2014-15

वार्षिक प्रतिवेदन

ANNUAL REPORT

सीएसआईआर–केंद्रीय खनन एवं ईंधन अनुसंधान संस्थान

(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)

CSIR-Central Institute of Mining & Fuel Research

(Council of Scientific and Industrial Research)

Dr. Amalendu Sinha, Director, CSIR-CIMFR delivering the welcome address on the occasion of 2nd International Seminar & Exhibition on "Recent Trends in Design, Development, Testing and Certification of Ex-equipments for Explosive Atmosphere" [DTEX-2014] organised during 7-9 November, 2014 at Kolkata

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

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

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CSIR-CIMFR

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FROM DIRECTOR'S DESK

I am delighted to present herewith the Annual Report of the CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad for the period 2014-2015. CSIR-CIMFR was thickly engaged in research, investigation, calibration and testing work related to mining and fuel sectors. The institute has also contributed significantly in some other areas of importance such as dams, tunnels, thermal projects, caves of archeological significance, railways, etc. In addition to these, CSIR-CIMFR has been entrusted with the responsibilities to work for Network Projects and accordingly, working on four Network Projects as Nodal Laboratory and in other five as Participating Laboratory in the areas of mining, fuel and allied sciences.

It is gratifying to record that during year 2014-2015, 363 externally funded projects were undertaken and executed, out of which, there were 51 sponsored projects, 275 Consultancy projects, 3 Collaborative projects, 33 Service to Industry Projects and 1 Grant-in-Aid project. Besides, 14 new In-house projects were also undertaken and are being executed. The total external cash flow (ECF) was 55.679 crores, which showed a marked growth of 6.91 % compared to previous year. Besides these, the institute has done an appreciable job which also reflected from good number of quality publications and patents filed in comparison to the previous years.

Over the years, the institute has established an array of meticulous and dependable testing and analytical services. The activities of the institute were not restricted to Indian territories only and the scientists were involved in a number of International bilateral projects with overseas countries.

I offer my sincere thanks to my predecessor, Dr. Amalendu Sinha, for his good leadership, valuable advice and continued guidance from time to time to put the institute to its present height. The contributions of the scientists and all other staff members of CSIR-CIMFR in their respective fields of activities are well acknowledged. I also take the opportunity to thank for the perennial guidance and support provided by CSIR, Headquarters, New Delhi, CSIR-CIMFR Research Council and Management Council for achieving the goals successfully. My sincere thanks to all the stakeholders for their support and trust in our capabilities and performance and look forward for their valued support and co-operation including suggestion in future as well.

PK Singh

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

अनुसंधान परिषद के सदस्यों की सूची / List of Research Council Members

अध्यक्ष / Chairman

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

बाहरी सदस्यगण / External Members

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

श्री एन कुमारः निदेशक (तकनीकी) कोल इंडिया लिमिटेड, कोल भवन, 10 नेताजी सुभाष रोड, कोलकाता-700001 / Shri N. Kumar: Director (Technical), Coal India Limited, Coal Bhawan, 10 Netaji Subhas Road, Kolkata - 700001

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

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

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

एजेंसी प्रतिनिधि / Agency Representative

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

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

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

सहोदर प्रयोगशाला **/ Sister Laboratory**

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

क्लस्टर निदेशक **/ Cluster Director**

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

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

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

निदेशक **/ Director**

डॉ. अमलेन्दु सिन्हाः निदेशक, सीएसआईआर-केंद्रीय खनन एवं ईंधन अनुसंधान संस्थान, धनबाद-826015 / Dr. Amalendu Sinha: Director, CSIR-Central Institute of Mining & Fuel Research, Dhanbad – 826 015

सदस्य सचिव **/ Member Secretary**

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

प्रबंधन परिषद के सदस्यों की सूची / List of Management Council Members

Dr. Amalendu Sinha, Director, CSIR-CIMFR, Dhanbad (Chairman)

Dr. S. Srikanth, Director, CSIR-NML, Jamshedpur (Member)

Dr. P. Pal Roy, Outstanding Sct. & Head, Blasting Division,CSIR-CIMFR, Dhanbad (Member Invitee)

Sri. A. K. Ghosh, Chief Sct. & Head, MSE, CSIR-CIMFR, Dhanbad (Member)

Dr. Bijay Kumar, Chief Sct. & Head, BDIL, CSIR-CIMFR, Dhanbad (Member)

Dr. Bably Prasad, Principal Sct., CSIR-CIMFR, Dhanbad (Member)

Dr. Amar Prakash, Sr. Sct., CSIR-CIMFR, Dhanbad (Member)

Sri Manoj Kumar Sethi, Sct., Bilaspur Unit, CSIR-CIMFR (Member)

Dr. Raja Sen, Principal Tech. Officer, CSIR-CIMFR, Digwadih Campus, Dhanbad (Member)

Sri Ashok Kujur, Finance & Account Officer, CSIR-CIMFR, Dhanbad (Member)

Sri P. G.Deogharia/Representative, CoA, CSIR-CIMFR, Dhanbad (Member Secretary)

Dr. S. R. K. Rao, Chief Sct., CSIR-CIMFR, Digwadih Campus, Dhanbad (Invitee)

Dr. V. K. Kalyani, Sr. Principal Sct., CSIR-CIMFR, Dhanbad (Invitee)

IV. STRENGTH OF STAFF OF CSIR-CIMFR (AS ON 31.03.2015)

Group/Grade	SC	ST	OBC	General	Grand Total
Director	-	-	-	01	01
Group IV	19	08	18	101	146
Group III	14	05	21	59	99
Group II	14	05	00	50	69
Group I	18	10	01	85	114
Administrative	26	11	10	93	140
Total	91	39	50	389	569

V. EXPENDITURE FOR THE YEAR 2014-15

Head	Amount (₹ in lakhs)
Capital	1500.093
Revenue	6442.134
Staff Quarters	92.760
Total	8034.987

A. NETWORK PROJECTS

1. Project Title: Robotics & Micro-machines

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

Objective: Design and development of a system for early detection of fire and real time monitoring of fire associated gases for underground coal mines.

Work done: Proximate analysis of coal samples collected from fiery seams of different underground coal mines has been completed. Development of remote monitoring device for underground coal mine gases using roof based traction system is being developed. Apart from it, design of wireless sensor networking integrating the sensors for the fire impending parameters is under progress.

Benefits: Underground coal mine fire mostly occurs due to self heating, thermal runaway and ignition. Underground mine fire has huge economic, social and ecological impacts. These can be controlled if the mine fire is reported at its earliest stage with the use of sensors for the fire impending parameters. Therefore, development of a reliable and effective technology i.e. development of a system for early detection of fire including real time monitoring of fire associated gases for underground coal mines is of paramount importance. The project work is in progress.

2. Clean Coal Technology (TAP COAL): WP 1: Coal Combustion & Gasification Technologies. Activity 5: Co-gasification of High Ash Indian Coal and Biomass

Outcome:

- Collection of different biomass samples (Rice Husk, Ground nut, Bagasse, wheat husk, saw dust) and coal
- Characterization of biomass and coal samples for physical and chemical properties
- Gasification reactivity study for biomass (Rice husk, saw dust, press mud, coconut shell) and coal at different temperatures in TGA
- Studied the fluidization behavior of different biomass and coal samples in fluidized bed test facility at cold & hot conditions.
- Development of online gas analyzer and thermo gravimetric reactor (TGR) facility.

Contribution to economy: This data bank will be helpful in the development of suitable gasifier for co-gasification of coal and biomass.

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

Objective:

- Gasification Reactivity of coal-biomass blends with different gasifying agents
- Gasification performance of coal and coal-biomass blends in the fluidized bed gasifier (FBG) test facility
- Ash agglomeration behavior and entrainment during co-gasification of coal and biomass in FBG
- Empirical modeling of the data generated in Thermo Gravimetric Reactor (TGR), Fluidized Bed Gasifier (FBG)

Outcome:

- Collection of different biomass samples(Rice Husk, Ground nut, Bagasse, wheat husk, saw dust) and coal
- Characterization of biomass and coal samples for physical and chemical properties
- Gasification reactivity study for two biomass(Rice Husk, Ground nut) and coal at different temperatures in TGA
- Studied the fluidization behavior of different biomass and coal samples in fluidized bed test facility at cold condition
- Procurement of Thermo gravimetric Reactor(TGR) and online gas analyzer is in progress

The project work is in progress.

4. Development of Suitable Design Methodology for Extraction of Coal at Depth (>300m) for Indian Geo-mining Condition (Deep Coal)

Task No. 5.1: Numerical Modeling of Longwall Mining (LWM) Method

Objectives:

- Longwall panel layout, Face length and Chain Pillar design.
- Estimation of support requirements.
- Development of guidelines for the design of suitable method of extraction at deeper horizon by Longwall Mining Method for different geo-mining conditions of Indian coal mines.

After generation of complete data set for a depth cover varying from 300m to 600m, suitable guidelines will be developed for Longwall Mining Technology for extraction of coal at deeper horizon. Work is in progress

5. Development of Suitable Design Methodology for Extraction of Coal at Depth (>300m) for Indian Geo-mining Condition (Deep Coal)

Task No. 5.2: Numerical Modeling of Coal Extraction using Continuous Miners

Objectives:

- Pillar, stook and fender design to ensure the stability and optimal and fast liquidation of pillars
- Estimation of support requirements.
- Development of guidelines for the design of suitable method of extraction by CM & Shuttle cars combination for different geo-mining conditions of Indian coal mines

After generation of complete data set for a depth cover varying from 300m to 600m, suitable guidelines will be developed for Coal Pillar Extraction Using CM Technology for Deep Coal.

6. Development of Suitable Design Methodology for Extraction of Coal at Depth (>300m) for Indian Geo-mining Condition (Deep Coal)

Task No. 4.1: Procurement, installation, and commissioning of HPC system

Objectives:

- Creation of HPC infrastructure
- Installation and commissioning of HPC system

Conclusion: This HPC has been procured under the network project “DeepCoal” and it will be used for stability analysis and numerical simulation of different mining methods for mine design

at greater depth, development of integrated system for assessment, control and monitoring of ventilation parameters for deep coal mines, hydro-geological study for different mining methods and mine layout.

7. Clean Coal Technology Tap Coal

Objectives:

- Oxy-fuel combustion: Evaluating the effect of coal characteristics and other operating parameters like oxygen concentration, recycle ratio, etc., during oxy-fuel combustion on ignition, flame stability, emission and associated ash depositional problems in the existing pilot scale combustion facilities.
- Co-combustion of coal and biomass: Co-combustion studies of different types of biomass (green or partially pyrolysed) with coal. Generation of basic co-combustion data of Indian coal with different biomass (raw and partially pyrolysed).
- Chemical Looping Combustion (CLC): Development of cold model CLC set up for establishing flow (material circulation in loop) and for studying the flow characteristics

Work done:

- Test run in Fuel Evaluation Test Facility for oxy-fuel combustion studies is under progress. In oxy-fuel combustion study, achieved CO_2 percentage of 69.7 in the flue gas. Flame temperature is 1435°C.
- Co-combustion of blends of two washery reject & raw corn cob were studied in TGA as well as in DTF. Different blend compositions up to 30% biomass content were attempted in this study. Preparation of pellet of coal-biomass blends for further studies and optimization of pellet size with binder percentage are in progress.
- Studies on flow behaviour in CLC cold model.

Observation:

- Cold model set up successfully worked with Ilmenite sand
- Oxy-fuel combustion successfully operated up to 69.7% CO_2 concentration
- Biomass in blends with coal mostly brings out positive effect depending on the proper selection of blend combination and blend proportion.

Conclusion:

- Advancement in oxy fuel technology may be potentially integrated with CO_2 capture technology
- Effective implementation of co-combustion technology will lead to savings of precious fossil fuel and reduce GHG emission

Benefits achieved:

- Knowledge-base generated on low emission or zero emission technologies
- Increased awareness on new technology development for coal based power generation

8. Assessment of mercury emissions from coal based thermal power plants and development of coal derived activated carbon for mercury capture

Objective:

- Direct measurement for assessing species specific emissions of mercury from the thermal power plants including the partitioning of mercury in the combustion products.

- Laboratory scale assessment of reduction of potential mercury and other heavy metals achievable as co-benefit by washing of non-coking coals at different ash levels.
- Process development for preparing Coal Derived Activated carbon for removal of flue gas mercury based on high sulphur tertiary coals of Assam

Work done:

- Process development for steam activated carbon is continuing.
- Mercury emissions study from stack of a 500MW boiler unit of Kahalgaon Thermal Power Station (NTPC) has been done.

9. Advanced Ceramic Materials and components for Energy and Structural Applications (CERMESA)

Objective:

- To develop novel membrane based process technologies for sustainable energy devices
- To develop new generation structural ceramics for high temperature and optical application
- To develop advanced composite armor for protection against medium caliber threats

Work done: Testing of three sets of supporting and filter medium in Drop Tube Furnace has been done at our Institute under network program.

Benefits achieved: Developed ceramic based filter for separation of ash particles from flue gas for its potential use in the power plants.

10. Inter Agency Project on "Development of Zero Waste Technology for Processing and Utilization of Thermal Coal (ZWT-CUP)

Objective:

i) To develop suitable technology for dry beneficiation of thermal coals from India to produce 34% and 25% ash clean coal

ii) Wet beneficiation of the rejects of dry circuit for maximum recovery of combustibles from thermal coal

The anticipated deliverables of this project can be categorized as following:

I. Technology for dry beneficiation of coal

II. Wet processing scheme for the rejects of the dry circuit for further recovery of combustibles

Achievements:

- The performance efficiency studies on the laboratory ore sorter while treating coals collected from Dakra CF, CCL, Rajmahal CF and Gare Coals, indicated that the efficiency is poor while treating high ash coals.
- The flow sheet for Dry Beneficiation is freezed and work is in progress

Benefits accrued: The Data analysis, comparative evaluation and development of flowsheet for complete beneficiation of the coal samples along with Pilot scale demonstration of the dry beneficiation flowsheet will be helpful for the industry/society for setting up of coal washeries.

B. MINING AND OTHER SUNDRY CIVIL SECTORS

1. ADVANCED MINING TECHNOLOGY DEPARTMENT

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

Objective: Development of Wireless Technology for monitoring of roof/strata conditions.

Work done: Design of compatible wireless module for vibrating wire based sensor such as stress meter has been completed and laboratory trial and fine tuning are being carried out. In addition, a laboratory scale wireless sensor network (WSN) has been developed for transmission of the sensed data from the various potentiometer and thermistor based sensors.

Benefits accrued: Development of remote operation technologies will technologically empower Indian coal industries for efficient exploitation of underground coal seams. The remote operation technology enables continuous and on-line monitoring of real time strata control parameters like stress on pillars/stooks/ribs in underground openings including underground coal mines and tunnels wirelessly and communicates the data to a safer and remotely placed computing station. The project is in progress.

2. Development of a Technology for Optimal Extraction of Locked-up Coal from Underground Mines using Artificial Pillars (ESC 0105, Acronym: De Coal Art)

In most of the coalfields in India, there are many mines where the seams are only developed by extracting 15-20% of coal but the pillars could not be extracted due to different constraints like presence of surface/subsurface features, forest area, danger of subsidence, lack of proper methodology, scarcity of suitable filling material, environmental issues, etc. As a result, a huge quantity of good quality coal (around 3000 million tons) is locked-up in pillars for many years. Besides loss of valuable coal resources in pillars; spontaneous heating, accumulation of toxic gases, creation of unsafe working condition, endangering of inhabitants and surrounding environment are some of the problems associated with locked-up coal standing in the pillars. These pillars are slowly becoming unapproachable due to a variety of reasons like increasing time dependent complexity in geotechnical conditions of the pillars. It is anticipated that it may not be possible to extract this huge quantity of coal in future if an early action is not taken for development of a suitable technology for their extraction. This research proposal aims to develop a suitable technological package for optimal extraction of locked-up coal from underground mines by replacing coal pillars with artificial pillars mainly from the standing pillars locked-up under different constraints. No established technology is available in the world for extraction of coal pillars by replacing them with artificial pillars. The entire project is divided into three Work Packages and is being implemented by the three CSIR laboratories namely, CSIR-CBRI, CSIR-CMERI and CSIR-CIMFR. The task titles of CSIR-CIMFR are as follows:

Task 1.1. Geotechnical evaluation of locked-up pillars in underground coal mines, design and development of artificial pillars.

Task 1.2. Numerical modelling and stability analysis, method of work, laboratory scale demonstration.

Task 1.3. Instrumentation and monitoring of various stability related parameters in the laboratory scale model.

Work done: The work done in this project during the period by CSIR-CIMFR are as follows:

The estimation of locked up coal is already completed in the major coal fields. The design and

development of artificial pillar is already completed using numerical modeling and the method of extraction is also been developed. In absence of known suitable material properties, the range of Young's modulus for the material of construction of artificial pillar is estimated which is found to be most influential parameter by the study. The optimum size of the artificial pillar is also determined. Detailed methodology is being designed and studied by numerical modelling with stability analysis for its suitability of application. Another study was done for extraction of locked-up coal by strengthening the reduced coal/rib pillars. Strengthening of remnant pillars is planned to be done by wrapping the reduced coal/rib pillars with suitable materials. From the findings of the numerical modelling study, it is concluded that in absence of any suitable existing technological option with reasonably high recovery, the locked-up coal is proposed to be extracted by strengthening the rib pillars by wrapping CFRP. Here, the increase of percentage of recovery of locked-up coal is to be done if strengthening of rib pillars method is adopted. Laboratory testing is carried out on a large number of coal samples of NX size. From the results of testing, it is observed that UCS can be possible to increase more than three times of original UCS of coal sample. Stability analysis through numerical modelling is carried out by considering the increase of UCS value of coal by three times. Two types of extraction methodologies are studied to evaluate the effect of strengthening of rib pillars and increase of percentage of extraction. It is found that double splitting method with strengthening the rib pillar may be suitable to extract the locked-up coal. Study is also done for scope of using different geotechnical sensors such as stress meter, load cells, remote convergence indicators, etc., for generation of data for laboratory scale model. Part appointment of Technical Human Resource has been made. Development of infrastructural facilities is in progress.

Benefits: In India, several coal seams are developed by extraction of 15-20% coal only due to different constraints. There is a need to extract these coal reserves under different constraints to meet the growing demand of coal requirement in the country. If this technology is developed in the lab scale, it can be experimented in the field and after successful experimentation in the field; it would be possible for the coal companies to extract the locked-up coal under different surface/sub-surface constraints. The project is in progress.

3. Robotics & Micro-machines (ESC0112)

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

Objective: Design and development of a system for early detection of fire and real time monitoring of fire associated gases for underground coal mines.

Work done: Proximate analysis of coal samples collected from fiery seams of different underground coal mines has been completed. Remote monitoring device for underground coal mine gases using roof based traction system is being developed. Apart from it, design of wireless sensor networking integrating the sensors for the fire impending parameters is also under progress.

Benefits: Underground coal mine fire mostly occurs due to self heating, thermal runaway and ignition. Underground mine fire has huge economic, social and ecological impacts. These can be controlled if the mine fire is reported at its earliest stage with the use of sensors for the fire impending parameters. Therefore, development of a reliable and effective technology i.e. development of a system for early detection of fire including real time monitoring of fire associated gases for underground coal mines is of paramount importance.

The project is in progress.

4. Advice for Feasibility of Extraction of Pillars in Contiguous V and VI Seams of 23/8 Incline, Bhowra (N) Underground Mine, BCCL

The workings of contiguous V and VI seams at Bhowra (N) Underground Mine, E. J. Area of M/s Bharat Coking Coal Limited are standing on pillars developed by bord and pillar method. The total thicknesses of the seam V and seam VI are 3.4 and 4.1m respectively. The size of the developed pillars varies from 30m × 30m to 30.5m × 30.5m. The width and height of the galleries vary from 4.2 to 4.8 and 2.8 to 3.0m respectively. The seam V is developed along floor leaving 0.4 to 0.6m coal in the roof. Similarly, the seam VI is developed along floor with average 3.0m height of the gallery leaving around 1.1m coal in the roof. The parting between V and VI seams is around 6m. The variation in depth of covers of the panel V 'A' in V seam and VI 'A' panel in VI seam vary between 127 and 147m and 135 and 148m respectively. The mine management proposed to extract the panels V 'A' and VI 'A' of the V and VI seams respectively with hydraulic sand stowing due to the built-up structures present on the surface above the workings. Accordingly, mine management requested CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad for a scientific study for feasibility of extraction of pillars in contiguous V and VI seam of 23/8 Incline, Bhowra (N) Underground Mine with hydraulic sand stowing with aims to the (i) assessment of the stability of the workings through numerical modelling and suggesting suitable method of working by hydraulic sand stowing, (ii) design of suitable support pattern based on the prevailing geo-mining conditions and (iii) prediction of subsidence, slope, compressive and tensile strains likely to develop on the surface due to the extraction of the panels if the suggested method of mining is applied. The study is in progress.

5. Scientific study for determination of size of split and slice gallery during depillaring with deployment of SDL at EF incline of JRD New Seam (10') of Sawang Colliery, Kathara Area, CCL

The 3.0m thick JRD new seam (10' seam) of Sawang Colliery of M/s Central Coalfields Limited (CCL) has been developed by bord and pillar method of mining. The width and height of the developed galleries vary from 4.2 to 4.5m and 2.8 to 3.0m respectively. The panel B of the seam of EF Incline is proposed to be depillared by splitting and slicing method of mining with sand stowing using SDL. The seam in panel B is dipping at 1 in 3.15. Due to this high dipping of the seam, it is very difficult to operate the SDL for depillaring operation. So, the size and orientation of the split and slice would be such that depillaring should be convenient with SDL as much as possible. The scientific solution of the problem was urgently required to enhance productivity, improve the percentage of extraction of coal and to make the operation safe. Mine management requested CSIR-Central Institute of Mining and Fuel Research (CSIR-CIMFR), Dhanbad for a scientific study for determination of size of split and slice for depillaring with deployment of SDL in panel B of JRD new seam at EF incline, Sawang Colliery and Kathara area, CCL. Accordingly, this scientific study was undertaken by CSIR-CIMFR, Dhanbad. The study is in progress.

2. BLASTING DEPARTMENT

During April 2014 to March 2015, the Blasting Department has undertaken various assignments on blast optimization and safety related problems for mining, quarrying, construction and tunnelling sectors.

The clients included M/s Ultra Tech Cement Limited, Jindal Steel & Power Limited, Vikram Cement Limited, Jindal Power Limited, South Eastern Coalfields Limited, Singareni Collieries

and Companies Limited, Electrosteel Casting Limited, Jamadoba group of mines of Tata Steel Ltd., Noamundi, Katamati, Joda East and Khomdbond Iron Mines of OMQ division of Tata Steel Ltd., Joda West Manganese Mine and Sukinda Chromite Mine of FAMD group of Tata Steel Ltd., Muraidih Colliery of BCCL, UTKAL B coal block of M/S JSPL, RSMML mine at Jhamarkotra, M/s Kayad Underground Mine, Rampura Agucha open pit as well as underground mine, Sindesar Khurd Mine of Hindustan Zinc Limited, Rajasthan, World Bank funded projects in the state of Mizoram, Konkan Railways, M/s ACC Ltd., M/s Dalla Cement Factory, Baglihar Hydroelectric Project, Stage-II (J&K) etc. At Sharda Highwall Mining Project of South-Eastern Coalfields Ltd., improvement in powder factor in overburden blasting and stability of highwall faces using smooth blast blasting techniques was carried out. At Parbatpur Colliery of M/s Electrosteel Castings Limited, blast optimization study was carried out for enhancement of coal yield per blast in degree-III gassiness of underground coal mines under constrained conditions. In Kaladan Multi-Modal Transit Transportation Project in Mizoram state, funded by the World Bank, controlled blasting patterns were evolved for safeguarding the residential structures of Lawngtlai township and at the same time accelerated the progress of the work. In the opencast coal mine of M/s JPL, deep-hole opencast blasting was carried out and its impact on the safety and stability of the inclined drifts operating side-by-side was assessed. This Department is also involved continuously for the last five years in establishing the controlled blast design patterns at Aditya Limestone Mine, Shambhupura, Chittorgarh of M/s UltraTech Cements Limited wherein ground vibration, noise/air overpressure, flyrock and fragmentation are being controlled amicably for smooth running of the mine. Blasting training of mine officials is also imparted at regular intervals for communicating the best practices to overcome the political and environmental issues.

At Konkan railways, flattening of unstable slope using control blasting was carried out at nine sites successfully. Controlled blasting techniques considering the stability of cave lying within lease hold area were undertaken at Gagal Limestone Mine and controlled blasting for rock excavation of wagon tippler I&II complex of Jaypee Nigrie Super Thermal Power Project was undertaken. Ground vibration, fragmentation studies were carried out judiciously for the captive limestone mines of companies like M/s Jaypee Balaji Cement Plant, M/s Dalla Cement Factory and Gagal Cement Works, M/s ACC Ltd. Removal of protection wall of Tail Race Tunnel Outfall and Rock Barrier by controlled blasting was undertaken at Baglihar Hydroelectric Project, Stage-II (J&K).

Several blasts were conducted at Dragline benches of East and West section of Jayant and Nigahi Projects of Northern Coalfields Limited (NCL) under the in-house project titled “Standardization of dragline blast designs to control vibration within safe limit”. Extensive field investigations were carried out at Nigahi Project of NCL and Sonepur Bazari Project of ECL under the S&T project work on “Blast design and fragmentation control-key to productivity” funded by the Ministry of Coal.

Pre-split blast designs have been successfully implemented at Rampur Agucha mine. The pre-split holes of about 700000m are drilled annually with inclined holes at 60 degree which ensured the long-term stability of the mine. The present depth of the mine becomes 360m only because of successful implementation of presplit blasting. Delay scattering of shock tube (NONEL) systems of M/s Solar Industries India Ltd. was conducted at Kayad underground Mine, HZL for the first time with the help of High-speed video camera.

Final highwall obtained by smooth blasting at Sharda Trench Highwall Mining Project, SECL

Blasting training being imparted at M/s UltraTech Cement Ltd.

View of the all 36 benches (bench height-10 m) at Rampura Agucha Mine, HZL

View of the initiation of shock tube at Kayad underground Mine, HZL

Barrier blasting at Baglihar Hydroelectric Project, Stage-II (J&K)

3. BORD & PILLAR MINING DIVISION

1. Assessment and Advice on "Monitoring of strata behaviour during extraction of pillars in CMP-6 using CM Technology at VK7 Incline, SCCL"

At VK7 Incline in Kothagudem area of SCCL, strata monitoring investigation was conducted and necessary advice was rendered during successful extraction of CMP-6 panel in King seam by continuous miner.

2. Scientific Study for Stability Analysis of Konar Washery Site, Khas Mahal Project, CCL

A Scientific study was conducted and suggestions were given after stability analysis of developed pillars below the proposed Konar washery site for construction of a new washery.

3. Strata Monitoring of Blasting Gallery Depillaring Panels BG-4, BG-5 and BG-6 of 3 Seam at Vakilpalli Mine, RG-II area, SCCL

Strata monitoring investigation were conducted and necessary advice was rendered during

successful extraction of 9.5m thick seam 3 above the stowed goaf of lower seam 4 by Blasting Gallery method at Vakilpalli Mine of RG-II area of SCC.

4. Scientific study for determination of cavability characteristics and design of method of depillaring for contiguous seams, Upper and Lower Patpahari (UPP & LPP) including impact of depillaring on surface subsidence at Bhatgaon Colliery, SECL

At Bhatgaon colliery, SECL, study has been conducted to determine the cavability characteristics of the immediate roof rock strata of UPP seam and design of method of depillaring for contiguous seams(UPP and LPP seams) in the 18LN panel with design of suitable support, including impact of depillaring on surface subsidence at Bhatgaon colliery, SECL.

5. Scientific Study for monitoring the subsidence of different strata lying below Dhanbad-Chandrapura Railway line over X Seam fire affected area at Gopal Gareria Section of Sendra Bansjora Colliery, BCCL

A Scientific study was conducted using six numbers of Bore Hole Extensometer to monitor the subsidence of different rock strata above the fire affected X seam along the DC Railway line near the Bansjora railway station and necessary advice was given month wise.

6. Assessment and Advice on "Monitoring of strata behaviour during extraction of pillars in seam 5 using CM Technology at Panel CM-4B of NCPH Colliery, old Mine, Chirimiri, SECL

At NCPH Colliery, old mine, Chirimiri area SECL, strata monitoring investigation were conducted and necessary advice was rendered during successful extraction of CM-4B panel in seam 5 by continuous miner.

7. Scientific Study for Design of Method of Development and Extraction in Proposed Panel No. BG-9 in Queen Seam at 21 Incline, Yellandu Area, SCCL

In this project scientific study was conducted using numerical modeling technique and suggested suitable method of development and depillaring of the proposed panel No.9 in Queen seam by Blasting gallery method.

8. Scientific study for the design of Extraction Pattern for Developed Pillars of Sub-panels CMP-7A and 7B in King seam lying below Caved Goaf of Top seam using CM Technology at VK 7 Incline, Kothagudem Area, SCCL

In this project suitable extraction pattern of developed pillars along with support system was suggested based on numerical modeling technique for CMP-7 panel lying below Caved Goaf of Top seam using CM Technology.

9. Design of Suitable Method of Extraction in Proposed Panel No. "U" in V/VI Seam through - 3 Pit of Joyrampur Colliery, Lodna Area, BCCL

In this project scientific study was carried out for the design of suitable method of depillaring in the proposed panel No. U in V/VI seam at Joyrampur colliery of Lodna Area, BCCL.

10. Scientific study for stability analysis of various geometrical parameters associated with development and extraction of mica and associated minerals from mines located in the Nellore District, A.P.

In this project based on geo-mining data, laboratory tested data and numerical modeling studies, guidelines for exploitation of mica and associated minerals deposit was developed.

11. Scientific Study for the extraction of 6.5m thick seam with no subsidence impact on the floor of the overlying waterlogged XVI seam in Panel No. 3/15 at Katchi Balihari 10/12 Pits Colliery of PB Area, BCCL

In this project detailed scientific study was carried out and suitable method of depillaring in the proposed Panel No. 3/15 in XVI seam at Katchi Balihari 10/12 Pits Colliery of PB Area, BCCL along with support design was suggested without affecting the overlying waterlogged XVI seam from subsidence point of view.

12. Scientific study to extract coal of crown pillars in 12 & 13 seam of deep mine, Chasnala colliery. IISCO-SAIL

In this project scientific study was conducted for stability analysis of 1st Horizon of 12 and 13 seams using FLAC3D. Based on study extraction of crown pillars coal has been recommended.

13. Determination of Stope dimensions for stability and their supporting methods for Kayad Mines, HZL

Based on 3D Numerical model and Mohr Coulomb elasto-plastic failure analysis, failure around stope brow, stope back, wall rocks and displacement of stope have been analysed to recommend proper stope dimension and support system.

14. Evaluation of stability of Rampura Agucha underground mine and suggesting remedial measures for safe workings at Rampura Agucha mine of M/s Vedanta-Hindustan Zinc Limited, Bhilwara, Rajasthan

Based on rock mechanics instruments and visual observations, stability of the underground mine structure was monitored and it was recommended to prioritize filling of open stopes to reduce the deformation of hang wall drive.

15. Design of optimum thickness of crown and rib pillar for Durga and Shankar lodes of Nuasahi Chromite mines of IMFA Limited

Based on field geo-mining data and laboratory tested data, dimensions of crown pillar, rib pillars and other stoping parameters were designed using Numerical modelling Technique.

16. Scientific study for the workability of No.2 Seam at KTK-5 Incline, Bhupalpalli Area, SCCL

At KTK No.5 Incline, scientific study was conducted for the workability of No.2 Seam, with steep gradient of 1 in 2.5 (or dip 22°) due N 50 1/2° E at varying depth cover. In the report suitable method of extraction along with suitable design of support system during development and depillaring has been recommended. Suitable shape and size of pillars have also been suggested.

4. CALIBRATION CELL

Work done: Calibration Cell of CIMFR, Barwa Road Campus extended in-house calibration services as per requirements of ISO 9001:2008 for calibration of instruments related to electrical parameters, temperature and dimension measuring tools used by testing laboratories of CIMFR HQ. Calibration services provided by Calibration Cell are traceable to ERTL(E), Kolkata. Present setup at calibration cell consists of reference equipment like Universal Calibrator, Model 9100, Wavetek, 6-1/2 Digit Precision Digital Multimeter, Fluke 8846A, Precision Digital Power Supply, Tektronix PWS 4305, PRT Sensor, Fluke 5609, Temperature Calibrator, Beamex TC 305, Temp. Bath, Venus 2140(S), ISOTECH, Temp. Bath, Jofra ITC-650A, h) YOKOGAWA Oscilloscope,

DLM 2024 and Slip Gauges, TESA-RSD. In-house calibration services were extended for the calibration work of thirty-six equipments of CIMFR HQ during 2014-15.

5. COAL MINING AND HYDROLOGY

1. To find a methodology of safe liquidation in thick seams of Raniganj coalfields: design, development & show-casing demonstrative trials at khottadih colliery

Accomplishments as per the Proposed Action Plan of the project: A number of geotechnical instruments were installed in the panel B-2 (sub-panel A) during depillaring, observations were taken. This helped to extract more number of pillars (compared to the earlier occasions) in the panel within the incubation period and with 'controlled' spontaneous heating or fire. The panel preparation, including supporting all developed galleries with cable bolting, is in progress.

2. Scientific study for depillaring of T9 panel with support design at 3&4 inclines, Tandsi Mine, WCL

In Tandsi 3&4 mine, a III (Top) seam, having average thickness 3.27m, is being developed in bord and pillar pattern. The mine management has proposed to depillar it by deploying the same continuous miner, earlier used for its development. The neighbouring dip-side panel T-8, already developed by drilling & blasting and with the deployment of LHD, is now being depillared. The analysis of observations of tell-tales has provided insight of the likely roof behavior during depillaring.

