal and providing services to various Industries. The sophisticated facilities available are Proximate Analysis both Air dried & 60% RH & at equilibrated basis, Determination of Moisture and Ash both AD & Equilibrated, AFT (Ash Fusion Temperature Range), CHNS & CHNSO, Direct Determination of Sulphur, Determination of Phosphorus % (by conventional method), Ash Analysis, Swelling Index SI, LTGK Type (Low Temperature Grey King Assay), Distribution of Sulphur etc.



Sample Collection and Preparation









20. IPR CELL

■ 10 patents have been filed in India in the year 2018-19. Details are given below:

SNo	NFNO	Title	Inventors	Comp. Filing Date	Application No.
1	0177NF2017/IN	Pressurized Fluidized Bed Gasification Pilot Scale Test Facility With The Provision Of External Heating To Test The High Ash Coals, Biomass, Rejects And Their Blends	Chavan Prakash Dhondiram, Datta Sudipta, Saha Sujan, Sahu Gajanan, Dutta Pashupati, Singh Pradeep Kumar	13/Apr/2018	201811014119
2	0196NF2017/IN	An Intelligent Dust Suppression System For Industrial Applications	Chaulya Swades Kumar, Singh Tej Bahadur, Banerjee Gautam, Singh Pradeep Kumar, Naresh Kumar, Virendra Kumar, Singh Jitendra Kumar, Ghosh Tanmoya Nemai, Mandal Ranjeet, Chatterjee Debashis	16/Apr/2018	201811014398
3	0201NF2017/IN	A Novel Portable Device For Providing Hydration In Remote Areas	Pallabi Das, Sudhir Kumar Kashyap, Gautam Chandra Mondal, Krishna Kant Kumar Singh, Pradeep Kumar Singh	16/Apr/2018	201811014399
4	0046NF2018/IN	A Chemical Inhibitor Composition For Controlling And Combating High Intensity Fire In Surface Coal Mines	Ran Vijay Kumar Singh, Niroj Kumar Mohalik, Rakesh Kumar Mishra, Durga Dutt Tripathi, Ajay Khalkho, Jitendra Pandey, Pradeep Kumar Singh, Rajesh Hiralal Sabadra	24/May/2018	201811019438
5	0216NF2017/IN	Biometric-Based Exploder	Chaulya Swades Kumar, Roy Sanjay Kumar, Pal Roy Pijush, Singh Pradeep Kumar, Banerjee Gautam, Singh Jitendra Kumar, Naresh Kumar, Virendra Kumar, Chatterjee Debashis, Ghosh Tanmoya Nemai	26/Oct/2018	201811040426
6	0083NF2018/IN	Automatic Headlamp Dimming Device	Chaulya Swades Kumar, Banerjee Gautam, Singh Pradeep Kumar, Prasad Girendra Mohan, Chatterjee Debashis, Naresh Kumar, Virendra Kumar, Singh Jitendra Kumar, Kunal Saurabh	26/Oct/2018	201811040427
7	0012NF2018/IN	Biometric-Based Theft Control Device for Motor Bikes	Chaulya Swades Kumar, Banerjee Gautam, Singh Pradeep Kumar, Naresh Kumar, Virendra Kumar, Chatterjee Debashis, Ghosh Tanmoya Nemai	26/Oct/2018	201811040428
8	0089NF2018/IN	Blocks and Sand Manufacturing Process Using Mine Wastes	Chaulya Swades Kumar, Singh Raj Shekhar, Singh Shailendra Kumar, Singh Krishna Kant Kumar, Banerjee Gautam, Singh Pradeep Kumar, Singh Ranjeet Kumar, Chatterjee Debashis, Kunal Saurabh, Virendra Kumar	26/Oct/2018	201811040429
9	0178NF2017/IN	Dual Height Partial Recoverable Bolt	Dr. Ranjan Kumar, Mr. Niraj Kumar, Dr. Gautam Banerjee	29/Oct/2018	201811040691
10	0151NF2018/IN	Intrinsically Safe Digital Fuel Meter	Singh Jitendra Kumar, Chaulya Swades Kumar, Banerjee Gautam, Singh Pradeep Kumar, Prasad Gajendra Mohan, Abhishek Chaudhury, Naresh Kumar, Virendra Kumar	17/Dec/2018	201811047607





■ 6 patents have been granted in India in the year 2018-19. Details are given below:

SNo	NFNO	Title	Inventors	Grant Date	Patent No.
1	0250NF2005/IN	A Non-Air Based Permanent Floating Device Useful for Life Saving In Natural Calamities Situations	Maity Sibnath, Paul Biswajit	14/May/2018	296760
2	0101NF2007/IN	An Intrinsically Safe Power Supply Unit Useful for Providing High Output Power to Meet The Requirements of Hazardous Area Devices Within The Range of Variations of Main Supply Voltage	Maity Ranjit	31/Aug/2018	300585
3	0109NF2007/IN	Device To Measure Lateral Deformation Of Rock In A Heating Chambercoupled To An Universal Testing Machine	Dwivedi Ramadhar, Goel Rajnish Kumar, Prasad Vulugundam Venkata Ramana	01/Nov/2018	302830
4	0223NF2008/IN	Development Of Petroleum Residue- Water Emulsion;A Novel Fuel For Power Generation	Kashi Nath Bhattacharya, Sudipta Datta, Pianki Sarkar, Awadhesh Kumar Sinha, Swapan Kumar Ghosh	04/Dec/2018	303970
5	0004NF2006/IN	Microprocessor Based Multi-Channel Monitoring System Useful For Automatic And Reliable Measurement Of Vibrating Wire Sensors	Maity Ranjit	24/Jan/2019	306214
6	0013NF2009/IN	A Device For Clamping Armoured Cable In The Cable Gland	Vishwakarma Rajendra Kumar, Singh Arvind Kumar, Ahirwal Bhagirath, Sinha Amlendu	07/Mar/2019	308780

• Copyright filing/registration details for the year 2018-19 are given below:

SNo	CR Ref No.	Title	Filing Date	Registration Date	Registration No.
1	009CR2018	Integrated Water Absorption and Dewatering Assembly for Preferential Absorption and Release	21-Jun-18		
2	010CR2018	Write-Up and Design of the Reactor	21-Jun-18	16-Jan-19	L-80108/2019
3	024CR2018	Coal/Biomass Based Movable Rural Bio- Methane Reactor	07-Jan-19	25-Feb-19	L-81082/2019

A **Two-Day workshop on Intellectual Property Rights (IPR) was organized on 10th - 11th May, 2018 at CSIR-CIMFR, Digwadih Campus, Dhanbad** jointly by CSIR-CIMFR, Dhanbad and CSIR-IPU, New Delhi with a vision to enhancing capability for effective filing of patent & copyright as well as to emphasizing translational research for transferring IP to relevant stake holders . 50 scientists and Technical officers of CSIR-CIMFR participated in this training programme. **Prominent Experts in the field of IPR, such as, Dr. Chetan Kumar**, Scientist G and SiC, CSIR-IPU, New Delhi; **Dr. D.P. Bhatt**, Former Head, IP Cell, CSIR-NPL, New Delhi and **Sh R.P. Yadav**, Patent & Trade Mark Attorney, SR4IPR Partners, Ghaziabad delivered lectures covering various IP related issues.







Participants & Expert members in a Two-Day IPR workshop held at CSIR-CIMFR, DC, Dhanbad, on 10-11 May, 2018



D' CSIR-CIMFR addressing the Two-Day IPR workshop held at CSIR-CIM-FR, DC, Dhanbad on 10-11 May, 2018

21. INFORMATION AND INDUSTRIAL LIAISON

21.a. KNOWLEDGE RESOURCE CENTRE (DIGWADIH CAMPUS)

KNOWLEDGE RESOURCE CENTRE of CSIR-CIMFR Digwadih Campus plays important role in providing information and knowledge for its esteemed users viz. Scientific, Technical, JRF, SRF, Project Assistants and other staffs members of CSIR-CIMFR Digwadih Campus and its units always remains paramount. In addition of printed documents which will always be the main resource in KRC, internet based access to e-Journals has been also integrated into current practice as they have advantages because of quick search and dissemination. KRC-DC is always keeping pace with latest trends which are being followed in other CSIR KRCs. KRC is also playing a coordinating role between users and the literature and provides personal information service through Current Awareness System (CAS) and Selective Dissemination of Information (SDI) using modern information technology besides the day to day circulation, reference and reprographic services. To expand the horizon of information base of its scientific community, KRC is also rendering the services, like Documentation, List of latest addition, Bibliographic service, OPAC search, CD-ROM search, In-house database, Internet Facility & Access to E-journals. As per the 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) has also been implemented.