3. Scientific evaluation study related to volumetric computations including the method-audit of pachwara (central) opencast coal mine of PSPCL

The volumetric computation was done using latest surveying instrument (Total Station and accessories) at the mine-site. The rational computation taking the base line study on 6.1.2014. CSIR-CIMFR has reported a significant shortfall as calculated from volumetric audit and in comparison to production supply figure.

4. Scientific study to analyze options of safe liquidation of coal seams above the CM panels at Sarpi project, ECL, with aim to protect Ukhra Village

In Shyamsundarpur Colliery, ECL at its (South Bankola portion) Sarpi project, the Bankola seam (R-VII), about 5.0m thick is being developed in bord & pillar pattern at an average depth of cover 140-190m. Part of the developed CM panels is below Ukhra Village and the rest of the CM panels are below overlying RVIII-T2/RVIII-B1 seams contiguously developed in two sections with 3-4m parting. CIMFR has recommended to not depillar at the moment.

5. Scientific study to assess no adverse subsidence effect on important surface properties including the forest land due to underground mining during development in SECL, with special reference to Ketki and Binkara coalmines

On request from SECL, CSIR-CIMFR has taken up this scientific study to assess the impact of underground mining (for development stage only) on the surface (or the forest). With the help of empirical and numerical modeling approaches, the factor of safety (f.o.s) was calculated in this study-report to be more than 2.0, which means the statutory dimensions of development workings (especially vide CMR 99) would be stable on long-term basis, subject to their respective depth of covers.

6. Scientific Site Investigation (SSI) at Vijay West u/g mine of M/s SECL

Vijay West U/g mine is located in Sendurgarh Coalfield [1] of M/s South Eastern Coalfields

Limited. Within the proposed Vijay West U/G Project area, the potential seams for underground mining are seam-III, seam-II (Top) and Seam-I. This study includes both empirical and numerical approaches, applied comprehensively. The stability is ensured during development of seam III by analyzing various influencing mining related factors in total perspective, and accordingly, support design and instrumentation plan during development are suggested.

7. Advice on extraction of developed pillars in proposed CM Panels (P9, P12 & P13) in R-VII Seam, Sarpi Project of Bankola area, using 3-Dimensional Numerical Modelling

As a continuation of study as mentioned in item 4 of the Annual report of this department and on request from ECL, methods of liquidation in P9, P12 & P13 panels were designed by CSIR-CIMFR, ensuring no subsidence damage to the floor of R-IX(T) [Kajora seam] and also on surface, the Ukhra village primarily.

8. Advice on extraction of developed pillars in 124 LW panel of Churcha (RO) Mine, SECL with continuous Miner deployment and support design

East Block of Churcha (RO) mine, (after reorganization of 2 operating adjacent mines Churcha and Churcha West UG) has planned exploitation of seam-V of the Sonhat coalfield in the Rewa Gondwana basin. The operating depth of panel 124 LW is 385-398m. Above Seam V, there is a general presence of important geological feature i.e. strong Dolerite sill, competent in nature (75m-163m thick), occurring between 38-190m. The recommended maximum heights of extraction should be 4.5m or the thickness of the seam, whichever is minimum and not 4.2m as recommended during extraction by LHD deployment. Leaving of coal in the roof will invite chances of spontaneous heating. The “design by measurement” method may gainfully be utilized.

9. Advice on selection of a suitable mining method for all workable seams at Thesgora underground mine, Pench Area, WCL

In Thesgora mine, Pench area, WCL only four out of eleven coal horizons have workable thickness, namely seam I(B+C), Seam II, Seam III(B) & Seam V(A). Further seam II is identified by CMPDI, as ‘not workable’ by underground mining method. Underground mining methods are not feasible technically with due regard to safety & conservation. Even if, one go for depillaring by underground methods, the surface land above the area of extraction has to be acquired, as a requirement of law and also in vogue. For opencasting also, the surface land has to be acquired. However, we get higher productivity, high production and ensured safety in the latter. Therefore, opencasting will not only be technically recommended but also will provide better return on investment.

6. CSIR-CIMFR NAGPUR RESEARCH CENTRE, UNIT-1, NAGPUR

CSIR-CIMFR, Unit-1, Nagpur, dealing in four niche areas of mining exclusively viz. Blasting and productivity, Mine water environment, Slope stability and Rock Engineering (rock mechanics & underground space in particular underground constructions work) has enrolled 27 new R&D projects during 2014-15. The center has some previous years running R&D projects as well which were seven (07) in number. Fifteen projects (15) are completed during the year 2014-15. The unit has earned external cash flow (ECF) of 266.368 lakh rupees from industry and stood at fourth position in laboratory in terms of resource generation (data as per PME, CIMFR Dhanbad). In house project activities were also undertaken by the centre and four number of approved in-house projects were running. Apart from the project related activities the regional centre imparted training to students (under the HRD banner of CIMFR) to engineering colleges and institutes imparting science education i.e. B.Sc /B.Tech, M.Sc /M.Tech and BCA /MCA.

Scientists of the centre are also associated, as project member in Dhanbad HQ Projects. R&D works are accomplished based on field ,laboratory and advanced software namely FRAGALYST 4.0, PFC 2D, FLAC3D, GEOSLOPE, GALENA and COMSOL input. Up to date d latest know how have been used by the scientists for devising solutions to the various technical problems undertaken by the centre.

Significant achievements and work done of the division are as follows -

1. Lake-tapping work at MV-1, Modak Sagar, MCGM, Mumbai (controlled blast design of break through rock-plug).
2. Scientific consultancy services were provided for Indian Railways tunnel construction work in a big way. Geotechnical investigations, design of support system requirements and controlled blasting for rail tunnel were the major task handled. The name of the tunnels which were provided CIMFR know-how are- (a) Marugutti Tunnel near Gulbarga, South Central Railway, (b) Hassan - Bangalore New B.G line, South West Railway (C) Two rail tunnels near Kottayam Railway station (d) Mangalore-Panambur section, Southern Railway, Ernakulam (Kerala).
3. Safe design for rock blasting work near populated area for Bangalore Metro Project (Majestic Station and other metro stations).
4. Geotechnical assessment and advice on stoping parameters and instrumentation at Zawarmala underground lead zinc mine, Hindustan Zinc Ltd (HZL).
5. Numerical modelling is done for stope design and design of stoping parameters (below -62mRL at Rampura Agucha Mine, for stope design in SK-A6 and SK-A2 orebodies of Sindeshar Khurd Mine and for L1 & East Lode of Rajpura-Dariba Mines of Hindustan Zinc Ltd (HZL)
6. Technical advice are given on controlled blast design and vibration monitoring for construction works of Hydro-electric Power Projects (Koldam Hydroelectric Power Construction Project, Himachal Pradesh)
7. Design of Systematic Support Rule (SSR) for decline and development roadways (up to 12m RL) at Mahagiri Underground Mine of Indian Metals and Ferro Alloys Limited (IMFA) Ltd.
8. Subsidence study for new coal blocks and mines using CIMFR developed software were yet another significant achievement /work done by the centre e.g. for extraction of W-5C panel in G-I seam of Surakachhar 3&4 Inclines of M/s SECL.
9. Rock mechanics instrumentation work and data analysis of strain bars at Balaghat underground manganese mine of MOIL Ltd. (at 10th & 11th Level)
10. Advice on slope design and assessment of slope stability through slope monitoring based on geotechnical studies is done. Naokari mine of Ultratech cement, Mangampeth Barytes Project of Andhra Pradesh Mineral Development Corporation Ltd. (APMDC) and Maton rock phosphate opencast mine of Hindusthan Zinc Limited were provided technical guidance.
11. Geo-hydrological study for mining at deeper levels in Partipura limestone mine of M/s Trinetra Cement, District-Banswara, Rajasthan is done by the centre. Trinetra cement plant is owned by one of the biggest cement conglomerate of India, namely INDIA CEMENT and CIMFR study has helped the mine management in effective water management and obtaining statuary clearance for this mine.
12. Detailed parametric study of bulk head design for various water levels in open pit at Rampura Agucha Mine, HZL

13. Related to mining environment work studies on noise and ground vibration due to operations of heavy plant machinery in the working and nearby areas of Rauri Cement Plant of Ambuja Cements Limited (HCL), Darlaghat, HP have been done during 14-15.
14. Nagpur centre has provided 'service to industry' particularly to public sector mining company in terms of their mega excavation works e.g. shaft widening and deepening including winder installation etc. CIMFR Nagpur has helped M/s MOIL Limited in checking, evaluation and vetting of Techno-Economic Feasibility Report (TEFR) for vertical shaft deepening being planned at Kandri Mine. Such work require techno- economic feasibility assessment and third party evaluation and amounts to several crore rupees. The technicality involves the viability of project in terms of economics and which is evaluated on the basis of NPV, Profitability Index (PI) and Internal rate of return (IRR). This is a new engineering area being attended by the centre.
15. Nagpur centre advice on blasting work is taken by Atomic Energy Commission, Gov. of India for their nuclear installations and related to this a project titled 'Controlled blast design to evaluate the permissible vibration level & safe blasting pattern to contain damage at Kalpakkam nuclear construction, Tamilnadu' has been undertaken. The work was extremely challenging in view of site sensitivity.
16. Comprehensive blast analysis for evolving production pattern in Grasim Cement Mine, Kotputli, Rajasthan of Ultratech Cements Limited is the work done in the mine productivity improvement area. Controlled blasting in Singerani Collieries Company Limited (SCCL) e.g. RKP OC, Mandamarri Area has also provided production improvement.
17. Small scale mines and quarries studies are also undertaken at CIMFR, Nagpur and advice on blasting for safety and productivity is given to private mine enterpruners. A Granite quarry project : Scientific study on the Vibration monitoring and design of safe charge pattern at Thomsun Granites Mine, Idukki District, Kerala has been done.
18. Nagpur centre was instrumental in Pranahitha Chevella Lift Irrigation Project, Karimnagar, A.P. for studies on safe vibration limits, on tunnel shotcreting, green concrete and reservoir bund (at package 8 & 12).

Besides normal project related R&D activities taken up by the centre, the division is also engaged in frontier area of Highwall Mining Project in association with Dhanbad HQ. One group of scientist is carrying out development of Highwall Mineability Rating (HMR) for Indian conditions. One Ph. D. work concerning Highwall mining at present is going on at the centre and first lady mining engineer (Mrs. C.P. Verma) is engaged in this work.

7. CSIR-CIMFR ROORKEE RESEARCH CENTRE

Thrust Area: Tunnelling and Underground Space Technology

During April 2014 to March 2015, the CSIR-CIMFR Regional Centre Roorkee has undertaken assignments on design of highway tunnels, railway tunnels, slopes, rock mass characterization in a hydroelectric tunnels, blast optimization and safety related problems for tunnelling sectors.

The clients included M/s Larsen & Toubro Construction; ITNL (IL&FS), Mumbai; Consulting Engineers Group Ltd. (CEG), Udaipur; ITD-ITD CEM Joint Venture, New Delhi; Rail Vikas Nigam Ltd., Kolkata, THDC India Ltd., Tehri; Rithwik Power Projects Ltd; IOT Infrastructure & Energy Services Ltd. (IOTL), Vizag; Hindustan Petroleum Corporation Ltd., Visakhapatnam.

In Chenani-Nashri highway tunnel (the longest highway tunnel with 9.2km in India), J&K state due to frequently changing dipping pattern of the joints and other joint properties (spacing,

filling and tightness), larger tunnel deformation was attracted as compared to the expected deformation. To restrict further deformation, in consultation with project engineers CIMFR suggested additional supports as counter measures for implementation in tunnels. For the Chirwa ghat twin highway tunnels field and geotechnical investigations have been carried out to study the rock mass behaviour for assessing the tunnel support system during the excavation of the tunnels. Accordingly, the rock bolt and M25 steel fibre reinforced shotcrete (SFRS) support is suggested. The supports were assessed for implementation as per design of the tunnels support system. In the rail tunnel between Mahadevsal and Posoita section the excavation work of the tunnel portal at both Posoita and Goelkera end started in Dec. 2014 as per the advice of CIMFR. Moderately weathered, closely jointed phyllites and shales belonging to Singhbhum Group are exposed in this area. The portals have been supported with steel ribs as per the CIMFR design. Geological investigations of tunnel alignment reveal that in the Posoita end, rock cover is low upto initial 60m of tunnel. Therefore, the steel rib support was proposed to be extended upto 60 m in Posoita end instead of earlier recommended 20m. A controlled blast design with powder factor of 0.6kg/m^3 has been suggested and which shows the desired results as also demonstrated at site. In a hydroelectric project tunnel in Uttarakhand, the rock mass was characterized for the TBM excavated section. Estimation of Q-value using TBM Thrust or the indirect method indicates that rock mass requiring TBM thrust >8900kN has Q>4 and vice versa. In the TBM section of the tunnel a total of 5397.87m length was analyzed. Out of this length 1,562.81m (29%) was excavated in rock mass having Q>4 and 3,835.06m (71%) was excavated in rock mass having Q<4. The rock class distribution from direct method and indirect method are found to be comparable.

In the slope design and protection the work includes the design of open cut rock slopes for IGD airport underground metro stations being constructed by cut and cover method. CIMFR suggested a scheme of support system for the cut-slopes. During excavation, it was observed that the exposed quartzite rock on the southern cut-slope is traversed by two bands of mica schist rock. These bands of mica schist with varying thickness of 20 to 60 cm are dipping gently in the North-Eastern direction i.e. towards the Eastern slope of the Crossover-2 site. The orientation of mica schist band on the Southern slope indicates possibility of planar sliding along the mica schist band. For the treatment of the slopes where mica schist bands are encountered, it is recommended that the reinforcement for (Eastern as well as Southern) slopes of the excavation shall be same as that suggested in the report. In addition, it is recommended to extend the application of shotcrete with wire mesh beyond 5m depth till the bottom of the cut slope in the section where mica schist is exposed. For the slope stabilization work of HPCL at SPM tunnel portal of ISPRL cavern project, on the outlet portal side, it is suggested to remove loose boulders from the slope, insert resin grouted rock bolts and spray shotcrete on the slope surface, erect a rock fall barrier and also designed a steel canopy. At the inlet portal side it is proposed to extend the RCC portal for about 8.0m, construct RCC rock fall barrier and installation of welded wiremesh on pillars of pit valve area towards hill side. In another 2km long slope design work carried out for ISPRL cavern project at Visakhapatnam, the supports were designed for slopes behind boundary wall from pillar 1 to 6, below boundary wall including backside of control room and sub-station location. One rock fall barrier has been constructed as per the CIMFR suggestions.

In the Ratle hydroelectric power project number of trial blasts was carried out for the tunnel blast design to get the optimum pull for different class of rock mass. In the pump storage plant (PSP) project of THDC a number of underground structures are being excavated, including two head race tunnel (HRT) and two tail race tunnel (TRT). Some of the excavations were of very critical nature because of close proximity of two underground openings. CIMFR has helped in

designing the blast for optimum pull and controlling the balst vibrations. In the silt flushing tunnel (SFT) of another hydroelectric project, CIMFR has provided its expert advice for the controlled blast dsign for the excavation in highly jointed metabasic rock mass belonging to rock class IV (poor). The blast design was also modified for the low cover zone in the tunnel.

The longest highwy (Main and Escape) tunnels in J&K (Chenani-Nashri tunnels)

View of Tunnel Portal along the rail alignment between Mahadevsal and Posoita section

View of Chilling Plant and Mehram Singh Nagar along the cut slopes of IGD airport underground metro station, New Delhi

8. ELECTRICAL LABORATORY

1. In situ study 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 (H.P.)

Work done: Four number of track ropes [each of 30mm dia., full locked coil construction, Usha Martin Limited make] and two number of haulage ropes [each of 18mm (seal) dia.,6 × 19 (9/9/1) construction, right hand langs lay, fibre core] of Passenger Cable car Aerial Ropeway installation of M/s Timber Trail, Asia Resorts Limited, Parwanoo (H.P.), were scanned using INTRON Rope Tester, Russian make for monitoring their suitability in the installation.

2. Assessment of winding ropes of Narwapahar Mines (UCIL) by nondestructive method

Work done: Two ropes of Cage and two ropes of Skip each of 28mm dia full locked coil construction, lay RH & LH, galvanized of multirope friction winders (Main installation) of Narwapahar Mines (UCIL) have been subjected to nondestructive investigation for monitoring their suitability in the installation.

3. Nondestructive evaluation and advice on the present condition of ropes of man riding (Chair cars and Chairlift) systems at Goleti Mines (Quarterly) and RK6 Mines (half yearly) of SCCL

Work done: Two ropes (each) of 16mm dia. Sisal core, preformed 6 × 7 (6-1) stranded construction, lay-RH, galvanized dry lubrication of Chairlift Man riding system-1 and Chairlift man riding system-2 of Goleti 1-A incline Mine (Quarterly) and one rope of 16mm dia. Sisal core, preformed 6 × 7 (6-1) stranded construction, lay-RH, galvanized dry lubrication of chairlift man riding system on surface of RK-6 incline mine (Half yearly) of SCCL has been subjected to nondestructive investigation for monitoring their suitability in the installation.

4. Inspection and advice on the present condition of haulage rope of D.R.V. Ropeway at Darjeeling, West Bengal

Work done: One haulage rope of dia. 38 mm, 6 × 17 S performed construction (8-8-1) sisal core, R.H.L., galvanized, A2/W-3 lubrication (prestretched), over Darjeeling Ranjeet Valley (DRV) ropeway installation at Darjeeling, West Bengal has been subjected to in-situ study by non-destructive investigation.

5. Advice on the present condition of track ropes and haulage ropes at Nainital Ropeway

Work done: Two numbers of track ropes [each of 30mm dia.,full locked coil construction] and two numbers of haulage ropes [each of 17mm dia., 6 × 7 preformed (6-1) stranded construction, sisal core, lay- R.H.L] of “Aerial Express” passenger cable car ropeway (bi-cable zigback with cablins) of M/s Kumaon Mandal Vikas Nigam Limited, Nainital, Uttarakhand has been subjected to in-situ study by non-destructive investigation.

6. Evaluation and advice on the present condition of haulage rope of detachable grip mono-cable Passenger Ropeway at Trikutpahar, Deoghar, Jharkhand

Work done: One haulage rope of dia. 36mm,round strand, 6 × 19 Seale (9/9/1) ungalvanised Sisal core, Right hand Langs Lay of length 1700m monocable detachable grip Aerial Ropeway Passenger Cable car installed at Trikutpahar, near Deoghar has been subjected to in-situ study by non-destructive investigation for monitoring its present condition in the installation.

7. Assessment of haulage ropes of passenger cable car aerial ropeway installation of M/s Timber Trail, Asia Resorts Limited, Parwanoo (H.P)

Work done: Two number of haulage ropes [each of 18mm (seal) dia.,6 × 19 (9/9/1) construction, right hand langs lay, fibre core] of Passenger Cable car Aerial Ropeway installation of M/s Timber Trail, Asia Resorts Limited, Parwanoo (H.P.), were scanned using INTRON Rope Tester, Russian make for monitoring their suitability in the installation.

8. Inspection and advice on the present condition of haulage rope of Passenger Ropeway at Saputara, Dang, Gujarat

Work done: Two number of haulage ropes [each of 18mm (seal) dia.,6 × 19 (9/9/1) construction, right hand langs lay, fibre core] of Passenger Cable car Aerial Ropeway installation of M/s Timber Trail, Asia Resorts Limited, Parwanoo (H.P.), were scanned using INTRON Rope Tester, Russian make for monitoring their suitability in the installation.

9. Third party inspection and monitoring of projects under RGGVY in the state of Nagaland

Work done: During the reporting period (2014-15), 2nd stage and final field inspection under RGGVY scheme in balance 22 (twenty two) villages in 5 (five) districts of Nagaland - eg. Dimapur, Peren, Longleng, Kohima and Mokokchung have been carried out by CSIR-CIMFR. The details of villages are as follows:

1. District: Dimapur (8 villages in Block: Medziphema and 5 villages in Block: Kuhuboto)
2. District: Peren (2 villages in Block: Peren)
3. District: Longleng (One village in Block: Longleng)
4. District: Kohima (2 villages in Block: Tseminyu)
5. District: Mokokchung (4 villages in Block: Mangkolemba)

A total population of 16,76,294 (according to 2011 census) have been benefitted in Nagaland.

9. ENVIRONMENTAL MANAGEMENT GROUP

1. Studies on leaching characteristics of fly ash, bottom ash and pond ash of Durgapur steel thermal power station and Mejia thermal power station

The objective of study was to carry out leaching experiment of fly ash, bottom ash and pond ash and evaluation of different chemical parameters in fly ash, bottom ash and pond ash leachates. Leaching experiment conducted to know the leaching behavior in all the collected ashes. Moisture content, loss on ignition and total metal content of the samples were evaluated. Based on leached out water of fly ash, bottom ash and pond ash indicated very less concentrations of elements and are well within the permissible range. The recommendations is based on laboratory batch leaching experiment. However when the ash will be disposed of forever at any site, it may undergo weathering and there is change in its properties. This may cause leaching of more unwanted elements into groundwater. Therefore, it is advised to carry out study of groundwater quality at the ash disposal site on time to time basis.

2. Development of Methodology for Estimation of Greenhouse Gas Emissions in Mine Fire Areas and their Mitigation through Terrestrial Sequestration.

The study was inventorization and estimation of Greenhouse Gases (CO_2, CH_4) emission from coal mine fire areas, its temporal and spatial dispersion at ground level and to develop Greenhouse gas (GHG's) emission factor for coal mine fires. The study sites are Ena Fire

Project of BCCL an opencast mine, and Sangramgarh Colliery of ECL, worked in combination of opencast and underground mining methods.

CO_2 identified as the major GHG coming out of coal mine fire followed by CH_4 while N_2O was not detected. CO_2 emission factor is high in opencast colliery (Ena Fire Project) while CH_4 emission factor is high from underground developed galleries (Sangramgarh Colliery). ANN models indicated that surface temperature played an important role in the rate of emission from coal mine fire and high correlation coefficient in all cases ensures a good agreement of ANN model with the experimental data. CALPUFF dispersion model for CH_4 at hourly average ground level CH_4 concentration confirms its impact in the larger part of the study area.

CO_2 fixation (tonnes CO_2 hr^{-1} ha^{-1}) by a specific tree reveals that during all the seasons F. religiosa captured the highest CO_2 than other native plants. The changes in species diversity observed at mining areas indicated an increase in the proportion of resistant herbs and grasses. The benefits are strengthening of national data base on GHG, understanding on the role of coal mining emissions on climate change issues and enhanced CO_2 fixation in coal mining areas.

3. Environmental Monitoring of Mines / Wahseries of BCCL, TATA Collieris and Kathautia Open Cast Coal Mine, Daltonganj, Jharkhand as per the requirement of Environmental Acts, Laws and Environmental Clearance.

Environmental studies were carried out to evaluate the quality of Air, Water and Noise in and around all 17 clusters of mines of BCCL and TATA collieries (Sijua, Bhelatand Colliery and Bhelatand Coal Washery) and Kathautia OCP of Daltonganj. Air quality assessment has been made by deploying PM_{10} and $PM_{2.5}$ particulate matter samplers with gaseous attachments for SO_2 and NO_2 fortnightly following CPCB guidelines. Simultaneously noise level measurements were taken obeying CPCB guidelines. High traffic density, poorly maintained road networks, and active mining operations has aggravated pollution level in BCCL mines. The prominent streams draining the western and eastern part of the buffer zone of TATA are tributaries of Damodar river. It can be concluded that concentration of pollution were well within the limit. The mine management has been implementing different remedial measures in Kahautia OCP to make mining operation eco-friendly.

4. EIA study and preparation of EIA/EMP of Chasnalla and Jitpur, Begunia Collieries of SAIL, Fireclay and Magnetite mines in Latehar, Jharkhand, Aligadde quarry of Seabird, Karwar and Chittorgarh Fort of Rajasthan

EIA/EMP study has been undertaken for various components of Environment and to prepare an effective Environment Management Plan to minimize the negative impacts of mining areas. Based on primary as well as secondary field data collected for various environmental components as per TOR received from MOEFCC. Project Seabird is executing infrastructure development encompassing marine work and land based facilities at Karwar, for augmenting the Naval Base. Environmental clearance has been given by MOEFCC. In Chittorgah: Blasting allowed with 115 dia blast hole with explosive as there is no effect on dust & noise.

Green belt development including species for optimal dust and SO_2 arresting capacity around the limestone mines, fort and slope of the fort should be done.

5. Hydrology and Area Drainage Study of Gondavali, Maihar, MP, Kundanganj Area, UP, Kendadih, Rakha and Surda Mining Lease of Indian Copper Complex, Ghatsila and Mukutban, Maharashtra

The study included Hydrology and Drainage of the project area for determination of High

Flood Level and Safe Grade Elevation for the Project Areas. The monthly water balance study indicated that only 50% of available runoff results in stream flow in that month and remaining 50% is detained by diversion and storage in bunded fields and as ground water storage. The present source of water recharged only from rainfall. The dynamic water zone was present in the depth range of 4.10 to 6.30m in post monsoon. On the basis of above study it may be concluded that the proposed plant falls under the safe zone as per existing high flood level. Increase in impervious soil cover and greenery over pervious area are recommended. Rain water on impervious plant area should be harvested and utilized for recharging the ground water within the plant area itself by using appropriate technology.

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

The objective is to study water Conservation / Rain Water Harvesting of the areas. Estimation of storm water was computed to design the capacity of earthen dam. Detailed design of earthen dam based on the hydro-geological condition of the site was done. Constructions of Dams were done. By the implementation of rainwater harvesting in the study areas there will be increase in ground water recharge potential.

7. Development of algae based technology to mitigate energy crisis in coal mining area

The objective of the study was to produce green energy in the form of electricity and crude biodiesel from algae grown in waste water. A Pilot Plant produces algal biomass up to maximum of 250kg in one life cycle grown in waste water. The plant generator of capacity 35 KVA, can glow 100W × 300 bulb for a maximum of 3-6 hours and bio-diesel extractor will extract maximum of 63 liters biodiesel. This biodiesel will be used as B20 (20% of biodiesel) blended with pure diesel (80%) available in market to run generator or tractor or atta chaki or rice mill. The algae helps in cleaning pond.

8. Assessment of Groundwater Quality and Hydrological Parameters of National Capital Region

The ground water quality was assessed for its suitability to domestic and irrigation uses and to suggest suitable water management plan for the study area. A detailed hydrogeochemical investigation of National Capital Region generates a baseline water quality database for the NCR region which is essential for understating of the sources of the contaminants and to assess the groundwater quality status for drinking and irrigation uses. Infiltration test was also done in the NCR region to understand the groundwater recharge. The study will also help in planning the water resource management plan for the NCR area. Hydrological parameters were determined by slug test are representative only of the material in the immediate vicinity of the well and due to the localized nature of hydraulic response, the test might be affected by the properties of the well filter pack. The aquifer parameters like transmissivity (T), hydraulic conductivity (K) and storativity (S) were computed.

9. Evaluation of different Environmental Parameters like, Ambient Air Quality, Stack emission and Effluent Discharge at PTPS & TTPS

Evaluation of different Environmental Parameters like, Ambient Air Quality, Stack emission and Effluent Discharge are being carried out. Particulate emission from its two stacks were found higher than 150µg/m^3 then its prescribed limit while one stack was functioning well. Level of $PM_{2.5}$ and PM_{10} exceeded than their permissible limit of 60.00 and 100.00µg/m^3 at three

locations in winter months but the level of SO_2 and NO_2 remains under the threshold limit value of 80.00µg/m^3. Noise level were also found high in PTPS premises. The capacity of ash pond should be increased to minimize the pollution load.

At TTPS air, stack and water sampling was done at different places on monthly bases and analytical report was submitted in each month. After completion of investigation environmental statement was submitted. Recommendations for remedial measures were also provided.

10. Raw water sample testing and suggestions for treatment of water of South Eastern Coalfields Limited, Bilaspur

Water samples were collected from different water sources and analysed for physical, chemical and biological parameters and compared with the drinking water standard. All parameters were within limit except iron. Therefore, water treatment technology based on the principles of oxidation, precipitation and filtration may be applied for the removal of iron.

11. Feasibility Study for setting up of Sewage Treatment Plants in the residential Areas of Tisco Jamadoba Group of Collieries, Jharia, Dhanbad

This study includes available sewerage system for physico-chemical and microbiological properties of the discharged effluents, review of the different technologies for sewerage treatment systems, Identification of the suitable site and design of sewerage treatment system for each site, the feasibility of the reuse of treated wastewater for industrial and agricultural purpose and to identify the location of the discharge of effluent water in to the natural drainage system. The feasibility study of installation of sewage treatment plant Bhelatand and Adarsh Nagary colony was carried and report submitted .

12. Testing of Soda lime, water and cable wire

Six number of test samples of sodalime from industries were carried out for its use in life saving safety breathing apparatuses as per IS: 5321, 1969. Chemical characterization of water and cable wire were carried out as technical aid to mining and allied industries.

10. EXPLOSIVE AND EXPLOSION LABORATORY

1. Development and evaluation of alternative non-NG explosive-cord system for use in Ring Hole Blasting in Blasting Gallery Panels

Objectives: Development of alternative non-NG explosive-cord system for use in BG method of mining in underground coal mines.

Investigations: Studies into performance and incendivity parameters of four low grammage detonating cords and studies into sensitivity, safety and performance parameters of one emulsion explosive were done under the varying experimental conditions for assessing their suitability and possible improvements.

Findings: Emulsion explosive sample has met the initial requirement but, none of the cord samples could meet the initial statutory requirements of BG explosive-cord system. Therefore, no further trials of explosive and detonating cord together under other conditions could be done. Due to change in priority activities, failure to make low gramage cords with higher cooling contents with existing manufacturing technology and other unknown reasons, collaborating firm did not submit further samples of explosives or detonating fuse for evaluation, thus further trials under this project could not be continued. Although, alternative non-NG explosive-cord system could not be successfully developed, data pertaining to incendivity studies under different inflammable

atmospheres on different explosive and cord samples revealed some useful information which may be gainfully utilised in future by both organisations to make new, safer or cost-effective similar products.

Benefit accrued: Enhancement of safety as well as productivity in underground coal mines.

The project has been Completed in January 2015.

2. Development and evaluation of emulsion permitted (P_1, P_3 & P_5) explosives suitable for use in Indian underground coal mines

Objective: Development and evaluation of emulsion permitted explosives of all three groups suitable for use in Indian underground coal mines.

Investigations: Four emulsion explosives compositions were designed aiming at development of permitted explosives. They were studied for their sensitivity, incendivity, post detonation fumes, shelf life, etc., under varying laboratory conditions simulating worst possible conditions for their use in underground coal mines for assessing their suitability and possible improvements.

Findings: Emulsion explosive compostions with code nos. EP1-05 and EP3-03 met all statutory requirements of sensitivity, incendivity, post detonation fumes, shelf life, etc., and were found suitable for use in Indian Underground coal mines as permitted P_1 & P_3 group of explosives. Moreover, two emulsion explosive compositions with code nos. EP5-01 & EP5-02 are being evaluated under varying laboratory conditions to assess their suitability for use as P_5 explosives and for possible improvements thereon.

Benefit accrued: Enhancement of safety as well as productivity in underground coal mines.

The project work is in progress.

3. Periodic evaluation and advice on quality of emulsion based permitted explosives and detonating cords used in Blasting Gallery method

Objectives: Evaluation of quality of randomly selected samples of emulsion based permitted explosives (Powerring) and detonating cord (Powercord) from SCCL mines and advice on their suitability for use in on quality of used in different blasting gallery panels.

Investigations: Twelve samples of emulsion based permitted explosive (Powerring) and twelve samples of permitted detonating fuse (Powercord) used in Blasting Gallery method of SCCL were evaluated for their physical conditions, sensitivity, initiating power and performance parameters in open unconfined conditions. Moreover, trials for measurement of carbon monoxide and nitrous fumes in post detonation gases at the face after five minutes of blasting were carried out in GDK-11 Incline, Ramagundam on 09.04.2013 & 01.07.2014 and in 21 Incline, Yellandu on 24.08.2013 & 16.02.2015.

Findings: All twelve samples of detonating fuse (Powercord) and nine out of twelve samples of emulsion based permitted explosives (Powerring) were found to have satisfactory sensitivity, initiating power and performance parameters. Two samples of Powerring explosives failed to meet the quality requirement of density parameter and one sample of Powerring failed to meet the quality requirement of density and VOD parameters. Moreover, variations in VOD and density values were observed from batch to batch. Post detonation fumes evaluated in actual usage conditions in two different blasting gallery panels were also found within the permissible limits. From the analysis of the results, it was concluded that there was scope for minimising the variation in VOD and density values of Powerring explosives for consistency in their quality and thus in their safety and performance parameters. Sponsor organisation was advised to intimate

the manufacturer to maintain the quality of emulsion based permitted explosives (Powerring) and detonating fuse (Powercord) within their expected range with least possible variation to attain consistency in their performance in underground coal mines.

Benefit accrued: Enhancement of safety as well as productivity in SCCL mines.

The project has been Completed in March 2015.

4. Periodic evaluation and advice on quality of SMS/SME explosives of SCCL owned plants and OC/UG explosives and accessories of other firms

Objectives: Evaluation of quality of SMS explosives of SCCL owned plants and permitted / non-permitted explosives and accessories supplied by various manufacturers to SCCL for use in opencast and underground mines.

Investigations: Four samples of SMS of SCCL owned plants and one hundred thirty eight samples of explosives and accessories of other manufacturers comprising of 8 samples of permitted explosives, 5 samples of SME explosives, 3 samples of SMS of SCCL owned plants, 36 samples of LD explosives, 37 samples of nonels, 13 samples of cord relays, 14 samples of cast boosters and 26 samples of detonating fuse etc. of different manufacturers collected from different area magazine of SCCL were evaluated for different quality parameters to assess and advice on their quality standards.

Findings: Evaluation of quality parameters of SMS of SCCL owned plants and one hundred thirty eight samples of explosives and accessories of other manufacturers collected randomly from different areas by SCCL management revealed useful information on their conformity or deviation from declared/expected values. One sample of a permitted explosive failed to meet the requirement of post detonation fumes and thus it was not recommended to use further in underground coal mines. Some LD/SMS/SME explosives were not found meeting the quality requirements. Analysis of results revealed that most of the nonels and cord relays samples were not meeting the quality requirement of delay timing parameters. Based on our recommendations, SCCL management advised the concerned manufactures to take appropriate measures in the light of the result obtained for different quality parameters so that consistency in the quality of the explosive products supplied to SCCL may be achieved to get desired safety and performance and in some cases orders of the firms were cancelled also.

Benefit accrued: Enhancement of safety as well as productivity in SCCL mines.

The project work is in progress.

5. Periodic evaluation and advice on quality of Permitted Explosives, detonators, SMS/ SME, LD explosives and Accessories supplied to SCCL for use in in underground and opencast blasting

Objectives: Evaluation of quality of different types of permitted and non-permitted explosives and accessories supplied by various manufacturers to SCCL for use in opencast and underground mines and advice on improvement in their quality, safety and performance.

Investigations: One hundred thirty four samples of explosives and accessories of different manufacturers comprising of 37 samples of permitted explosives, 81 samples of permitted detonators, 2 samples of SME explosives, 4 samples of LD explosives, 4 samples of nonels, 2 samples of cord relays, 3 samples of cast boosters and 1 sample of detonating fuse collected from different area magazine of SCCL were evaluated for different quality parameters to assess and advice on their quality standards.

Findings: Evaluation of quality parameters of different permitted and non-permitted explosives and accessories supplied by different manufacturers for use in different underground and opencast mines of SCCL revealed useful information on their conformity or deviation from declared / expected values. Most of the cord relays and nonels were found to have their delay timings outside their expected ranges, which are undesirable from safety and production point of view. Moreover, variation in density and VOD outside the ranges in some samples and variation within the range from batch to batch were observed. Based on analysis of results, CSIR-CIMFR suggested for scopes of improvement in consistency of density & VOD values of explosives and delay timings of nonels and cord relays samples which led to improvement in quality and performance parameters of explosives and accessories

Benefit accrued: Enhancement of safety as well as productivity in SCCL mines.

The project work is in progress.

6. Periodic evaluation and advice on quality of OC explosives and accessories supplied by various firms to SCCL

Objectives: Evaluation of quality of different types explosives and accessories supplied by various manufacturers to SCCL for use in opencast mines and advice on improvement in their quality, safety and performance.

Investigations: One hundred forty five samples of opencast explosives and accessories of different manufacturers comprising of 12 samples of SME explosives, 6 samples of LD explosives, 86 samples of nonels, 4 samples of cord relays, 17 samples of cast boosters and 20 samples of detonating fuse collected from different area magazine of SCCL were evaluated for different quality parameters to assess and advice on their quality standards.

Findings: Evaluation of quality parameters of different OC explosives and accessories supplied by different manufacturers for use in different underground and opencast mines of SCCL revealed useful information on their conformity or deviation from declared / expected values. Most of the cord relays and nonels were found to have their delay timings outside their expected ranges, which are undesirable from safety and production point of view. Based on our recommendations, SCCL management advised the concerned manufactures to take appropriate measures in the light of the result obtained for different quality parameters so that consistency in the quality of the explosive products supplied to SCCL may be achieved to get desired safety and performance and in case of nonel where no improvement in quality was observed, purchase order to the firm was cancelled.

Benefit accrued: Enhancement of safety as well as productivity in SCCL mines.

The project work is in progress.

7. Evaluation and advice on interaction of SME explosives of M/s SIIL with blasted rock sample of Agucha mine of HZL

Objective: To study reactivity of SME explosive of M/s SIIL with blasted rock sample collected from the site of incidence of Agucha Mines of HZL.

Investigations: An unusual incident happened in Agucha Mine of Hindustan Zinc Limited (HZL) on 14.01.2015, wherein one hole charged with SME explosive (Solar BE-201) of M/s SIIL, booster of M/s Orica and electronic detonator of M/s GOCL were in use, suddenly exploded. In order to study interaction of overburden rock with SME explosive, it was planned to mix different percentage of supplied blasted rock sample collected from the site of incidence of

Agucha Mine of HZL with the SME explosive (Solar BE 201) of M/s SIIL, Nagpur and record temperature of the mixture after regular intervals to assess whether there are any interaction between SME explosive and rock sample which may lead to rise of temperature of the mixture. Moreover, SME explosive was also collected in polythene layflats of 125mm diameter to make cartridged explosives for checking their booster sensitivity and velocity of detonation in open unconfined condition.

Findings: Based on evaluation of different properties in open unconfined condition, it was concluded that SME explosive of M/s SIIL, Nagpur supplied at CSIR-CIMFR was booster sensitive and its average cup density and VOD were 1.13 g/cc and 5223 m/s. No increase in temperature of SME explosive was observed when mixed with a copper / aluminium shell and different percentage of supplied blasted rock sample collected from the site of incidence of Agucha Mine of HZL. Therefore, it was concluded that under the laboratory conditions SME explosive of M/s SIIL, Nagpur supplied at CSIR-CIMFR, did not interact with copper / aluminium shells and blasted rock sample collected from the site of incidence of Agucha Mine of HZL which may result in rise in temperature of mixture leading to its accidental initiation. The project work is in progress.

Benefit accrued: Enhancement of safety as well as productivity in SCCL mines.

8. Evaluation of P_5 emulsion explosives Supercoal-5 and advice on their suitability for use in underground coal mines

Objectives: R&D assistance in development of an improved emulsion P_5 explosive (Supercoal-5) of M/s Solar Industries India Limited, Nagpur and advice on its suitability for use in underground coal mines.

Investigations: Three different preliminary and modified emulsion explosive compositions were designed and were assessed for their safety, sensitivity and performance characteristics under varying laboratory conditions to assess their suitability for use in underground coal mines.

Findings: Out of three emulsion explosive compositions, one composition failed to meet the initial requirement of cap sensitivity and thus could not be studied further. Other two compositions were found cap sensitive but failed to meet the requirement of incendivity characteristics applicable to P_5 explosives. Therefore, none of the three emulsion explosive compositions could be recommended suitable for use in underground coal mines as a P_5 explosive. The project work has been completed in August 2014.

Benefit accrued: Enhancement of safety as well as productivity in SCCL mines.

9. Evaluation of slurry explosive composition Meccoal-5 in LDP Tubing and advice on its suitability for use in underground coal mines

Objectives: To study the effect of change of cartridging and clipping materials of slurry explosive compositions Meccoal-5 on its safety, sensitivity and other performance parameters and advice on its suitability for use in underground coal mines.

Investigations: Slurry explosive composition Meccoal-5 in LDP tubing with steel clips were checked under varying laboratory conditions as per existing specifications, guidelines and work instructions to evaluate the effect of change of cartridging and clipping materials on its safety, sensitivity and other performance parameters.

Findings: Meccoal-5 explosive packed in low density polythene (LDP) tubing and both ends sealed with steel clips was not found cap sensitive as many primed cartridges failed to detonate

during trials for different sensitivity, safety and performance parameters in the laboratory. Although, Meccoal-5 was found to possess satisfactory density, post detonation fumes, VOD and deflagration parameters, considering failure of this slurry composition to meet the requirement of cap sensitivity, it was not recommended suitable for use in underground coal mines as P_5 explosive. Project completed in October 2015.

Benefit accrued: Enhancement of safety as well as productivity in underground coal mines.

10. Evaluation of emulsion explosive compositions and advice on their suitability for use in underground coal mines as P_5 explosives

Objectives: Development of an emulsion explosive compositions meeting all safety, sensitivity and performance requirements suitable for use in underground coal mines as a P_5 explosive.

Investigations: Three different preliminary and modified emulsion explosive compositions were assessed under varying laboratory conditions for their safety, sensitivity and performance characteristics to assess their suitability for use in underground coal mines as a P_5 explosive.

Findings: First preliminary emulsion explosive composition failed to meet requirement of air gap sensitivity and incendivity characteristics. Second composition, which was modified based on result of earlier sample, passed air gap sensitivity but still failed to meet the incendivity requirement. Based on results obtained with first two samples, third modified composition was made in such a way that it met all requirements of permitted P_5 explosive and was recommended suitable for use in underground coal mines. The project work has been Completed in December 2014.

Benefit accrued: Enhancement of safety as well as productivity in underground coal mines.

11. Evaluation of Super coal delay detonators (0-6 delays) with powder (epoxy) coated steel shells and advice on their suitability for use in underground coal mines

Objectives: To assess suitability of modified Super coal delay detonators (0-6 delays) with powder (epoxy) coated steel shells of M/s Ideal Detonators Pvt. Ltd., Secunderabad for use in underground coal mines.

Investigations: Evaluation of incendivity, electrical properties, handling safety, strength and water resistance characteristics of modified Super coal delay detonators (0-6 delays) with powder (epoxy) coated steel shells of M/s Ideal Detonators Pvt. Ltd., Secunderabad was done under varying laboratory conditions.

Findings: Based on results of studies, modified Super coal delay detonators (0-6 delays) with powder (epoxy) coated steel shells were found to be meeting the requirement of safety, strength, electrical properties, handling safety etc. and hence it was recommended suitable for use in underground coal mines. The project work has been Completed in May 2014.

Benefit accrued: Enhancement of safety as well as productivity in underground coal mines.

12. Evaluation of incendivity and other properties of modified Premier coal delay detonators (0-6 delays) with NHN and advice on their suitability for use in underground coal mines

Objectives: To assess suitability of modified Premier coal delay detonators (0-6 delays) with NHN for use in underground coal mines.

Investigations: Evaluation of incendivity, electrical properties, handling safety, strength and

water resistance characteristics of Premier coal delay detonators (0-6 delays) with NHN were done under varying laboratory conditions.

Findings: Based on the results of studies conducted on modified passivated MS shell delay detonators (0 to 6 delays) of M/s Premier Explosives Limited, Secunderabad with brand name of Coal Delay Detonators (0-6) with NHN", it can be concluded that these detonators have exhibited satisfactory handling safety, electrical properties, strength and water resistance characteristics. But, delay nos. 1 to 6 of Premier Coal Delay Detonators (0-6) with NHN could not meet the statutory requirements as these detonators caused ignitions of inflammable gassy atmosphere more than permissible limits. Therefore, modified passivated MS shell delay detonators with brand name of "Coal Delay Detonators (0-6) with NHN" of M/s Premier Explosives Limited, Secunderabad can not be recommended suitable for use in underground coal mines for solid blasting where detonators of different delays are connected in series. Manufacturer was advised to improve Coal Delay Detonators (0-6) with NHN in light of the results to meet the statutory requirement of incendivity and other properties for their safe use in underground coal mines. Project has been Completed in July 2014.

Benefit accrued: Enhancement of safety as well as productivity in underground coal mines.

11. EXPLOSIVE RESEARCH LABORATORY

1. Advice and assessment on quality of Explosives and Blasting Accessories to improve productivity and safety in excavation works

Objective: Evaluation of explosives and blasting accessories and suggestion for quality improvement in field condition.

Work done: Explosive parameters such as velocity of detonation, density, water resistant properties, etc., were improved and suggestions were given to increase blasting efficiency in CIL subsidiaries and Tata Steel Ltd (NCL, MCL & Tata Ore Mines & Quarries).

Observations: Charging of bulk explosives below density 1.10g/cm^3 above 1.20g/cm^3 affects the explosive parameters. Few suppliers prefer to charge bulk explosive at lower densities that creates toe, poor fragmentation and post blast detonation fumes.

Conclusion: After the periodical field investigations, it was concluded that quality of explosives and blasting accessories were improved. The improved quality increased mine production & productivity and safety.

Recommendation: Bulk explosives should be charged in the range of 1.10 to 1.20g/cm^3 to get optimum blasting results. Water percentage in cartridge and bulk explosives should be in between of 15 to 18%. Velocity of detonation should be >3500 m/s in unconfined.

Benefits accrued: MCL, NCL and Tata Steel Limited were benefitted by getting improved quality of explosives and blasting accessories which helped to enhance the blasting performances.

2. Advice and assessment of bulk emulsion to improve productivity

Objective: Evaluation of the physical properties of emulsion matrix with special emphasis to VOD, viscosity, density and its suitability for surface mine blasting.

Work done: Emulsion matrix sample was received from AKS Expo Chem. Limited and properties like density, viscosity and detonation velocities were studied.

Observations: Emulsion matrix was blackish in colour and its physical appearance was good. It was viscous that indicates properly sheared during emulsification.

Conclusion: The viscosity of emulsion matrix was 70000 cps. The velocity of detonation of gassed emulsion was 3800m/s in unconfined that reflects its suitability for surface blasting.

Recommendation:

- Higher viscosity emulsion matrix >65000 cps is preferable for charging and blasting.
- The density should be in range of 1.10 -1.15g/cm^3 for hard strata and for soft strata reduced up to 1.05g/cm^3.

Benefits accrued: AKS Expo Chem Ltd. was benefited through suitable bulk emulsion for surface blasting.

3. Assessment of post-toxic detonation fume produced after the blast

Objective:

- Evaluation of fume characteristics NOx and CO
- Advice on toxic fume produced by using permitted delay detonator (PDD) of CDET-Vectra and CDET Electra-P

Work done: Three numbers of samples from Balgi Colliery, SECL were received through CDET Explosives Limited and analysed for post-detonation fumes with the help of multi gas analyser. Sirka U/g Colliery, CCL was visited and post detonation fumes were measured at site.

Observations: Result indicates that in samples from Balgi Colliery, the NOx fumes were in between 1.72 and 1.89 ppm and CO fumes were in the range of 3.04 to 3.11 ppm which is below permissible limit prescribed by DGMS. The NOx fumes measured at site from Sirka Colliery were 1 ppm and CO was 3.50 ppm after the blast.

Conclusion: The post detonation fumes produced due to Permitted Delay Detonators were less than DGMS safety limits in Balgi Project, SECL. The strength of PDD was satisfactory to fire permitted explosive in degree I mines.

The post detonation fumes produced due to PDD and Instantaneous Electric Detonator (Electra – P) were less than DGMS safety limits in Sirka U/g Colliery, CCL. The strength of PDD was satisfactory to fire permitted explosive in degree II mines.

Benefits accrued: M/s. CDET and Mine will be benefited by getting actual detonation behavior and their fume characteristics of the Products. This enhances the safety limit of the mine and production as well as productivity.

4. Advice and suggestion on detonation sensitivity and shock wave detonation of Ammonium Nitrate prill

Objective: Advice on detonation properties of low density Ammonium Nitrate Prill (Optimex) and Gap Sensitivity.

Work done: Gap sensitivity and shock wave detonation of AN prill were carried out in GI pipe by using high temperature resistant and non reactive material.

Observations: The AN prills were uniform in size and density (0.780g/cm^3), and no detonation was found in air gap sensitivity experiments.

Conclusion: The gap sensitivity and shock wave detonations were found negative under the confinement of high temperature-resistant non-reactive mater.

Benefits accrued: DFPCL will be benefitted by getting safe product suitable for handling, transportation and blasting.

5. Improvement and suggestion on non-permitted emulsion explosive composition, process parameters and infrastructure/equipment up gradation at CDET Explosive Industries (P) Ltd.

Objective:

- Modification and improvement in emulsion explosives, NPSD products. High detonation velocity and enhances the shelf life more than 1year.
- Suggestion on emulsions explosives, equipment up-gradation and optimization of emulsion process parameters.

Work done: CDET plant of Coimbatore (TN) was visited and suggestions were given for improvement of hardware.

Observations: Some modification is required in emulsifier and cartridge processing unit.

Conclusion: This work is in progress and will be concluded after completion of the project.

Benefits accrued: M/s. CDET will be benefited through improved emulsion explosives, process parameters and equipment up-gradations.

12. FLAME AND EXPLOSION LABORATORY

1 Assessment and advice for suitability of electrical equipment installed at hazardous areas of Eastern, Western, Central and Southern Regions of ONGC as per different relevant standard

M/s. ONGC, Corporation-HSE, Delhi offered different certified flameproof, intrinsically safe and increased safety electrical equipment for their suitability to use in hazardous explosive atmosphere. Based upon the physical assessment and visual inspections of different certified electrical equipment maintain the integrity of their type of protection as flameproof, intrinsically safe and increased safety, the above listed certified equipments are suitable for safe use in Gas Group IIA/IIB & Zone 1 & 2 hazardous atmospheres of Eastern Region (Silchar, Jorhat and Assam), Southern Region (Rajmundry and Karaikol), Central Region (Tripura and CBM-MBA) and Western Region (Mehsana, Ahmedabad, Ankeleswar, Cambay and Jodhpur) of ONGC asset.

2. Assessment of electrical safety parameters and advice on one no. non-sparking Ex 'n' motor rated at 37KW/415V AC/2pole, frame size: E200L as per IS/IEC 60079-15:2005 FOR USE IN Zone-2 hazardous area

M/s. Marathon Electric Motors (India) Ltd., Kolkata-700 024 offered one no. aforesaid non-sparking (Ex 'n') motor along with design drawings for necessary examination, investigation and advice at their shop. Based on the above conclusions, the non-sparking (Ex 'n') motor rated at 37KW/415V AC 2pole, in frame size: E200L is deemed suitable for use in Zone-2 hazardous area as per IS/IEC 60079-15:2005.

3. Assessment of electrical safety parameters and advice on one no. increased safety (Ex 'e') and non-sparking (Ex 'n') squirrel cage induction motor rated at 1325KW/3.3KV/2pole, in frame size: 1SJ7565-2 as per IS/IEC 60079-7:2006 & IS/IEC60079-15:2005 for use in Zone-2 hazardous area

M/s. BHEL, Bhopal offered 01 no. aforesaid motor along with design drawings for necessary

assessment of electrical safety parameters and advice at their shop. Based on the above conclusions, the increased safety (Ex 'e') and non-sparking (Ex 'n') squirrel cage induction motor rated at 1325KW/3.3KV/2pole, insulation class 'F', M/c no. 43199-A411-11-01 in frame size: 1SJ7565-2 complies with applicable requirements of IS/IEC 60079-7:2006 for type of protection Ex 'e' and IS/IEC 60079-15:2005 for type of protection Ex 'n' and deemed suitable for safe use in Zone-2 hazardous area as defined in IS:5572.

13. GEOMECHANICS AND MINE DESIGN DIVISION

1. Scientific study for determination of RMR of five working Sections of Hirakhand Bundia mine, Orient Area, MCL

Objective: To design support system for the mine roadways on the basis of these RMR value

Work done: CSIR-CIMFR conducted geotechnical studies in U/G mine at different locations and rock/coal sample has been collected for testing.

Observation: During mine visit it is observed that the immediate roof of working sections are generally composed with coal and shaly coal and layer thickness in between 5-11.5cm. Generally two sets cleats/joints have been observed and mine roof is dry.

Conclusion: RMR value of section A', A, B, C and C' is 49.14, 51.3, 48.96, 47.56 and 42.66 respectively.

Recommendation: RMR values would be used for design of support system for mine roadways. Project has been completed.

Benefits Accrued: Would give proper guideline for designing adequate support system for mine roadways ensuring better safety and productivity.

2. Scientific study for determination of RMR of four district for I seam combined working at Gayatri underground mine ,Bishrampur Arae, SECL

Objective: To formulate support design of mine roadways on the basis of these RMR value.

Work done: CSIR-CIMFR conducted geotechnical studies in U/G mine at different locations and rock/coal sample has been collected for testing.

Observation: During mine visit it is observed that the immediate roof of working sections are generally composed with sandstone and layer thickness in between 8-10cm. Generally random joints have been observed and mine roof is moist to dry.

Conclusion: RMR values of Panel 50 LE,57 LE,58LW and 42LE are 51.3, 51.3, 52.2, and 46.8 respectively.

Recommendation: RMR values would be used for design of support system for mine roadways. Project has been completed.

Benefits Accrued: Would give proper guideline for designing adequate support system for mine roadways ensuring better safety and productivity.

3. Feasibility study of installation of chair lift man riding system in mine No. 4 Orient Area, MCL

Objective: To assess the stability of the mine gallery of 1127 m length from 15Lto 61L and design of support system for gallery.

Work done: CSIR-CIMFR conducted geotechnical studies in U/G mine at different locations and rock/coal sample has been collected for testing.

Observation: During mine visit it is observed that the immediate roof of different locations are generally composed with coal, shale and sandstone. Generally two sets of cleats are observed in coal roof and random joints have been observed in shale/sandstone roof .Mine roof is dry.

Conclusion: Support design is reassessed and formulated. The safety factor obtained for gallery and junction are 2.11 and 2.91 respectively, which advocates that the roof of man riding gallery is well supported and stable. Project has been completed.

Recommendation: Gallery is strengthened using resin grouted bolts .

Benefits Accrued: The gallery would be long term stable for man riding system with suggested support system ensuring better safety and productivity.

4. Scientific study for RMR determination & design the suitable support system of drift of seam II, III, IV of coal block Gare Pelma IV/2&IV/3 at Jindal Power Ltd.

Objective: To formulate support design of mine roadways on the basis of RMR.

Work done: CSIR-CIMFR conducted geotechnical studies in U/G mine at different locations and rock/coal sample has been collected for testing.

Observation: During mine visit it is observed that the immediate roof of different locations are generally composed with shale and sandstone. Most of cases random joints have been noticed in shale/sandstone roof .Mine roof is moist.

Conclusion: The RMR of roof rock is 43.83. It comes under the fair categories.

Recommendation: RMR values would be used for design of support system for mine roadways. For gallery width of 4.8m (existing panel), 5.5m (CM panel) and 6.0m (CM Panel) has been supported with four, five and six full column resin grouted bolt in a row. Junction has been supported by resin grouted bolt with W-strap. Project work is in progress.

Benefits Accrued: Would give proper guideline for designing adequate support system for mine roadways ensuring better safety and productivity.

5. Scientific study for stability of roof and sides of U/g galleries laying beneath railway acquired land /line of Ballarpur 3&4 pits colliery, Ballarpur Area, WCL

Objective: To assess the stability of roof and side of underground gallery during working and suggest remedial measures.

Work done: CSIR-CIMFR conducted geotechnical studies in U/G mine at different locations and rock/coal sample has been collected for testing.

Observation: During mine visit it is observed that the immediate roof of top section is composed of coal and overlain by intercalation of shale and sandstone. Mine roof is full of cleats/joints/ slips. The roof of mine is dry.

Conclusion: The RMR of 4.2m and 5.5m wide gallery are 47.7 & 42.93 respectively. Design of support has been formulated with resin bolts. Project has been completed.

Recommendation: The 4.2m wide gallery has been supported with three full column resin grouted bolt in a row at grid pattern with 1.5m interval leaving 0.6m from both side of pillar. The 5.5m wide gallery has been supported with four full column resin grouted bolt in a row at grid pattern with 1.5m interval leaving 0.5m space from both side of the pillar.

Benefits Accrued: Would provides long term safety in underground galleries beneath railway lines and railway acquired land.

6. Scientific study for RMR determination and support design for depillaring panel of VIII B seam at Maheshpur Colliery, Govindpur Area, BCCL

Objective: To design support system of mine roadways on the basis of RMR and Q value using numerical modeling.

Work done: CSIR-CIMFR conducted geotechnical studies in U/G mine at different locations and rock/coal sample has been collected for testing.

Observation: During mine visit it is observed that the immediate roof composed with sandstone. Random joints have been noticed in roof. Mine roof is dry.

Conclusion: The RMR of roof rock is 47. It comes under the fair categories. Project has been completed.

Recommendation: RMR values would be used for design of support system for mine roadways. For slice & split of width of 4.2m has been supported with four full column slow setting resin grouted bolt in a row with bolt spacing 1.0m. Row spacing in split is 1.5m and in slice is 1.0m respectively.

Benefits Accrued: Would give proper guideline for designing adequate support system for mine roadways ensuring better safety and productivity.

7. Scientific study for RMR determination of II seam Top at Tetulmari colliery, Sijua Area, BCCL

Objective: To determine RMR on the basis of geotechnical studies.

Work done: CSIR-CIMFR conducted geotechnical studies in U/G mine at different locations and rock/coal sample has been collected for testing.

Observation: During mine visit it is observed that the immediate roof of working sections is composed of sandstone and average layer thickness is 7.0cm. Mine roof is full of joints/slip and roof condition is dry.

Conclusion: RMR value of II seam top of Tetulmari colliery is 43.2. Project has been completed.

Recommendation: RMR values would be used for design of support system for mine roadways.

Benefits Accrued: Would give proper guideline for designing adequate support system for mine roadways ensuring better safety and productivity.

8. Scientific study for RMR determination of VIII seam at 6&7 Pit collery, Tata Steel Ltd.

Objective: To determine RMR on the basis of geotechnical studies.

Work done: CSIR-CIMFR conducted geotechnical studies in U/G mine at different locations and rock/coal sample has been collected for testing.

Observation: During mine visit it is observed that the immediate roof of working sections is composed of sandstone and average layer thickness is 8.0cm. Random joints have been observed and mine roof is moist/dripping.

Conclusion: RMR value is 44.64. Project has been completed.

Recommendation: RMR values would be used for design of support system for mine roadways.

Benefits Accrued: Would give proper guideline for designing adequate support system for mine roadways ensuring better safety and productivity.

14. INSTRUMENTATION DIVISION

1. Development of feasibility assessment model for adaptation of underground coal gasification technology in the North-East Region of India

Objective:

- Development of a feasibility assessment model for adaptation of underground coal gasification (UCG) technology in the North-East Region of India.
- Development of gas monitoring and power cut-off system for existing underground coal mines to avoid explosion.
- Development of database related to coal deposits of North-East Region and web-enabling of the information.

Work done:

- Local methane detector system has developed.
- Integrated gas, strata and environmental monitoring system.
- Web enabled database software of primary coal properties in NER of India has developed.

Observations: Underground coal gasification (UCG) is a new type of coal energy extraction method in the form of synthetic gas without mining it. UCG is a gasification process applied to in situ coal seams. UCG is very similar to aboveground gasification where synthetic gas (syngas) is produced through the same chemical reactions that occur in surface gasifiers. UCG has a large potential for providing a clean energy source through carbon capture and storage techniques

Conclusions: UCG offers a coal extraction and conversion method in a single process that evades many of the challenges associated with conventional mining practices. UCG also has the potential to store CO_2 within voids created during its operation, which reduces the need for transport and storage site identification. UCG would provide a cost-effective, near-zero-carbon, energy source through the use of a self-contained system with a closed carbon loop.

Recommendations: The developed system should be implemented in different areas of industry and coal mining industries.

Benefits accrued: UCG has the potential of exploiting coal resources, enhances workable coal reserves, Smaller carbon footprint, Minimal use of local natural resources, e.g., water, Low risk of surface water pollution, reduced methane emissions, Capital and operating costs are lower than in traditional mining etc.

The project work is in progress.

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

Objective:

- Development of coal transportation tracking and control system using RFID tags and GPS in authorized route.
- Development of vehicle detection system using and microwave sensors in unauthorized routes.
- Development of application software for controlling the systems.
- Deployment of developed systems in a coal mine of North Eastern Coalfields, Assam.

Work done:

- Weighbridge automation modules has been installed successfully and duly certified by Excise department, Government of Assam.
- The subsystem modules like CCTV, RFID, PLC Boom Barrier, Control room, etc. has been installed.
- Static and in-motion weighbridge has installed.
- Centralized billing and software solution for dispatch with mobile App has been made.
- Proximity warning for heavy earth moving machinery has installed and tested on Dumpers.
- RFID based tracking for dumpers have done.

Observations: Mine transport surveillance system which is useful technology for improving safety, illegal mining and productivity, and controlling illicit coal/mineral transportation in coal mines. Weighbridge automation system helps in preventing unauthorized entry of vehicle; prevent mineral overloading, accelerated weighing process and automated weighing process and automated weighing record of each vehicle. Dumper queuing at loading and dumping areas results in lower productivity and higher fuel consumption and costs 50-60% of the total mining cost. The equipment optimization system provides optimization of dumper assignments in real-time, minimizing both truck queuing and shovel hang time. The system helps mine management to utilize time and resource to the fullest. Proactively detected faults will decrease wastage of time and improve equipment effectiveness which in turn results in increase of overall productivity.

Conclusions: Mine transport tracking surveillance system detection and production management uses GPS, RFID, and microwave sensor combined with wireless networks, production scheduling and unauthorized mineral transportation can be controlled by implementation of above mentioned tracking, monitoring and surveillance technologies. The project work is in progress.

Recommendations: The developed system should be implemented in other mines for enhancement of safety and productivity and controlling illicit mineral transportation.

Benefits accrued: This system should be implemented in other mines.

15. LONGWALL MINING DIVISION

1. Numerical Modelling based study on the effect of an Overburden Dump on underlying Longwall Workings and Barrier Pillars

The main objective of the project is to study the impact of OB dump on the stability of interpanel barriers and its effect on longwall workings at Adriyala block.

Numerical modelling of longwall caving behaviour and goaf compaction, provides a better understanding of the mechanics of the overall ground movement and simulation of the characteristic behaviour of a longwall working. In the aforementioned study it is observed that the pillar width should be 45m for a depth of 393.8m without overburden and 60m with overburden dump of 120m height. Similarly, for a depth of 542.8m the pillar size should be 55 m without overburden and 67m with overburden dump of 120m.

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

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

The strata control observations were found to be within limits and there is no significant variation.

This shows that the supports which have a designed capacity of 105 t/m^2 after cut is adequate for the existing geo-mining condition.

The pressure readings are compared between normal and weighting periods. The maximum variation observed during the weighting period from the normal was 39, 37 and 29 bar in the bottom, middle and top zone respectively.

The tale tales were installed at various locations to monitor the movement of the overlying strata. No roof separation was observed. This indicates that there is no significant roof separation taking place in the immediate roof within 4m.

3. Strata and support behaviour monitoring of Longwall Panel 1 of Adriyala Longwall project, SCCL

The study objectives include analysis of caving observations for prediction of strata and support behaviour during weighting and normal periods and suggest corrective measures on any strata control problems during extraction of longwall panel No.1. The findings of instruments observations shows that designed support is working satisfactorily.

4. Design and development of a prototype for on-line data generation of drilling parameters to investigate various rock properties

The main objectives of this project are:

- Design of a prototype for on-line data generation of drill parameters.
- Determination of the physico-mechanical properties of rock from the drilling parameters.

Assessing the physico-mechanical properties of rock is one of the important factors of concern to the engineers in the general field of rock excavation. In the system, relations between various physico-mechanical properties of rock and drilling parameters are established and are used to estimate the required engineering properties of rocks.

5. Design of the methodology for blind backfilling to stabilise the old abandoned inaccessible mine galleries below railway tracks

The study was undertaken to investigate the stability of the roof of the galleries below the railway tracks by numerical modeling and To design the methodology of blind backfilling of the galleries for its stabilization. The findings are as follows:

The input concentration plays an important role in the slurry transportation process. Increasing input concentration causes an increase in the pressure drop and a decrease in efficiency of transport, probably due to agglomeration and flocculation of solid particles. Increasing the grain size increases the pressure loss and decreases efficiency of transport.

From numerical modelling using FLAC-3D, it is found that the roof condition and the pillar strength increases after filling the void with the fill material (slurry). The safety factor increases after filling the void and the abutment stress is also decreasing leading to the stability of the railway lines running over the mined out gallery.

16. MATERIAL TESTING SECTION

1. Study and advice on the soundness of vital components of winding systems used for hoisting in Kharkharee colliery, Govindpur Area III, BCCL, Dhanbad, Jharkhand

Study was conducted to ascertain the soundness of vital components of mine winding systems of Pit 1 & 2 of Kharkharee colliery, Govindpur Area-II, BCCL, Dhanbad. These vital components were subjected to visual examination for operational condition, magnetic particle crack detection

for signature of surface imperfections and ultrasonic flaw detection for internal flaws where these tests are applicable. The above mention components were found free from surface and internal flaws of harmful character except a few components. It was recommended that the defective items must be discarded for safe use of mine hoisting systems, whereas, sound items may be used for further investigation as per guidelines of DGMS Circular.

2. Study the condition of winding ropes used for hoisting in Khetri mine and Kolihan mine, HCL, Rajasthan (India) and advice thereof

In this period two numbers of 51mm dia 6 × 49 Round Strand construction wire rope samples were evaluated for their conditions duly sent by M/s. AGM (Expl) & Agent Mines Khetri Copper Complex, District - Jhunjhunu, P.O.- Khetri, Rajasthan-333 504. Reports were sent in the form of certificates to meet the statutory requirements of mine management. On the basis of good examination results the lives of representative ropes were recommended for further continuance in the installations by the competent authority.

3. Testing, Evaluation and Calibration jobs undertaken

During the period April 2014 to March 2015 the under mentioned items have been tested and analyzed and reports have been sent to the concerned customers through proper channel. The following different types of items were tested for its quality evaluation:

Wire ropes-22 nos, Safety Hooks-112 nos., C. S. Gear (Distribution Plate)-118 nos., Rope Cappel (FWRC)-154 nos., Bridle Chains-457 nos., Cage shackle with pin-205 nos., Pins-229 nos., Suspension gear head rope attachment-15 sets., Single point CS Gear-10 nos., Cleavy hook-2 sets, Connector plated-9 nos, uplifting chain/kibble chain-24 nos., Prototype rope attachment (FWRC)-1 no., Tub Couplings-(D link with pin)-459 nos., C type coupling-189 nos., J-hook coupling-71 nos., Drawbars-13 nos., Haulage rope cappel with pin-81 nos., Lashing chain-50 nos., Small man clip-1 no., Lashing chain-50 nos., Safety chains-16 nos. and safety belts-25 nos,

Total certificates issued to customers-1371 nos.

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.

Repair, maintenance and Calibration of the following testing machines were done:

- 5 Tonnes Universal tensile Testing Machine;
- 10 Tonnes Universal Tensile Testing Machine;
- 50 Tonnes Universal Tensile Testing Machine;
- 60 Tonnes Horizontal Tensile Testing Machine;
- 500 Tonnes Horizontal Tensile Testing Machine (under progress);
- Universal Magnetic Particle Crack Detector;
- Portable Magnetic Particle Crack Detector;
- Ultrasonic Flow Detector.