Collection Strength of CIMFR-DC KRC

Books, Reports, Standards, Specifications and Bound Volumes	: 34038
CD Collection	:149
Current Journals subscription	: 42

21.b. PUBLICATION AND INFORMATION

This section is regularly providing information to the needy people. Sales and distribution of institute's publication are done. Publication of institute's documents like Annual Report, Newsletter, Project & Work Record Book, Pocket Address Book, Conference proceeding, Souvenir etc. are regularly done. Participation in exhibitions at various places of India is regular activities of the section. Organizing of exhibitions is also done whenever any request comes.

22. RIGHT TO INFORMATION CELL

RTI Cell is regularly providing information to the requester. Quarterly report is also submitted to Central Information Commission, New Delhi. Some of the information are provided online to the requester when information is asked online.



D. STAFF NEWS 2018-19 & OTHERS

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- 36. Pradeep G., Budi A, Ramulu M. and. Murthy V.M.S.R (2019): A Survey on Blast-Induced Ground Vibration Prediction Models and Rock Properties for Safe Blasting Practice, Nat. Sem. on Mines Safety Management and Sustainable Mineral Development, Hyderabad, India, 16 Jan. 2019, pp.35-43
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- Ramulu M, Choudhury P.B., Gujjula P. and Singh P.K. (2018): Control of blast induced damage and overbreak in heterogeneous rock masses or road tunnel construction project in Jammu & Kashmir, 28 April 2018. Nat. Sem. on Recent Challenges in Mining Industry (RCMI 2018), CSIR-CIMFR, Dhanbad India, pp. 377-383
- 39. R.P. Singh, Mousumi Mallick, M. K. Verma and J. K. Pandey(2018): "Experimental Mine Fire Model Gallery to understand dynamic phenomenon of open fire in underground coal mines", Workshop on Safety of Mining Equipment and their Corrosion Control at CSIR-CGCRI, Kolkata
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- 45. T. Gouri Charan. U. S. Chattopadhyay, S. C. Maji, Sanjay Choudhuri and P. S. Prasad (2018): "Value Addition From Rejects And Tailings Generated From Indian Coal Washeries" NMD-ATM'2018, 14th to 16th Nov'2018
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5. BOOK:

- 1. Hazra B.,Wood D.A.,Mani D,Singh P.K. and Singh A.K.(2019): Evaluation of Shale Source Rocks and Reservoirs,Springer Nature
- 2. Mukhopadhyay S, Masto R.E., Tripathi R.C. and Srivastava N.K. (2018): Application of Soil Quality Indicators for the Phytorestoration of Mine Spoil Dumps. In Phytomanagement of Polluted Sites, Pandey V.C., BauddhK (eds.), Elsevier, 361-388
- 3. P. Sarkar, S.G. Sahu, A. Mukherjee and M. Kumar (2018):India Second Biennial Update Report to the United Nations Framework Convention on Climate Change, ©Ministry of Environment, Forest and Climate Change, Government of India, 2018 ISBN: 978-81-938531
- 4. Vetrivel Anguselvi, Reginald Ebhin Masto, Ashis Mukherjee and Pradeep Kumar Singh (2019) : Algae:CO2 Capture for Industries by Algae:DOI:10,5772 Intech open,UK

6. HONOURS

- 1. Dr A.K. Soni, Chief Scientist was appointed as Chairman, Course Committee (2018-19) for Diploma Programme in Mining and Mine Surveying (MS) / Mine Engineering (MN) and Mining Engineering (MZ) by Maharashtra State Board of Technical Education (MSBTE), Mumbai (for framing new curriculum scheme and programme Structure)
- 2. Dr A.K. Soni, Chief Scientist was appointed as 'Member', Assessment committee and Screening Committee(s) of NEERI, Nagpur
- 3. Dr A.K. Soni, Chief Scientist was appointed as 'Member', Screening Committee, AcSIR for NEERI, Nagpur
- 4. Dr A.K. Soni, Chief Scientist got honor as member-organizing committee for the MEAI Nagpur National Workshop titled "Managing Excavation Stability through Design, Analysis and Monitoring"
- 5. Dr A.K. Soni, Chief Scientist Chaired / Co-chaired technical sessions in (a) National Seminar on "Responsible Mining in New Paradigm and Growth & Investment Opportunities for Mining and Steel in Mineral Rich States", Raipur, C.G., 24-25 April, 2018, Organized by NMDC Ltd. Hyderabad & FICCI New Delhi and (b)National Workshop of MEAI on "Managing Excavation Stability through Design, Analysis and Monitoring, Sept 24, 2018, Nagpur
- 6. Dr A.K. Soni, Chief Scientist was appointed as 'Reviewer' for technical papers of International Journal
- 7. Dr A.K. Raina, Senior Principal Scientist was Co-opted as Member, Board of Studies in RTMN University and received appreciation from reviewer on paper published in JGGE
- 8. Dr Ashok K. Singh, Sr. Principal Scientist was Organizing Secretary, International Conference on Coal & Environment (ENCO-2019) held at Vigyan Bhawan, New Delhi during 20-22 February 2019
- 9. Dr Ashok Kumar Singh, Sr. Principal Scientist through Coal Petrology Section, RQA, with Professor Joan Esterle, Australia is coordinating an international working group (WG-3) of International Committee for Coal and Organic Petrology (ICCP) on Optimization of Vitrinite reflectance of Complex Coal Blends





- 10. Dr. M. K. Singh, Chief Scientist was a member for approval of Curricula & qualification files of five courses under Flexi-MoU scheme of MSDE (DGT), Govt. of India in compliance of National Skill Qualification Framework (NSQF)
- 11. Dr. M. K. Singh, Chief Scientist got honor as a Principal Executive member of BIS Committee on " Wire rope products section committee, MED 10" and "Mining techniques and equipment sectional committee, MED 08".
- 12. Dr. M. K. Singh, Chief Scientist got honor as a life member of "Vigyan Bharti".
- 13. Mrs. M. Mallick, Sr. Scientist, got Elsevier Reviewer Recognition for reviewing a paper in Engineering Failure Analysis.
- 14. Mrs. M. Mallick, Sr. Scientist, got an invitation for External examiner of the M.tech viva-voce exam of final year student of Metallurgical Engineering, B.I.T, Sindri.
- 15. Dr. Sudhir Kumar Kashyap ,Scientist has been nominated as Member , in organizing committee of IISF 2018 public outreach programme held on 24-25, September 2018 at CSIR-CIMFR
- 16. Dr. Sudhir Kumar Kashyap, Scientist has supervised the project of B.Tech. students of GITA Engineering College, Khurda, Bhubaneswar (Odisha)
- 17. Dr. Sudhir Kumar Kashyap,Scientist has been appointed as an External Examiner by Head, Department of Mechanical Engg. B.I.T.Sindri, Dhanbad for the Viva-Voce Examination of M.Tech (Mechanical Engg.) (Heat Power) 4th semester students (05Nos.)
- 18. Dr. Sudhir Kumar Kashyap,Scientist has been appointed as an External Examiner by Head, Department of Mechanical Engg. B.I.T. Sindri ,Dhanbad for the Viva-Voce Examination of M.Tech (Mechanical Engg.) (Heat Power & Machine Design) 3rd semester students
- 19. Dr. Sudhir Kumar Kashyap ,Scientist has been nominated by the Management Council, CSIR-CMERI Durgapur as a Member for the Assessment Committee for assessment promotion of Technical Officer under Revised MANAS for the assessment year 2013-14, 2014-15 & 2015-16
- 20. Dr. Sudhir Kumar Kashyap, Scientist has been nominated by the Management Council, CSIR-CMERI Durgapur as a Member for the Assessment Committee for assessment promotion of Technical Officer (Gazetted and Non-Gazetted) under Revised MANAS for the assessment year 2016-17 and 2017-18
- 21. Dr. Sudhir Kumar Kashyap , Scientist was nominated by the Management Council, CSIR-CMERI Durgapur as a Member for the Assessment Committee for assessment promotion of Technical Officer (Non-Gazetted) under Revised MANAS for the assessment year 2017-18 and pending cases
- 22. Dr. Sudhir Kumar Kashyap , Scientist has been nominated by Director, CSIR-CMERI Durgapur as Chairman of the Screening Committee for short listing of candidates for the post of Technician I (Group II)