17. METHANE EMISSION & DEGASIFICATION DIVISION

1. Development of Underground Coal Gasification Technology in India 'CoalGasUrja'

Characteristics of Indian coals were assessed with regard to underground coal gasification to finalize the coal/lignite fields for detailed investigations. Since lignite is reactive and is best suited for underground coal gasification, it is planned to collect lignite samples from Gujarat

and Rajasthan for detailed investigations. Contacts have been established with GIPCL, GMDC, SWML and RSMML for detailed investigations of the lignite deposits in their command areas in Gujarat and Rajasthan. The work is in progress.

2. Role of coal composition and maturity on the sorption behavior of Indian coals for gas storage estimation

The National Facility for High Pressure Adsorption Isotherm (HPAI) construction, the centre piece of the project, was designed, fabricated and installed. A specially designed water bath was fabricated to perform experiments on four different samples simultaneously at different temperatures. Around 140 coal samples were collected from Damodar Valley, Son Valley coalfields and coalfields of Assam, Arunanchal Pradesh, Meghalaya and Nagaland. Proximate, ultimate, pertrographic and sorption analyses of 30 samples have been completed. Analysis of remaining samples and reservoir simulation will be carried out in the next reporting period. The work is in progress.

3. Investigation on methane emission for classification of degree of gassiness of Seam-II at Ushaa coal mine, JNIL and advice on associated gas hazard

Emission of methane from coal seam-II top at Ushaa coal mine, Jaiswal Neco Industries Limited (JNIL), Raigarh was investigated to determine degree of gassiness of the seam. The work is completed.

4. Investigation on methane emission for classification of degree of gassiness of VII (Bottom) seam of Bararee Colliery, BCCL and advice on associated gas hazards

Emission of methane from VII (Bottom) seam, Bararee Colliery, BCCL was investigated to determine degree of gassiness of the seam. The work is completed.

5. Investigation on Methane Emission for Classification of Degree of Gassiness of Coal Seam IV seam at underground coal mines of Jindal Power Limited Tamnar, Raigarh, Chhattisgarh and Advice on Associated Gas Hazards

Field investigation was carried out to determine the rate of emission of methane per tonne of coal raised, methane content in general body and borehole air samples. It was found that the gas hazards can be safely tackled by the ventilation system. The work is completed.

6. Baseline Study on Carbon Footprint at Ashoka and Piparwar Projects of CCL

The project activities included collection, collation, documentation, verification and analysis of all data related to activities contributing to the life-cycle carbon footprint of coal from selected projects – Piparwar and Ashoka of CCL. The performance of GHG emissions per tonne of coal production at Ashoka and Piparwar OCPs have improved year on year. In the year of 2010-11 it was 28.05kg CO_2e per tonne of coal production and in the year of 2012-13 it reduced at 26.40kg CO_2e per tonne of coal production which shows performance improvement of about 9% from the 2010-11 level at Ashoka OCP. In the year of 2010-11, it was 31.27kg CO_2e per tonne of coal production and in the year of 2012-13 it reduced at 29.72kg CO_2e per tonne of coal production which shows performance improvement of about 5% from the 2010-11 level at Piparwar. The work is completed.

7. Determination of maximum desorbable gas content of coal core samples, prediction of specific gas emission and advice on associated gas hazards at Gomia underground coal block of MMTC Ltd.

Investigation on determination of maximum desorbable gas content of coal core samples,

prediction of specific gas emission and advice on associated gas hazards at Gomia underground coal block of MMTC Limited was undertaken on the request of the General Manager (Projects), Metals and Minerals Trading Corporation of India Limited (MMTC), New Delhi and the work was sponsored by this company.

A maximum of 11.86 m3/t of gas content was determined for the coal sample 15-A#14 retrieved from a depth of about 702.50 m from borehole no. 15-A. Maximum desorbable gas content of Sawang A, Sawang B, Local, Sawang C, Upper Kathara, Kathera, Utchidih, Kargali Top, Kargali Bottom and Bermo seams have been determined as 5.03, 6.24, 5.49, 5.32, 6.66, 4.07, 7.42, 10.42, 3.43 and 11.86 m3/t respectively. The work is completed.

18. MINE FIRE DIVISION

1. Scientific study and advice for safe extraction of depillaring with stowing 4SS 2A panel of No. 4 seam to avoid occurrences of spontaneous heating at GDK No. 10 incline mine, Adriyala project Area, SCCL

Work Report: In Indian coalmines, Blasting Gallery method of extraction is the most successful method of extraction for thick seams with higher percentage of extraction. In most of the mines of SCCL, the thick No. 3 Seam is underlain by No. 4 Seam of 3 to 4 meters thickness. Extraction of coal from 4 SS 2A panel has been started from 22nd December, 2011 and sealed on 5th May, 2014 after regular thermocompositional monitoring of the panel as per the site specific situation. Extraction of coal from 4SS 2A panel was stopped from 27th October, 2012 to 8th January, 2013 due to shortage of supply of sand. Total area of the panel was 50,450m^2 and finally 1,38,612 tonne of coal successfully extracted from depillaring with stowing 4 SS 2A panel without occurrences of spontaneous heating.

2. Scientific investigation to access the possibility of spontaneous heating/fire in the panel B-1 of H.L.C.-1 Mine, Chandrapur Area, WCL

Work Report: The rise sides property of the of HLC No.1 colliery was depillared in different panels with hydraulic sand stowing leaving very limited numbers of approach gallery towards dip side properties. Symptoms of spontaneous heating were observed previously in panel B-1 at 16L/40D on 29.06.2008. Again it has been observed on 26.01.2011 at 18L/40D of panel B-1. The detailed investigation of the HLC No.1 mine has been carried out which includes study of coal characteristics, thermo-compositional analysis of sealed off area, implementation of suitable control measures, monitoring of fire after application of control measures at certain time intervals and advice to ensure further course of action to avoid such occurrences. The field investigation for detection of possibilities of spontaneous heating/fire in sealed off panel and further implementation of suitable control measures, spontaneous heating/ fire has been control successfully. The operation of mine has been resumed by DGMS on the basis of CIMFR study.

3. Scientific study and advice for safe extraction of BG-J(1) panel of No. 3 seam to avoid occurrences of spontaneous heating at GDK 11 Incline Mine, Ramagundam Area-I, SCCL

Work Report: The problem of spontaneous heating in Blasting Gallery (BG) panels during extraction is a major threat to safety and productivity in SCCL mines. Most of the BG panels have been sealed due to the occurrences of spontaneous heating during extraction of the panel. After sealing of the panel, it is much difficult to re-open the panel.

Extraction of coal from BG-J(1) panel has been started from 30th October, 2013 and sealed on 26th April, 2014 after regular thermocompositional monitoring and infusion of Carbondioxide

to interise the goaf in running panel as well as adjoining BG-1H3 panel as per the site specific situation. Total area of the panel is 14150m^2 containing extractable 190000Tonne of coal. Finally, 163462 tonne (85%) of coal has been successfully extracted from BG-J(1) panel without occurrences of spontaneous heating.

4. Scientific investigation for determination of incubation period of coal seam of Jhingurda OCP, NCL and advice thereof

Work Report: Jhingurda OCP, Northern Coalfields Limited (NCL) is situated in Singrauli District of MP. The Jhngurda coal seam is having 40m to 138m varying thickness in the lease hold property. After carrying out detailed studies of coal characteristics parameters reveals that the Jhingurda coal seam is highly susceptible to spontaneous heating. The field investigation reveals that the Jhingrrda seam is most favourable to initiate spontaneous heating. The mining parameters, geological conditions, coal characteristics and site-specific experiences study concluded that the incubation period of Jhingurda coal seam of Jhingurda Area may be considered as one month.

5. Advice for determination of incubation period of Tura and Purewa seams of Nigahi Project, NCL

Work Report: After carrying out detailed studies of coal characteristics parameters reveals that the Purewa coal seam is highly susceptible to spontaneous heating as compared to Tura seam. The mining parameters, geological conditions, coal characteristics and site-specific experiences study concluded that the incubation period of Purewa (merged, top and bottom) coal seam of Nigahi Area may be considered as three months. The Purewa top coal seam is more susceptible as compared to Purewa bottom and merged seam. However, the Turra seam has no history of fire as per field investigation and laboratory investigation shows that the seam is moderately susceptible towards spontaneous heating. The analysis results concluded that the incubation period of Tura coal seam of Nigahi Area may be considered as six months.

6. Comprehensive scientific study regarding XI/ XII seam and VIII seam fire at Bassuria & GKKC Project, BCCL and advice therof

Work Report: Spontaneous heating/fire took place in the above area due to cracks, fractures and subsidence of goaf areas. Propagation of fire affects Gondudih village, Gowala Basti, Quarters of BCCL and Dhanbad-Chandrapur railway line etc. The fire affected part of VIII and X seam goaves in north side of Gondudih village was at a distance of 50m from permitted boundary of Q patch open cast workings.

Active intensive fire (more than 600°C temperature) was noticed along the edge of the barrier as well as quarry edges of X seam using surface thermography techniques. There are least chances of X seam fire travel to bottom seams as parting between X seam and VIII seam is 31m hard sandstone. The scientific investigation at present site specific condition concludes that active fire exists in North Side of Immam Bara. No fire has been observed after surface thermal monitoring of earlier fire area of Tiwari Basti near Shiv Mandir using surface thermography (thermal camera). East part of Ekra Jore, near KDS haul road area cracks and visible hot gases has been observed above 7/8 seam.

7. Scientific Investigation for determination of incubation period of Upper Patapari Seam of Bhatagaon colliery, SECL and advice thereof

Work Report: Bhatgaon Colliery of Bhatgaon area, South Eastern Coalfields Limited (SECL) is situated in Surguja District of Chhattisgarh. There are three numbers of coal seam viz. Masan seam, Upper Patapahari (UPP) seam and Lower Patapahari (LPP) seam of varying thickness

exist in the lease hold property of Bhatgaon colliery. The study of mining parameters, geological conditions, coal characteristics and site-specific experiences concluded that the incubation period of UPP coal seam of Bhatgaon Colliery may be considered as fifteen months.

19. MINERS' SAFETY EQUIPMENT LABORATORY

1. Testing of Flame Safety Lamp with Accessories

At the request of M/s J. K. Dey and Sons, Kolkata, eight nos. of Flame safety lamps were tested as per IS:7577-1986 to check their quality. This is used to measure percentage of methane on the basis of the flame height where the lamp is placed. The flame height was checked with different methane concentrations in gas chamber containing methane 0 to 5% by volume. The mechanical strength of the glass which is fitted with the lamp was also tested. All tested lamps conformed to the requirement. The test certificates were issued to the applicant through the Testing Cell of the Institute.

2. Testing of Miners' Cap Lamp with Accessories

Six nos. of LED cap lamps with Li-ion battery power backup submitted by M/s S. G. Electrochemicals, Howrah were tested for performance assessment as per International Standards, IEC 690079-35-1 & 2 of 2011 and IS :5679-1986. These cap lamps have given more than 3000lux after 16hours continuous switch on and complied with the requirement given in the IEC. Test certificates were issued to manufacturer.

The electric bulb is used in lead acid miners cap lamp as lamp, 110 bulbs were tested as per IS:2596: 2004 during the year and test certificates were issued to M/s Bureau of Indian Standard, Bengaluru, M/s Engel Industries Kolkata and M/s G.E. Electricals & Technocrats, Dhanbad

3. Testing of Industrial Safety Helmet

During the year, a total of twenty four industrial safety helmets were tested to check their qualities as per IS: 2925-1984 and with its amendment. The general examination of helmets was carried out by measuring brim, peak, head band width, ventilation gap, cradle and strap of the chin as well as nape. The size of helmet was determined by putting the helmet on head form and is changed by increasing/decreasing head band. Tests such as water absorption, shock absorption, penetration, flammability, heat and electric resistance were also carried as per the above standards. Test certificates were issued to the chief Manager (mine), BCCL, Dhanbad; M/s the Chief Carporate Safety, Tata Steel, Jamshedpur and M/s Industrial Components, Kolkata.

4. Testing of Flammability of Safety Belt

The flammability of six nos. of Safety belt was tested as per IS Code: IS: 3521 -1999 (Annexure-'A'). The Specimens were prepared and conditioned as mentioned in the Indian Standard. The test certificates were issued to M/s Continental Manufacturing Company, Rewari; M/s Unicare, Engineering Pvt. Ltd., Thane, M/s Super House limited, Unao and M/s Safetech Redifing Safety, Kolkata.

5. Testing and Certification of Conveyor Belt

The strength of cover rubber of conveyor belt was tested as per Indian Standard 15134 of 2002. The samples were prepared by cutting top and bottom covers of the conveyor belt which was submitted by the manufacturer. After conditioning the samples as per the standards, Tensile strength, Elongation at break, Abrasion resistance and Hardness tests were carried out. The sample of conveyor belt of Northern coalfields limited was failed. Test certificates were issued

to M/s the General Manager, Northern Coalfields Limited, Singaurli and M/s Phoenix Conveyor belt India (P) Limited, Kolkata.

6. Calibration of Methanometer and Luxmeter

One luxmeter ranges 0-20000 lux submitted by M/s the Manager Godhar-Kusunda Colliery, Bharat Coking Coal Limited, Dhanbad, Jharkhand was calibrated. The calibration certificate was issued to the applicant.

7. Evaluation of Performance, Calibration and Technical Advice on Safety Equipment (Methanometer) of Satgram Area, ECL

Methane emitted from coal seam is responsible for many explosions in underground coal mines and more than 40% disasters have occurred due to methane explosion. In order to control hazards due to methane explosion, methane content is monitored during explosion by Methanometer. Methanometer and other gas monitoring instruments such as Toximeter, Oxymeter and Multigas Detectors shall be calibrated on quarterly basis.

At the request of the Chief General Manager, Satgram Area, ECL, the work on calibration/ repairing of Methanometers (D6 MSA make) was undertaken on annual contract basis as per DGMS/ (Tech.)/Circular No.9/ Dhanbad dated 9th July 2002.

Methanometers of Satgram Area, ECL have been calibrated and made fit for accurate measurement of methane. The work is in progress.

8. Performance evaluation of Safety Equipments (Methanometer) of Kajora Area by calibration and advice on their performance

At the request of the Area Safety Officer, Kajora Area, ECL, the performance of Methanometers was checked in gas chamber and they were calibrated to make them fit for measurement of accurate methane percentage in underground coal mine workings. Some Methanometers found defectives during calibration were also repaired. Advice on working performance of Methanometers was reported to sponsor. The work was completed.

9. Performance Evaluation, Calibration and technical advice on Localy Methane Detector (LMD) at Amalgamated Sudamdih and Patherdih Colliery, Jharia coalfields, BCCL

On the request of the Manager, Amalgamated Sudamdih and Patherdih Colliery, BCCL, the work on performance evaluation and calibration of locally methane detector was carried out. It was observed that both the LMDs in the mine were working properly after service and calibration. The work was in progress.

10. Performance Assessment and Calibration of Localy Methane Detector (LMD) at Bhowrah underground mine, BCCL

On the request of the Area Safety Manager, Bhowrah Colliery, BCCL, the work on performance assessment and calibration of locally methane detector was sponsor for one year. It was observed that both the LMDs in the mine were working properly after service and calibration. The work was in progress.

HRD services rendered: A team of participants of Institute of Miners' and Metalworkers Education, Dhanbad visited Miners' Safety Equipment Laboratory to acquire knowledge about use of safety equipments in u/g coal mines. Technical specification of Flame Safety Lamp, Miners' Cap Lamp and Miners Shoes/Boots was discussed. Gas cap of flame safety lamp with percentage methane in explosive chamber were demonstrated to them.

20. MINE STOWING & FILLING DEPARTMENT

1 Design of Stowing Plant for SECL Underground Mine for Ash Stowing with Ash from Korba Super Thermal Power Station, NTPC

Field studies were carried out to obtain data regarding RL of surface and underground workings and surface survey for site selection of stowing plant. Mine data and survey records were obtained from the site (Surakachar 3&4 Incline). On the basis of field studies, pipe line

route for ash stowing range was decided. Site for installing the ash stowing plant was fixed and detailed design of ash stowing plan along with the mixing trough and stool bends were prepared in the laboratory.

Field studies indicated that some of the property of the mine had adverse gradient and the angle of dip of the seam was found to be very less. To negotiate this, modifications were incorporated in pipe route to keep the hydraulic profile line below the gradient line. The Hydraulic profile for the proposed experimental panel - E 8 was found to be well below the gradient line and therefore the choice of the location is optimum. It is expected that the stowing plant once constructed will help the mine management to extract coal with bottom ash stowing at the same time it will also help the power plant for environment friendly disposal of bottom ash.

2. Scientific study on coal ash dumping at opencast mine of Sarguja Power Private Limited

Suitability studies on coal ash sample as an opencast backfill material and to provide the design guidelines for environment friendly dumping of coal ash in admixture with overburden at the nearby captive open cast coal mine. Field studies were carried out for mining data, overburden sample, water sample collection etc. Laboratory studies were carried out on samples of ash, overburden and their admixture to find their physical, chemical, geotechnical, etc., characteristics. These properties were used in numerical modelling to assess bench configuration for different mix. Water samples collected from field were tested to find its vulnerability to pollution. Laboratory studies of coal ash indicated that it could be used as a backfill material in opencast mines. Results of Numerical modelling on different configuration of bench dimension and ash-OB mix indicated that a stable bench slope of 28 degree is optimum for ash mix of 25%. It can be concluded from the above studies that ash can be used in admixture with overburden in right proportions under proper monitoring.

3. Suitability studies on coal ash from RSTPS – NTPC, Jarangdih - CCL, HWP- Manuguru for filling of coal mines

Suitability studies on coal ash sample regarding their physical properties, drainage behaviour, etc., were carried out in the laboratory and its suitability as a mine fill material was assessed. Laboratory and model studies indicated that coal ash from the above mentioned source is suitable for filling in mines but with proper monitoring and supervision. The outcome of this project will lead to environment friendly utilization of coal ash as a mine fill material.

4. Monitoring of backfilling with overburden and pond ash in open cast mines of JSPL

Accomplishments of project: studies for data collection and monitoring of benches to enhance safety and for environment friendly disposal of coal ash in opencast mines. Laboratory investigation to monitor pond ash filling in admixture with overburden at their captive mines included carrying out field investigation with respect to air quality monitoring, monitoring of sub-surface aquifers, hydrometeorology, ground water flow pattern, water quality in the core and buffer zone of

the mine. During laboratory and field it was observed that ash can be used in admixture with overburden in a ratio of 25% by volume for backfilling purpose as it not only enhances bench stability but also helps plant to thrive on it as ash contains numerous micronutrients. Mixing ash with overburden during backfilling did not have any adverse effect on environment (surface and sub-surface) and stability of overburden dumps. The outcome of this project will lead to overall increase in ash utilization at National level and will help in achieving targets laid by MOEF to achieve 100% ash utilization

5. Advice during field experimentation of ash stowing at GDK-1 & 3 Incline and SRP 3 & 3A Mines of SCCL

Field studies were carried out during ash stowing operations at GDK-1 & 3 and SRP 3 & 3A mines of SCCL regarding various ash stowing parameters. Shrinkage studies on ash stowed in experimental panel were also carried out to determine the percentage shrinkage. The result of field studies indicated that ash experienced negligible shrinkage after being stowed in underground void and long term shrinkage was found to be the same. Puncturing of rib pillar exhibited a self-standing height of ash fill of height 2.5m to 3m and the ash fill was found to be consolidated. The outcome of this field experimentation has instilled confidence in mine operators to adopt ash as an alternative stowing material to sand.

21. MINE SUBSIDENCE DEPARTMENT

1. Assessment of barrier thickness between old abandoned waterlogged workings of Pure Kenda Colliery in R-V Seam and the present workings of Pit no.7 of Lower Kenda Colliery in R-V Seam

The MineVue radar survey were conducted along the three profiles (L1, L2 & L3) at the proposed mine sites of Lower Kenda Colliery, ECL lying within the proposed mining lease area for assessment of barrier thickness. After interpreting MineVue radar section along all the three profiles, it may be concluded that voids are present at the depth of 20, 42 and 50m respectively from the proposed surveyed site. It may be also concluded that the coal seam is waterlogged and highly saturated. After getting information about the barrier thickness, Mine management could extract coal further safely after leaving a barrier of 60m between present workings and unapproachable abandoned mine workings. The project has been completed.

2. Feasibility of extraction in IX/8-S and IX/1-S panels with hydraulic sand stowing under built-up area at Digwadih colliery and 6 & 7 Pits Bhutgoria amalgamated colliery of Tata Steel Limited

Geo-mining details, relevant plans and borehole sections were collected. Borehole section and plan showing overlying goaves and surface features were prepared in AutoCAD. Co-ordinates were generated from the AutoCAD plan as input data. Three dimensional modeling was carried out to predict subsidence, slope and strain using Influence Function Method.

The cumulative maximum subsidence, slope, compressive and tensile strain at the surface due to extraction in 8S and 13S panels are 69.1mm, 0.50mm/m, 0.32mm/m and 0.21mm/m respectively. The above magnitude of ground movements are well within the safe limit (i.e. tensile strain less than 3mm/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. It is recommended to extract the panel with percentage of extraction of 85 percent for 2.94m thick coal in proposed IX/8S panel with hydraulic sand stowing. It is also recommended to monitor subsidence movements during depillaring of 8S panel to know

the actual movement to validate the subsidence prediction model. Coal can be extracted safely over built up area.

The maximum subsidence, slope, compressive and tensile strains at the surface due to extraction of 1-S panel are 29.42mm, 0.16mm/m, 0.14mm/m and 0.07mm/m respectively. Cumulative subsidence, slope and strains were calculated and the corresponding values at the surface, vertically above the proposed panels, are within safe limits. It is recommended to depillar 3.06m thick coal with 70 percent extraction from proposed 1-S panel of 9 seam with hydraulic sand stowing. Coal can be extracted safely over built up area. The project is completed.

3. Scientific evaluation related to volumetric computation including method-audit of Pachwara (Central) opencast coal mine of Panem

Collected geo-mining profile of the opencast mine. Details related to general performance of surface miner were collected. Reconnaissance survey was conducted and discussions on the relevant plans and sections were done for carrying out the traverse surveys for volumetric computation of coal from opencast mine. Closed traverse of opencast mine using Total Station was carried out three times. Plan and section at 10m interval were prepared in AutoCAD after each survey. Area along each section and volume of exaction after each measurement was computed. Boreholes data were analysed to assess the parting thickness of sandstone intruded in coal seam. Variation between the actual tonnage production provided by the mine management and the tonnage indirectly calculated by volumetric computation was obtained.

The tonnage of coal excavated between 6th January, 2014 and 30th June, 2014 as computed by survey, inclusive of 10% mining loss, was 21,27,908.08 t. It comes to an average daily production of 14281 t per day. A variation of 2.29% from actual coal production is not a significant amount due to the variation in seam thickness extraction and daily tonnage handled. It is recommended that the mine management should generate real-time supply tonnage data so as to have a better comparative study between tonnage obtainable by volumetric computation and actual production. Results would help the sponsor in scientific evaluation study of volumetric computations including the method-audit of Pachwara (Central) opencast coal mine. This project is completed.

4. Assessment of pot-hole potentiality in Nongtrai limestone mine of Lafarge Umium Mining Private Limited, Shillong, Meghalaya

Detailed information and data related to geology of the area, past records of occurrence of pot-hole within mining area, statistics of annual rainfall of last ten years, intact rock property of limestone, status of groundwater level, borehole data for void assessment and geo-mining status were collected. Potentiality of pot-hole was assessed based on rating of causative parameters. Mitigative measures were suggested to avoid occurrence of pot-hole.

The past history indicates the proneness of occurrence of pot-hole in this region. Rainfall is generally heavy, the average annual rainfall being in the range of 2000 to 5000mm. The overall uniaxial compressive strength (UCS) of limestone in the mining area was 114.41MPa assuring higher strength of rock. Groundwater level showed a constant reading at around 50m. The borehole data showed existence of cavity/fractured void at different depth and locations. The presence of voids nearest to surface in different boreholes ranged from 0.20m to 22.20m from the surface. The rock of the study area was highly weathered having vertical fractures and at most of the places filled with clayey material. Crevices with an opening of 0.40 to 0.50 were also observed at the surface. The pot-hole potential ratings of pot-holes at Nongtrai limestone mine is 70.

The main causative factors of pot-hole subsidence are shallow depth of void open geological discontinuities in the form of crevices and fractures, water seepage and heavy rainfall. The potential risk of pot-hole occurrence in this limestone formation is medium which is further aggravated by heavy rainfall. Open surface cracks should be filled in to avoid downward movement of water particularly in rainy season. Proper surface drainage should be maintained to drain water outside the mining lease area to avoid infiltration of water into groundwater. Geophysical technique like Ground Penetrating Radar (GPR) can be used to know the extent, depth and size of void before the formation of pot-hole on the surface to shift the manpower as well as machines at the safer place in time. Client can maintain the safety of men and material during mining operation. The project is completed.

5. Safety evaluation of different surface features and structures due to subsidence movements at Tata Steel collieries in Jharia Coalfield

Subsidence investigations were conducted over 10 stowed panels during April, 2013 to March, 2014 at Jamadoba 1 & 2 Pit, Jamadoba 6 & 7 Pit, Digwadih, Sijua and Bhelatand collieries of Tata Steel in Jharia Coalfield for the safety evaluation of different surface features and structures.

The general lithologies of the overburden in all the five collieries are sandstone, shale, shaly sandstone, sandy sandstone, carbonaceous shale and coal seams. Sandstone and shale are the dominant lithologies in the overburden. Percentage of sandstone lying over the working panels varied from 47.71 to 95%. The gradient of seam varied from 1 in 4.36 to 1 in 7.2. All the panels were extracted by bord and pillar method of mining with 70-90 percent of coal extraction. Depillaring operations were carried out at depths varying from 83m to 558m. The width - depth ratio of the panel varied between 0.36 and 1.20 i.e. all the panels were under sub-critical width. All these panels were extracted under multi-seam mining condition with overlying old stowed and caved goaves except 15A panel of Jamadoba 1 & 2 Pit during the study period. Three panels were completed during the study period. The important surface features over most of the panels include company quarters, private roads, ponds, filter plant, high tension lines and private buildings.

Maximum subsidence movement was 1.66% of extraction thicknesses over the 13S completed panel at Jamadoba 1 & 2 Pit whereas it was 2.31% of extraction thicknesses over the 2S progressive extraction panel at Digwadih colliery. Magnitude of maximum subsidence of 144mm, having 2.1% extraction thicknesses, was observed over 10S panel at Sijua colliery. Maximum slope, compressive and tensile strains observed over completed panels was 2.7mm/m, 1.09mm/m and 1.03mm/m respectively. Subsidence, slope and strains profiles were influenced by overlying old goaves, position of goaf edges, inclination of the seam, topography of the surface profiles as well as left out stooks/ribs in the overlying seams worked by bord and pillar method of mining. Subsidence movements did not cause any adverse impact on surface features and structures. The client will be able to extract coal from different panels safely. The project has been completed.

22. MINES SYSTEMS ENGINEERING DIVISION

1. Preparation of Mining Plan for Sijua colliery of TATA STEEL, Jamadoba

Objective: Development of Mining Technology for the Exploitation of Complex Coal

Work done: Preparation of mining plan of Sijua and Bhelatand Collieries is continuing and ine closure plan is also in preparation.

Benefits accrued: Mine plan of two collieries namely Digwadih, 6&7 Pits colliery of Tata Steel

have already been accepted and permission granted by Ministry of Coal, Govt. of India. This will further enhance the coal production from these mines after permission. The project work is in progress.

2. Geotechnical Study and Analysis of Ground behaviour and Evaluation of Caving Characteristics of Roof during Depillaring in 66 LE depillaring Panel of West block & 14 LE of East block of Churcha Mine (Ro), SECL

Objective: Development of Mining Technology for the Exploitation of Complex Coal Deposits

Work done: 66 LE & 14 LE Panel have been extracted safely with proper instrumentation and continuous monitoring of roof behavior. Additionally, nnumerical simulation of workings has been carried out for better understanding of strata behaviour and to predict induced caving height.

Benefits accrued: Modified goaf edge blasting and strata behaviour study has improved working condition and thereby safety of the miners. Ongoing study will enable the mine management to carry out safe and effective depillaring of other panels with increased production and productivity. The project work is in progress.

3. Excavation and ground control design for a proposed railway tunnel between Jamalpur and Ratanpur Railway Stations, Eastern Railway, Jamalpur

Objective: Data generation of design of excavation and ground control and monitoring of stability of the proposed tunnel as well as of the adjacent existing tunnel.

Work done: Collection of relevant information and analysis of collected data were performed.

Benefits accrued: The study will help the railway management to safely drive and permanently support and stabilise a new tunnel beside an old adjacent tunnel for lying double track between Jamalpur and Ratanpur Railway Stations, Eastern Railway, Jamalpur.

The project work is in progress.

4. Advice and Plan to design safe Rock Excavation Pattern at Jangalpur Stone quarry near Govindpur

Objective: Design of safe and controlled excavation pattern without causing any damage to the nearby structures

Work done: Thirteen (13) rounds of experimental blasts were carried out at the site with 110mm dia. blast holes. Control vibration magnitude within the permissible measurements was made with a seismograph within the specified distance ranges.

Benefits accrued: The study enabled the management to execute safe excavation pattern for feeding the crusher with 800mm size fragments. The crusher output is being used for road construction in expansion project of NH road for 4-lane to 6-lane. The project work is in progress.

5. Technical Appraisal of the Mining Plan of XV Seam underground Project of Moonidih, BCCL

Objective: Technical Appraisal of the Mining Plan of XV Seam underground Project of Moonidih, BCCL for the approval from the Ministry of Coal.

Work done: Discussed with mine management with brief overview of geology and underground workings at the site. Study of the existing Mining Plan with Auto CAD drawing is in progress.

Benefits accrued: The exercise will provide the mine management to run the mine in planned

and organised fashion with adequate safety and productivity in years to come. The project work is in progress.

6. Design of ground control system For the critical part of the Incline at a depth of 16 to 30m being driven by M/S JMS Mining Services Pvt. Limited in a Coal Mine Bicharpur near Shahdol, MP

Objective: To design the support system for the incline to be driven in critical ground condition at a depth of 16 to 30m.

Work done: Discussed with mine management with brief overview of geology and underground workings at the site. Collected data and information. Analysis of collected data and information. Development of the design. Design of precautionary measures. Preparation and submission of report.

Benefits accrued: The exercise will ensure the overall safety of the mine entry throughout its life covering safety transportation men, machines and materials, and ventilation of the mine. The project work is in progress.

23. MINE VENTILATION DISCIPLINE

1. Ventilation investigation in respect of pressure and air quantity survey to improve woekplace environment of these three mines (I) Piparia mine, Johilla Area, SECL (II) Birsinghpur mine, Johilla Area, SECL and (III) Kunustoria Area, ECL

These old &extensive mines were facing acute problem of ventilation. On request from mine management in-depth study of present ventilation system of each mines has been carried out to take corrective measures accordingly.The results of ventilation investigation comprising pressure survey, air quantity survey, hygrometric survey, study of performance of fans, analysis of data and computer simulation studies of ventilation networkof each mines have led to working out of suitable measures in improvement in ventilation for the respective mines. The work on later mine is in progress.

2. Scientific study and advice for control of open fire with sealing from surface vis-a-vise status of underground environment of fire affected at sealed-off mine/ Area for reopening ofthe five mines, viz. (i) NCPH (R-6) Mine, SECL, (II) Surakachhar 3 & 4 inclines, SECL (III) fire at Bhurkunda Colliery, CCL (IV) 3 & 4 Pits Ballarpur colliery and (V) Rayatwari colliery 6, 7 & 8 Incline, WCL

Open fire in these five mines has been controlled successfully by applying modified mine sealing strategies without any explosion. Results of the key parameter, viz. Reliability of sealed-off area, selection of representative sampling points and their dependability, analysis of representative air samples, use of suitable fire indices, measurement of temperature and determination of explosibility of environment inside, preparation and execution of comprehensive reopening activities plan, application of developments for quick isolation of the area using adjustable height telescopic GI Prop and CGI sheet stopping using Vent Seal followed by ventilation control technique in each mines have led to their successful reopening and recovery. The work has been completed

3. Control of open fire without sealing these two mines from surface (I) in R-VI seam at MIC unit of Jhanjra project colliery ECL (II) in panel-3 and its control at Mandaman Colliery, Mugma area, ECL

Main Industrial Complex (MIC) unit of Jhanjra project colliery, Jhanjra was affected with open fireat 23D near B-shaft. On 3rd October 2014 an incidence of fire was noticed near B-shaft

bottom, of one of the upcast shaft in the night shift. The fire was too active that it started belching out smoke and coal dust through fan evasse in a very short time. Immediately, persons from underground were withdrawn for safety reasons. This has resulted in pushing of the mine for virtual closure along with suspension of coal production @ 4500 tones/day. At this juncture a compresensive technology comprising ventilation control in conjuction with Injection of High pressure high stability Nitrogen Foam through boreholes close to seat of fire followed stratrgic monitoring have led to control of fire and its effective isolation in underground. This has resulted in resumption of production wihin 10 days time. The work has been completed.

Mandman colliery, Mugma Area was affected with open fire on 13th August 2014 indicating noxious gases in high concentration through sampling pipes provided in Isolation stoppings in A-3 panel. The panel is a caved goaf in Kalimatti Bottom seam situated in a complex situation at the averaged depth of 40m from surface. Logistic model of fire indicated,Upstream - Upper part of OB dump, Active fire in bottom part of OB dump: Downstream - Panel A-3 underground. Application of fire control measures, viz, (a) Establishment of dynamic balancing of pressure technique around panel A-3 to reduce effect of fan over the fire and (c) Strengthening of stoppings (d) compacting of top of OB dump and Cooling of Active fire zone have led to successful control of fire and resumption of production within a month time. The work has been completed.