- 23. Dr. S.P. Singh, Sr. Principal Scientist was guest of honor of inaugural function of International conference on Advances and challenges in Energy Research 15-16 March 2019 organized by Department of Mechanical Engineering, Shri Ramdeobaba college of Engineering and Management, Nagpur
- 24. Mrs. Seema A. Topno, Principal Scientist chaired the technical session at International conference on Advances and Challenges in Energy Research (ICACER 2019) 15-16 March 2019 organized by Ramdeobaba college of Engineering and Management, Nagpur
- 25. Dr R. D. Dwivedi is Co-supervising two M. Tech. (Tunnelling and Underground Space Technology) Students of IIT Dhanbad of Academic session 2017-18 for their M. Tech. Thesis work.
- 26. Dr. R. K. Goel, Chief Scientist attended meeting of Indian Road Congress (IRC) Committee H10 on 'Hill Roads on Tunnels' in May 2018. The committee has been constituted in Jan 2018 with three years term (2018-2020).
- 27. Dr. Harsh Verma, Scientist elected Member, Executive Committee, Institution of Engineer (India) Roorkee Local Chapter.
- 28. Dr. R. K. Goel, Chief Scientist delivered lecture on "Tunnel Engineering" on 19.7.2018 in statelevel training porgramme under 'Jigyasa' program of CSIR and Kendriya Vidhyalaya at CSIR-CBRI Roorkee. More than 150 students from different schools in and around Roorkee participated in the programme.
- 29. Dr. R.D. Dwivedi,Scientist delivered invited lecture on Exposure to Tunnel Engineering for the students of Class 10 to 12 and B. Tech. under CSIR programme on faculty training & motivation and adoption of schools and colleges by CSIR labs. The program was organized on Sept 28, 2018 by CSIR-CBRI, Roorkee.
- 30. Dr. R. K. Goel, Chief Scientist delivered lecture on "Tunnel Engineering" on 24.1.2019 in two-days Student-Scientist connect programme under 'Jigyasa' to observe International Day of Education at CSIR-CBRI, Roorkee.
- 31. Dr. R.K. Goel, Dr. R.D. Dwivedi and Dr. Harsh Verma, Scientists acted as peer reviewers for the articles submitted in various SCI Journals.
- 32. Dr. R.K. Goel, Chief Scientist handled papers submitted for publication in 'Tunneling and Underground Space Technology', Elsevier Journal, as one of its Editors.
- 33. Dr. R K Goel and Dr. R D Dwivedi,Scientists edited one volume of IJRMTT as Editor and Associate Editor respectively for the July 2018 issue of the journal.
- 34. Dr. R.K. Goel, Chief Scientist reviewed six full length papers submitted for presentation in 10th Asian Rock Mechanics Symposium, The ISRM International Symposium for 2018 held at Singapore from Oct 29 to Nov. 3, 2018.
- 35. Dr. R.K. Goel, Chief Scientist reviewed abstracts of five papers submitted from India for ISRM Congress 2019 to be held at Foz do Iguassu, Brazil from Sept 13 to 18, 2019.





7. AWARDS:

- 1. Dr. Arun Kumar Singh, Senior Principal Scientist, received National Geo-science Award-2018 and a cash prize of Rs. 3 lacs by Ministry of Mines, Goverment of India
- 2. Dr. S.K. Chaulya, Dr. G.M. Prasad, Dr. G. Banerjee, Scientists and Dr. P. K. Singh, Director received the "Merit Certificate for CSIR Technology Award 2018" by CSIR and the Award was handed over by the Minister of Science and Technology, and Environment, Forests and Climate Change, Government of India.
- 3. Dr. M. Ramulu ,Sr. Principal Scientist received "CSIR Technology Award -2018" from CSIR New Delhi for Business development in mining, civil and infrastructure projects (A team recognition), Sept. 2018.
- 4. Mr. Ashok Kumar Singh, Scientist, received MEAI- Sitaram Rungta Memorial Award for presenting an excellent paper on mining related issues in the year 2018.
- 5. Professor M. P. Singh Coal Science Award 2018 conferred by MGMI, Kolkata to Dr Ashok K. Singh, Scientist for his meritorious contribution in Coal Science
- 6. Dr. S.K. Chaulya Scientist received "MEAI-NMDC Award 2018" by Mining Engineers Association of India
- Mr. Arka Jyoti Das, Scientist and his team received third best poster paper award for the paper titled "Design of extraction methodology of contiguous coal seams under surface structures" authored by A. J. Das, A. Prakash, P. K. Mandal and S. Tewari in the International Conference and Exhibition on Energy & Environment: Challenges & Opportunities (ENCO- 2019), 20-22 February 2019, New Delhi
- 8. Dr. Bhagwan Singh, Award-2018 was conferred to Dr. A. K. Singh, Scientist for highest ECF in CIMFR, Dhanbad
- 9. Dr. V. Anguselvi received Best Poster Award in ENCO 2019 for the paper Journey of Archaea "Methanogens" from Coal Mines to Clean Fuel
- 10. Dr. Harsh Verma, Principal Scientist, CIMFR Roorkee Research Centre is awarded CSIR Technology Award-2018 along with other team member of CIMFR Dhanbad. The award was presented to the team on 26.09.2018, the foundation day of CSIR, at Vigyan Bhawan, New Delhi.
- 11. Dr. R.K. Goel, Chief Scientist received the Institution of Engineers (India) Roorkee Centre award on Excellence in Academics / Research for the year 2018 in the age group of 40 plus. The award was given away during the Engineers' Day function on Sept. 20, 2018 at Roorkee.