4. Scientific study to ascertain status of fire beneath the railway acquired land of Dhanbad-Chandrapura railway line passing over (I) ixv seam goaf (top & bottom) section branch line of Mudidih Colliery, Sijua area of BCCL(II) South Govindpur and TetuliyaColliery, Govindpur Area BCCL, (III) Sealed panels of Upper Nakari, Lower Nakari, Upper Semana and Lower Semana seams above Panel-5 of Hathidari seam, Bhurkunda colliery, CCL

In assessment of extent and status of fire investigation comprised of selection of sampling points, pressure measurements through isolation stoppings, collection of air samples through stoppings/Boreholes and their analysis and interpretationhave been carried out in the above mines. Considering the efficacy of fire control measuresIt was also recommended for:

I. Periodic monitoring of boreholes should be continued to know the status of fire and to adopt control measures accordingly.
II. Application of water with sodium silicate in boreholes on regular basis in north and south sides of railway line.
III. Control of leakage of air by filling with incombustible material on regular basis.
IV. Arrangement of water injection with sodium silicate making a suitable water reservoir in south side of railway line. The work has been completed.

5. Calibration of Anemometer, Velometer & Manometer.

Sponsoring Agency : M/s Nanda Manufacturing Co., Calcutta
: M/s Citadel Engineers Pvt. Ltd, Kolkata
: M/s BCCL, Dhanbad
: M/s TISCO, Dhanbad
: M/s NRTC, Parwanoo (H.P.),
: M/s WCL, Nagpur,
: M/s CCL, Ranchi,

- Quality control testing. Results are required for measurement of air velocity and pressure in mines.

- These instruments are used in underground mines where the atmosphere is hot, humid and dusty. After repeated exposure to such atmosphere in underground they get deteriorated resulting to incorrect reading. Therefore, these instruments need calibration from time-to-time.
- During the reporting period 32 Anemometers were received and calibrated
- This test is important for safety in mines.

6. Testing of Brattice cloth

Sponsoring Agency : M/S Ventilation Engineering, Kolkata
: M/s Rohan Engineering Enterprises, Kolkata
: BCCL, Dhanbad

- Quality control testing
- Tests on one sample of Brattice cloth was carried out as per IS: 4355-1977 in respect of Breaking Load in as received condition and accelerated weathering condition and Air permeability test.
- The test is important for safety in mines.

24. NON COAL VENTILATION & MINE FIRE GALLERY & METALLURGICAL LABORATORY

1. Study the condition of winding ropes with regard to metallurgical parameter used for hoisting in Khetri mine & Kolihan mine, HCL, Rajasthan (india) & advice thereof

Wire ropes of Hindustan Copper Limited of Khetri & Kolihan Copper Mines, Rajasthan were received to study whether it can be continued in the installation or discarded. The wire ropes and individual wires were subjected to different tests like visual examination, break load test, wear & corrosion test, lubrication test, tensile test, torsion test and reverse bend test. On the basis of different test results the wire ropes stood satisfactory as per relevant standards. The study is in progress.

2. Failure analysis of 32mm dia guide rope of 6 Pit mine of Katras Choittodih Colliery, Katras Area, BCCL

Failed guide rope sample of 32mm diameter from 6 pit mine of Katras Choitodih Colliery have been received for investigating the causes of its failure. The investigation has been carried out in two parts: Part A - Metallurgical investigation which includes visual examination, examination of wear & corrosion, lubrication content, micro-examination & chemical analysis and Part B - Mechanical investigation which includes calculated breaking load and tensile strength. The study is in progress.

3. Study on failure of 25mm diameter 6X8FS construction winding rope of Victory 2Pit (south side) Bastacolla Area, BCCL, Dhanbad, India

The failed wire rope samples of 25mm from Victory No. 2 Pit (South Side) Bastacolla area have been received to evaluate the causes of failure. The investigation has been carried out in two parts: Part A - Metallurgical investigation which includes visual examination, examination of wear & corrosion, lubrication content, micro-examination & chemical analysis and Part B - Mechanical investigation which includes breaking load of individual wire, tensile strength, torsion & reverse bend. The study is in progress.

4. Metallographic studies on thermal behavior of Ferro-Alloy used in mine appliance

The objectives of this project are as under:

- Study of chemical and structural properties of mine appliances (like rope capple, case suspension gear, cage hanger, wire rope etc.)
- Structural changes after heat treatment and phase analysis
- Studies on improvement of metallurgical properties of used mine appliances for its re-use without affecting the safety norms.

Experiment on a part of cage suspension gear used in underground mines has been done. The component has been gone through two different heat treatment processes and their effect has been studied. The results indicated improvement of property on heat treatment.

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

25. RESPIRATORY PROTECTION LABORATORY

1. Studies on determination of free silica (α quartz) content in Respirable Air Borne Dust (ARD) in Coal Mines and preparation of data bank of free silica and other minerals present in dust as well as in coal

First comprehensive study focusing work place environment of 285 coal mines of Coal India Limited. Major achievements of the study includes

- A state of art laboratory equipped with XRD, FTIR, microbalance, particle size analyser, proximate analysis etc has been developed at CSIR-CIMFR, Dhanbad for studying all aspect of respirable aerosol.
- Direct-on-filter analysis (DFA), a quick, non-destructive and reliable technique for quartz analysis in respirable dust collected on filter paper has been developed.
- About 1000 Coal and immediate rock samples and 2387 air borne respirable dust samples have been collected and studied.
- A data base software ALPHA has been developed and all the analysis results including ARD concentration, free silica and other mineral content has been compiled as DATA BANK.
- All the coal seam has been classified into low, high and very high silica content. This may be very useful information for taking preventive measures for ensuring healthier workplace environment in coal mines.

2. 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 125 SCSR samples of different make and model from various manufacturing industries and coal mines has been evaluated on artificial breathing simulator machine in laboratory condition. This include 38 Nos for Bench Test as per IS 15803:2008 and 87 SCSR samples for functional ability tests as per DGMS (Tech.) Circular No. 08A of 2008.

Besides, performance of two nos of Close Circuit Breathing Apparatus (CCBA) [BIOPAK 240R of Biomarine INC, USA and Model P-30 of JSC DONETSK Mines Rescue equipment plant, Ukrain] has also been evaluated as per IS 10245(PART I): 1996 using breathing simulator machine and other associated set ups. Coal dust Explosibility Meter Model CDEM-1000, a new equipment

to predict explosibility behavior of coal dust in any working mines, has also been evaluated for its working performance in laboratory condition.

3. Studies and Advice on Air Circulation of Patal Bhubaneswar Cave, Pithoragarh (UK)

Patal Bhubaneswar cave is an ASI protected, mythologically important, cave temple in Western Himalayan of Pithoragarh District attracting increasing large number of devotee tourists. Visitors to the cave temples and local Mandir Committee members observed difficulty in breathing inside the cave during rainy season. Keeping in view the importance of criticality of the problem, ASI has entrusted CSIR-CIMFR to take up a comprehensive scientific study on air circulation in the cave temple for addressing the problem without disturbing the aesthetics of the cave temple.

Study included a six month monitoring of the underground cave environment suggested that during mansoon season, surface air become lighter as compared to dry air and it is not able to replace the heavier carbon dioxide accumulated inside the cave due to breathing of the persons visiting the cave with the help of natural forces alone. To address the problem, 4 possible alternative mechanism has been worked out and based on feed back of ASI and Mandir committee, a feasible a set of artificial aid to natural ventilation has been worked out and recommended for adequate amount of fresh air to support the breathing need of a maximum of 100 visitors at any time inside the cave. Besides, few safety arrangements have also been suggested as precautionary measures. The recommended arrangement ensure minimal disturbance to aesthetics of the cave temple.

4. Ventilation and Air Circulation in Coal and Non-coal mines

Adequate ventilation is key to underground coal mine safety and to maintain production efficiency of workers. During the year 2014-15, ventilation studies of two mines viz., Godhur-Kusunda Colliery and Dhewadih, Shighali and Bagdewa mines of DSB sub area, Korba Area, SECL has been undertaken which included pressure, quantity and hygrometric surveys of the mine and analysis of the data for improving the ventilation condition of all working places in the mines. Both the studies suggest significant improvement in ventilation condition with proper sectionalisation and minimizing leakage. Ventilation study of Dhewadih, Shighali and Bagdewa mines also included ventilation planning for coping with projected ventilation requirement at future date.

26. ROCK TESTING LABORATORY

1. Geotechnical investigation of borehole rock core samples of footwall, ore body and hangwall to evaluate different physico-mechanical properties, Matun Mines, Hindustan Zinc Ltd.

Hindustan Zinc Limited is working with conventional shovel dumper combination with 10m bench height at Matun Rock phosphate Mines, Udaipur, Rajasthan. Central Institute of Mining and Fuel Research, Dhanbad undertake the Geotechnical investigation of borehole rock core samples of Foot wall, Ore body, and Hangwall to evaluate different physico-mechanical properties. Procedures suggested by the ISRM/BIS codes were followed for preparations and evaluation of physico-mechanical properties of the rock samples, obtained from the boreholes.

From the data and Box-Whisker plot it has been noticed that the uniaxial compressive strength of dolomite is higher than the other three rock types. Whereas Jasper quartzite is seems stronger than Ortho quartzite.

The average values of compressive strength of Phyllite, Ortho Quartzite, Dolomite and Jasper Quartzite found as 22.32, 22.47, 58.39 and 53.25MPa respectively whereas the Apparent Cohesion of these rock types found as 3.57, 14.94, 13.74 and 14.97 respectively.

2. Rock Mechanics investigation to evaluate strength behavior of rock cores of Total CBM Solutions India Pvt. Ltd.

M/s Total CBM Solutions India Pvt. Ltd., New Delhi, has given a work order to CSIR-Central Institute of Mining and Fuel Research, Dhanbad for Rock Mechanics investigation to evaluate strength behavior of rock cores from coal measure formations.

The investigation result of intact rock core samples was analyzed and the average value of Uniaxial compressive strength is found as 16.20MPa in saturated condition with standard deviation 10.09. The Young's Modulus value found as 3.46GPa in saturated condition with standard deviation 2.24. Average value of poisson's ratio found as 0.15 in saturated condition with standard deviation 0.09.

3. Geo-technical investigation to evaluate Strength characteristics of rock core samples from Patal East Coal Block of BH # MBPE-13 and MBPE-52 in South Karanpura coal field, distt. Ranchi & Hazaribagh, Jharkhand and advice thereof

CSIR-Central Institute of Mining and Fuel Research, Dhanbad undertook laboratory physico-mechanical investigation to evaluate different characteristics of borehole rock core samples of BH # MBPE-13 and MBPE-52 from Patal East Coal Block in South Karanpura coal field, distt. Ramgarh, Jharkhand in response to the request of Head (Business Development and planning), Mineral Exploration Corporation Limited, Nagpur.

In sandstones, the density distribution shows an increase in value with decreasing grain size and decreasing trend with carbonaceous content. Similar trend is observed in Uniaxial Compressive Strength, Tensile strength, Young's modulus and apparent cohesion values.

Cerchar Hardness Index (CHI) of Shale, Coal and Shaly sandstone has shown higher values over sandstone in general. Cerchar Abrasivity values are lower for most of the rock samples excepting a few due to litho variation and compact grains. The variation in Cerchar Hardness and Abrasivity values is attributed to Coarse and medium grained with weak cementing material, Coarse and large angular grains-low values, Mineralogical variations due to layers present and Cutting in irregular horizon representing litho variations.

Among several rock types investigated, the average values of Density and Porosity for coal core samples found as 1486Kg/m^3 and 5.57% respectively whereas point load and tensile strength found as 0.44MPa & 1.32MPa respectively. The average value of compressive strength and Young's Modulus of Coal core samples found as 15.23MPa & 2.04GPa respectively whereas the Cerchar Abrassivity Index and Cerchar Hardness found as 3.10 & 0.50 respectively.

4. Geotechnical investigation to evaluate strength charecteristics of rock core samples of three borehole for ground stability study of proposed MGR alignment OPGC over u/g coal mine workings in Orient area of MCL, Odisha

M/s Odisha Power Generation Corporation Limited has given a work order to Central Institute of Mining and Fuel Research, Dhanbad for Geotechnical investigation to evaluate strength characteristics of Rock Cores from three boreholes for ground stability study of proposed MGR alignment OPGC over u/g coal mine workings in Orient area of MCL, Odisha. Three borehole rock samples have been provided for determination of Physico-mechanical properties like Density, Uniaxial Copressive Strength, Tensile Strength (Brazilian method), young's modulus and Poisson's ratio. The tests were conducted in dry condition and the results of the laboratory investigations reveal the following:

The Density increases in sandstones gradually with decreasing grain size due to compactness of grains with finer one and decreases with increase in carbon content. Uniaxial Compressive Strength and Tensile strength value of sandstone rock samples also shows a similer trend. The ratio of Uniaxial Compressive Strength to Tensile strength found as around 1.67 excluding the carbonaceous one.

The average values of Density for coal core samples found as 1354Kg/$m^{3.}$ The average Compressive strength and Tensile strength of coal core samples found as 25.95MPa & 2.31MPa respectively. The average value of Young's Modulus and Poisson's ratio of Coal core samples are found as 2.48GPa and 0.26 respectively.

5. Geotechnical investigation to evaluate strength characteristics of rock core samples from Kulti Block and advice thereof

MECL Eastern zone, Ranchi was carrying out detailed exploration at Kulti Coal Block of Raniganj Coal Field, Burdwan, West Bengal for coal mining. In this regard core samples from a borehole were studied for different physico-mechanical properties in dry conditions.

The results of the laboratory investigations reveals that the density increases with reduced in grain size due to compactness of grains with finer one and decreases with increase with carbon content. Uniaxial Compressive Strength value of rock samples shows increase in strength with decrease in grain size and again decreases with increase in carbonaceous matter. Cerchar abrasivity index values are much low for most of the rock samples. In a few rocks these values were marginally high due to lithology, grain size and cementing variations. Rocks with higher silica content (sandstone) have yielded relatively higher abrasivity values over other rock suits, namely, coal and shale.

The average values of Density and Porosity for coal core samples found as 1944Kg/m^3 and 3.54% respectively whereas point load and tensile strength found as 0.33MPa & 2.15MPa respectively. The average value of compressive strength and Young's Modulus of Coal core samples found as 22.02MPa & 4.51GPa respectively whereas the Cerchar Abrassivity Index found as 0.58.

27. SLOPE STABILITY DEPARTMENT

1. Advice for Optimum Slope Design of Dungri Limestone Mine Bargarh, Odisha, ACC Ltd.

The optimum bench design of final mine slopes should be as follows.

Geo-mining condition	Bench Parameters		
	Bench height (m)	Exposed width (m)	Angle (deg.)
Top bench in top soil, clay and weathered shale	6	6	70
Rest of the benches in unweathered shale and limestone	9	6	80

2. Advice on optimum design of the bench configuration of Dorli OCP-II, SCCL

The optimum design of final mine slopes should be as follows:

Optimum design of final highwall slope			
Geo-mining condition of the highwall	Bench Parameters		
	Height (m)	Exposed width (m)	Angle (deg.)
Top soil, clays, weathered sandstone (minimum top 20m)	5	10	70
Rest of the highwall slope	10	7.5	80

Dumps should be developed as follows:

Geomining condition
Proposed top deck over existing external dump: • Maximum height of top lift/ deck: 30m • Minimum exposed bench/ berm width below top deck: 31m • Maximum Total height: 120m
Any new external dump of the pit: • Maximum height of each lift/ decks: 30m • Minimum exposed bench/ berm width: 31m • Maximum Total height: 120m

3. Advice for Optimum Slope Design of Laxmi Limestone Mine and dumps, JK Laxmi Cement, Rajasthan

The optimum bench design of final mine and dump slopes should be as follows.

Geo-mining condition	Bench Parameters		
	Bench height (m)	Exposed width (m)	Angle (deg.)
Hangwall mine slope	9	7.4	80
Footwall mine slope	9 9	8.3 7.4	80 75
OB dump slope	10	9	37 (Angle of repose)
Screen dump slope	10	12	35 (Angle of repose)

4. Advice on optimum pit slope design up to 340 mRL depth at Malanjkhand copper project, M/s HCL

The optimum bench design of final mine slopes should be as follows.

Bench height (m)	Bench width (m)	Bench angle (deg.)
Top weathered zone (up to 544 mRL)		
12	10	60
156 m (from 544 mRL to 388 mRL)		
12	6	70
48 m (from 388 mRL to 340 mRL)		
12	7	70

28. SUPPORT DEVELOPMENT & TESTING DIVISION

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

Objective:

Phase-I: To establish the feasibility of nuclear technique method with dual-gamma-ray transmission for analysis of coal for ash and moisture content.

Phase-II: Design & development of integrated Truck Mounted Mobile Coal Sampler for instant coal ash & moisture analysis.

Work done:

Phase-I: The nuclear technique method with dual-gamma-ray transmission for analysis of coal ash and moisture content has been developed successfully and the draft report of the same has been submitted in 48th SSRC meeting held on 18/12/2013.

Phase-II: The design of the Mobile Coal Sampler with complete units has been finalized and the prototype of the coal sampler with drilling mechanism has been developed. The procurement of the equipment and instrument and fabrication of full scale truck mounted mobile coal sampler is in advanced stage with most of is units like the Truck, Eco-friendly generator, Crusher and Mixer have been purchased and the truck body layout and fabrication of drilling machine is in advanced stage.

2. Study of Prototype Pit Bottom Buffer

Objective: The objective of study was to investigate for physico-mechanical properties for mines safely.

Work done: At one instant the required load was applied. Further, the physico-mechanical properties is being assessed.

3. Study and advice on physic-mechanical properties for prototype 50 Tonne steel cog

Objective: The objective of study was to investigate for physico-mechanical properties for mines safety.

Work done: The required load i.e. Axial, Eccentric & Overload were applied as per DGMS circular and interim report was sent to the party. Detailed study is being carried out as per the said guidelines.

4. Study and advice on physic-mechanical properties for prototype 30 Tonne Steel Hollow Section prop

Objective: The objective of study was to investigate for physico-mechanical properties to be used in mines for safety.

Work done: The required load i.e. Axial, Eccentric & Overload were applied as per DGMS circular and interim report was sent to the party. Detailed study is being carried out as per the said guidelines.

5. Development of suitable design methodology for extraction of coal at greater depth (>300m) for Indian geomining conditions (Deep Coal Art) (Task: No.5.4; Numerical Model for Realistic Simulation of Support – Strata Interaction)

Objective: The major objective of the project is to prepare guidance, nomograms and design methodology for extraction of coal at greater depth (>300m) for Indian geo-mining conditions.

Objective: The major objective of the project is to prepare guidance, nomograms and design methodology for extraction of coal at greater depth (>300m) for Indian geo-mining conditions.

6. Research Task No. 5.4

Objectives: Stress analysis by 3D Finite Element method of powered support under different loading conditions.

Work done: CMERI Durgapur was asked for design of the powered support under different loading conditions. After getting design and its parameter the said powered support would be modeled.

7. Testing and analysis of physico-mechanical properties for prototype steel cogs 30 Tonne

Objective: The objective of study was to investigate for physico-mechanical properties for mines safety.

Work done: The interim report was sent for use of the cog in the mines. The detailed study report as per DGMS circular is in process.

8. Testing undertaken

Steel telescopic /Adjustable cross bar Support : 159 Nos.
Steel Cog : 436 Nos.
SHS prop : 190 Nos.
Telescopic Prop : 189 Nos.

Name and Address of the Sponsoring Agency:

M/s. Bilaspur Mining Industries (P) Ltd., Bilaspur.
M/s. Burma Engineering Works, Dhanbad.
M/s. B.C.C.L, Dhanbad.
M/s. Tubes & Structural, Katras Road, Dhanbad.

- Testing /analysis is batch testing

Brief of testing work done: Following tests were carried out: Axial load test, Eccentric Load Test, Over Load Test and as per relevant standards.

Benifits accrued: This investigational studies enhances safety in mines.

29. THICK SEAM MINING & STRATA MECHANICS DEPARTMENT

Mandate: R&D for safe and efficient underground coal mining of a difficult coal seam, utilising basic principles of rock mechanics and ground control. Extensive laboratory testing including study on simulated models (both, physical and numerical) and field studies are basic tools of the department to study the response of rock-mass under the redistributed state of stress conditions of an underground excavation for an efficient design of different mining structures.

R&D work: The department conducted different laboratory (on simulated models) and field investigations for ten industry sponsored, one collaborative (international) and one in-house projects during the reporting period. These investigations are aimed at an efficient design of underground coal mining structures for a given site conditions. Our R&D activities remained focused, mainly, on the following four areas of underground coal mining:

1. Rib design in CM based mechanised depillaring of the existing square/ rectangular pillars

Indian coal mining industry has, recently, conducted mechanised depillaring (MD) operations in a number of coal seams (developed on room and pillar by conventional drilling and blasting), with depth of cover ranging from 60 to 377m. A study of the procured core samples of the roof strata at these MD sites showed the presence of easy to difficult roof (from caving point of view) with a variation in Caveability-Index ranging from 2300 to 10500. MD of the existing square/rectangular shaped pillar by a continuous miner (CM) produced an irregular shaped rib/snook against the goaf. The position and shape of such a rib/snook and uniqueness of geo-mining conditions of Indian coalfields limit the scope of application of the conventional design approaches. Results of field investigations showed mixed performances of the adopted sizes of the ribs/snooks at these MD sites. On the basis of the data and guidance provided by these field investigations, a detailed parametric investigation was conducted in laboratory on the calibrated simulated models. A Mohr-Coulomb Strain-Softening/hardening (MCSS) model of FLAC^{3D} is used for the simulation of the depillaring and the available empirical formulations for Indian coal fields are used for subsequent calibration. Final selection of the MCSS parameters was undertaken through comparison of results of a number of tests models for pillar strength. An analysis of stress redistribution for different stages of the MD in simulated models provided an important guideline regarding the significance of the moderate roof strata for the rib/snook design. An analysis of results of the field and laboratory investigations (simulation models) provided a model for the rib design in CM based mechanised depillaring of the existing square/ rectangular pillars.

2. Roof-bolt (high capacity, pre-tensioned, resin grouted and stiff) based breaker-line design for the mechanised depillaring

Goaf encroachment/overriding during caving of a competent roof can effectively be controlled, mainly, by suitable design of natural supports. However, there is a requirement of applied supports (called breaker-line) against immediate roof as considerable portion of this roof is exposed due to presence of different openings along the goaf line. Placement of conventional breaker-line supports is time and space consuming and, generally, does not suit for a mechanized depillaring face. Available empirical norms are valid for systematic support of roof (SSR) for 4.2m width only. Further, these approaches are difficult to be applied for breaker-line support design. Most of the mechanized developments are being made with nearly 6.5m wide galleries and, therefore, this width of galleries is, relatively, more vulnerable for goaf encroachment during caving. Applications of high capacity, pre-tensioned, stiff and resin grouted roof bolts as breaker-line support may alleviate most of the problems of a conventional breaker-line support. Field and laboratoty investigations are in progress for the roof-bolt based breaker-line design for the mechanised depillaring.

3. Roof pillar interaction studies for underground extraction of total thickness of thick coal seam in single lift

Literature survey shows that the mining of total thickness of a thick coal seam in single lift (TTTCSSL) has replaced conventional multi-section mining approach for underground extraction of a thick coal seam. Different variants of longwall and room and pillar (popular as Bord and Pillar; B&P) methods for mining of TTTCSSL are able to extract a maximum10-12m thickness only. Inherited adverse effects of the increased extraction height over natural supports (pillars) during TTTCSSL are, relatively, challenging during the B&P mining. B&P is a dominant mining method

for thick coal seams in India. Most of the competent thick coal seams (developed along floor) in the country are extracted by single lift depillaring of total thickness (SLDTT) adopting induced caving of the roof coal band during retreat. A number of field trials of SLDTT under competent overlying roof strata also experienced pillar instability. Transformation in the nature of a barrier pillar from squat to cylinder due to the increase in the extraction height during depillaring caused the instability. The increase in height of the void causes: (i) dilution in pillar strength; (ii) large amount of overlying strata movement and (iii) requirement of high roof support. Again, when natural or induced caving of roof coal band is involved for the extraction of TTTCSSL, winning and withdrawal of the roof coal band are important issues for the efficiency of the mining. If the primary working (development) of normal height in a thick coal seam is done along floor and SLDTT is planned, an efficient winning of roof coal band is an important issue. It is observed that uniform fracturing of the roof coal mass is significant to improve the efficiency of under-winning of the roof coal band. Further, it is also realized to dilute the competency of the overlying rock strata for an efficient performance of the heightened natural supports. After an extensive investigations in laboratory, the field studies are in progress for the successful translation of this simple idea into field practices.

4. Hard roof management for safe and efficient extraction of bump prone deep seated coal seams

This collaborative study with the Institute of Geonics, Ostrava is conducted under bilateral S&T programme of ASCR, Czeck Republic-CSIR, India. The Lazy Colliery in the Ostrava–Karvina Coalfield (OKC) of the Upper Silesian Coal Basin (USCB) adopted modern longwall technology for an underground extraction of coal seam No. 504. This coal seam is located at a cover depth of approximately 700m. The seam thickness varied from 3.1 to 5.0m in the selected longwall panel. Two overlying coal seams, Nos. 512 and 530, experienced irregular mining at average heights of 58 and 75m, respectively, from the planned working horizon of the seam No. 504. The proposed longwall panel was adversely situated below goaf edges of the workings in these two overlying extracted seams. An analysis of the inter-burden rock-mass among these coal seams showed the presence of strong, massive strata of sandstones and conglomerates with uni-axial compressive strengths between 70 and 120MPa. The stress is measured at different mining stages by Compact Conical-ended Borehole Monitoring (CCBM). A simple laboratory test of the coal sample found a high value of the ratio of the elastic deformation to the total deformation (>0.8), indicating the energy-storing characteristic (prone to burst/bump) of the coal seam. Under the site's existing geo-mining conditions, a suitable destress blasting (long-hole drilling and blasting) design is adopted to pre-fracture the identified competent strata from both gate roads in advance. The total length of the panel could be extracted without any bump/rock-burst after the destress blasting. The efficiency of the adopted destress blasting at the different mining stages is evaluated in terms seismic effect (SE), which is calculated through the available seismic monitoring data and weight of explosive charge. These technical evaluation methods provided satisfactory results for the destress blasting design process. The systematic adoption of the destress rock blasting led the 300 m long longwall panel to be smoothly extracted without any further rock-bursts.

C. FUEL SECTORS

1. COAL CARBONISATION DIVISION

1. Study on the partial replacement of Charcoal with lignite, processing of charcoal & lignite fines for value addition and development of existing charcoal kiln

Summary of the activity: Above project has been funded by M/s Snam Alloys Private Limited, one of the big players in ferro alloys production sector in India. M/s Snam Alloys Pvt. Ltd is using wood charcoal as reductant in their submerged arc furnaces since its inception. But in recent past as the price of charcoal is in stiff rise, they requested CIMFR to explore on the partial substitution of charcoal technically as well as economically. Most of the ferro alloys company use low ash reactive coal and coke for their production along with small quantity of pet coke. But CIMFR has potentially explored lignite as a substitution of charcoal. Lignite was segregated in optimized size fractions, compacted under different process parameters and finally thermally treated at different temperatures to get a resistive mass having high degree of reducibility.

Above activity has been concluded on the observation that technically and economically it is possible to substitute a part of wood charcoal with lignite that is abundantly available in the mines under Neyveli Lignite Corporation, Tamil Nadu. The project work is going on.

2. Study on the potentiality of making briquettes and pellets from coke fines generated during the production of coke from NE coals

Summary of the activity: M/s Pride Coke Private Limited, producer of coke from coal of NE region of India and marketed their products mainly to aluminum industries. But during production of coke in non recovery ovens, they generates sizable amount of coke fines that has to be out gate at a throw away price. The Director of M/s pride Coke Private Limited communicated their wish for the participation of CIMFR with the objective to explore on the value addition of coke fines.

CIMFR since last six months extended studies on the management of coke fines. Characteristics of coke fines evaluated so far focused much on the reason behind the generation of fines upto the considerable extent. Coke fines were made in size under compaction and routed through briquetting & pelletization. Different binders were tested for their suitability. Out of two organic binders, asphalt found to be most suitable. It was also found that characteristic nature of fines may not stand for high compressive strength when it was bonded with starch. But for pelletization, both the organic binders do not prove their suitability for some technical reasons.

Project activity was concluded on the observation that briquettes made with organic binders would deliver both moderate to high strength and their compatibility may be evaluated through applications in different areas. Pelletization of coke fines may also be done for value addition, but as some of the binder technically restrict operation mode, this may also established through mode of applications. The project work is going on.

3. Techno Commercial Feasibility Study of Coke Dry Quenching (CDQ) in Heat Recovery type Coke Oven

Summary of the activity: Tata Steel Limited funded this project to make a Techno Commercial Feasibility Study on Coke Dry Quenching in Heat Recovery type coke oven at Haldia Met Coke. Hooghly met coke is producing Blast Furnace grade coke for their captive consumption since last few years. They are having wet quenching system in their coke oven (non recovery type) at

Haldia and both dry & wet quenching system at their Byproduct recovery Coke Oven, Jamshedpur unit. Currently they have a proposed expansion programme for Haldia Met Coke and under this programme they also like to explore the feasibility of CDQ for non recovery type oven.

Above study was initiated with the visit of coke ovens under Tata Steel both at Jamshedpur and Haldia followed by technical discussions with management as well as operators for different units. Activity was designed with basic data collection includes operational data and their interpretation followed by evaluation as per the need of the activity.

Project was concluded with the observation that CDQ system for Non Recovery Type Coke Oven seems to be not feasible both economically as well as technically. The project work has been completed.

4. Development of coal compacting and levelling equipment after top charging at Drag Type Coke Oven

Summary of the activity: Drag type coke ovens are equipped with coal top charging facility. M/s Jwala Coke Private Limited intends to change over their existing system with stamp charging facility for betterment in coke quality as well as increase in productivity. Stamp charging equipment including other accessories as designed by CIMFR is a new kind of approach especially for coke oven with drag type operation.

CIMFR has designed a suitable stamp charging machine with leveling equipment that suits the operation of existing drag type coke oven owned by the funding agency. The project work has been completed.

2. COAL GASIFICATION DIVISION

1. Study on Multi-feed gasification performance of high ash coal, biomass and MSW blends in the existing Fluidized bed gasification unit

Objective:

- Studies on Gasification behavior of coal, biomass, MSW and blends in Thermogravimetric analyzer(TGA)
- Gasification performance of coal, biomass, MSW and blends in Fluidized Bed Gasification (FBG) Test facility at different operating conditions.
- Selection of blends and operating parameters based on gasification performance (carbon conversion and heating value of product gas).

Outcome/R&D progress:

- Physical and chemical characterizations of coal and biomass samples.
- Preparation of binary blends of coal and biomass at different proportions.
- Gasification of coal, biomass and their binary blends in CO_2 atmosphere using Thermo-gravimetric Analyzer (TGA).
- Feeding and fluidization behaviors of coal, biomass and their blends in existing fluidized bed gasifier under cold condition.

Contribution to economy: Experimental findings and experience gathered during this studywill guide DRDO-VRDE to setup multi-feed gasifier for end use applications at clients site. The project has been completed in October, 2014

2. Pre-feasibility study on Coal Gasification to supplement Natural gas with Syngas

Objective:

- Survey of coal Gasification Technology options available globally according to the types of coals and their pros and cons
- Technology options for conversion of CO + H_2 into CH_4 (Methane) enabling transportation of coal Gas (converted into Methane) commingled with Natural Gas through existing gas pipeline network in Morbi.
- Examining the possibility of setting up of centralized coal Gasification plant in Morbi to generate coal gas equivalent 3.5 MMSCMD of Natural Gas per day.The technology should adhere to the GPCB/CPCB norms.
- Estimated quantity and quality of coal required for running aforesaid centralized coal gasification plant on long term basis.
- CAPEX & OPEX of one/two selected technologies for the centralized coal gasification plant will be included in the final report.
- Economic analysis comparison of coal gas generated mainly from Imported coal vis-à-vis Imported natural gas.
- Effluent treatment plan and disposal management involved in coal Gasification plant adhering to the norms and guidelines of GPCB/CPCB.
- Health Safety and Environmental aspects.
- Conclusion & Recommendations

Outcome/R&D progress:

- Survey of coal Gasification Technology options available globally according to the types of coals and their pros and cons
- Technology options for conversion of CO + H_2 into CH_4 (Methane) enabling transportation of coal Gas (converted into Methane) commingled with Natural Gas through existing gas pipeline network in Morbi.
- Examining the possibility of setting up of centralized coal Gasification plant in Morbi to generate coal gas equivalent 3.5 MMSCMD of Natural Gas per day.The technology should adhere to the GPCB/CPCB norms.
- Estimated quantity and quality of coal required for running aforesaid centralized coal gasification plant on long term basis.
- CAPEX & OPEX of one/two selected technologies for the centralized coal gasification plant will be included in the final report.
- Economic analysis comparison of coal gas generated mainly from Imported coal vis-à-vis Imported natural gas.
- Effluent treatment plan and disposal management involved in coal Gasification plant adhering to the norms and guidelines of GPCB/CPCB.
- Preparation of report.

Contribution to economy:

- The pre-feasibility report will provide detailed information and comparison of various technologies available globally for coal gasification.
- The report will help the client in selection of suitable gasifiers with regard to feed-stock and desired end products.

The project has been completed in March, 2015

3. Studies on Co-gasification kinetics of Petroleum coke/Biomass and high ash coals

Objective:

- To study the co-gasification kinetics of petroleum coke and high ash coal / biomass with respect to pyrolysis and gasification using carbon dioxide as a gasifying agent
- To study the effect of physical and chemical properties of feed materials on reactivity
- To study the effect of inherent mineral matter on reactivity

Outcome/R&D progress:

- Feed samples have been collected
- Characterization and gasification experiments are in progress

Contribution to economy: This data bank will be helpful in the development of suitable gasifier for Indian Coals. The project work is in progress.

3. COAL PREPARATION DEPARTMENT

1. Value Addition from coking coal slimes lying in waste settling ponds of washery

Objective: The main objective is to reduce the environmental pollution by treating the coal slurry lying in waste settling ponds at Coking coal washery through beneficiation routes and utilize the clean coal effectively.

Outcome: Detailed laboratory flotation studies on the slurry sample indicated that, it is possible to recover clean coal from the slurry at an ash content of <15% and recovery about 60%. Flotation Experiments were carried out based upon the release analysis technique in order to optimize the cleans yield at a desired ash level. The result indicates that the samples are amenable for beneficiation by flotation technique. Pilot scale flotation tests using the 400kg/hr test facility were carried out with the coal fines collected from the settling pond considering 1.5kg/t LDO and 0.5kg/t MIBC. It was observed that the yield of concentrate at desired ash level is almost at par with the release analysis data. The project work is in progress.

2. Development of an on-line coal washability anayser

Objective: The objective is to develop an X-ray-based, on-line coal washability analyzer and demonstrate the capabilities of the analyzer by comparing efficiency data from traditional float sink tests with efficiency data generated by the washability analyzer. It is proposed to develop a laboratory scale model initially to establish the concept and derive the required parameters and to develop suitable software.

The second phase of the system may be upgraded for online operations.

Outcome: The laboratory scale on line washability analyzer is being designed and fabricated at Ardee Hi-Tech Pty Ltd., Visakhapatnam and the necessary software is being prepared. The project work is in progress.

3. Development of zero waste technology for processing & Utilization of Thermal Coal

Objective: The Objectives are as follows :

i) To develop suitable technology for dry beneficiation of thermal coals from India to produce 34% ash and 25% ash clean coal.

ii) Wet beneficiation of the rejects of dry circuit for maximum recovery of combustibles from thermal coal.

Outcome: The laboratory ore sorter was tested with three coals viz., Dakra, Gare and Rajmahal. It was found that the performance of the ore sorter is good when the coals of Dakra and Rajmahal were treated and the response of Gare coals to ore sorting is poor. The performance efficiency tests indicated that the ep values are in the range of 0.16 to 0.22. The project work is in progress.

4. R & D Studies on beneficiation of Washery rejects

Objective: The objective is to study the Iceaning potentialities of the Coal washery rejects through washability investigations followed by bench scale investigations/pilot plant testing and generation of clean coal sample at 18% and 34% ash level for use in metallurgical and thermal purposes.

Outcome: The rejects collected from operating coking coal washery are suitable for thermal power generation if beneficiate judiciously. The cleans generated after beneficiation may be utilized in Power station and the remaining rejects may be utilized as FBC boiler feed.

The laboratory washability tests and chemical characterization studies reveal that the washability potential of Chakabura Reject Sample is good out of the three reject samples. The washability potential of reject sample from Dipka was moderate and ST-CLI reject sample was poor. The project has been completed.

5. Fundamental studies on surface characteristics of coal fines using Zeta Potential and contact angle analyzer for upgradation by froth flotation

Objective: The objective of the project is to carry out systematic studies of elector kinetics and contact angle of coal fines which is necessary for understanding their role in controlling complex processes of fine coal beneficiation based on surface characteristics.

Outcome: The laboratory flotation test on the coal sample indicated that an yield of 68.8% with desired ash level at an ash level 17.5% under the operating process conditions as collector dosage, frother dosage , RPM as 1.60kg/t, 0.17kg/t and 1600 respectively whereas the tailings yield was found as 31.2% with an ash value of 65.6%.

It was found that the zeta potential value (-mv) varied from 14.2 to 26.7. The best result was obtained with an yield of 68.8% at desired ash level of 17.5% when zeta potential reached the minimum (negative) value as 14.2. Whereas the minimum yield of clean coal was recorded as 51.0% with an ash value 12.9% when zeta potential reached the maximum (negative) value as 26.7. Hence decreasing of negative value of zeta potential enhances the clean coal recovery.

It was found that the contact angle value varied from 67.2° to 110.6°. The best result was obtained with the yield% of 68.8% at desired ash level of 17.5% when contact angle value reached the maximum of 110.6°. The minimum yield of clean coal was recorded as 51.0% with ash% 12.9 when contact angle value reached the minimum of 67.2°. Hence increasing the contact angle value enhances the clean coal recovery. The project has been completed.

6. Studies on the Effects of design and operating variables of 100 & 150mm diameter Heavy Medium Cyclone for achieving maximum yield at desired quality from difficult-to-wash Indian Coking Coals

Objective: The objective of the project is to study the performance of 100 and 150mm diameter Heavy Medium Cyclone Treating difficult-to-wash low volatile coking coals of India and select the level of parameters of achieving maximum yield at desired quality.

Outcome: The studies on H.M.Cyclone indicated that the performance of 100mm dia cyclone is good compared to the 150mm dia cyclone, while treating difficult-to-wash high ash Indian coking coal. The project has been completed.

7. Detailed investigation of Termi OCP, CCL for washability characterization and generation of clean coal at three different ash levels through Pilot Plant Operation

Objective: The objective of the project is to carry out detailed basic study on the washability characteristics of the pre-cleans followed by pilot plant investigations to generate cleans at 19%, 16% and 13% ash content.

Outcome: The raw coal was crushed at 75mm and the crushed product was deshaled in a pilot scale two product Baum Jig. The yield of pre-cleans was observed 58.5% at the ash content 22.8%. The detailed washability studies on the pre-cleans crushed at 25mm indicated that the theoretical yield at 13%, 16% and 19% ash level was observed as 30.3% (17.7%), 52.1% (30.4%) and 74.7% (43.8%) respectively. The detailed washability studies on the pre-cleans crushed at 13mm indicated that the theoretical yield at 13%, 16% and 19% ash level was observed as 32.3% (18.9%), 54.0% (31.6%) and 75.9% (44.4%) respectively.

For generation of cleans at 19% ash level, the overall yield% achieved through pilot plant operation is 40.7%. For generation of cleans at 16% ash level, the overall yield% achieved through pilot plant operation is 25.9%. For generation of cleans at 13% ash level, the overall yield% achieved through pilot plant operation is 19.0%. The total rejects generated from each of the schemes may be used for power generation. The project has been completed in June 2014.

8. Washability flotation, generation of cleans and characterization of one sample supplied by JSPL

Objective: The main objective is to estimate the theoretical yield% at different ash levels from washability data, flotation of coal fines, Generation of cleans and its characterization on the sample provided by JSPL.

Outcome: The screen analysis of the sample tested indicated that the coarser fraction consists of high ash. The washability of the coarser fraction indicated that the theoretical yield at 13.5% and 15% ash level was observed as 40.0% and 48.0% respectively while the corresponding rejects ash was noted to be 50.5% and 54.7%.

The flotation response of the coal fines is good and high recoveries are achievable at the required ash levels. The characterization of the clean copal indicated that the clean coal is matured and may be used for metallurgical purposes. The project has been completed in February, 2014.

9. Sampling and analysis of 645305.32 te accessible quantity of BCCL washeries

Objective: The main objective is collection of representative samples and analyses of samples with respect to proximate analysis.

Outcome: Representative samples were drawn by following the standard procedure from different ponds lying at Moonidih and Patherdih washery. Each sample was analyzed for proximate analysis. The average ash, moisture, volatile matter and fixed carbon content of the various samples were estimated and reported. The project has been completed in June, 2014.

10. Studies on the effects of operating variables of 1 meter diameter Coal Spiral for achieving maximum yield at desired quality from Indian Coking/non-coking fine coal

Objective: The objective of the project is to study on the effects of operating variables of 1

meter diameter coal spiral for achieving maximum yield at desired quality from Indian Coking/ non-coking fine coal.

Outcome: Coal sample lying in the ponds of operating coal washery was tested in the spiral and the results indicated that the performance is satisfactory. Further tests are in progress.

11. Sampling and Analysis of imported coal unloaded at port ends- MV Navious Ionian Laycan

Objective: The main objective is the collection of representative samples during unloading at the port ends, preparation of sample /sub samples and characterization tests as per the standard procedure and as desired by the sponsor.

Outcome: Imported coal samples were collected while the coal was unloaded at the wharf of the port. The samples were characterized for Total moisture, proximate, CSN, Petrography and sulfur. The project has been completed in November, 2014.

12. Sampling and Analysis of imported coal unloaded at port ends- MV Great Eternity Laycan

Objective: The main objective is the collection of representative samples during unloading at the port ends, preparation of sample /sub samples and characterization tests as per the standard procedure and as desired by the sponsor.

Outcome: Imported coal samples were collected while the coal was unloaded at the wharf of the port. The samples were characterized for Total moisture, proximate, CSN, Petrography and sulfur. The project has been completed in December, 2014.

13. Sampling and Analysis of imported coal unloaded at port ends- MV Bao Success

Objective: The main objective is the collection of representative samples during unloading at the port ends, preparation of sample /sub samples and characterization tests as per the standard procedure and as desired by the sponsor.

Outcome: Imported coal samples were collected while the coal was unloaded at the wharf of the port. The samples were characterized for Total moisture, proximate, CSN, Petrography and sulfur. The project has been completed in January, 2015.

14. To study the in plant heat loss of coal at Budge Budge Thermal Power Station-CESC

Objective: The objective of the project is to identify the reasons for GCV loss inside the plant and quantify the same and suggest the remedial action plan to reduce the loss.

Outcome: Samples from Wagon top, before primary crusher, after primary crusher and after secondary crusher were collected as per standard at CESC, Budge Budge plant. Samples were also collected at the stacker reclaimer point. Detail analysis is under progress. The project work is in progress.

15. Sampling and Analysis of imported coal unloaded at port ends- MV ROSCO OLIVE

Objective: The main objective is the collection of representative samples during unloading at the port ends, preparation of sample /sub samples and characterization tests as per the standard procedure and as desired by the sponsor.

Outcome: Imported coal samples were collected while the coal was unloaded at the wharf of the port. The samples were characterized for Total moisture, proximate, CSN, Petrography and sulfur. The project has been completed in February, 2015.

4. CSIR-CIMFR, BILASPUR RESEARCH CENTRE

1. Resource Quality Assessment of virgin coal resources of Chhattisgarh, M.P., Odisha and Uttar Pradesh

- Borehole coal core Received : 13,087.28m
- Result dispatched : 5,820.34m
- Sample prepared : 16,145
- Total Number of sample prepared (Including BH, PO, HGI, Overall and Projects) : 20,992
- Pending Meterage of borehole as on 31.03.2015 : 6,249.32m

2. Quality study through testing and analysis of coal samples under Aid to Industry

Sponsoring Agencies: CCO, MCL, JSPL, ACB (India), Prakash Industries, Neeco-Jaiswal, Balco, Adani, SECL, Bhushan, Nabha Power, Sharda Energy, Vedanta, Sterlite, Monnet, MPPGCL, DB Power, SKS Power, NTPC, BIML etc.

- Ash and Moisture, Proximate, Gross CV, Ultimate, AFT, TS, AA and HGI

Projects undertaken

1. Characterisation of coals from different coalfields explored by CMPDIL RI-V through borehole coal core study, Phase I

- Funding Agency: M/s CMPDIL RI-V, Bilaspur

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

- Funding Agency : M/s CMPDIL RI-V, Bilaspur

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

- Funding Agency & Project Cost: M/s CMPDIL RI-V, Bilaspur

4. Characterisation of coals from different coalfields explored by CMPDIL RI-V through borehole coal core study

- Funding Agency : M/s CMPDIL RI-V, Bilaspur

5. Characterisation of coals from different coalfields explored by CMPDIL RI-V through borehole coal core study, Phase V

- Funding Agency & Project Cost: M/s CMPDIL RI-V, Bilaspur

6. Screen Analysis of ROM(Dispatch) Coal of Milupara Mines, Raigarh Coalfield (C.G.)

- Funding Agency: M/s Monnet Ispat & Energy Limited, Raigarh

7. Collection and Characterisation of Coals at different points of coal movement at Sipat Super Thermal Power Plant of NTPC, Bilaspur

- Funding Agency: SSTPS, NTPC, Bilaspur

8. Collection of samples from coal supplied to SGTPS,MPPGCL from different SECL sidings and at different points of coal movement at SGTPS, Birsinghpur and their Characterisation

- Funding Agency: SGTPS, MPPGCL, Birsinghpur (M.P.)

9. **Lab Scale Washability Study of ROM Coals from Chhal O/C Mines, Raigarh Coalfield**
   - Funding Agency: M/s Bhatia Energy and Minerals Pvt. Limited, Raigarh

10. **Collection of samples from coal supplied to SGTPS,MPPGCL from different SECL sidings and at different points of coal movement at SGTPS, Birsinghpur and their Characterisation**
    - Funding Agency: SGTPS, MPPGCL, Birsinghpur (M.P.)

11. **Preparation of a data bank comprising of basic quality data of virgin coal resources of Son-Mahanadi Valley Coalfields of Chhattisgarh**
    - Funding Agency: In-house Project

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

1. **List of ongoing projects:**

i) Sponsored projects:

1. **Collection preparation and analysis of 120 nos coal samples at loading ends of WCL, supplied to STPS, Sarni**
2. **Quality assessment of imported coal samples received at STPS Sarni of MPPGCL**
3. **Quality assessment of imported coal and indigenous coal samples received at Barath Aluminium Co Korba (CG)**
4. **Benchmarking Specific Diesel Consumption (SDC)of Gevra Opencast Mine South Eastern Coalfields Ltd., Bilaspur**
5. **Benchmarking Specific Diesel Consumption (SDC)of Kusmuda Opencast Mine South Eastern Coalfields Ltd., Bilaspur**
6. **Benchmarking Specific Diesel Consumption (SDC)of Dipka Opencast Coal Mine South Eastern Coalfields Ltd., Bilaspur**
7. **Electrical Energy Audit & Benchmarking Electrical Power Consumption of AKWM Colliery of Katras Area including colony and offices of Bharat Coking Coal Limited, Dhanbad**
8. **Benchmarking Specific Diesel Consumption (SDC)of AKWM Open Cast Coal Mine of Bharat Coking Coal Limited, Dhanbad**
9. **Energy Audit of Jalgaon Jilla Sahakari Dugdh Utpadak Sahakari Sangh Ltd (JJSDUS), Jalgaon**

ii) Testing and analysis (CLP) Projects:

I. Resource Quality Assessment of borehole coal cores: During the period 7600.80mts of coal and lignite core drilled by coal exploratory agencies in 28 blocks of 13 coalfieldswas received. Out of this 2667.02mts of coal core was logged, processed, analyzed and data dispatched.

II. Technical Aid to industry and Consultancy: Quality analysis of 2616 coal/coke/ lignite/ biomass /oil samples received from different coal producer/user industries.

iii) In-House Project:

1. **To study the effect of blending of imported coal and Indian coal on coal quality parameters**

2. **Systematic compilation of coal quality coal property and coal ash quality data for preparation of data bank of virgin coalfields of Maharashtra, Madhya Pradesh, Andhra Pradesh, Odisha, Chattisgarh and Lignite fields of Tamil Nadu, Gujarat and Rajasthan**
3. **To study the suitability of various non-toxic inorganic liquids and saccharides for float sink test of coal**
4. **Energy conservation and study of mine safety aspects of electrical and mechanical machineries in opencast mines using infrared Thermography technique**

iv) **Grant in Aid Projects**

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

v) **Consultancy Projects**

1. **Collection, preparation and analysis of 10nos of coal samples at loading end supplied by WCL and 10 nos of samples at unloading end at STPS, Sarni**

vi) **List of Completed Projects**

1. **Preparation of data bank comprising of basic quality data of virgin coalfields of Maharashtra, Parts of AP, MP & lignite fields of Rajasthan, Gujarat and TN**
2. **Characterization of bore hole coal cores from Milupara U/G coal mines, Raigarh (C.G.)**
3. **Coal Characterization &Washability study of ROM Coal crush to 25mm at specific gravity 1.4 to 1.6 from Marki – Mangli OCM to find out maximum yield of clean at 0.5% Sulphur & 23% Ash**
4. **Benchmarking Specific Power Consumption (SPC)of Dipka Opencast Coal Mine South Eastern Coalfields Ltd., Bilaspur**
5. **Benchmarking Specific Diesel Consumption (SDC)of Bhatadi Opencast Coal Mine, Chandrapur area of M/s Western Coalfield Ltd., Nagpur**

6. CSIR-CIMFR RANCHI RESEARCH CENTRE

Running Projects

1. **Characterisation, Testing & Analysis of Coal**
   - Funding Agency: CMPDI, GSI & CCL
2. **Systematic generation, compilation of basic quality data of virgin/running coal resources and computerization of analytical data of CMPDIL, CCL, MCL & GSI areas viz. East Bokaro, West Bokaro, North Karanpura, South Karanpura, Ramgarh, Singarauli, Talchir etc.**
   - Funding Agency: In-house project.
3. **Determination of Correlation Coefficient between Ash and Total Mineral Matter content of Coal at different Ash level**
   - Funding Agency: In-House Project.
4. **Characterisation of coals from different coal fields explored by CMPDIL RI-III, through borehole coal core study – Phase I (For coal cores received between 05.12.2011 to 30.06.2012)**
   - Funding Agency: CMPDIL RI-III, Gondwana Place, Kanke Road Ranchi (Jharkhand)

5. **Characterisation of coals from different coal fields explored by CMPDIL RI-III, through borehole coal core study – Phase II (For coal cores received between 01.07.2012 to 31.03.2013)**
   - Funding Agency: CMPDIL, Gondwana place, Kanke Road Ranchi

6. **Characterisation studies of coal seams encountered in Borehole No.- CMMJ- 73, 78, 80, 89, 90, 91, 93, 94 ,98, 99 & 100 Porda Block, Mand Raigarh Coal Fields**
   - Funding Agency: CMPDIL, Seepat Road, Bilaspur (C.G)

7. **Quality Assessment study of the coal received from M/s Total CBM Solution Pvt. Ltd, New Delhi**
   - Funding Agency: M/S Total CBM Solution Pvt. Ltd. New-Delhi

8. **Quality Assessment of Coking and Non-Coking coal of North & South Karanpura, East & West Bokaro Coalfields for Seam/Steam/Channel samples**
   - Funding Agency: CCL, Ranchi

9. **Potentiality Study of Banhardi coal Block, Latehar, Auranga Coalfield through Characterisation, Testing & Analysis of Bore Hole Coal Core**
   - Funding Agency: JSEB, Ranchi. Jharkhand

10. **Potentiality Study of Lajkura, Rampur&IB Seam at SAMLESWARI Block, IB-Valley Coalfield through characterization, Testing & Analysis of Bore Hole Coal core**
    - Funding Agency: Central Mine Planning & Design Institute Limited, Regional Institute–7, Gruha Nirman Bhawan, Sachivalaya Marg, Bhubaneswar

11, **Characterisation of coals from different coal fields explored by CMPDIL RI-III, through borehole coal core study-Phase II (For coal cores received between 01.04.2013 to 31.03.2014)**
    - Funding Agency: CMPDIL, Gondwana Place Kanke Road, Ranchi

12. **Sampling & Analysis of washery rejects of Kathara Washery**
    - Funding Agency: CCL, Ranchi

13. **Characterization of coals from different coal fields explored by CMPDIL RI-III, through borehole coal core study-phase IV (For coal cores received between 01.04.2014 to 31.03.2015)**
    - Funding Agency:CMPDIL, RI-III, Gondwana Place, Kanke Road Ranchi

14. **Potentiality Study of Lajkura, Rampur & IB Seams at LAJKURA DIP SIDE AND BURAPAHAR Block, Ib-Valley Coalfield through Characterisation, Testing & Analysis of Bore Hole Coal Core**
    - Funding Agency: CMPDIL,RI-VII,4th -7th Floor, Gruha Nirman, Sachivalaya Marg, Unit-3, Bhubaneswar-751001, Orissa

15. **Quality Assessment of Coking and Non-Coking coal of North & South Karanpura, East & West Bokaro Coalfields for Seam/Steam/Channel samples**
    - Funding Agency: Central Coalfields Limited, Dharbhanga House, Ranchi

7. ENVIRONMENTAL MANAGEMENT DIVISION

1. Potassic (K) fertilizer Technology to Empower the Nation (K-TEN)

CIMFR Activity: Development of biomass ash/ biochar based slow release potassium fertilizer (SRKF)

Objective:

a) To explore and identify the biomass ashes and biochar suitable for exploiting K fertilizer (based on inherent K content and availability).

b) To develop process for preparation of slow release K fertilizer (SRKF) from biochar and biomass ash.

c) To optimize the process parameters for preparation of SRKF.

d) To study the K release pattern from the SRKF in different types of soils.

e) To study the response of different crop species to SRKF.

f) To setup lab scale and pilot plant for preparation of SRKF.

Outcome:

❖ Biomass ash samples were collected from different biomass power plants (10-20 MW capacity) of UP, WB, TN and Rajasthan. These plants use different feed materials like rice husk, sugarcane bagasse, agricultural, coconut, plywood, rubber wood, match stick wastes, Juliflora, spice waste, etc.

❖ Potassium was extracted from these ashes by using water and different acids. The results showed water extraction is sufficient for getting >90% recovery. The extracted solutions were evaporated and the resultant salt was pelletized using suitable binder. The process parameters were optimized.

❖ Based on the results obtained in laboratory experiments, a bench scale K extraction plant was designed and fabricated. The plant is installed and the optimization of process parameters in the lab scale unit is under process. The picture of lab scale plant is given below:

❖ Kinetic studies on the release of potassium fertilizer are under process. Preliminary results showed that the release of K from SRKF is much slower than the conventional muriate of potash fertilizer.

Contribution to economy:

- ❖ Ash generated from the biomass-based power plants is a menace; development of fertilizer from the ashes will offset significantly the operational cost of the plant.
- ❖ Since the product will be developed in the power plant site itself, expenditure on energy and logistics will be minimum.
- ❖ The collection of biomasses and their transport to the respective plants sites has already contributed to significant rural employment. This K-fertilizer technology will generate additional employment opportunities at the manufacturing and application sites.

2. Assessment of exposure risks to toxic metals and carcinogens (PAHs and dioxins) for commuters in Jharia coalfield

Objectives:

a) Vehicular emission inventory for CO, SOx, NOx, PM, trace elements, and PAHs/ Dioxins.

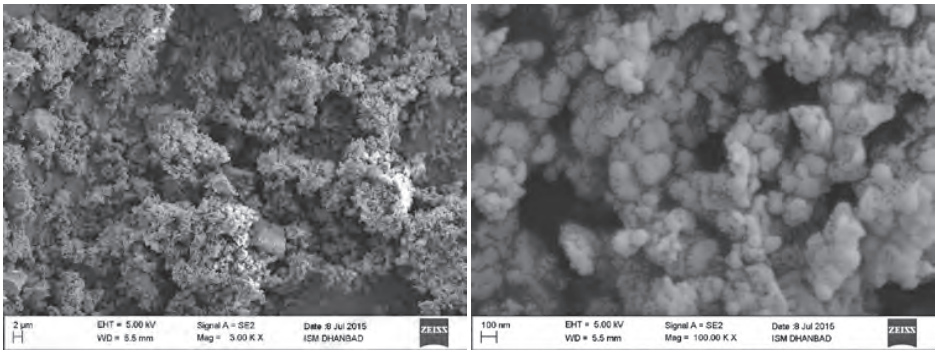
b) To identify personal exposure risks for commuters in Jharia coal field roads.

c) To characterize the exposure risks to roadside residents and shop keepers.

d) To compare the exposure risks for different modes of travel.

Outcome:

- ❖ Vehicular density was higher for motor bikes (716-1218/hr) and auto rickshaws (231-678/hr) in Dhanbad roads.
- ❖ Vehicular exhaust soot emission rate was higher for jeep (41.6 mg/m^3) followed by motor bikes (7.1-21.8 mg/m^3) and car (2.57 mg/m^3). PAHs content was more in the soot particles than the gas phase. Motor bikes emitted higher PAH than jeep and car. Older bikes emitted more PAHs than new ones. The SEM image of the soot particle is given below:



- ❖ Among the different trace elements, the emission rate was higher for Fe (20-320 µg/m^3), Zn (3.7-43.9 µg/m^3), Ni (6.2-18.6 µg/m^3), and Mn (0.67-10.8 µg/m^3).
- ❖ Based on the traffic density and specific emission factors, the potential emission for 1 km road length is:Soot particles, 0.58 mg/s; total PAHs, 2.44 µg/s; particulate PAHs, 2.23 µg/s; gaseous PAHs, 0.214 µg/s.
- ❖ The content of heavy metals and PAHs in the road dusts was estimated and the potential human exposure risks were characterized based on three exposure pathways: dust ingestion, dust inhalation and dermal absorption.
- ❖ The exposure risks to commuters in the roads were assessed by using vehicle mounted mobile high volume, and respirable dust samplers. The PAHs content was higher in respirable particulates (168-897 µg/m^3) than the suspended particulates (63-230 µg/m^3).

Contribution to economy: The data generated would be helpful for the regulatory authorities to design permissible limits for emission of PAHs from vehicles.

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

Objectives:

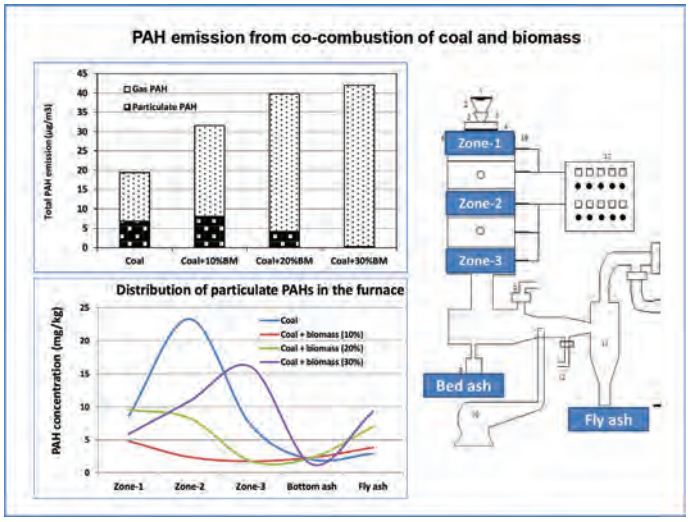
a) Qualitative and quantitative estimation of PAHs in coal/ lignite and other feed stocks used for combustion in power plant.

b) Sampling and analysis of particulate and gas samples for the PAH, to determine the emissions resulting from coal combustion.

c) Profiling of PAH emissions with the feed/combustion parameters.

d) To assess the potential human exposure risks from PAH emissions from power plants.

Outcome: PAHs being the toxicants of health concern, their emission and distribution from coal combustion sources are being studied in this project. Baseline data on PAH content in different coal samples were generated. PAH emissions from combustion facilities like drop tube furnace and co-gasification facility were monitored for PAH emissions in different combustion conditions and feeds. PAH emission was fond to be higher in lignite combustion than coal; higher combustion temperature decreased the PAH emissionrate. Distribution of particulate PAHs in the drop tube furnace is given below:



Contribution to economy: The data from this study will help to derive PAH emission standards for coal fired thermal power plants of the country.

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

Objective:

a. To assess the carbon accumulation in different tree species growing in reclaimed mine spoils of Jharia coal field.

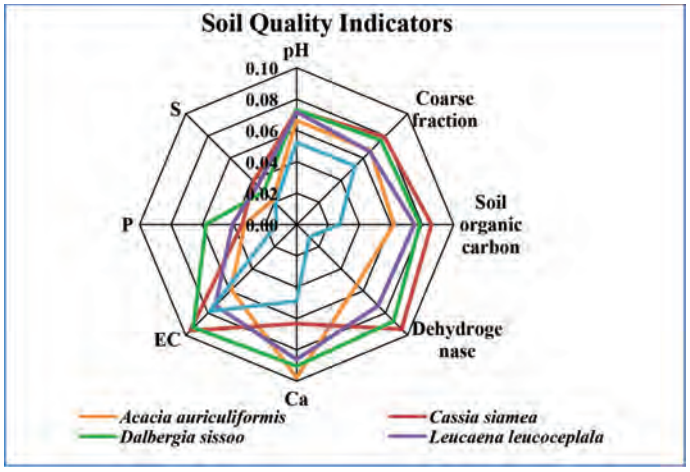
b. To assess the soil carbon storage potential and carbon stability under different tree canopies of reclaimed mine spoils.

c. To evaluate the potential of locally available amendments like farmyard manure (FYM), poultry manure (PM), biochar along with fly ash to restore the barren coal mine spoil.

d. To assess the carbon storage potentials of different biosolid amendments.

Outcome:

- Carbon accumulation index (CAI) developed for reclaimed coal mine spoils
- Above ground and below ground carbon stocks of reclaimed coal mine spoils have been assessed.
- Rhizosphere indicators and indices influencing carbon density of tree species growing on the mine spoil have been identified.
- The soil quality index of different tree species growing on reclaimed coal mine spoils are given below:



Contribution to economy: The data generated would be helpful for mining companies to calculate the carbon foot prints of mining.

8. FUEL SCIENCE DIVISION

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

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

Work done: Coal tar samples were sourced from various nearby coke plants such as Barari, Lodna, Bhowrah etc. and also from our Coal liquefaction (CTL) plant. Coal Derived Asphaltene (CDA) sample could be successfully prepared as per ASTMD2007-80 method from respective tar samples and derived anthracene oil. The (CDA) sample was characterized by CHN, NMR, UV and Fluorescence spectroscopic analysis. Aggregation studies of CDA have been done in organic solvents with series of electron acceptors as probe materials.

Observations: CDA forms 2(CDA): 1 (fullerene) molecular complex with [60] fullerene whereas 3(CDA): 1(fullerene) with [70] fullerene in organic medium of CCl_4.

Conclusions: Although CDA is insoluble in water yet CDA could be successfully dissolved in

some aqueous micellar media. Successful molecular interaction study of CDA with TCNQ has been performed both in organic and aqueous micellar medium.

Recommendations: The aggregation behavior of CDA in absence and presence of micro quantity of water has been further investigated with [60] fullerene as an acceptor.

Benefits accrued: The project work is in progress. The findings of this work will be helpful to the coal liquefaction researches and petroleum industry where asphaltene aggregation is a serious problem.

2. Synthesis of Graphenes from Coal Derived Asphaltene

Objective of the project: Coal derived asphaltene (CDA) contains fused polycyclic aromatic hydrocarbons (PAHs). The present work aims to synthesize Graphene from CDA by regularly joining the PAHs of the CDA.

Work done: About 10g of Coal Derived Asphaltene (CDA) sample could be successfully prepared as per ASTMD2007-80 method from crude anthracene oil collected from Barari Coke Plant. The coal and asphaltene based rods were subjected to arcing reactions. The soot obtained from the arc discharge experiments of coal and asphaltene mixture was examined with Transmission Electron Microscope (TEM). The studies revealed presence of Graphene in the soot.

Observations: The CDA was mixed with coke powder at different ratio and was converted into conducting rods. As a pilot study the obtained conducting rods were then subjected to arc discharge in an inert atmosphere to obtain soot over a metal substrate.

Conclusions: Graphene could be detected on characterization of the soot thus obtained by Transmission Electron Microscope.

Recommendations: Other method of synthesis of Graphenes from asphaltene should also be explored. Coking of the coal sample was done followed by crushing to –212 micron size to get coke powder.

Benefits accrued: The project work is in progress. Coal may be considered as a very cheap and abundant raw material for synthesis of Graphene which has futuristic technological utility.

3. Development of a coal based organic binder for pelletization of iron ore finesfor suitable application in both conventional and advanced steel making process.

Objective: This project envisages the development of lignite/coal base humic organic binder for Iron ores that are characteristically friable in nature due to which during mining and processing a large amount of fines (as high as 1.5 times of lump ore) are generated.

Work done: Broad Literature survey has been completed. Collection of coal & lignite and Iron ore (Haematite) sample for this study has been done. Acid demineralisation of two coals and a lignite sample has been carried out. Extraction of humic acid from raw lignite with and without the application of promoting agent has been completed. Preparation of humic acid using wet oxidation of coal is being carried out.

Observations: Extraction level of Neyveli lignite with alkali increases by use of promoting agent Extaction Level of Samla coal is insignificant.

Conclusions: Raw samla coal is unsuitable for extraction of humic acid using alkali wet oxidation of coal raw lignite needs to be done to enhance the humic acid content in the coals and lignite, this is being carried out using oxygen alkali method.

Recommendations: Considering substantial deposits of lignite in our country, preparation of humic type organic binder using lignite will be most appropriate.

Benefits accrued: The project work is in progress.

4. Structural studies on nature and constitution of coal and lignite with special reference to anomalous behavior of lignite during low temperature oxidation vis a vis their self heating character.

Objective of the project: To develop a methodology to reduce spontaneous heating risks in coal and lignite by establishing an improved correlation and categorization of coal according to their proneness towards self heating tendency using inherent moisture and structural parameters as important factors generally found in low rank coals and lignite.

Work done: Collection of six lignite and coal samples from various locations having proneness to higher spontaneous combustion character. Literature survey on auto-oxidation properties of lignites with special reference to their structural studies on nature and chemical constitution. Influence of moisture on spontaneous combustion character of Rajasthan lignite samples have studied using Crossing/Ignition Point Temperature (CPT/IPT) determination apparatus.

Observations: CPT of all lignite samples are within range of 150-160°C.

Conclusions: CPT value decreased with moisture content of lignite samples.

Recommendations: A broad study required to investigate the dilemma of spontaneous combustion of coal and lignite in relation to their physic-chemical character which would be helpful to enumerate the minimum essential test parameters required to classify the spontaneous character of coals and lignite based on their chemical nature and constitution.

Benefits accrued: The project work is in progress

5. Coal Constitution. CLP 3009

Objective of the project: Routine analysis and tests done for outside parties and various on-going projects in this institute. Analysis and tests done are chiefly Crossing Point Temperature (CPT) and Ignition point temperature(IPT) in Coal. Quantitative determination of various functional groups in coal.

Work done: CPT and IPT of samples were determined on payment basis.