8. ATTAINMENT OF QUALIFICATION:

- 1. Dr. Rakesh Kumar, Principal Scientist was awarded Ph.D. degree on 1st December 2018 from IIT (ISM), Dhanbad. The title of thesis was "A strata control approach for safe and efficient depillaring of thick coal seams in single lift".
- 2. Dr. Sahendra Ram, Senior Technical Officer-1 has completed first 3 months of his Post-Doc research work from the Institute of Geonics of the Czech Academy of Sciences, Ostrava, Czech Republic.
- 3. Mr. Amit Kumar Singh, Senior Technical Officer-1 has submitted thesis for his PhD degree from Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot-485 334, Satna (M.P.) The title of thesis is "Impact of mining on Socio-economic status of beneficiary in coal mining area of district Dhanbad (Jharkhand)".
- 4. 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"

9. DEPUTATION ABOARD

- 1. Dr. A.K. Singh attended Brisbane ICCP Council/Brainstorming meeting and presented a research paper therein. He also attended a meeting on developments in WG-3 on complex blend coal reflectance measurement with international working group at Brisbane, Australia during 21.09.2019 to 28.9.2019.
- 2. Dr A.K. Singh attended International Workshop on Coal Just Transition and CO2 Mitigation at Cape Town, South Africa during 25.02.2019 to 01.03.2019.
- 3. Debashish Mishra visited Bhutan on 28.09.18 to 03.10.18 in connection with a consultancy project entitled "Scientific investigation on resuming exploratory drift work of Amari II Powerhouse at Martshala, Samdrup, Jongkhar, Bhutan and Advice thereof.
- 4. Dr. John Loui P., Sr. Principal Scientist attended Asian Rock Mechanics Symposium (ARMS) -2018 during 29 Oct to 03 Nov 2018 in Singapore and presented research paper
- 5. Shri. M.K. Sethi, Senior Scientist attended 35th International Pittsburgh Coal Conference hosted by University of Pittsburgh and China University of Mining and Technology held at Xuzhou, China on 15-18 October 2018
- 6. Dr. Manish Kumar, Principal Scientist visited China for the period from 12.10.18 to 21.10.18
- 7. Dr. M. Ramulu, Sr. Principal Scientist was deputed to Sweden to attend Fragblast -12 international symposium during 09 -15 June 2018
- 8. Dr. Arun Kumar Singh, Senior Principal Scientist visited United States of America from 23-07-2018 to 28-07-2018 to participate and present a paper in person in 37th International Conference on Ground Control in Mining-2018 (ICGCM-2018).





- 9. Mr. Ashok Kumar, Scientist visited United States of America from 23-07-2018 to 28-07-2018 to participate and present a paper in person in 37th International Conference on Ground Control in Mining-2018 (ICGCM-2018).
- 10. Dr. Sahendra Ram, Senior Technical Officer-1 has stayed in Czech Republic to completentis Post-Doc research work from the Institute of Geonics of the Czech Academy of Sciences, Ostrava, Czech Republic from October, 2018 to December 2018 and February 2019 to April 2019.

10.National Workshop on Tunnel Engineering:

CSIR- Central Institute of Mining and Fuel Research (CIMFR), Research Centre Roorkee has organised a National Workshop on Tunnel Engineering during 10-12 October 2018 together with the Institution of Engineers (India) Roorkee Local Centre and Indian Society of Rock Mechanics and Tunnelling Technology (ISRMTT) Roorkee Chapter. The venue of the Workshop was the Institution of Engineers (India) Roorkee Local Centre, IIT Roorkee Campus, Roorkee. During the workshop there were 4 keynote lectures and 23 invited lectures by experts from field, academic & research institutions and CIMFR scientists to cover various aspects of tunnel engineering like geological & geophysical investigations, engineering behaviour of rock mass, tunnel excavation methods using DBM & TBM, construction approaches such as NATM & NMT, geotechnical instrumentation and numerical modelling. About 75 delegates have participated in the workshop from various government and private institutions. Some students from IIT (erstwhile ISM) Dhanbad and IIT Roorkee have also participated. At the end of the workshop participants were of the view that such workshops should be organised at frequent interval to impart training and to enrich the knowledge of field engineers / practitioners for the benefit of the projects. One day technical field visit to THDC-PSP, Tehri site on 13th Oct 2018 has also been arranged for the interested delegates.

Er. H.L. Arora, Director (Tech). THDC Ltd., Rishikesh inaugurated the above workshop in the august presence of Dr. P.K. Singh, Director, CSIR-CIMFR Dhanbad. The organising team of the workshop is as follows:

Patron	: Dr. P. K. Singh, Director, CSIR- CIMFR, Dhanbad
Chairman	: Dr. R. K. Goel, Chief Sc. & Sc. Incharge, Roorkee Centre
Co-Chairmen Chairman, IEI (RLC)	: Dr. J. K. Mohnot, Chief Scientist, CIMFR and Er. Malvinder Singh,
Coordinators Principal Scientist, CIMFR	: Mr. Anil Swarup, Sr. Pr. Scientist, CIMFR and Dr. R. D. Dwivedi,
Organising Secretaries Hon.Secretary, IEI (RLC)	: Dr. Harsh Kr. Verma, Pr. Scientist, CIMFR and Dr. Achal Mittal,



11. GLIMPSES OF EVENTS











Her Excellency Smt. Draupadi Murmu , Honourable Governor of Jharkhand and other dignitaries are releasing the volume of All India Seminar on Technological Advancements and

Emerging Mining Methods held at CSIR-CIMFR Auditorium during 24-25 August 2018

NUMBER OF STREET

Her Excellency Smt. Draupadi Murmu,Honourable Governor of Jharkhand is inaugurating the new administrative building of CSIR-CIMFR on 24th August, 2018. Dr. Pradeep K Singh, Director, CSIR-CIMFR is seen on her left





Ceremonial Lamp on the occasion of 76th CSIR Foundation Day on 4th October, 2018 at CSIR-CIMFR

Mr. Shailesh Nayak,

Director, National Institute of Advanced Studies, Bengaluru and former secretary,

Ministry of Earth Sciences, GOI, New Delhi is lighting the



Mr. Shailesh Nayak, Director, National Institute of Advanced Studies, Bengaluru and former secretary, Ministry of Earth Sciences, GOI, New Delhi is delivering the

Foundation Day Lecture on the occasion of 76th CSIR foundation Day celebration at CSIR-CIMFR, Dhanbad on 4th October, 2018







Dr. Pradeep K. Singh, Director, CSIR-CIMFR is addressing the staff members on the occasion of 76th CSIR foundation Day

celebration at CSIR-CIMFR, Dhanbad held on 4th October, 2018



Dr. Pradeep K. Singh, Director, CSIR-CIMFR is felicitating the retired staff member of CSIR-CIMFR by giving a memento during 76th CSIR foundation Day celebration at CSIR-CIMFR on 4th October, 2018







Winning participant is awarded by Dr. Pradeep K. Singh, Director, CSIR-CIMFR for participating in a competition held in the institute to celebrate the CSIR foundation Day,on 4th October,2018



Portrait of Dr .C. V.Raman, the first Nobel Laureate of India is being garlanding with honour by the chief

guest,Prof.K.K.Shukla,Director,National Institute ofTechnology,Jamshedpur on 28.02.2019 at CSIR-CIMFR







Prof. K.K. Shukla, Director, National Institute of Technology, Jamshedpur, Chief guest is delivering Lecture on the

occasion of National Science Day held at CSIR-CIMFR on 28.02.2019



Dr. Pradeep K. Singh, Director felicitating Mr. Gopal Singh, CMD, BCCL on the occasion of National Seminar on Rock Blasting Techniques--Challenges and Opportunities held at CSIR-CIMFR on 23-24 November, 2018







The Seminar Volume is being released by the dignitaries on the occasion of National Seminar on Rock Blasting Techniques--Challenges and Opportunities held at CSIR-CIMFR on 23-24 November, 2018



Prof. Bharat B.Dhar, Former Director, erstwhile CMRI is delivering his Inaugural speech on the occasion of National Conference on Recent Challenges

in Mining Industry (RCMI, 2018) held at CSIR-CIMFR on April 28, 2018









Engineering Group of CSIR-CIMFR is with the CSIR Technology Award 2018



Mine Design Simulation Group of CSIR-CIMFR is with the CSIR Technology Award-2018







Glimpses of the 50th SSBMT organised by CSIR-CIMFR at Dhanbad during 31.01.2019 to 03.02.2019. Dr. Alok Dhawan, Director, IITR and President, SSBMT and Dr. Pradeep K.Singh, Director, CSIR-CIMFR with other dignitaries may be seen