9. LIQUID FUELS SECTION

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

Objectives:

a) To develop suitable catalysts and to study the coal-to-liquid conversion technology in Pilot Scale in an integrated plant consisting of low cost air blown gasifier and a multi-tubular fixed bed reactor (Catalyst Capacity: 10.0 L);

b) To test high ash Indian coals in the gasifier;

c) To generate basic design & process parameters for further scale-up to commercialization;

d) To characterize the products (liquid and gaseous) and its up-gradation/processing for commercial use

R & D Progress: The CTL-Pilot Plant has been successfully commissioned and two Co-based

catalysts have been tested. One 400 h and another 250 h of continuous experimental runs have been completed. The project is in the verge of successful completion.

Contribution to economy: This is a national test facility and other organizations who are working for development of CTL catalysts, they can also use this facility for integrated testing of CTL technology development including coal gasification, gas cleaning and liquefaction. This will facilitate for commercialization of the indigenously developed CTL technology and lessen the burden for petroleum crude import.

2. A novel process for production of hydrogen from renewable and fossil fuel based liquid and gaseous hydrocarbons by non-thermal plasma reformation technique

Objectives:

(a) To design a vortex flow type as well as a conventional cylindrical fuel reformer equipped with pencil plasma torch.

(b) To study the conversion efficiencies of methanol, ethanol, and bio-diesel for on-board hydrogen production by non-thermal plasma reformation

(c) To study the conversion efficiencies for various hydrocarbon feed like methane, naphtha, gasoline, diesel, kerosene and heavy oil.

(d) To combine selective catalytic reaction technique for obtaining fuel cell grade hydrogen.

(e) To propose a compact multi-fuel fuel processor.

R & D Progress: Experiments have been conducted for non-thermal plasma reformation of soybean oil, methanol and ethanol with both conventional cylindrical fuel reformer as well as vortex type reformer. Maximum up to ~ 11.65 L of H_2 production is achieved with soybean oil feed of 0.4 mL/min in a total mixed gas of ~ 41.0 L produced per minute. Maximum up to 18.40 L/min of hydrogen was produced in mixed gas @ 28.0 L/min with a methanol input of 4.5 mL/min. Ethanol has produced maximum up to 26.47 L/min of H_2 for 5.6 mL/min flow of ethanol with a total output mixed gas flow of 45.18 L/min.

Contribution to economy: Hydrogen is considered to be an ideal energy carrier in the foreseeable future. Hydrogen can be used as a fuel in furnaces, internal combustion engines, turbines and jet engines, even more efficiently than fossil fuels, i.e., coal, petroleum and natural gas. Hence hydrogen from non-thermal reformation of renewable fuels will be a great benefit to hydrogen economy.

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

Objective: The main objectives of the proposed project are summarized below:

(i) Synthesis and characterization of iron & cobalt based mesoporous and macroporous catalysts with high surface area, tailorable pore sizes, controllable particle sizes and shapes.

(ii) To determine conversion efficiency of catalysts towards syngas to liquid hydrocarbon through Fischer-Tropsch synthesis.

(iii) To maximize conversion efficiency and C_{5+} selectivity with variable reaction parameters like H_2/CO ratio, space velocity, reaction temperature and pressure.

(iv) To increase catalyst life and mechanical stability with different types of structural promoters (Zr, Al, B etc.).

(v) To increase thermal efficiency of the reaction and to increase syngas conversion and C_{5+} selectivity with doping of trace amount of reduction promoter like Ru, Pd, Pt, Cu.

Outcome/R&D progress: Mesoporous alumina Carbon nano-composite support has been prepared and characterized by N_2 adsorption-desorption isotherm. Cobalt and copper metals is deposited on this mesoporous support along with structural promoters (Mg & Zr) by wet impregnation method. Prepared catalyst has characterized by Temperature Programmed Reduction as well as NH_3-Temperature Programmed Desorption techniques. 170 h continuous experimental run has been completed at 220°C temperature and 20 bar pressure with syngas in a fixed bed single tube reactor for activity study through Fischer-Tropsch synthesis. Estimation of results is in progress.

10. NON-CONVENTIONAL ENERGY & INSTRUMENTATION DIVISION

The division Non-Conventional Energy & Instrumentation is relatively a new division formed to look into installation of non-conventional energy sources, especially solar energy, for various needs of the Institute and Instrumentation aspect of coal related testing and analysis.

The division at present serves the Institute through the following on-going activities:

1. Provision of Multimedia, Audio Video System and PAS for various functions, Programme, Seminars / lectures arranged within the Institute, club complex, etc.
2. Provision of telephone services including repair and maintenance of EPABX, telephone sets and lines in Office and colony premises
3. Repair of furnaces, reactors, ovens, temperature baths, water distillation apparatus, geysers, UPS, stabilizers, variacs, etc.
4. Repair and maintenance of sophisticated instruments of lab, plant, etc.
5. Verification, Installation of new / old equipments in plants / labs of the Institute
6. Vocational training to polytechnic and engineering students of various colleges
7. Development of instrument for coal testing at Instrumentation Division Barwa Road Dhanbad
8. Setting - Up of Safety Testing Laboratory at CSIR-CIMFR Barwa Road Dhanbad for testing of Electronic, IT products and all House-hold appliances as well as industrial equipments, etc. The Safety Testing Laboratory project funded by DietY (Ministry of Communication and Information Technology).

Training programme for outsiders conducted: Vocational training to 12 nos. ofB.Tech students of B C Roy Engineering college of West Bengal, DIT Dehradoon and Engineering college, Bhubnashar for the period: 01.04.2014 to 31.03.2015 .

11. POWER COAL DIVISION

Thrust Areas of the Division:

- Combustion behavior of pulverized coal
- Effect of Blending of Coals on Milling, Combustion and Slagging Behavior
- Impact of coal qualities in power Plant Performance
- Estimation of carbon emission factors of Indian coals & lignite and GHG emission
- coefficients of key sectors
- Equivalency of UHV & GCV of non coking coals
- Thermal analysis of lignites, coals, cokes, char and coal ash
- Fly ash utilisation for building materials
- Ash composition, Ash fusion behaviour & Trace Elements

- Mercury emission assessment from Power Plants
- Coal water mixture preparation and combustion
- Analysis of Coal Minerals and its High Temperature Phase Transformation
- Analysis of Coal Microstructure
- Preparation of guidelines for estimation normative coal requirement by different industries as required for framing policy decisions in respect of judicious allocation of different grades of coals

Facilities Available for Combustion Studies:

Special features Drop Tube Furnace:

- Heating provision at different temperature at different zones.
- Char and flue gas sampling at different height of the furnace.
- Bottom ash and fly ash collection.
- Online flue gas analysis.

Drop tube Furnace

Fuel Evaluation Test facility

Special Features of Fuel Evaluation Test Facility:

- Provision of sample (solid & gas) collection along the length of the Furnace with cooling arrangement.
- Slagging rates & heat flux reduction.
- Fouling rates & heat flux reduction.
- On line gas (O_2, CO, CO_2, NO_x & SO_x) analysis.
- Erosion study.
- CCTV Camera for flame photography.
- DAS for data recording & monitoring.

Other Facilities Available: CFD Software, DSC-TG, Leitz Heating Microscope for Ash Fusion Temperatures, X-Ray Diffractometer for quantitative mineral analysis, Atomic Absorption spectrometer, UV Visible Spectrometer, Hydraulic Press for Building Brick Manufacturing, Autoclave (High Temperature Programmable Furnace and X-Ray Diffractometer with In situ Heating and Capillary Technique.

1. Investigation on the combustion behavior of coals/coal blends of different types and origin to assess their suitability for pulverized coal injection in Blast Furnace

Objective: To find out general criteria of choosing coals for PCI injection using nine individual coals and their blends.

Work done:

- Combustion behavior of the selected coal and their blends were investigated with the help of TGA and Drop Tube Furnace at different oxygen concentrations, particle size distribution etc. In DTF studies effect of residence time was also investigated
- Efforts are made to increase the burning efficiency of the high rank coals having relatively poor burnout by varying the PSD of the feed, oxygen concentration etc.

Observation: Characteristic combustion parameters revealed substantial improvement of reactivity on increase in oxygen concentration in reacting gas mixture. General observations reveal that at lower concentrations of bendable coals combustions characteristics are mostly synergistic.

Conclusion: The results suggest that out of nine coals, two coals are most suitable for PCI injection. The burning behavior of another coal at 31% oxygen is very good and can be used in PCI injection. The other six higher rank coals may not very suitable for PCI and if charged singly, they can lead to significant proportions of unburnt char.

Recommendation: To attempt utilization of specified coals and their blends as PCI in accordance with observed combustion characteristics under different conditions as indicated in the report.

Benefits accrued: The proposed study will help the sponsor to utilize specified coals for pulverized coal injection (PCI) in Blast Furnace.

2. Energy Sector Inventory: Biennial Update Report (BUR- 1)

Objective:

Activity 1: Refinement of NCVs of coking, non-coking and lignite used for various industries for 2010.

Activity 2: Estimation of GHG emission inventory for Energy Industries and Manufacturing Industries for 2008, 2009 and 2010.

Work done: National GHG Inventory for Energy and Manufacturing Industries for the year 2008-2010 were prepared following IPCC-2006 guideline and communicated to sponsoring agency. For coal combustion related issues Tier-II approach was followed for estimation.

Observation: Time series analysis showing trends of CO_2 emission for different fuel categories.

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

Benefits accrued: National GHG Inventory for Energy and Manufacturing Industries for the year 2008-10 and emission trends since year 2000, impact of which on climate change issues are worked out and strategic programs for emission reduction are taken time to time.

3. Setting up of modalities for normative coal requirement in respect of cement and sponge iron industries

Objective: Fixation of normative quantity of coal requirement for consumer segment of cement and sponge iron industries based on present GCV based grading system.

Work done: Normative requirement of coal for cement and sponge iron industries were evaluated based on available literature and information collected from both the industrial sectors of India. Final report was submitted.

Observation: Realistic coal allocation guideline for cement and sponge iron industries which has been accepted by CIL after thorough review

Conclusion: This guideline will help CIL to adopt policies for judicious allocation of different grades of coal to cement and sponge iron industries.

Recommendation: To adopt the general guideline detailed in the report. Allocation of particular grade of coal to be calculated based on the data submitted by the industries in duly filled up information sheet after verification of their data. (information format and calculation procedure attached in the report) .

Benefits accrued: 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.

4. Setting up of modalities for normative coal requirement for different industries

Objective: Fixation of normative quantity of coal requirement for consumer segment of different industries (specified by CIL) based on present GCV based grading system.

Work done: Normative requirement of coal for 17 different industries were evaluated based on available literature and information collected from various industries/ sectors of India. Final report was submitted.

Observation: Realistic coal allocation guidelines for 17 different industrial sectors which have been accepted by CIL after thorough review

Conclusion:

- Specific energy consumption (SEC) of different industries/ product categories is the primary basis of this estimation.
- Estimation of normative coal requirement have been made on current GCV based coal grading system, where the range within each grade is 300kcal/kg.
- This report also includes guideline for collection of desired information and calculation methodologies.
- Approach based on basic units like, PG plant, Boiler and hot air generator, etc. is preferred option wherever applicable.

Recommendation: This report finally recommends allocation of coal quantity based on basic units like, PG plant, Boiler and hot air generator, wherever applicable. When such approach is not applicable then final-product based approach, as elaborated in the report with example, to be followed.

Benefits accrued: 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.

5. Study on the preparation of Activated Carbon from tertiary coal (low ash) of North Eastern region of India

Objective: Preparation of Coal Derived Activated Carbon from low ash, high sulphur tertiary coals of NE region of India, to assess the physico-chemical properties of the activated carbon, laboratory scale investigations on the mercury absorption capacity of the prepared activated carbons, exploration on the feasibility of making activated carbon from coke fines, etc.

Work done: Process has been developed for preparing steam activated carbon based on coal and other carbonaceous materials. Activation has been done in a Fluidised bed steam activation unit designed by CIMFR.

12. RQA DIVISION (Coal Characterization & Coal Petrology)

1. Quality evaluation of coal cores explored from different regions of India

Progress: After signing of MoU between CSIR-CIMFR and CMPDIL approximately 25000m of coal core samples were processed and analyzed also several thousands of band by band and overall samples prepared and analyzed during this period.

2. Testing & Analysis (Chemical)

Funding agency: External organizations viz. CIL subsidiaries such as BCCL, CCL, ECL and several other Govt., public and private industries like-ONGC, NTPC, Coal Controllers Organization (CCO), CCSO, SAIL, SGS Pvt. Ltd., Total CBM solution Pvt. Ltd. etc. Apart from above agencies, the samples are analyzed for several of CIMFR internal and externally funded projects, being executed in different Divisions of this institute.

Progress: Several thousands of coal, coke & other carbonaceous samples were analyzed as aid to industry & basic research.

3. Coal quality Assessment from virgin coalfields of Damodar & Mahanadi Valley Coalfields as aid to Power & Steel Industries in India

Progress: This project is being executed in the form of in-house project and service to the industry is being provided in many ways through generation of technical data on coals and also in erection of new facilities or renovation of existing ones through in-house project funding.

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

Outcome: The samples of washed and raw coals being dispatched to different SAIL plants from different loading points of CCL mines such as: Dhori, Karo, Swang, Kathara, Rajrappa & Kedla are being sampled on daily basis and after preparation their qualitative analysis is being done for total moisture, moisture on Air Dried (AD) basis and ash contents.

5. Testing & Analysis (Petrography)

Funding agency: External organizations viz. Customs, NTPC, BCCL, Coal Controller, Dhanbad & Ranchi, CCSO, SAIL. Total CBM solution Pvt. Ltd. and others

Progress: During the above mentioned period micro petrographic analysis of about 275 number of samples have been analyzed during this year.

6. Consultancy on quality assessment and beneficiation potential of borehole coal cores samples drilled from Trans-Damodar Sector Coal Block, P.S.-Barjora, District –Bankura, W.B.

Progress: Logging along with band-by-band analyses were carried out on borehole coal core of Barjora area, Raniganj coalfield. Proximate, Ultimate GCV, ash analyses, AFT, petrography, Sp gravity etc were carried out on the overall samples. Beside these, as per advice of sponsor, Float & Sink study for assessment of beneficiation characteristics were carried out on two borehole coal core.

7. Revalidation of GCV at station end of NTPC, Farakka, W.B.

Progress: Sampling & sub-sampling job at site was finished. Final report has been submitted.

8. Quality assessment & Float & Sink studies of Borehole coal cores from Tete Province of Mozambique, for industrial application. Phase-I

Progress: After logging of ~375 meter of coal core sent by CIAL in 73 boxes band by band analyses were carried out. Float & sink studies were done on 186 bands of coal as per advice of the sponsor. Besides these studies, determination of Gross Calorific Value has been done on 110 bands whose ash is up to 60 percent.

Several Projects on Quality monitoring of coal at loading and unloading points were carried out during this period. The project names and numbers are as follows:

9. Quality monitoring of coal loaded from Rajmahal area for dispatch to different Power Plants

Progress: Sampling, sub-sampling and analysis were carried out at site. Final report has been submitted.

10. Quality monitoring of coal unloaded at NTPC, Kahalgaon

Progress: Sampling & sub-sampling job at site was finished. Final report has been submitted.

11. Quality monitoring of coal loaded from Rajmahal area for dispatch to different Power Plants (phase-II)

Progress: Sampling & sub-sampling job at site was finished. Final report has been submitted.

12. Quality monitoring of coals at station end of Singrauli Super Thermal Power Station, Shaktinagar, Sonbhadra, U.P.

Progress: Sampling & sub-sampling job at site was finished. Final report has been submitted.

13. Quality monitoring of coals at station end of NTPC, Vindhyachal Super Thermal Power Project, Singrauli, M.P.

Progress: Sampling & sub-sampling job at site was finished. Draft copy of the analytical results sent. Final comments awaited to prepare the final project completion report.

14. Quality monitoring of coals at station end of NTPC, Rihand, Dist- Sonbhadra, U.P.

Progress: Sampling & sub-sampling job at site was finished. Final report has been submitted.

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

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

16. Coal quality evaluation at unloading point of NTPC, Vindhyachal Super Thermal Power Project (VSTPPS), Singrauli, M.P.

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

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

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

18. Quality monitoring of coals at station end of TSTPS, NTPC (Talcher- Kaniha), Angul, Orissa

Progress: Round the clock sampling & sub-sampling job at site are going on. As per agreement for phase-wise results were sent to the party.

19. Quality monitoring of coals at unloading point of NTPC, Vindhyachal Super Thermal Power Project (VSTPPS), Singrauli, M.P.

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

20. Coal quality evaluation at unloading point of NTPC, Rihand, Dist. Sonbhadra, U.P - Phase-II

Progress: Sampling & sub-sampling job at site are going on. During this period the samples collected at NTPC end are brought at CIMFR for different analyses viz. Moisture on 60% RH at 40oC, Ash & Gross Calorific value. The draft copy of the results was sent to them phase-wise as per the agreement of the project.

21. Coal quality monitoring at unloading point of NTPC, Unchahar, U.P.

Progress: Sampling & sub-sampling job at site was started and round the clock sampling work done. During this period the samples collected at NTPC end were brought at CIMFR for different analyses viz. Moisture on 60% RH at 40°C, Ash & Gross Calorific Value.

22. Validation of GCV of coals at unloading point of NTPC, Tanda, U.P.

Progress: Sampling & sub-sampling job at site was started and round the clock sampling work done. During this period the samples collected at NTPC end were brought at CIMFR for different analyses viz. Moisture on 60% RH at 40°C, Ash & Gross Calorific value.

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

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

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

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

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

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

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

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

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

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

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

Progress: Band by band analyses of Dharma block, Narankuri, and Bishtupur blocks have been carried out and the results were sent to RI-I. After getting the advice for overall samples, different analyses will be carried out.

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

Progress: Band by band analyses of Singra and Kapuria block have been carried out and the results were sent to RI-II. After getting the advice for overall samples, different analyses will be carried out.

30. Quality assessment of coal cores received from Kulti and Sitarampur Block, W.B. and technical advice for its industrial utilization

Progress: Most of the analytical results including washability of eight coal seams have been submitted to the party. Due to their slow drilling at site some samples were received in later phase and analysed.

31. Consultancy on collection and quality monitoring of coking coal samples dispatched to SAIL integrated steel plants from CCL Washeries and ROM Coal

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

32. Quality assessment and technical advice for industrial utilization of coal cores drilled from Patal East Coal block through chemical analysis and washability investigations

Outcome: Geological, chemical, petrographic and washability investigation was done on received borehole coal core samples.

33. Quality assessment of coal cores drilled from Patal East coal block through petrographic investigation for industrial application - Phase 2

Progress: Petrographic studies have been carried out on the borehole coal core of Patal East Block.

34. Comparison of coal as received and coal as fired at Vindhyachal Super Thermal Power Project (VSTPPS), Singrauli, M.P.

Progress: Samples were collected from unloading point and also from the site of coal as fired. The quality parameters like total moisture, Ash percentage and GCV were determined and submitted to the party.

35. Quality evaluation of unloaded coal at NTPC, Kahalgaon, Bihar

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

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

Progress: After logging of ~1512 meter of coal core sent by CIAL, band by band around 3500 samples were analyzed for moisture and ash content and preparation and analyses of overall samples.

37. Characterisation of coals from different coalfields explored by CMPDIL RI-III, through borehole coal core study - Phase I (For coal cores received between August 2013 and March 2014)

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

D. INFRASTRUCTURE AND TECHNICAL SERVICES

1. CSIR-CIMFR, ACADEMY OF SCIENTIFIC & INNOVATIVE RESEARCH (AcSIR)

The Academy of Scientific & Innovative Research (AcSIR), set up by an act of Parliament, an institute of National importance in the year 2011. The mission of the academy is to create highest quality personnel with cross-disciplinary knowledge, aiming to provide leaders in the field of science and technology.

- Nurture a research-propelled, technology-enabled, industry-linked, socially conscious higher education platform
- Achieve a seamless integration of intellectual strengths with current market needs with a people centric focus.
- Develop niche capability required to bolster research efforts in futuristic science.
- Provide the opportunity to work on the frontier and contemporaneously challenging areas for nurturing innovation

In CSIR-CIMFR, the activities of AcSIR were started in the year 2012 and the first batch of Integrated M.Tech. Ph.D. in mine safety engineering (IMP-MSE) was started by engaging 10 No. of Trainee Scientists for the academic session 2012-14. CSIR-CIMFR has also engaged 5 No. of Trainee Scientists for the academic session 2013-15.

During the financial year 2014-15, the first batches of Trainee Scientists have completed their M.Tech. in mine safety engineering with distinction. The topic of their M.Tech. Dissertation is given as under:

Sl. No	Name of The Trainee Scientist	Thesis Topic	Name of the Guide(s)
1	**Arka Jyoti Das** Enrollment No: 30EE12A43001	Development of underground methodologies for extraction of locked-up coal from developed pillars using artificial pillars and/or strengthened reduced coal pillars based on numerical modeling study.	Dr. Prabhat Kumar Mandal
2	**Nilabjendu Ghosh** Enrollment No: 30EE12A43002	Assessment of goaf properties and its numerical modeling for realistic simulation of stress distribution around caved long wall faces	Dr Gautam Banerjee
3	**Md. Tanweer** Enrollment No: 30EE12A43003	Study of the various parameters of standing mine support and their optimization through fuzzy logic	Dr. S. K. Kashyap Dr. Dayal R. Parhi (Co-Guide), NIT, Rourkela
4	**Swaha Mahapatra** Enrollment No: 30EE12A43004	Design of the methodology for blind backfilling to stabilize the old abandoned inaccessible mine galleries below railway tracks	Dr. C.N.Ghosh Dr. G. Banerjee
5	**Satya Prakash Sahu** Enrollment No: 30EE12A43005	Subsidence prediction for stowed workings in Jharia Coalfield	Dr. K.B.Singh Dr. Amar Prakash (Co-Guide)
6	**Santosh Kumar Behera** Enrollment No: 30EE12A43006	Estimation of locked up coal in pillars in some of the Indian coalfields and design of artificial pillar to extract the locked up coal	Dr. C. N. Ghosh

Sl. No	Name of The Trainee Scientist	Thesis Topic	Name of the Guide(s)
7	**Prasad Bhukya** Enrollment No: 30EE12A43007	Some studies on mine electrical safety and assessment of energy losses in UCIL - Narwapahar mines	Dr. D. Basak
8	**Vivek Kumar Himanshu** Enrollment No: 30EE12A43008	Stability analysis of backfilled stopes opted below open pit hard rock mine by numerical modeling techniques.	Dr. Mohan Prasad Dr. A. Kushwaha
9	**Jaywardhan Kumar** Enrollment No: 30EE12A43009	Determination of National Emission Factor for Estimation of current fugitive methane emission from coal mining and handling activities in India and its abatement strategies.	Dr. A. K. Singh
10	**Debashis Mishra** Enrollment No: 30EE12A43010	Studies on parameters responsible for oppressive workplace environment in deep shaft coal mines in Jharia coalfield	Dr. N. Sahay

The Trainee Scientists of batch 2013-15 registered in IMP-MSE, have completed their course credits and they are carrying out their M.Tech dissertation project work.

Under Ph.D. programme for the academic session august 2014, 12 candidates (10 Trainee Scientists of 2012-14 + 2 CSIR UGC/NET) qualified candidates have been offered admission in Ph.D. in Engineering and similarly 11 candidates (6 Project Assistants + 1 Inspire Fellow + 4 CSIR UGC/NET) have been offered admission in Ph.D. in Science.

2. BUSINESS DEVELOPMENT, INFORMATION & LIAISON (BDIL)

The following events were organized by BDIL Department during 2014-15:

i. Institution Mining Day was observed on 10 May, 2014 at CSIR-CIMFR, Barwa Road, Dhanbad.

ii. CSIR Foundation Day was celebrated on 29th September, 2014. Foundation Day Lecture was delivered by Sri S.V.S.S. Ramalingeswarudu, GM (R&D), SCCL on an issue related to Problems and prospects of Mining in India. Sri Ramalingeswarudu delivered the talk on behalf of Sri S. Bhattacharya, CMD, Singerani Collieries Company Limited. On the occasion, felicitation of retirees and presentation of mementos to the staff who have completed 25 years of services besides honouring wards of staff for various events was organized in a befitting manner.

iii. National Science Day was observed on 28th Feb, 2015. Prof. A. Chattopadhyay, Former Director, ISM, Dhanbad delivered the Science Day Lecture on the topic "Science & Scientific Mining as an aid to Safe and Sustainable Development".

3. COMPUTER SECTION

Area of Activities:

- Faculty Member, CSIR- AcSIR , Mathematical & Information Science Group
- To implement various ERP Modules of CSIR Enterprise Transformation Project at the Institute
- To maintain and manage the IT infrastructure covering 4 Servers, 10 High Speed Network Switches to connect about 200 Nodes thru CAT 6 Cables, Internet connectivity with 10 Mbps(1:1) bandwidth Leased Line access

- To maintain the Video Conferencing systems for conducting meetings related to Network Projects with different CSIR laboratories / Institutes through IP connectivity with ISDN backup.
- To cater the various needs of the users in terms of H/W & S/W related problems.
- To maintain the entire Hardware infrastructure
- To upgrade & modify the INTRANET of CIMFR, Digwadih Campus for easy retrieval of day to day usable Forms, Memos and current information related to CIMFR, Dhanbad.
- To upgrade & modify the websites www.cimfr.nic.in and www.cfriindia.nic.in
- Conducted Vocational training to M.Tech / B.Tech students of Computer Science & Engineering from various technical institutions
- Hands on training on ERP for role based e-Workdesk on 07/07/2014 & 09/07/2014 to the Staff Members of CIMFR-DC at CIMFR, Digwadih Campus.

An INTRANET, developed by the Computer Section is working very satisfactorily for accessing various office related forms, procedures, memos, documents etc.

Information Infrastructure Security Policy of CSIR & CSIR Labs has been implemented in the form of installing antivirus, antispam & antispyware softwares and applying the appropriate patches/security updates as received from CERT-In website (www.cert-in.org.in).

4. DEPARTMENT OF HUMAN RESOURCE DEVELOPMENT

I. Lectures Organized at CSIR-CIMFR

Sl. No.	Name of Topic	Name, Designation and Address of person delivered lecture	Date
1.	How to write a Technical papers	Prof. S. S. Jamuar, School of Microelectronics Engg University, Malaysia (UNIMAP)	21st May, 2014
2.	Hydraulic Mining in Steeply Inclined Mines	Dr. Robert Hughes from New Zealand	29th May, 2014
3.	a) Application of terrestrial 3D Laser Scanning in Antropogenous Mining Environment' b) Alternative Methods of Rock Mass Failure Determination in Schistose and laminated rock'	Dr. Vlastimil Kajzar & Dr. Martin Vavro from Institute of Geonics, Studentska, The Czech Republic	25th Nov, 2014
4.	Science & Scientific Mining as an Aid to Safe and Sustainable Development	Prof. A. Chattopadhayay, Former Acting Director,ISM, Dhanbad	2nd March, 2015
5.	Research Opportunities in the Field of Coal and Oil	Shr. P. N. Hazara, Ex. DG, ONGC	11th March, 2015

II. Training courses arranged for CSIR-CIMFR personnel:

Sl. No.	Title of the Course	Name & place of Organizer	Name & designation of Staff	Date
1.	MATLAB based Soft Computing Techniques	ISM, Dhanbad	Dr. S K Kashyap, Sr. Principal Sct, Dr. V K Kalyani, Sr. Principal Sct., Mr. Prashant, Sr. Sct.	27 June - 2 July, 2014

Sl. No.	Title of the Course	Name & place of Organizer	Name & designation of Staff	Date
2.	Diabetes Update 2014	Dr. Mohan's Diabetes Centre, Chennai	Dr.(Major) Chandan, CMO	11-13 July, 2014
3.	Open Source (Wordspress/ SEO)	Suhanasoftech Pvt. Ltd, Kolkata	Mr. Kalyan Das, Sr.Tech. Officer Mr. S. Mitra, Sr.Tech(1)	4-10 Aug, 2014
4.	Rock Mechanics & Ground Control	BHU(IIT), Varanasi	Mr. Manish Kr., TO Mr. Rakesh Kumar Singh, TO	16–21Aug, 2014
5.	Science administration & Research Management	ASCI, Hyderabad	Dr. M N Bagde, Pr. Sct Mr. M K Sethi, Sct	15-26 Sept, 2014
	ESTABS	CAD ZONE, New Delhi	Mr. Ajit Kumar, Sr. Principal Sct	28 Oct - 4 Nov, 2014
6.	Creativity & Innovation Management in Research	ESCI, Hyderabad	Dr. M Ramulu, Pr. Sct	17-21 Nov
7.	CAD 2D Drafting	ATI, Kolkata	Mr. A. K. Singh, Sr. Tech(1)	16-27 Feb, 2015

III. Facilitation provided for CSIR-CIMFR Personnel to attend in organized seminar, symposium, and workshop: No. of beneficiaries = 124

IV. Training organized:

Sl. No.	Subject of Training	Name & Address of Participants	Duration
1.	Onsite Training Program to BCCL Personnel for Pilot Plant Operation & Maintenance at Pilot Plant Site, PB Area, Putkee	9 Participants of BCCL	One Week (3-7 Nov, 2014)

V. Summer/ Vocational/Industrial Training arranged to students of different Indian Universities: 215 students

VI. Workshop organized under the aegis of CSIR Program on "Faculty Training and Motivation and Adoption of Schools and Colleges by CSIR labs":

Under this CSIR scheme, in addition to Sanskriti Vidya Mandir, Digwadih No. 10 (adopted in 2012), Al-Islah School, Wassepur, Dhanbad, a minority school, affiliated to Jharkhand Academic Council, Ranchi was adopted during 2014-15. The majority of the students of the school belong to privileged society consisting of more than 70% girl students. The selection of school was done in consonance with our national objectives 'Women Empowerment through Education.' The training & workshops organized during the period:

Sl. No.	Name & theme of Workshop	Name & address of Participant	Venue	Date
1.	Learning Science through experiments	Students of Sanskriti Vidya Mandir Digwadih No. 10 & Al-Islah School, Wassepur	CSIR-CIMFR, Barwa Road & Digwadih	17-18 March, 2015
2.	Recent Trends in Science Education	Science Teachers of Govt. & Govt. aided School of Dhanbad district.	CSIR-CIMFR, Barwa Road, Dhanbad	19 March, 2015

5. HUMAN RESOURCE DEVELOPMENT SECTION

Areas of Activities:

- To implement CSIR-HRD Schemes at the Institute.
- To assess laboratory specific training needs and design, develop and organize training programme to meet these needs.
- To organize vocational / educational training programme for the Pastgraduate (Science) students, B.Tech/BE, M.Tech/ME students.
- To organize customized/ tailor made training courses for the outside organization as per their requirement.
- To facilitate the staff members to attend in different organized national or international seminar/ conference/ symposium.
- To facilitate the NET/GATE qualified students and project Assistants to pursue Ph.D from any university by providing Laboratory Facility and Co-guide at CIMFR-DC.

1. **Training Programme for CIMFR(DC) Staff Member for 2014-15:** Nupur S. Naidu, Rupali M. Gedam, Swai R. Panchbudhe, Vishal T. Chauhan, Mohd Amir Khan, Rajshree O. Yenkie, Mohd Ibrahim Nomani, Mohd Rizwan and Tausif Malik were imparted training on Implementation of ISO/IEC 27025:2005 and Internal Auditing at CSIR-CIMFR-Nagpur Unit(II) during 31/07/2014 to 05/08/2014.

2. **Vocational/Summer/Industrial/Practical Training for Students:** 94 students of different universities & institutes were provided summer training.

3. **Excursion Visit Programme arranged:** 19 students of Trainee Geologist of GSI on 16/10/2014.

4. **Laboratory Facility and Co-guide Provided for Pursuing Ph.D**

Sl. No.	Name of Candidate (s)	Name of Co-guide & Deptt	Topic of Ph.D	Name of University where enrolled for Ph. D
1.	Manash Gope	Dr. R.E. Masto, EMD	Street and Urban settled dust-Heavy metals and PAHs	Visva-Bharti, Shantiniketan, WB
2.	Shikha Tejswi	Dr. P. Dutta, CLF	Catalytic alkylation of naphthalene over zeolites	JNU, Jaipur
3.	Tanmay Laha	Dr. R.E. Masto, EMD	Mobility and bioavilablity of potentially toxic elements in the soils of Khagra, Murshidabad district, West Bengal.	Visva-Bharti, Shantiniketan, WB
4.	Ashok Kumar Dubey	Dr. R.E. Masto, EMD	PAHs and heavy Metals emissions form vehicular exhaust and their exposure to roadside commuters in industrialized belt of Dhanbad eastern India.	ISM, Dhanbad
5.	Santosh Kumar Verma	Dr. LC Ram, EMD	Impact of Fly Ash in the surroundings of Thermal Power Plant with respect to Heavy Metals, Rare Earth Elements and PAHs on Soil Biological activities and assessment of Toxicity Risks.	ISM, Dhanbad

5. Laboratory Facility and Co-guide Provided for Pursuing M. Tech. Thesis work

Sl. No.	Name of Candidate (s)	Name of University where enrolled for M. Tech	Topic of M. Tech	Name of Co-guide & Department
1.	Kundan Kumar Singh, M. Tech, Thesis work, 2nd Year, Mech. Engg.	BIT, Mesra	Some Studies on Chemical Looping Combustion and on Co-combustion of Coal and biomass	Dr. P. Sarkar and Dr. SG Sahu, Combustion Section
2.	Sidharam S. Gobbur, M. Tech. Thesis work, 2nd Year, Mech. Engg.	BIT, Meshra	Some Studies on Chemical looping Combustion	Dr. P. Sarkar
3.	Pikkoo Oraon, M. Tech Project work, 2nd Year, Chemical Engg.	BIT, Sindri	Fischer-Tropsch synthesis studies on Fe and Co-Fe based bimetallic catalysts with lean syngas composition	Dr. S. Maity, LF Section
4.	Amrendra Singh, M. Tech Thesis work, 2nd Year, (Env. Engg.)	IET, Lucknow	Emission of polycyclic aromatic hydrocarbons and heavy metals from co-gasification: A pilot plant study	Dr. R.E. Masto, Environment Mangnt Division
5.	Shishir Tiwari, M. Tech Thesis work, 2nd Year, (Fuel. Engg.)	ISM, Shanbad	Co-gasification performance study of different high ash Indian coals and biomass in fluidized bed gasifier.	Dr. D. Chavan Prakash, Gasification Division

6. INFORMATION TECHNOLOGY CENTRE

Computing and Internet facilities extended:

I. Centre with its existing facilities continued to offer computational facilities to CIMFR Scientists. The facilities have been used for computational, mathematical modeling; statistical analysis and graphical works related with various R & D projects of different areas of Mining & Environment.

II. To speed-up the internet connectivity the capacity of leased line has been increased from 10 Mbps to 45 Mbps. Also the internal website renovated & re-designed.

III. ERP service book entries of all the employees have been fully completed & validated. Other entries like Facility Management, Project Data, Stores and Accounts Data are almost completed to raise the on-line indent towards the implementation of CSIR Transformation and ICT Intervention Project.

IV. Under Employees Self Service (ESS) various activities such as Telephone reimbursement, Medical Claim, GPF Advances, Festival Advance, Conveyance Advance, Leave. Children Education Allowance, LTC, etc have been started on-line.

VI. Coordination of Computer hardware/software maintenance of all the systems installed in the Institute.

VII. The Centre provided the LAN/Intranet and INTERNET facilities through BSNL Leased Line & NIC-NKN to CIMFR Scientists/Staffs to update their research database and knowledge base for better R & D outputs.

VIII. Extended the Video Conferencing facility for various project discussions, assessment of Scientists & meetings with CSIR HQ/ other CSIR Laboratories.

7. KNOWLEDGE RESOURCE CENTRE (HEADQUARTERS)

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

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

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

EM Security system at KRC was done successfully.

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

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

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

Collection Strength

Books, Reports, Standards, Specifications and Bound Volumes	32385
CD Collection	896
Current Journals subscription	62
Translation of Foreign Language Articles	495
Photocopies of Technical Articles	342

8. KNOWLEDGE RESOURCE CENTRE, DIGWADIH CAMPUS

The Knowledge Resource Centre (Library) of CIMFR, Digwadih campus supports its scientists, Technologist and other supporting staffs with up to date R & D information through well organized library resources.

KRC is committed for latest Knowledge Dissemination. The main job includes running of a big library with large number of reading materials (as shown below) along with procurement of books, journals, e-journals, standards, CDs etc. Readers/users assistance in searching books, journals, article search & download through CSIR-NKRC e-Journals Consortium/Union Catalogue of CSIR, Inter-library loan service etc is also provided along with Photocopying services of articles, newspapers etc.

KRC Holdings at a glance

Sl. No.	Documents/Books/Journals/CDs etc	Acquisition during the period 2014-15 i.e. (01.04.14 to 31.03.15)			Total No. as on 31.03.14
1.	Books (including reference books)	English	Purchase	18	1252
			Gift	00	
		Total		**18**	

Sl. No.	Documents/Books/Journals/CDs etc	Acquisition during the period 2014-15 i.e. (01.04.14 to 31.03.15)		Total No. as on 31.03.14
2.	Bound volumes of Journals		Nil	13127
3.	Number of current Journals	Indian	18	–
		Foreign	13	
		Total	**31**	
4.	Annual reports	03		–
5.	CDs & DVDs	24 DVDs		–

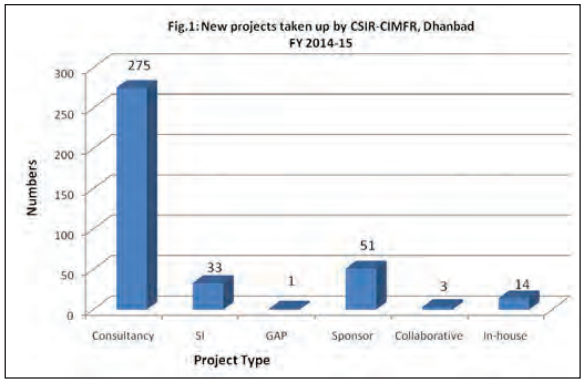
9. PROJECT MONITORING AND EVALUATION (PME) CELL

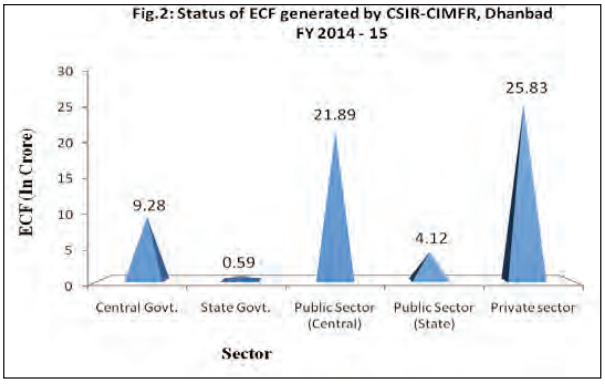
PME Cell of the institute, by virtue of its scope and jurisdiction, has a very onerous task and handling various projects covering the mining and its allied industries. The main activities of PME Cell during the period:

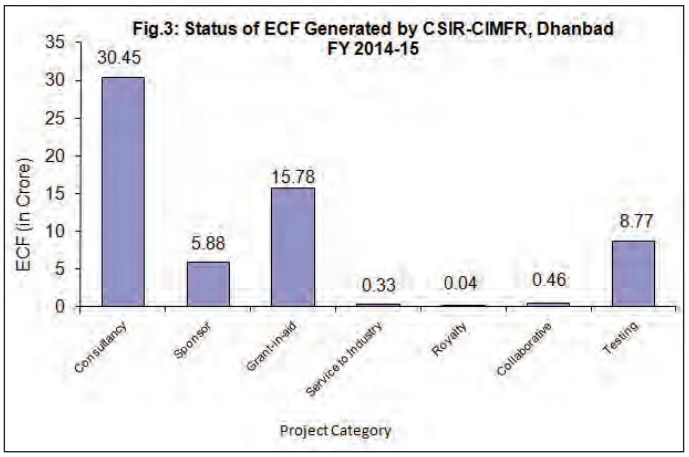
- Periodically updating of all the information concerning project in such way that any specific information about a particular project is available readily;
- Planning, monitoring and evaluation of all externally-funded projects;
- Performance management of all the CSIR-CIMFR plan projects;
- Comprehensive development and maintenance of project related data base;
- Preparation of quarterly and annual performance reports of all the ongoing projects;
- Periodical review of performance of all the ongoing R&D projects;
- Compilation of all data generated while executing the projects by the scientists;
- Preparation of Annual Budget in consultation with the scientists.

As regards the details of projects handled during year 2014-15, it is informed that total of 363 externally funded projects were undertaken and executed, out of which 51 were Sponsored projects, 275 were Consultancy projects, 3 were Collaborative projects, 33 were Service to Industry Projects and 1 Grant-in-Aid project. Besides, 14 other new In-house projects were also undertaken and are being executed and projected in the form of a bar chart in Fig.-1.

In terms of external total fund received (₹ 61.71 crore), which shows a marked growth of 7.25% compared to previous year (FY 2013-14), break-up of which is Government fund ₹ 9.87 crore, public sector ₹ 26.01 crore and private sector ₹ 25.83 crore, for clarity the same is depicted in **Fig.-2**. Project category wise external cash flow of the institute is shown in the **Fig.-3**.







10. RTI - CELL

During the period (April 2014 - March 2015) 67 Nos. of applications were received and satisfactory reply was given to them. However, 05 Nos. of application approach to first Appellate Authority and all of them were satisfied with the information provided by the first Appellate Authority and non of them approach to CIC, New Delhi.

An amount of Rs. 620/- were collected as processing fee and Rs.5370/- as additional fee towards xeroxing charges.

11. SCIENCE COMMUNICATION AND PUBLICITY DEPARTMENT (SCPD)

Annual Report: Reports related to the activities like R&D work, supporting services, etc, for the year 2013-14 were collected from all the departments of the institute and edited, compiled and published in the form of CSIR-CIMFR Annual Report (bi-lingual). .

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

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

Press Release and Press Conference: News items on various research and developments, honours and awards received, important visitors, events like seminars, symposia, conferences, workshops, etc, held at the laboratory were prepared and issued to different daily newspapers and technical journals. A number of press conferences were organised during the year.

CSIR Annual Report: An abridged report on important R&D work and other technical services of CSIR - CIMFR for the year 2013-14 was prepared and sent for inclusion in CSIR Annual Report.

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

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

Technical Enquiry: During the year 2014-15, a large number of scientific and technical enquiries sent by various organizations in India and abroad were attended.

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

CSIR-CIMFR Project and Work Record Book: CSIR-CIMFR Project and Work Record Book for the year 2014 was published and distributed amongst all the scientists, officers and other staff members of the institute.

Participation in Exhibition: CSIR-CIMFR participated in the following Exhibition and exhibited through posters about the R & D Highlights, Areas of expertise, Testing and Calibration services provided to the clients:

1. 2nd International Seminar & Exhibition on "Recent Trends in Design, Development, Testing and Certification of Ex-equipments for Explosive Atmosphere" [DTEX-2014] organised at Science City, Kolkata during 7-9 November, 2014.
2. 12th International Mining & Machinery Exhibition (IMME 2014) held at Salt Lake Stadium Grounds, Salt Lake, Kolkata, WB, during 03-06 December, 2014.
3. International Conferences & Exhibitions on Materials Engineering, Technology + Heat Treatment (MET+HTS 2014), held at the Exhibition Centre, Mahatma Mandir, Gandhi Nagar, Gujrat during December 4-6, 2014.
4. 45th All India Mines Rescue Competition held at CCL, Ramgarh during January 14-17, 2015.
5. International Conference on Safety & Health Management in Mining Industry held at Kolkata during 29-31 January, 2015.
6. National Level Vendor Development Programme; Exhibition & Buyer - Seller Meet (NLVDP) held at Bokaro during 11-13 March, 2015

12. Standards, Technology Management & International S&T Affairs Division

(A) ON ISO 9001:2008 Certification Programme: CSIR-CIMFR successfully cleared the 3rd Surveillance Audit on 05th May 2014 and 4th Surveillance Audit as per ISO 9001:2008 conducted by DNV on 21st November 2014.

(B) New MoUs' / Agreements signed during 2014-15:

Sl. No.	Title of the Agreement	Party Name and Address	Amount (₹)	Date
1.	Development of Polyethylene Teraphthallate based products & their application	Jayant Enterprises, 105-Kanchan Apartment, East High Court Road, Ramdaspeth, Nagpur-440010	5.62 Lakhs	16/04/2014
2.	"Development and Evaluation of Emulsion Permitted (P1, P3 & P5) Explosives Suitable for Use in Indian Underground Coal Mines	M/s IDL Explosives Limited, Kukatpally, Post Bag No. 1, Sanathnagar (IE) P.O., Hyderabad-500018, Andhra Pradesh	13.48 Lakhs	08/08/2014

Sl. No.	Title of the Agreement	Party Name and Address	Amount (₹)	Date
3.	Ground Penetration Radar (GPR) surveys for sub-surface lithological mapping at Nee Soon Catchment Area	Tropical Marine Science Institute, National University of Singapore, Singapore	10.00 Lakhs	21/08/2014
4.	Agreement for marketing of CIMFR technologies between CSIR-CIMFR & CSIR-Tech Pvt. Ltd., Pune	CSIR-Tech Pvt. Ltd., 100 NCL Innovation Park, Dr. Homi Bhabha Road, Pune-411008	NA	01/10/2014
5.	MoU for characterization of shale horizons with respect to shale gas and quantitative estimation of shale gas resources by direct method in Mohuda sub basin of Jharia Coalfield	Natural Energy Resources, Mission-IIB, Geological Survey of India, Govt. of India, Ministry of Mines, Kolkata-700 091	7.20 Lakhs	18.12.2014
6.	Setting of new facility for Electronic Product Safety Testing at CSIR-CIMFR, Dhanbad	Department of Electronics & Information Technology (DeitY), Govt. of India, New Delhi	1.4275 Crores	01.01.2015

Premium/ Royalty received during 2014-15:

Sl. No.	Title	Client	Amount (₹)	Date
1.	Fragalyst 4.0 Software	Anna University, Chennai	1,79,776=00	08/07/2014
2.	Fragalyst 4.0 Software	Explotacion de Minas, Universidad de Vigo, Spain	2,50,121=00	02/02/2015
3.	Resin Capsule	Pawan Enterprises, Dhanbad	1,708=00	02/02/2015
4.	Mine Environment Monitoring System	M/s. Jagdamba Tyre Retreading Co., Gandhi Nagar, Dhanbad	30,000=00	04/03/2015
		Total:	4,61,605=00	

Deputation of CIMFR, Scientists abroad for attending Seminar/ Symposia/ Conference, Business Development, Bilateral Exchange Program, Scholarship, International Project, Lecture etc.:

Sl. No.	Name of the Scientist	Designation	Period	Country Visited	Purpose
1.	Dr. R. K. Goel	Chief Scientist	6-7 June 2014	Beijing, China	Key note address in the 2014 ISRM conference on soft rocks
2.	Dr. Arun Kr. Singh	Principal Scientist	21 June - 01 July 2014	Czech Republic	Bilateral Exchange Program
3.	Sri. Sahendra Ram	Sr. Tech. Officer-1	21 June - 01 July 2014	Czech Republic	Bilateral Exchange Program
4.	Dr. Rajendra Singh	Chief Scientist	29-31 July 2014	West Virginia, USA	To attend conference

Sl. No.	Name of the Scientist	Designation	Period	Country Visited	Purpose
5.	Dr. S. K. Ray	Principal Scientist	2-8 Aug' 2014	Sun City, South Africa	To attend conference
6.	Dr. P. K. Singh	Senior Principal Scientist	21-24 Sept' 2014	Aachen, Germany	To attend conference
7.	Dr. M.N. Bagde	Principal Scientist	12-16 Oct' 2014	Sapporo, Japan	To attend conference
8.	Dr. D. Mohanty	Senior Scientist	23-27 March 2015	Montreal, Canada	Discussion on UCG Project

13. TESTING CELL

Testing Cell of CIMFR, Barwa Road Campus, Dhanbad is a single focal cell which provides ready assistances to the Mining and Allied Industries and the manufacturers of different equipment/ component/materials in getting the required items tested, evaluated, calibrated and certified. The cell also co-ordinates and monitors the testing, analysis and calibration related activities of eleven testing laboratories of CIMFR, Barwa Road Campus, Dhanbad and the concerned customers, and releases the relevant test certificates for both indigenous and foreign make equipment/components.

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

Total 1,037 numbers (One thousand and thirty seven) of testing and evaluation reports of various samples including equipment/components were issued by the cell during the year 2014-2015 and an amount of revenue of ₹ 4,26,81,524.00 (Rupees Four crore twenty six lakhs eighty one thousand five hundred twenty four) only were generated through the same. This amount includes the foreign currency of US $ 3,20,545 (Three lakh twenty thousand five hundred forty five U.S. Dollar).

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अग्रवाल दीपा, मिश्रा के के, पाण्डेय जे के, विश्वकर्मा एम के एबं बंदोपाध्याय ए के, 2014, मजदूरो मे होनेवाली सिलिकोसिस बीमारी के बिबिध कारण, इसका निदान व रोकथाम के उपायों का एक अध्ययन, कोयला उपयोग–दृश्टि–2025, (सं. एल सी राम एवं अन्य) सीएसआईआर–केन्द्रीय खनन एवं ईंधन अनुसंधान संस्थान (बरवा रोड) धनबाद, पेज 218–225.

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Singh Abay Kumar, Mondal G C and Singh T B (2014). Damodar River Basin: Storehouse of Indian Coal, (title of the book *"The Indian Rivers - An Introduction for Science and Society"* edited by Prof. D. S. Singh, Dept. of Geology. Lucknow University, published by: Centre of Advance Study in Geology, University of Lucknow, Lucknow-226 007), pp. 171-181.

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Singh A K and Mohanty D (2015). CO_2 Sequestration Potential of Indian Coalfields (Chapter-9). In: Carbon Capture, Storage and Utilization: a possible climate change solution for energy industry (eds. Goel M., Sudhakar M., Shahi R. V.), The Energy Research Institute (TERI), 133-147.

Singh A K, Vishwakarma R K and Ahirwal B (2014). Recent Trends in Design, Development, Testing & Certification of Ex Equipment, published by CSIR-CIMFR, Dhanbad (India) (ISBN 978-93-5196-303-5).

Goel R K and Singh Bhawani (2016). 'Tunnels in the Himalaya' (title of the book 'Rock Mechanics and Engineering' (Revised Edition of Comprehensive Rock Engineering, edited by Prof. Xia-Ting Feng. published by CRC Press, Taylor and Francis.

DEPUTATION ABROAD:

Dr. M.N. Bagde, Principal Scientist was deputed to Sapporo, Japan during 14-16, October 2014 for presenting a paper at 8th Asian Rock Mech. Symposium (ARMS8). He was visited Hokkaido University to present a paper at Rock Mech Engineering Division.

Dr. P.K. Singh, Director was deputed to Aachen, Germany to attend 12th International Symposium continuous surface Mining-Aachen in September, 2014.

Dr. R.K. Goel, Chief Scientist was deputed to Beijing, PR China during 4-9 June 2014 for attending ISRM International Symposium on Soft Rocks 2014 and was delivered a Keynote address and Co-chaired a Technical Session during the Symposium.

Dr. Santosh Kumar Ray, Principal Scientist visited South Africa to attended 10th International Mine Ventilation Congress (IMVC 2014) during 4-9 August 2014.

Shri S.K. Kashyap, Sr. Principal Scientist visited Kyoto, Japan to present a technical paper in 14th IACMAG, 2014 organized by University of Kyoto, Kyoto, Japan on 22-25, September, 2014.

ATTAINMENT OF QUALIFICATION:

Shri Amar Prakash, Senior Scientist was awarded Ph.D. degree in May, 2014 from Indian School of Mines, Dhanbad. The title of thesis was "A study into the influence of intact rock and rock mass properties on the performance of surface miners in Indian geo-mining conditions".

Shri Amit Jaiswal, Sr Technical Officer (1) has been awarded A.M.I.E. degree from The Institution of Engineers (India).

Shri B. Ahirwal, Sr. Scientist has been awarded Ph.D. degree from ISM, Dhanbad. The title of the topic is "Some studies on safety aspects of high tension increased safety squirrel cage induction motors for hazardous."

Shri Harsh Verma, Sr. Scientist has been awarded Ph.D degree from Civil Engineering Deptt of IIT Roorkee. Roorkee. The title of the topic is 'Evaluation of Blast Induced Damage in Underground Excavations'

Mr. Harshit Agrawal, Trainee Scientist has been awarded M.Tech. degree on the topic entitled "Geotechnical issues in coal extraction with special reference to rib-mechanics for better coal recovery" in 2014.

Mrs. Manjula Sharraf, Technical Officer has been awarded Ph.D. Degree in Chemistry by Guru Ghasidas, Central University, Bilaspur.

Dr. Kumar Nikhil awarded with M.A in Sociology passed in 1st division from SHOBHIT UNIVERSITY, Sobhit Institute of Engineering & technology, Established u/s of UGC Act, 1956, MEERUT, U.P, India, School of Distance Education, in September, 2014.

Shri R.D. Dwivedi, Principal Scientist, has been awarded Ph.D degree from IIT Roorkee. Roorkee. The title of the topic is 'Behaviour of Underground Structures in Squeezing Ground Conditions.

Shri Subhasis Biswas, Chief Scientist has been awarded Ph.D degree from Jadavpur University, Kolkata. The title of the topic is 'Studies On the Effect of Blending on the Burning Behaviour of Indian Non-Coking Coals in Thermo Gravimetric Analyser (TGA) and Drop Tube Furnace (DTF).

AWARD:

Dr. A K Raina, Principal Scientist received - Commendation by Secretary, National Disaster Management Authority, Ministry of Home Affairs, Govt. of India for Clearance of the blockage on River Phuktal, Zanskar J&K during Feb.-March, 2015.

Dr. A K Raina received Dr. P N Bose Award for Geological Sciences and its application in Mining, the IME Journal Annual Awards Function, 21-22 June, New Delhi, 2014.

Dr. R K Goel received best paper award for the year 2013 for the paper published in Journal of Rock Mechanics and Tunnelling Technology. The ISRMTT award was announced in Oct. 2014 and presented during the Indorock 2014 conference on Nov. 12, 2014 at CSMRS, New Delhi.

Dr. R K Goel received certificate of 'Outstanding Contribution in Reviewing' in Oct. 2014 from Elsevier Ltd. to enhance the quality of International Journal 'Tunnelling and Underground Space Technology'.

Dr. Sanjay Kumar Roy was conferred Mining Engineering Design Award – 2014 by the Institution of Engineers on 19.12.2014 in recognition for his significant contribution in Mining Technology.

Dr. Santosh Kumar Ray, Principal Scientist has received MEAI-Sitaram Rungta Memorial Award for the best paper on mining related issues. Award was given on July 2014.

Patent:

Patents Granted in Foreign Countries

Country	Title	Inventors	Grant Date	Patent No.
EP	A Device for Roof Support of Underground Mine /Tunnel	Sudhir Kumar Kashyap & Amalendu Sinha	23/04/2014	2536919
PL	A Device for Roof Support of Underground Mine /Tunnel	Sudhir Kumar Kashyap & Amalendu Sinha	23/04/2014	2536919
	Tracking and monitoring system for opencast mines	Lakshmi Kanta Bandyopadhyay, Swades Kumar Chaulya & Pankaj Kumar Mishra	26/08/2014	8816850

Patents Filed in India

NFNO	Title	Inventors	Comp. Filing Date	Application No.
0222NF2014/IN	Flue Gas Recirculation System For Oxy Fuel Coal Combustion In Pulverized Coal Fired Combustor	Manish Kumar, Ashis Mukherjee, Ashis Kumar Adak & Subhasis Biswas	25/09/2014	2750DEL2014
0241NF2014/IN	A Process For Increasing Carbon Dioxide Concentration In Flue Gas	Ashis Mukherjee, Manish Kumar, Santi Gopal Sahu, Ashis Kumar Adak & Subhasis Biswas	28/01/2015	0232DEL2015

Patents Granted in India

NFNO	Title	Inventors	Grant Date	Patent No.
0215NF2005/IN	A Movable Roof Support Canopy as a Safeguard for Working Under Fresh Roof in an Advancing Mine or Tunnel	Maity Sibnath & Paul Biswajit	28/05/2014	260373
0454NF2004/IN	A Method for Solid Blasting In Underground Coal Mines	Sanjay Kumar Roy & Rajeev Ranjan Singh	14/10/2014	263217

12.8.14 को आयोजित हिन्दी कार्यशाला की एक झलक

15.9.2014 को आयोजित हिन्दी पखवाड़ा सह हिन्दी दिवस की एक झलक

15.9.2014 को आयोजित हिन्दी पखवाड़ा सह हिन्दी दिवस की एक झलक

11.12.2014 को हिन्दी बैठक एवं डा. पूरन पाल, वरिष्ट हिन्दी आधिकारी, सीएसआईआर, द्वारा निरीक्षण की एक झलक

Dr. Amalendu Sinha, Director, CSIR-CIMFR performing Bhumi Pujan on the occasion of Mining Day Celebration

Dr. Amalendu Sinha, Director, CSIR-CIMFR delivering Welcome Address on the occasion of CSIR Foundation Day Function

Prof. A. Chattopadhyay delivering the National Science Day Lecture

FTAM & Adoption of Schools by CSIR-CIMFR, Dhanbad

To enlarge the science base in the country, it is prudent to encourage quality science education at school & college levels. In keeping with the aims and objectives of the scheme HRD group of CSIR-CIMFR, Dhanbad had drawn a detail programme related to adoption of schools & various academic activities including faculty training, etc., under the aegis of CSIR-HRDG, New Delhi. The selection of schools for adoption namely Sanskriti Vidya Mandir at Digwadih and School Al- Islah, Wasepur, at Dhanbad was based on the guidelines of CSIR-HRDG, New Delhi. Dr. A Sinha, Director in his inaugural address during adoption program said that the primary aim of CSIR-CIMFR is to promote interest and aptitude in the minds of the students towards science and motivate the students to continue science education in future.

CSIR-CIMFR organized workshop in January, 2015 for both the teachers as well as the students. Prof. B.N. Das was invited as resource person from Kolkata. The purpose of the workshop was to enable teachers and students to carry out experiments using simple materials to verify the scientific theories effectively even in the absence of a regular laboratory. To develop the scientific aptitude among the students a Science exhibition was organized in the school campus of Sanskriti Vidya Mandir, where large number of students participated. Models on bio-fuel, bio-char, liquid fuels from waste plastics, etc., were presented by the students. Science exhibition was inaugurated by Dr. A. Sinha, Director, CSIR-CIMFR. The exhibition was organized with the guidance of Scientists of CSIR-CIMFR, Digwadih Campus. To ensure capacity building among the teachers a workshop on 'Recent trends in Science education' was organized for the science teachers of the district at CSIR-CIMFR, Barwa Road, Dhanbad in February, 2015. Besides, training on modern teaching methodologies in the area of Chemical and Physical Sciences was given to the teachers and the teachers were also appraised of the status and management of both Ground and Mine Water in the region of Dhanbad. Our endeavour in this regard has been highly appreciated by the District Education Department, Dhanbad, Jharkhand.

Under the scheme, CSIR-CIMFR gifted laboratory equipments consisting of biological microscope, chemical balance, pH meter and laboratory appliances to both the schools, so that they can develop small laboratories at their end. To start a science library in both the schools a good number of science books were handed over to the representatives of the schools by Dr. A.Sinha, Director, CSIR-CIMFR.

सीएसआईआर केन्द्रीय खनन एवं ईंधन अनुसंधान संस्थान, धनबाद द्वारा संकाय प्रशिक्षण और प्रोत्साहन एवं विद्यालयों तथा माविद्यालयों का अंगीकरण

देश में विज्ञान के आधार का विस्तार करने के लिए यह आवश्यक है कि स्कूल और कॉलेज स्तर पर विज्ञान की शिक्षा में गुणवत्ता को प्रोत्साहित किया जाए। इस योजना के लक्ष्य एवं उद्देश्य को ध्यान में रखकर सीएसआईआर-सीआईएमएफ़आर, धनबाद के मानव संसाधन विकास समूह ने स्कूल एवं महाविद्यालयों का अंगीकरण से संबन्धित अन्य शैक्षणिक गतिविधियों जैसे संकाय प्रशिक्षण आदि का पूर्णस्वेण कार्यक्रम सीएसआईआर-मानव संसाधन विकास समूह, नई दिल्ली के तत्त्वावधान में किया गया। सीएसआईआर-मानव संसाधन विकास समूह, नई दिल्ली के दिशानिर्देशों के तहत संस्कृति विद्या मंदिर, डिगवाडीह एवं अलइस्लाह विद्यालय, वासेपुर, धनबाद का चयन किया गया। निदेशक डॉ अमलेन्दु सिन्हा कार्यक्रम के उदघाटन के अवसर पर सीएसआईआर-सीआईएमएफ़आर का मुख्य उद्देश्य पर प्रकाश डालते हुए अपने सम्बोधन के क्रम में विद्यार्थियों को विज्ञान के प्रति अपनी रुचि और जागरूपता बनाए रखने पर बल दिया एवं भविष्य में विज्ञान शिक्षा जारी रखने हेतु प्रोत्साहित किए।

इसी कार्यक्रम के तहत सीएसआईआर-सीआईएमएफ़आर शिक्षकों एवं छात्रों के लिए जनवरी 2015 में एक कार्यशाला का आयोजन किया। कार्यक्रम में कोलकाता के डॉ बी एन दस को विशेषज्ञ के रूप में आमंत्रित किया गया। कार्यशाला का मुख्य उद्देश्य प्रभावी रूप से नियमित प्रयोगशाला के अभाव में सरल सामाग्री के प्रयोग से वैज्ञानिक सिद्धांतों को सत्यापित करना था। छात्रों में वैज्ञानिक अभिरुचि का विकास करने के लिए संस्कृति विद्या मंदिर के स्कूल परिसर में एक विज्ञान प्रदर्शनी आयोजित की गई जिसमें छात्रों की बड़ी संख्या ने भाग लिया। छात्रों द्वारा बेकार प्लास्टिक के जैव ईंधन, जैवचार, तरल ईंधन आदि पर मॉडल प्रस्तुत किया गया। विज्ञान प्रदर्शनी का उदघाटन निदेशक डॉ अमलेन्दु सिन्हा किये। सीएसआईआर-सीआईएमएफ़ आर डिगवाडीह परिसर के मार्गदर्शन में प्रदर्शनी का आयोजन किया गया। शिक्षकों के बीच क्षमता निर्माण सुनिश्चित करने के लिए जिले के विज्ञान शिक्षकों के लिए विज्ञान शिक्षा के क्षेत्र में नई दिशा पर एक कार्यशाला सीएसआईआर-सीआईएमएफआर, बरवा रोड, धनबाद में आयोजित किया गया। इसके अलावा, रसायन विज्ञान और भौतिक विज्ञान के क्षेत्र में आधुनिक शिक्षण प्रणाली के साथ धनबाद क्षेत्र में भूजल एवं खान में उपलब्ध जल की स्थिति और प्रबंधन पर भी सीएसआईआर-सीआईएमएफ़आर के वैज्ञानिकों द्वारा शिक्षकों को अवगत कराया गया। सीएसआईआर-सीआईएमएफ़आर के इस प्रयास को जिला शिक्षा विभाग, धनबाद, झारखंड द्वारा बहुत ही सराहा गया।

इस योजना के तहत सीएसआईआर-सीआईएमएफ़आर दोनों विद्यालयों को अनेक प्रयोगशाला उपकरणों जैसे जैविक सूक्ष्मदर्शी, रासायनिक माप, पीएच मिटर आदि प्रदान किया ताकि वे अपने खुद का छोटा प्रयोगशाला विकसित कर सके। विद्यालयों में विज्ञान पुस्तकालय शुरू करने के लिए कुछ विज्ञान पुस्तकें संस्थान के निदेशक डॉ अमलेन्दु सिन्हा द्वारा विद्यालय के प्रतिनिधियों को प्रदान किए।

Glimpses of Events organised at CSIR-CIMFR, Digwadih Campus

Oath taking ceremony for Quami Ekta Week at CIMFR-DC. Dr. L. C. Ram, Scientist-In-Charge administering the oath to the staff members on 19.11.2014

Dr. Amalendu Sinha, Director, CIMFR, inspecting a platoon of security guards on Republic Day celebration on 26.01.2015. Shri J. M. Choudhury, Sr. Security Officer is also seen

Flower show organized at CIMFR-Digwadih Campus on 12.02.2015. Dr. L. C. Ram, Scientist-In-Charge, CIMFR-DC, Dr. N. K. Srivastava and Shri A. K. Sinha are also seen

Workshop on Chemical Science for the students of Swarsati Vidya Mandir on 17.03.2015. Prof. A. K. Rana demonstrating the experiments to the students

A view of audience of students and teachers of Swarsati Vidya Mandir during Workshop on Chemical Science on 17.03.2015

Workshop on Physical Science for students of Swarsati Vidya Mandir on 18.03.2015. Dr. B. N. Das demonstrating the experiments to the students on Physical Science

Rally in CIMFR-Digwadih Campus on 02.10.2014 during Swachha Bharat Abhiyan. Shri Subhasish Biswas and others are seen

Brooming of road in CIMFR-Digwadih Campus by staff members on 02.10.2014. Dr. L. C. Ram and his wife along with others are seen

Inaugural programme of workshop on Industrial meets on Clean Coal Technology on 13.10.2014. On the dias (L to R) Dr. P. Chavhan, Dr. L. C. Ram, Dr. Amalendu Sinha, Director, CIMFR and Dr. Ashis Mukherjee

A view of audience of workshop on Industrial meets on Clean Coal Technology on 13.10.2014

Dr. Promod Pathak, Head, Business Management Studies, ISM, Dhanbad delivering a talk on 28.10.2014 during Vigilance Awareness Week Programme. On the dias (L to R) Shri Sanjay Kumar, Dr. Amalendu Sinha and Dr. L. C. Ram

Oath taking ceremony for Sadbhavana Divas on 21.05.2014. Dr. L. C. Ram, Scientist-In-Charge, CIMFR-DC is administering the Oath to the staff members

Wards of employees of CIMFR-DC participating in essay competition on 31.08.2014 under CSIR Foundation Day Programme

Wards of employees of CIMFR-DC participating in drawing competition on 31.08.2014 under CSIR Foundation Day Programme

Inauguration of Hindi Pakhwara – 2014 on 01.09.2014. On the dias (L to R) Dr. L. C Ram, Dr. Amalendu Sinha, Prof. Gurdeep Singh, VC, Vinova Bhabe University, Hazaribagh, Prof. J. B. Pandey, Hindi Deptt., V.B. University, Hazaribagh and Shri Subhashish Biswas

Wards of employees of CIMFR-DC participating in essay competition on 07.09.2014 organised under Hindi Pakhwara Programme-2014

Introductory programme of Kavi Sammelan on 10.09.2014 under Hindi Pakhwara. On podium Dr. L. C. Ram. On the dias (L to R) Sunil Kr. Tang, Basant Joshi, Mahesh Mehndi, Dr. Sangita Nath, Mukesh Anand, Akhilesh Dwivedi, Raunak Shashtri

A view of audience on 10.09.2014 during Kavi Sammelan under Hindi Pakhwara-2014

Dr. Amalendu Sinha, Director, CIMFR, Dhanbad while hoisting the Tricolour on 15.08.2014

The volume being released on the occasion of 2nd International Seminar & Exhibition on "Recent Trends in Design, Development, Testing and Certification of Ex-equipments for Explosive Atmosphere" [DTEX-2014] organised during 7-9 November, 2014 at Kolkata

Dignitories lighting lamp on the occasion of 2nd International Seminar & Exhibition on "Recent Trends in Design, Development, Testing and Certification of Ex-equipments for Explosive Atmosphere" [DTEX-2014] organised during 7-9 November, 2014 at Kolkata