Sports personalities of different CSIR Labs. are on March Past during the inauguration

of 50th SSBMT held at CSIR-CIMFR on 31.01.2019









CSIR lab pledge is being taken by Sports persons of different CSIR Labs on the occasion of 50th SSBMT held at CSIR-

CIMFR, Dhanbad during 31.01.2019 to 03.02.2019



School children are performing Dance programme during the inauguration of 50th SSBMT held at CSIR-CIMFR on 31.01.2019





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EVENTS AT DIGWADIH CAMPUS



Public outreach programme for the students of nearby school was organized to make aware the scientific work going on in the institute on 25.09.2018. On the podium Dr. P.K. Singh. On the dais (L to R) Dr. N.K. Srivastva, Dr. Rajendra Singh, Shri. A. K. Singh and Dr. A. Mukherjee



Under outreach programme students are explained about the gasification activities by Dr. P. D. Cavhan on 25.09.2018



A cricket match is going on under 50 th SSBMT at BCCL, Jealgora stadium on 01. 02. 2019



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Students participating in Outreach programme on 25.09.2018



On the occasion of Republic day (26.01 2019) Dr. P. K. Singh, Director, CIMFR hoisted tricolour. Shri. Anit Kumar, Security Officer is also seen







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Ladies Carom match is going on under 50 th SSBMT at CIMFR-DC club hall during 01.02. 2019



Bridge match is going on under 50 th SSBMT at Dr. Adinath Lahiri hall during 02.02.2019



Visit of Dr. Sekhar C. Mande, Director General, CSIR, New Delhi at CIMFR-DC on 07.02.19. Dr. P. K. Singh, Director, Dr. Ashis Mukherjee, Dr. A. K. Singh and others are also seen



Table tennis match (Ladies Single) is going on under 50 th SSBMT at CIMFR-DC club hall during 02.02. 2019



Final cricket match between CIMFR, Dhanbad team and CMERI, Durgapur team under 50th SSBMT on 03.02.19 at TATA Cricket stadium, Digwadih



Cricket match between Directors of CSIR-Labs. XI and CIMFR team on 07.02.19







A candle march by staff of CIMFR-Digwadih Campus on 17.02.19 for the martyrs of Pulvama (J&K) terrorist attack



Zigyasa programme was organized at CIMFR-DC on 26.03.19. Students are explained about the activities of Coal Quality Assessment department by Ms. Jyoti Kumari



On the podium Prof. Rajeev Shekhar, Director, IIT-ISM, Dhanbad and on the dais (L to R) Dr. T. Gouricharan, Dr. P.K.Singh, Director, CIMFR and Dr. Ashis Mukherjee



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A meeting of CIMFR-DC staff was organized on 19.02.19 to pay the homage of martyrs of Pulvama (J&K) terrorist attack. The meeting was led by Dr. Rajesh Kumar



New Advanced X-ray Diffraction Instrument was commissioned. Dr. Sudip Maity is working on it.



Workshop is on progress at a panel discussion with experts of coal scientist. On the dais (L to R) Dr. T. Gouricharan, Dr. T.K.Das, Shri. N.C.Jha, Shri. S.K.Jaiswal and Shri. V.R.Sahay





Coal - to - Liquid Pilot Plant of CSIR-CIMFR for indirect liquefaction of coal where coal is first gasified by steam and air for production of Syngas followed by liquefaction of syngas over Fe/Co based catalysts at elevated pressure and temperature through Fischer-Tropsch process.



His Excellency Shri Ram Nath Kovind, Hon'ble President of India releasing the Souvenir on the occasion of International Conference and Exhibition on "Energy and Environment: Challenges and Opportunities (ENCO-2019)" on 20th February, 2019 at Vigyan Bhawan, New Delhi. On the dais (From L to R): Dr. Pradeep K Singh, Director, CSIR-CIMFR; Dr. Harsh Vardhan, Hon'ble Minister of Science & Technology, Earth Sciences and Environment, Forest & Climate Change; Sri Ram Nath Kovind, Hon'ble President of India, Dr. V. K. Saraswat, Hon'ble Member of NITI Aayog, GOI and Dr. Shekhar C Mande, DG, CSIR & Secretary, DSIR, GOI, New Delhi



सीएसआईआर - केंद्रीय खनन एवं ईंधन अनुसंधान संस्थान (वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्) CSIR - Central Institute of Mining and Fuel Research (Council of Scientific and Industrial Research) बरवा रोड, धनबाद, झारखंड - 826015, भारत Barwa Road, Dhanbad, Jharkhand- 826015, India

